O.E.Kepe, Ya.A.Viba, O.P.Grapis

NAZARIY MEXANIKA

FANIDAN QISQA MASALALAR TO'PLAMI

O‘ZBEKISTON RESPUBLIKASI O‘LIY VA O‘RTA MAXSUS TA’LIM VAZIRLIGI

O.E. KEPE, YA.A. VIBA, O.P. GRAPIS

NAZARIY MEXANIKA fanidan qisqa masalalar to‘plami

O.E. Kepe tahriri ostida

O‘zbekiston Respublikasi Oliy va o‘rta maxsus ta’lim vazirligi tomonidan (520600, 520800, 580200) – bakalavriyat yo‘nalishi talabalari uchun darslik sifatida tavsiya etilgan

Toshkent
“Yangi asr avlodi“
2008

Kitobda nazariy mexanikaning barcha qismlariga oid bo'lgan, jami bo'lib 1757 ta, shu jumladan, statika qismida 449 ta, kinematika qismida 434 ta va dinamikada 874 ta masalalar mavjud.

Ushbu kitob o'zining tuzilishi va mazmuniga ko'ra, talabalarni o'z bilimlarini mustaqil ravishda mustahkamlashlarida, test sinovlarini operativ ravishda olib borishda, amaliy mashg'ulotlar jarayonida qisqa vaqt ichida reyting nazoratlarini o'tkazishda asosiy vosita bo'lib xizmat qilishga qaratilgan. Barcha masalalarning javoblari asl nusxadagi bitta natija shaklida keltirilgan. Bunga sabab, Oliy o'quv yurtlarida joriy etilgan reyting baholashga juda qo'l keladi.

Talabalarning reyting nazoratlarini faol ravishda o'tkazish bo'yicha tegishli metodik ko'rsatmalar berilgan.

Mazkur to'plam texnika talabalari uchun mo'ljallangan bo'lib, undan shu sohaga qiziquvchi barcha kitobxonlar ham foydalanishlari mumkin.

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SO‘Z BOSHI

Nazariy mexanika fundamental fan hisoblanib, uning usullari ko‘p sohalar bo‘yicha injenerlik masalalarini yechishda undan keng qo‘llanilib kelinadi. Shu sababli, boshqa fundamental fanlar kabi, har bir texnika oliy o‘quv yurtlarida, tegishli ajratilgan soatlarga bog‘liq ravishda albatta o‘rganiladi.

Nazariy mexanika fanini o‘rganishda, tabiatdagi hodisalarni kuzatib, tadqiq qilishda, ularni matematik ko‘rinishda ifodalash va modellashtirish usullari juda muhim ahamiyatga ega bo‘lganligi uchun uni o‘rganish ayrim qiyinchiliklarga olib keladi. Shu sababli, muqim bir masalani yechish jarayonida talabalar ma’lum uslubiy qiyinchiliklarga duchor bo‘ladilar. Buning asosiy sababi shundan iboratki, ular nazariy bilimlar bilan amaliy masalalarni orasidagi bog‘lanishlarni qiyinchilik bilan tushunadilar. Shu sababli o‘qituvchilarning oldida, talabalarni ilmiy tadqiq qilish usullarini o‘rgatish muammosi turadi.

Mazkur kitobni o‘z oldiga qo‘ygan maqsadi shundan iboratki, talabalar va o‘qituvchilar uchun katta miqdordagi sodda va yengil bo‘lgan qisqa masalalar keltirilib, ularni yechish jarayonida nazariy bilimlarni amaliyot bilan bog‘lashlarida katta ahamiyat kasb etadi. Bundagi masalalarni yechishda murakkab matematik o‘zgartirishlarni bajarish va hisoblash talab qilinmaydi, lekin ularning fizik mazmunini to‘la tushunib olish zarur bo‘ladi. Masalalarga qo‘yilgan asosiy talab shundan iboratki, fan dasturida keltirilgan har bir mavzudagi nazariy bilimlarni tegishli masalalarni yechish orqali amaliy mohiyatini tushunishda qo‘l keladi.

To‘plamdagi masalalar turli xil o‘quv va reyting nazoratlarini o‘tkazishda keng foydalanishga yo‘l ochib beradi, ayniqsa talabalarni mustaqil ta’lim olishlarida, fanni mustaqil o‘zlashtirishlarida, masofaviy ta’lim olishlarida, o‘zlarining bilimlarini tekshirishlarida alohida ahamiyat kasb etadi.

Ushbu kitob yordamida nazariy mexanika kafedrasida ko‘p yillik olib borilgan o‘quv mashg‘ulotlari natijasi shuni tasdiqladiki, masalalarning qisqaligi, ularni yechishda foydalaniladigan matematik amallarning soddaligi, fanning nazariy bilimlari bilan uzviy bog‘liq ekanligi, murakkabligi deyarli bir xil tarzda ekanligi va masalalar sonining katta miqdorda ekanligi talabalarda yetarli darajada mustahkam ko‘nikmalar olishlarida hamda murakkab masalalarni yechishlarida qo‘l kelishi mumkin bo‘lgan bilimlarni o‘zlashtirishlarida muhim ahamiyat kasb etadi.

To‘plamdan amaliy foydalanish jarayonida quyidagilarga alohida e’tibor berish lozim:

- har bir masalaning javobi (o‘lchov birliksiz) qavs ichida masalaning oxirida keltirilgan.
- barcha javoblar SI sistemasida berilgan; agar javoblar o‘nlik, kasr yoki boshqa birliklarda bo‘lsa, bu haqda masalaning ichida aytib o‘tiladi.
- tenglamalardagi barcha qiymatlar SI sistemasi bo‘yicha ifodalangan;
- javoblardagi kasr sonlar, verguldan keyingi 3 raqamgacha ixchamlangan.

To‘plamda quyidagilarga yo‘l qo‘yilgan:

- agar masalaning matnida birorta jismning massasi, og‘irligi, ishqalanishi yoki boshqa xususiyatlari keltirilmagan bo‘lsa, demak ularni hisobga olish zarur emas;

- barcha egiluvchan jismlar (sim arqon, arqon, ip va boshqalar)ni cho'zilmaydi deb hisoblash lozim, bloklar ustida sirpanish bo'lmasligi tayin etilsin;
- jismlarning dumalashlari sirpanishsiz sodir bo'ladi, deb hisoblansin;
- so'nuvchi tebranishlarning dekrementi, umumlashgan koordinatalarning ketma-ket ikkita maksimal qiymatlarining nisbatiga teng deb qabul qilinsin.

Bunday qoidalardan istisno bo'lgan masalalarda ular haqida matnda alohida ko'rsatib o'tiladi.

Reyting baholashning quyidagi uslubi taklif etiladi. O'qituvchi o'z oldiga qo'ygan maqsadiga mos ravishda har bir mavzu yoki bir necha mavzular bo'yicha komplekt kartochkalar tuzadi (25...50 donadan). Har bir kartochkalarda 4 tadan 10 tagacha masalalar bo'lishi mumkin. Har bir kartochkadagi masalalar har xil bo'lishi ma'qul hisoblanadi.

Kartochkalarni ko'rinishi quyidagicha bo'lishi mumkin. To'plamdan ko'chirilgan (masalan, kompyuterda chiqarilgan yoki kseroks qilingan) masalalar, nomerlari va javoblari ko'rsatilmagan holda, birin-ketin quyidagi jadvalga joylashtiriladi:

№	Dinamika	Kartochka
1		
2		
-		
-		
n		

Masalalar tartib nomerlar orqali 1 dan n-gacha belgilanadi, n kartochkadagi masalalar soni. Kartochkaning yuqorigi qismida komplekt kartochkaning nomi ko'rsatilgan, masalan «Statika». Demak, ushbu kartochka tegishli qismning barcha mavzulari bo'yicha masalalar bilan ta'minlangan. Agar kartochkalar komplekti birorta mavzudagi masalalarga qaratilgan bo'lsa, uning mavzusi ko'rsatiladi, masalan «Nuqta kinematikasi» va shu mavzuga oid bo'lgan barcha maslalar keltiriladi.

Talabalar o'zlari yechgan barcha masalalarni quyidagi jadvalga tushirib topshirishlari lozim bo'ladi:

1	2	3	4	5	6	7	n
javob.	javob.	javob.	javob.	javob.	javob.	javob.	javob.

Jadvalning yuqoridagi o'ng tomoniga kartochkaning nomeri yoziladi, birinchi qatorga masalalarning nomerlari yoziladi, ikkinchi qatorga shu masalalarni yechish natijasida aniqlangan javoblar yoziladi.

Tekshiruv ishlarini tezlashtirish uchun ushbu kartochkalardagi masalalarning to'g'ri javoblari oldindan tayyorlab qo'yilgan bo'lishi lozim.

Dinamika										
Kartochka№	Kartochkadagi masalalar №									
1	1	2	3	4	5	6	7	8	9	10
2										
3										
k										

Jadvalning yuqorisiga kartochkaning nomi yoziladi. Jadvaldagi *k* kartochkalar sonini belgilaydi. Har bir qatorga kartochkadagi tegishli masalalarning yechimlari yozilgan bo'ladi.

Agar kompyuterlar mavjud bo'lsa, tegishli kartochkalar uning xotirasiga kiritib qo'yilsa ma'qul bo'ladi.

Ushbu kitob O.E.Kepe boshchiligida bir qancha mualliflarning ko'p yillik olib borgan o'quv ishlarining mahsuli hisoblanadi.1976-yildan boshlab, bu kitobning ayrim qismlari Riga (Latviya) politexnika institutining bosmaxonasida rus tiliga tarjima qilinib, chop etilgan. O'sha masalalar Latviya oliy o'quv yurtlarida va Moskva energetika institutidagi ko'p yillab o'tkazilgan amaliy mashg'ulotlar natijasi asosida qaytadan tahrirlanib, tegishli o'zgartirishlar va to'ldirishlar kiritilgan.

Mazkur masalalar to'plami Latviyadagi oliy o'quv yurtlarining nazariy mexanika fani professor-o'qituvchilarining metodik ishlarini bir qismi hisoblanib, O.E.Kepe, Ya.A. Viba muallifligida yozilgan «Nazariy mexanika» (Riga, Zvayzgne, 1982) hamda O.E.Kepe muharrirligida tayyorlangan «Nazariy mexanika amaliyotda» (Riga, Zvayzgne, 1976) nomli o'quv qo'llanmasida o'z aksini topgan.

Kitobni nashrga tayyorlashda quyidagi mualliflar faollik qilishgan: O.E.Kepe (4, 7, 12, 13, 20-boblar), Ya.A.Viba (5, 8, 10,16, 22-boblar), O.P.Grapis (14, 17, 21-boblar), Ya.A.Svetinish (15, 18-boblar), B.K.Grasmanis (2, 6, 23-boblar), T.N. Novoxatskaya (19-bob), E.E.Krumin (1, 11-boblar), A.A.Kishenko (9-bob), I.I.Vyaters (3-bob) Masalalar tuzishda I.M. Kashlinskiy, Ya.Ya.Lauva, A.K. Gulbe, A.Ya. Mejs, I.A.Myerkulov, I.A.Tipans, L.I.Machabeli, Ya.Ya. Vizbulis, V.A. Ageyevlar ishtirok etdilar.

Mualliflar ushbu qo'llanmani taqriz qilishda ishtirok etgan va o'zlarining qimmatli maslahatlari bilan qatnashgan hamkasblarga cheksiz minnatdorchilik izhor etadilar.

Ushbu qo'llanma bo'yicha taklif va e'tirozlarni quyidagi manzilga yuborishingiz so'raladi: 101430, Moskva, GSP-4, Neglinnaya ko'chasi, 29/14, «Высшая школа» nashriyoti.

BELGILAR RO'YXATI

Belgilar	Nomlari	O'lchov birliklari, SI
A	Tebranishlar amplitudasi	m
a, b, c, h, l	Uzunlik, oraliq masofa	m
a	Tezlanish	m/s^2
a_e	Ko'chirma tezlanish	m/s^2
a_k	Koriolis tezlanishi	m/s^2
a_n	Normal tezlanish	m/s^2
a_r	Nisbiy tezlanish	m/s^2
a_t	Urinma tezlanish	m/s^2
$\overline{b}$	Binormal o'q bo'ylab yo'nalgan birlik vektori	-
C	Integral doimiylari	-
c	Qattiqlik (bikrlik) koeffitsiyenti	N/m
c	o'zgarmas qiymat	-
c_φ	Burilma qattiqlik koeffitsiyenti	N/rad
D, d	Diametr	m
e	2,7183 soni	-
e	Siljish, eksentrisitet	m
F	Kuch	N
F_0	Uyg'otuvchi kuchning amplitudasi	N
F_{ishq}	Ishqalanish kuchi	N
$(\overline{F}, \overline{F}')$	Juft kuch	N
f	Sirpanib ishqalanish koeffitsiyenti	-
G	Og'irlik kuchi, vazn	N
g	Erkin tushish tezlanishi	m/s^2
I	O'qqa nisbatan inersiya momenti	$kg \cdot m^2$
I_x, I_y, I_z	Koordinata o'qlariga nisbatan inersiya momentlari	$kg \cdot m^2$
I_{xy}, I_{xz}, I_{yz}	Markazdan qochma inersiya momentlari	$kg \cdot m^2$
$\overline{i}, \overline{j}, \overline{k}$	Koordinata o'qlari bo'yicha yo'naltiruvchi birlik vektorlar	-
k	Xususiy tebranishlarning chastotasi	rad/s
k	Tiklanish koeffitsiyenti	-
L	Kinetik potensial	J
M	Juft kuchning momenti	N·m
M_O	Kuchlar sistemasini O markazga nisbatan bosh momenti	N·m
$M_O(\overline{F})$	$\overline{F}$ kuchning O nuqtaga nisbatan momenti	N·m
M^{in}	Inersiya kuchlarining bosh momenti	N·m
m	Massa	kg
mv	Moddiy nuqtaning harakat miqdori	kg·m/s
N	Normal reaksiya	N
$\overline{n}$	Bosh normal o'q bo'yicha birlik vektori	-

n	Aylanishlar chastotasi	ayl/min
n	Uyg'otuvchi kuchning chastotasi	Gers
n_1, n_2	Mexanik sistemaning xususiy tebranish chastotalari	Gers
P	Tishli g'ildiraklarning o'zaro ilashishlaridagi kuch	N
p	Uyg'otuvchi kuchning chastotasi	rad/s
p	Bosim	N/m
Q	Mexanik sistemaning harakat miqdori	kg·m/s
Q	Umumlashgan kuch	-
q	Taqsimlangan kuchning intensivligi	N/m^2
q	Umumlashgan koordinata	-
R	Reaksiya kuchi, qarshilik, reaktiv kuch	N
R	Radius	m
$\overline{R}^e$	Tashqi kuchlarning bosh vektori	N
$\overline{r}$	Radius vektor	-
r	Radius, qutb radiusi	M
S	Kuch impulsi, zarba impulsi	N·s, kg m/s
T	Kinetik energiya	N·m,kg m/s
T	Tebranish davri	s
t	Vaqt	s
v	Tezlik	m/s
v_e	Ko'chirma tezlik	m/s
v_r	Nisbiy tezlik	m/s
X, Y, Z	Reaksiya kuchlarining tashkil etuvchilari	N
x, y, z, s	Koordinatalar	m
z	G'ildirak va shesternyalarning tishlari soni	-
α	Burchak, boshlang'ich faza	rad
β, γ	Burchak	rad
γ	Chiziqli og'irlik, sirt og'irligi, solishtirma og'irlik	N/m, N/m^2 N/m^3
δ	Dumalab ishqalanish koeffitsiyenti	m
δ	Majburiy tebranishlarning boshlang'ich fazasi	rad
δA	Elementar ish, virtual ish	N·m
$\delta\overline{s}, \delta\overline{r}$	Mumkin bo'lgan ko'chishlar	m
$\delta\varphi, \delta\alpha$	Mumkin bo'lgan burchak ko'chishlar	rad
ε	Burchak tezlanish	rad/s^2
ε_e	Ko'chirma burchak tezlanish	rad/s^2
ε_r	Nisbiy buchakli tezlanish	rad/s^2
η	Dinamiklik koeffitsiyent	-
θ	Eyler burchagi	rad
λ	Prujinaning statik deformatsiyasi	m
μ	Muhitning qarshilik koeffitsiyenti	kg/s
Π	Potensial energiya	N·m
π	3,14159 soni	-

ρ	Egrilik radiusi, inersiya radiusi	m
$\bar{\tau}$	Urimna o'q bo'yicha birlik vektor	-
τ	Qisqa vaqt oralig'i	s
F^I, Φ^I	Inersiya kuchi	N
F^e, Φ^e	Ko'chirma inersiya kuchi	N
F^r, Φ^r	Nisbiy inersiya kuchi	N
φ	Burchak, Eyler burchagi, qutb burchak,	rad
ψ	Burchakli koordinata, Eyler burchagi	rad
ω	Burchak tezlik	rad/s
ω_e	Ko'chirma burchak tezlik	rad/s
ω_r	Nisbiy burchak tezlik	rad/s

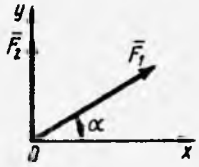
STATIKA

I BOB. KESISHUVCHI KUCHLAR SISTEMASI

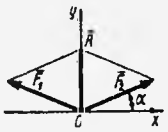
1.1. Tekislikda joylashgan kesishuvchi kuchlarni qo'shish va tashkil etuvchilarga ajratish

1.1.1. O'zaro $\alpha=45°$ burchak hosil qiluvchi ikki $F_1=F_2=5N$ kuchlarning teng ta'sir etuvchisining qiymatini toping. (9,24)

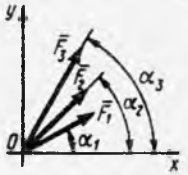
1.1.2. Agar $F_1=10N$ kuch Ox o'qiga $\alpha=30°$ burchak ostida, ikkinchi $F_2=8N$ kuch esa Oy o'qi bo'ylab yo'nalgan bo'lsa, ularning teng ta'sir etuvchisi Ox o'qi bilan qanday burchakni tashkil etadi? (56,3)



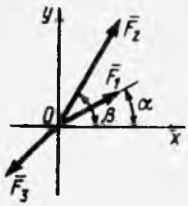
1.1.3. O'zaro teng $F_1=F_2=15N$ kesishuvchi kuchlarning teng ta'sir etuvchisining qiymati $R=10N$ bo'lib, Oy o'qi bo'ylab yo'nalgan bo'lsa, bu ikki kuch Ox o'qi bilan qanday α burchak tashkil qiladi (graduslarda)? (19,5)



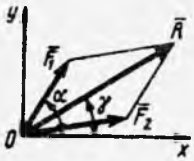
1.1.4. Bir nuqtada kesishuvchi uchta kuch F_1=10N, F_2=15N va F_3=20N vektorlari Ox o'qi bilan mos ravishda α_1=30°, α_2=45° va α_3=60° burchaklar tashkil etsa, ularning teng ta'sir etuvchisining miqdorini aniqlang. (44,1)



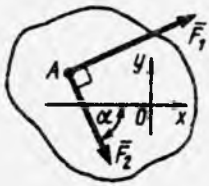
1.1.5. Agar O nuqtaga ikkita F_1=2N va F_2=4N kesishuvchi kuchlar Ox o'qiga nisbatan mos ravishda α=30° va β=60° burchak ostida qo'yilgan bo'lib, uchinchi F_3 kuchining qanday qiymatida uchala kuchning teng ta'sir etuvchisi nolga teng bo'ladi? (6,62)



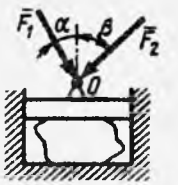
1.1.6. Ikkita $\bar{F}_1$ va $\bar{F}_2$ kesishuvchi kuchlarning teng ta'sir etuvchisi R=10N, shuningdek F_1=5N bo'lib, $\bar{F}_1$ va $\bar{R}$ Ox o'qi bilan tashkil qilgan burchaklari mos ravishda α=60° va γ=30° bo'lsa, $\bar{F}_2$ kuchning modulini aniqlang. (6,64)



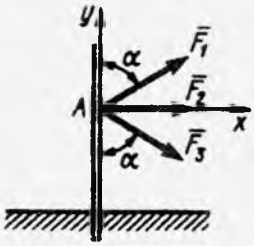
1.1.7. Qattiq jismning A nuqtasiga qiymatlari F_1=6N va F_2=3N bo'lgan ikki kuch ta'sir qiladi. Agar bu kuchlar bir tekislikda joylashgan bo'lib, $\bar{F}_2$ Ox o'qi bilan α=60° burchak tashkil qilgan va bu kuchlar o'zaro perpendikular bo'lsa, ularning yig'indisining Ox o'qiga proyeksiyasini toping. (0,402)



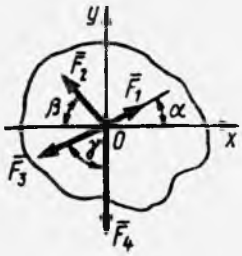
1.1.8. Pressning O nuqtasiga kattaliklari F_1=5N va F_2=7N ikki kuch ta'sir qiladi. Agar ular bir tekislikda joylashgan va vertikal bilan α=30° va β=45° burchak tashkil etsa, jismni siquvchi kuchning vertikal tashkil etuvchisining qiymatini aniqlang. (9,28)



1.1.9. Vertikal sim yog'ochning A nuqtasiga uchta kuch ta'sir etadi: $F_1=F_2=F_3=10$N. Agar bu kuchlar bir tekislikda joylashgan bo'lib, F_1 va F_3 kuchlar gorizontal Ax o'qqa $\alpha=60°$ burchak ostida qo'yilgan bo'lsa, bu kuchlar yig'indisining gorizontal tashkil etuvchisini toping. (27,3)



1.1.10. Qattiq jismning O nuqtasiga 4 ta kuch ta'sir etadi: $F_1=1$N; $F_2=2$N; $F_3=3$N; $F_4=4$N. Agar bu kuchlarning Ox va Oy o'qlarga nisbatan $\alpha=30°$; $\beta=45°$; $\gamma=60°$ burchaklar ostida joylashishi berilgan bo'lsa, kuchlar yig'indisining Oy o'qiga nisbatan proyeksiyasini toping. (-3,22)



1.1.11. Tekislikda joylashgan $\bar{F}_1=3\vec{i}+4\vec{j}$; $\bar{F}_2=5\vec{j}$ va $\bar{F}_3=2\vec{i}$ kesishuvchi kuchlar sistemasi uchun teng ta'sir etuvchining qiymatini hisoblang. (7,35)

1.1.12. $\bar{F}_1$ va $\bar{F}_2$ kesishuvchi kuchlar teng ta'sir etuvchisining son qiymati $R=8$N bo'lib, Ox o'qi bilan $\alpha=30°$ burchak tashkil qiladi. Agar $\bar{F}_1$ kuch vektori Ox o'qi bo'ylab, $\bar{F}_2$ kuch vektori esa Ox o'qiga $\beta=60°$ burchak ostida yo'nalgan bo'lsa, F_1 kuchining qiymatini toping. (4,62)

1.1.13. Tekislikda joylashgan $\bar{F}_1$, $\bar{F}_2$ va $\bar{F}_3$ kesishuvchi kuchlar o'zaro muvozanatlashadi. Agar $F_1=3$N, $F_2=2$N va $\bar{F}_1$, $\bar{F}_2$ kuchlarning vektorlari Ox gorizontal o'q bilan $\alpha_1=15°$ va $\bar{F}$ $\alpha_2=45°$ burchak ostida yo'nalgan bo'lsa, $\bar{F}_3$ ning miqdorini aniqlang. (4,84)

1.1.14. Kesishuvchi ikki F_1 va F_2 kuchning teng ta'sir etuvchisi Ox gorizontal o'qqa R_x=5N proyeksiyaga ega bo'lsa, F_{1x}=7N deb olib, F_{2x} ning qiymatini toping. (-2)

1.1.15. $\overline{F}_1$ va $\overline{F}_2$ kesishuvchi kuchlarning koordinata o'qlaridagi proyeksiyalari mos ravishda F_{1x}=3N, F_{1y}=6N, F_{2x}=5N, F_{2y}=4N bo'lsa, teng ta'sir etuvchining miqdorini toping. (12,8)

1.1.16. Uchta $\overline{F}_1$, $\overline{F}_2$ va $\overline{F}_3$ kesishuvchi kuchlar bir tekislikda joylashgan bo'lib, jismga ta'sir qiladi. Agar kuchlarning koordinata o'qlariga nisbatan proyeksiyalari mos ravishda: F_{1x}=10N; F_{1y}=2N; F_{2x}=-4N; F_{2y}=3N; F_{3x}=-6N; F_{3y}=-5N bo'lsa, jism muvozanatda bo'ladimi? (Ha)

1.1.17. Tekislikda joylashgan $\overline{F}_1$, $\overline{F}_2$, $\overline{F}_3$ va $\overline{F}_4$ kesishuvchi kuchlar sistemasi o'zaro muvozanatda bo'lib, koordinata o'qlaridagi proyeksiyalari mos ravishda: F_{2x}=4N; F_{2y}=7N; F_{3x}=-5N; F_{3y}=-5N; F_{4x}=-2N; va F_{4y}=0 bo'lsa, $\overline{F}_1$ kuchining qiymatini aniqlang. (3,61)

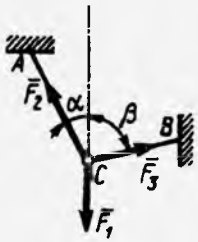
1.1.18. Tekislikda joylashgan $\overline{F}_1$, $\overline{F}_2$ va $\overline{F}_3$ kesishuvchi kuchlar sistemasining teng ta'sir etuvchisi $\overline{R}$ kuchi bo'lib, ularning koordinata o'qlaridagi proyeksiyalari mos ravishda: F_{2x}=-9N; F_{2y}=-7N; F_{3x}=12N; F_{3y}=0 va Rx=18N, Ry=24N bo'lsa, $\overline{F}_1$ kuchining modulini toping. (34,4)

1.1.19. Tekislikda joylashgan $\overline{F}_1=3\overline{i}+2\overline{j}$ va $\overline{F}_2=5\overline{i}+7\overline{j}$ ikki kuchning $\overline{R}$ teng ta'sir etuvchisi Oy o'qining musbat yo'nalishi bilan necha gradusli burchak tashkil qiladi. (41,6)

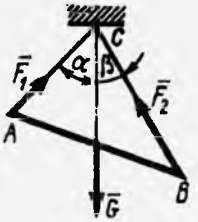
1.2. Tekislikda joylashgan kesishuvchi kuchlar sistemasining muvozanati

1.2.1. Tekislikda joylashgan kesishuvchi uchta $\overline{F}_1$, $\overline{F}_2$ va $\overline{F}_3$ kuchlar o'zaro 120° burchak ostida yo'nalgan bo'lib, $F_1=F_2=10$N bo'lsa, ular muvozanatda bo'lishi uchun F_3 kuch qanday qiymatga ega bo'lishi lozim? (10)

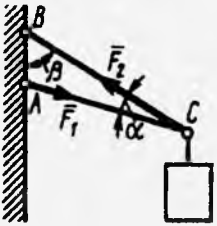
1.2.2. AC va BC sim arqonlarga mahkamlangan C sharnirga F_1 vertikal kuch ta'sir etadi. Agar sim arqonlar vertikalga nisbatan $\alpha=30°$ va $\beta=75°$ burchak tashkil qilgan bo'lib, AC sim arqonning taranglik kuchi $F_2=15$N bo'lsa, BC sim arqonning tarangligi $\overline{F}_3$ ni aniqlang. (7,76)



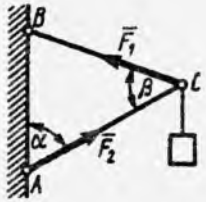
1.2.3. AB to'sin AC va BC arqonlar yordamida shiftga osib qo'yilgan. Agar arqonlar vertikalga $\alpha=45°$ va $\beta=30°$ burchak ostida, arqonlardagi zo'riqishlar $F_1=120$N $F_2=80$N bo'lsa, to'sinning og'irligini aniqlang. (154)



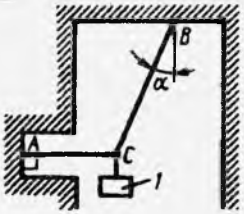
1.2.4. Og'ir jism devorga ikkita sterjen yordamida mahkamlangan. Agar sterjenlar $\beta=60°$, va o'zaro $\alpha=15°$ burchak ostida, sterjenlardagi zo'riqishlar $F_1=17$N va $F_2=45$N bo'lsa, jismning og'irligini toping. (10,44)



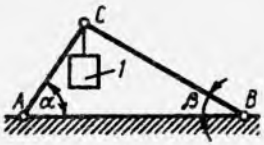
1.2.5. Og'ir yuk *AC* va *BC* vaznsiz sterjenlar yordamida devorga mahkamlangan. Agar *AC* sterjen devor bilan $\alpha=60°$, sterjenlar o'zaro $\beta=45°$ burchak tashkil qilgan bo'lib, *AC* sterjenning siqilishi $F_2=25$N bo'lsa, *BC* sterjendagi zo'riqishni hisoblang. (48,3)



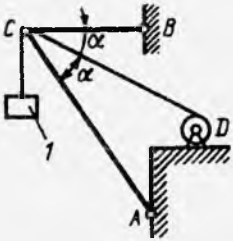
1.2.6. Og'irligi 2N bo'lgan yuk vertikal tekislikda joylashgan ikki arqon yordamida muvozanatda turibdi. Agar $\alpha=30°$ bo'lsa, *BC* arqonning zo'riqishi qancha bo'ladi? (2,31)



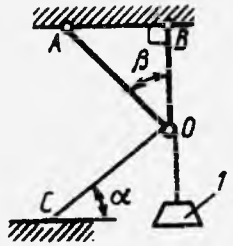
1.2.7. Og'ir yuk vaznsiz ikki sterjen yordamida yerga mahkamlangan. Agar *AC* sterjen yerga nisbatan $\alpha=60°$, *BC* esa $\beta=30°$ burchak tashkil qilib, *AC* sterjenning zo'riqishi 43N bo'lsa, *BC* sterjendagi reaksiya kuchini aniqlang. (-24,8)



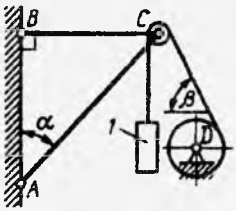
1.2.8. Og'irligi 14N bo'lgan yuk devorga mahkamlangan. *AC* va *BC* sterjenlar hamda *D* barabanga o'ralgan zanjir *C* blok yordamida osib qo'yilgan. Agar zanjir sterjen bilan $\alpha=30°$ burchaklar hosil qilsa, *AC* sterjenning zo'riqishini aniqlang. (-24,2)



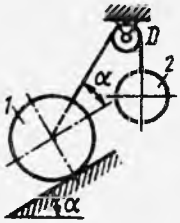
1.2.9. Og'irligi 20N bo'lgan yuk shiftga mahkamlangan *OA* va *OB* sterjenlarga hamda *C* nuqtaga bog'langan arqon yordamida osib qo'yilgan. Agar α=40° va β=45° bo'lsa, *OA* sterjenda hosil bo'lgan reaksiya kuchini toping. (-21,7)



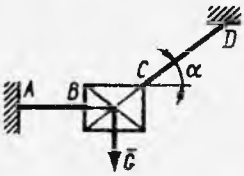
1.2.10. Og'irligi 10N bo'lgan yuk devorga mahkamlangan, *AB* va *BC* sterjenlarga hamda *D* barabanga o'ralgan arqon bilan *C* blok yordamida osib qo'yilgan. Agar α=45°, *AB* β=60° bo'lsa, *AC* sterjenda hosil bo'ladigan zo'riqishni hisoblang. (-26,4)



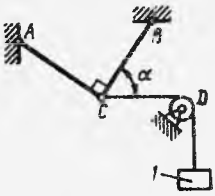
1.2.11. Og'irligi 16N bo'lgan 1 shar 2 sharga ip vositasida blok orqali bog'langan holda muvozanatda turibdi. Agar α=30° bo'lsa, 2 sharning og'irligini toping. (9,24)



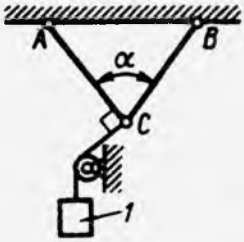
1.2.12. Og'irligi *G*=8N bo'lgan plastina (yassi shaklli jism) vertikal tekislikda joylashgan *AB* va *CD* arqonlar yordamida osib qo'yilgan. Agar α=30° bo'lsa, *CD* arqondagi taranglik kuchini aniqlang. (16)



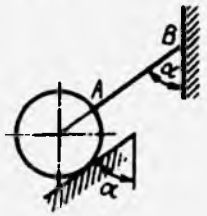
1.2.13. Ikki sterjen *AC* va *BC* o'zaro *C* sharnir yordamida bog'langan. Agar *C* sharnirga *D* blok orqali og'irligi 12N bo'lgan yuk osilib, α=60° bo'lsa, *BC* sterjenning reaksiya kuchini toping. (-6)



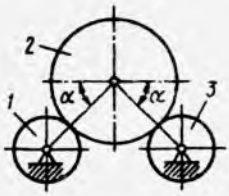
1.2.14. Og'irligi 6N bo'lgan yuk shiftga mahkamlangan teng uzunlikdagi *AC* va *BC* sterjenlarga rasmda ko'rsatilganidek *C* sharnir orqali osib qo'yilgan. Agar $\alpha=60°$ va *BC* sterjendagi zo'riqish 6,94N bo'lsa, *AC* sterjenning zo'riqishini hisoblang. (-3,45)



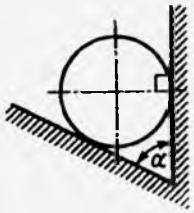
1.2.15. Og'irligi 12N bo'lgan bir jinsli shar ideal silliq qiya tekislikda *AB* arqon vositasida muvozanatda ushlab turilgan bo'lsa, $\alpha=60°$ da sharning tekislikka bosimini hisoblang. (10,4)



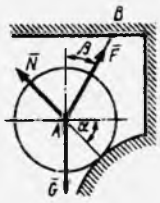
1.2.16. Og'irligi 36N bo'lgan bir jinsli 2 shar qo'zg'almas bo'lgan 1 va 3 g'ildiraklar yordamida muvozanatda ushlab turilgan bo'lsa, $\alpha=45°$da sharning 1 g'ildirakka bosimini toping. (25,5)



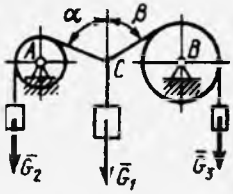
1.2.17. Og'irligi 40 N bo'lgan bir jinsli shar o'zaro $\alpha=60°$burchak ostida joylashgan ikki tekis-likka tiralgan holda muvozanatda turgan bo'lsa, sharning qiya tekislikka ko'rsatayotgan bosimini aniqlang. (46,2)



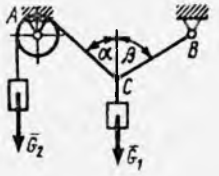
1.2.18. Og'irligi $\overline{G}$ bo'lgan silindr *AB* arqon vositasida silliq teksilikda muvozanatda turibdi. Agar tayanch tekislikning normal reaksiyasi *N*=40N va $\alpha=45°$, $\beta=30°$ bo'lsa, arqonning taranglik kuchini toping. (56,6)



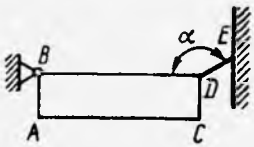
1.2.19. Og'irliklari $\overline{G}_1$, $\overline{G}_2$ va $\overline{G}_3$ bo'lgan yuklar iplar yordamida bloklarga osilgan holda muvozanatda turibdi. Agar G_2=55N va α=75°, β=60° berilgan bo'lsa, G_3 ning qiymatini aniqlang. (61,3)



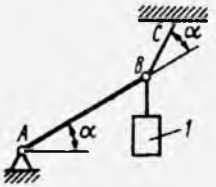
1.2.20. Og'irliklari $\overline{G}_1$ va $\overline{G}_2$ bo'lgan ikki yuk B sharnirga va A blokka ip vositasida osilgan. Agar G_2=90N, α=45°, β=60° berilgan bo'lsa, BC ipning taranglik kuchini hisoblang. (73,5)



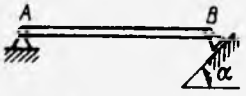
1.2.21. Og'irligi 200N li gorizontal brus B sharnir hamda DE arqon yordamida mahkamlangan. Agar brusning o'lchamlari 4AB=AC va α=150° ma'lum bo'lsa, B sharnirda hosil bo'lgan reaksiya kuchini aniqlang. (200)



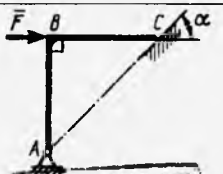
1.2.22. AB vaznsiz sterjen A nuqtasida qo'zg'almas sharnir va BC ip yordamida mahkamlangan. Agar sterjenning B uchiga og'irligi 50N bo'lgan 1 yuk osilsa, α=30° da BC ipning taranglik kuchi qancha bo'ladi? (86,6)



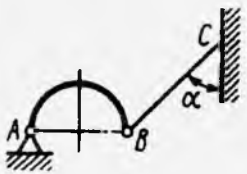
1.2.23. Bir jinsli AB gorizontal to'sinning og'irligi 180N bo'lsa, α=45° uchun A sharnirning reaksiya kuchini toping. (127)



1.2.24. Bukilgan ABC vaznsiz sterjen A nuqtasida yerga qo'zg'almas sharnir vositasida mahkamlangan bo'lib, C uchi esa α=45° burchak ostida silliq sirtga tayanadi. Agar unga F=10N kuch ta'sir qilsa, A sharnirda hosil bo'ladigan reaksiya kuchini aniqlang. (7,07)



1.2.25. Og'irligi 5N bo'lgan yoysimon AB brus A nuqtada qo'zg'almas sharnir orqali, yerga mahkamlangan. B nuqtasida BC arqon yordamida bog'lab qo'yilgan. Agar $\alpha=45°$ bo'lsa, A sharnirdagi reaksiya kuchini aniqlang. (3,54)



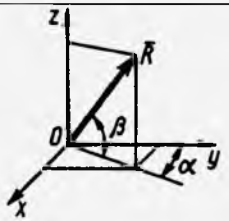
1.3. Kesishuvchi fazoviy kuchlarni qo'shish va tashkil etuvchilarga ajratish

1.3.1. $\bar{F}$ kuchining koordinata o'qlaridagi proyeksiyalari: $F_x=20$N; $F_y=25$N; $F_z=30$N ni tashkil qilsa, uning modulini aniqlang. (43,9)

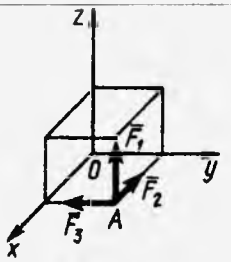
1.3.2. $\bar{F}=3\vec{i}+4\vec{j}+5\vec{k}$ kuchning vektori Oz o'qi bilan orasidagi burchak kosinusini aniqlang. (0,707)

1.3.3. $\bar{F}=3\vec{i}+2{,}45\vec{j}+7\vec{k}$ kuchining vektori bilan Ox o'qi orasidagi burchak kosinusini aniqlang. (0,375)

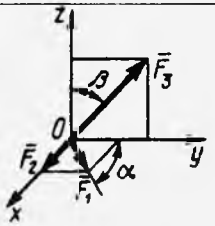
1.3.4. Fazoviy kesishuvchi kuchlar sistemasi-ning teng ta'sir etuvchi $\bar{R}$ ning moduli 150N. Agar burchaklar $\alpha=30°$ va $\beta=60°$ bo'lsa, $\bar{R}$ vektorning Oy o'qidagi proyeksiyasini aniqlang. (65)



1.3.5. *A* nuqtaga qo'yilgan F_1=12N, F_2=10N va F_3=9N kuchlarning teng ta'sir etuvchisining modulini aniqlang. (18,0)



1.3.6. Fazoviy kuchlar F_1=15N, F_2=20N va F_3=25N ning teng ta'sir etuvchi kuchi miqdorini aniqlang. $\bar{F}_1$ va $\bar{F}_3$ kuchlarining koordinata o'qlari bilan hosil qilgan burchaklari α=60° va β=45°. (50,5)

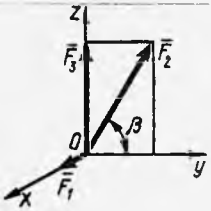


1.3.7. Uchta kuchning teng ta'sir etuvchisining moduli R=33,8N berilgan bo'lib, uning yo'naltiruvchi kosinuslarini $\cos(\bar{R},\hat{}x)$=0,325; $\cos(\bar{R},\hat{}y)$=0; $\cos(\bar{R},\hat{}z)$=0,946 va kuchlarning koordinata o'qlaridagi proyeksiyalari F_{1x}=7N; F_{1y}=10N; F_{1z}=0; F_{2x}=−5N; F_{2y}=15N va F_{2z}=13N bo'lsa, $\bar{F}_3$ kuchning modulini aniqlang. (32,6)

1.3.8. Uchta kuchning koordinata o'qlaridagi proyeksiyalari F_{1x}=7N; F_{1y}=10N; F_{1z}=0; F_{2x}=-5N; F_{2y}=15N; F_{2z}=12N; F_{3x}=6N; F_{3y}=0; F_{3z}=−6N berilgan bo'lsa, ularning teng ta'sir etuvchisining modulini toping. (26,9)

1.3.9. To'g'ri burchakli koordinatalar sistemasi markazi *O* ga $\bar{F}_1=5\bar{i}+7\bar{j}+9\bar{k}$ va $\bar{F}_2=4\bar{i}+9\bar{j}+11\bar{k}$ ikkita kuchlar qo'yilgan bo'lsa, ularning teng ta'sir etuvchisining qiymatini aniqlang. (21,7)

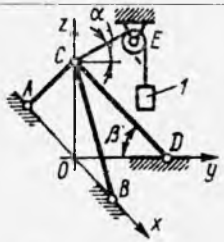
1.3.10. Koordinata markaziga qo'yilgan uchta kuch: F_1=5kN; F_2=12kN; F_3=9kN va burchak β=60° berilgan bo'lsa, teng ta'sir etuvchi kuchning modulini aniqlang. (20,9)



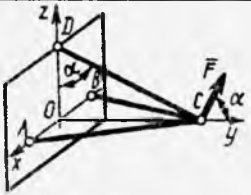
1.4. Fazoda joylashgan kesishuvchi kuchlar sistemasining muvozanati

1.4.1. Uchta $F_1=F_2=F_3$=30N kuchlar koordinata o'qlari bo'ylab yo'nal-gan bo'lsa, F_4=51,96N kuch bilan ular muvozanatlashgan kuchlar sis-temasini tashkil qila oladimi? (Ha)

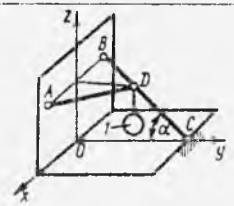
1.4.2. Og'irligi 60N bo'lgan yuk arqon vositasida *E* blok orqali sharnirli uchta sterjenlarga osib qo'yilgan. Agar α=30° va β=45° burchaklar berilgan bo'lsa, *DC* sterjendagi zo'riqishni aniqlang. (-73,5)



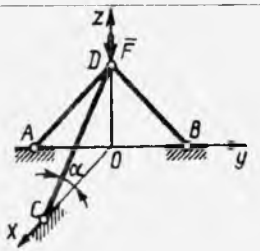
1.4.3. Uchta sterjen *AC*, *BC* va *DC* sharnirlar yordamida mahkamlangan bo'lib, *C* sharnirda ularga *Oyz* tekisligida joylashgan $\bar{F}$ kuchi ta'sir qiladi. Agar *F*=50N va α=60° berilgan bo'lsa, *DC* sterjenning zo'riqishini aniqlang. (-86,6)



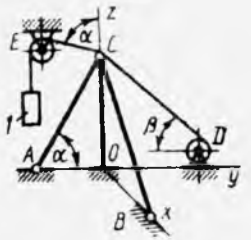
1.4.4. Uchta sterjen *AD*, *BD* va *CD* sharnirlar bilan mahkamlangan bo'lib, *D* sharnirga 20N li yuk osilgan bo'lsa, *CD* sterjenning zo'riqishini toping (α=45°). (-28,3)



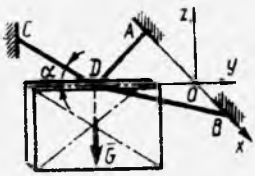
1.4.5. Uchta *AD*, *BD* va *CD* sterjenlar *D* nuqtada sharnir vositasida bog'langan bo'lib, shu nuqtaga *Oyz* tekisligida joylashgan *F*=8N kuch ta'sir etadi. Agar α=20° bo'lsa, *CD* sterjenning zo'riqishini toping. (0)



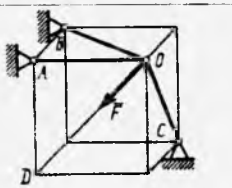
1.4.6. Og'ir yuklarni ko'tarish uchun ishlatiladigan «uch oyoq» uchta *AC*, *OC* va *BC* sterjenlar hamda dastakli barabandan iborat. Agar 1 yukning og'irligi 60N va burchaklar α=60°, β=45° bo'lsa, *AC* sterjen zo'riqishini aniqlang. *DCE* sim arqon *Oyz* tekisligida joylashgan. (-19,1)



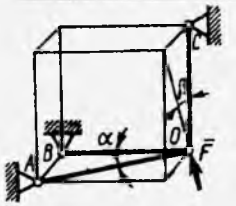
1.4.7. Og'irligi *G*=100N bo'lgan bir jinsli plita uchta sim arqonlar yordamida *Oyz* tekisligida muvozanatda ushlab turilibdi. Agar *CD* sim arqon *Oyz* tekisligida bo'lib, burchak α=30° bo'lsa, *CD* sim arqonning taranglik kuchini aniqlang. (200)



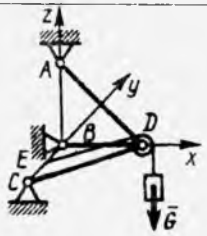
1.4.8. Uchta *AO*, *BO* va *CO* sterjen sharnir yordamida bog'langan bo'lib, *O* sharnirga *F*=12N kuch ta'sir etadi. Agar *AB*=*AO*=*AD* bo'lsa, *CO* sterjenning zo'riqishini aniqlang. (13,9)



1.4.9. Uchta *AO*, *BO* va *CO* sterjen sharnir vositasida bog'langan bo'lib, *O* sharnirga *F*=18N kuch ta'sir etadi. Agar burchaklar α=30°va β=45° bo'lsa, *AO* sterjendagi zo'riqishni toping. (-25,5)



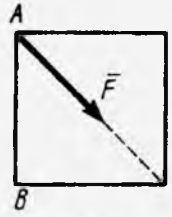
1.4.10. Sharnirli konstruksiyaning D nuqtasiga G=200N yuk osilgan. Agar masofalar CE=BE=2m va AB=BD=4m berilgan bo'lsa, CD sterjendagi zo'riqishni aniqlang. (-127)



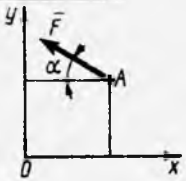
2.1. Kuchning nuqtaga nisbatan momenti. Juft kuchning momenti

2.1.1. Tashkil etuvchilari $F_x=F_y=210$N dan iborat bo'lgan kuch koordinatalari $x=y=0{,}1$m nuqtaga qo'yilgan. Kuchning koordinata boshiga nisbatan momentini toping. (0)

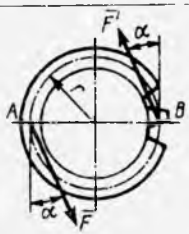
2.1.2. Kvadrat plastinaning A nuqtasiga $F=150$N kuch ta'sir etadi. Agar kvadratning tomonlari 0,2m bo'lsa, kuchning B nuqtaga nisbatan momentini toping. (-21,2)



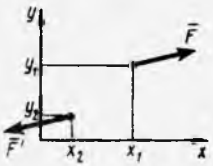
2.1.3. *Oxy* tekislikda yotuvchi $F=420$N kuch koordinatalari $x_A=0{,}2$m; $y_A=0{,}3$m bo'lgan A nuqtaga $\alpha=30°$ burchak ostida qo'yilgan. O nuqtaga nisbatan kuchning momentini toping. (151)



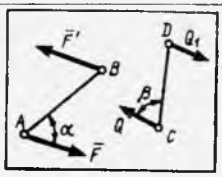
2.1.4. Radiusi $r=0{,}04$m bo'lgan tishli g'ildirakka $\alpha=20°$ burchak ostida $F=F'=100$N juft kuchlar ta'sir etadi. Juft kuchning momentini toping. (7,52)



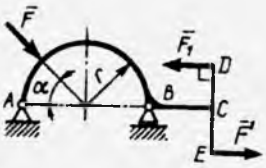
2.1.5. $(\bar{F},\bar{F}')$ juft kuchning proyeksiyalari $F_x=-7{,}5$N $F_y=-F'_y=2{,}5$N bo'lib, koordinatalari $x_1=0{,}1$m, $y_1=0{,}15$m, $x_2=0{,}015$m, $y_2=0{,}02$m nuqtalarga qo'yilgan bo'lsa, ularning momentini hisoblang. (-0,62)



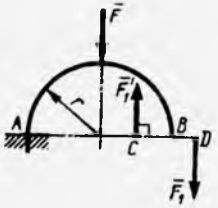
2.1.6. Tekis plitaga miqdorlari $F=F'=8N$ va $Q=Q_1=5N$ ga teng bo'lgan juft kuchlar ta'sir etadi. Agar masofalar $AB=0,25m$, $CD=0,20m$ va burchaklari $\alpha=60°$, $\beta=70°$ bo'lsa, juft kuchlar momentining yig'indisini toping. (0,792)



2.1.7. ABC arkaga $(\overline{F_1}, \overline{F_1'})$ juft kuch va $F=2N$ kuch ta'sir etadi. Agar juft kuch miqdori $F_1=3N$, arka radiusi $r=1m$, juft kuchning yelkasi $DE=1,2m$, $\alpha=45°$ bo'lsa, B nuqtaga nisbatan ularning momentlari yig'indisining miqdorini aniqlang. (5,01)

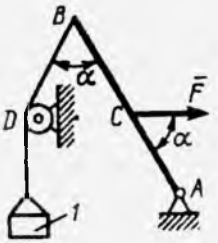


2.1.8. AB arkaga $(\overline{F_1}, \overline{F_1'})$ juft kuch va $\overline{F}$ kuchi ta'sir etadi. Agar kuchlarning miqdori $F=4N$, $F_1=2N$, arka radiusi $r=2m$, juft kuch yelkasi $CD=1,5m$ bo'lsa, ularning A nuqtaga nisbatan momentlarining yig'indisini aniqlang. (-11,0)

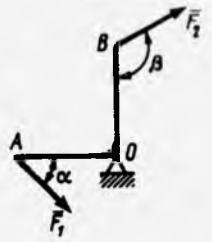


2.1.9. Bir tekislikda joylashgan uchta juft kuch muvozanatda bo'lib, $M_1=510N\cdot m$, $M_2=120N\cdot m$ bo'lsa, M_3 momentning miqdorini toping. (390)

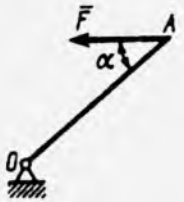
2.1.10. A nuqtasida sharnir yordamida mahkamlangan AB sterjenga $\overline{F}$ kuchi va BD ip vositasida 1 yuk osilgan bo'lib, $AC=BC$, $\alpha=60°$ va yukning og'irligi 2N bo'lsa, stergenni muvozanatda ushlab turish uchun $\overline{F}$ kuchining miqdorini aniqlang. (4,0)



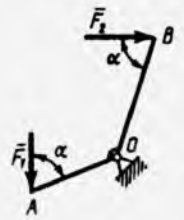
2.1.11. *O* nuqtasida sharnir orqali mahkamlangan richagga $\overline{F}_1$ va $\overline{F}_2$ kuchlar ta'sir etadi. Agar F_1=4N, α=45°, β=120°, masofalar AO=0,5m, BO=0,6m bo'lsa, richagni muvozanatda saqlash uchun $\overline{F}_2$ kuchning miqdorini toping. (2,72)



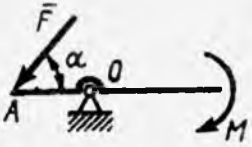
2.1.12. *O* nuqtasida sharnir yordamida mahkamlangan, bir jinsli *OA* sterjenga α=45° burchak ostida $\overline{F}$ kuchi ta'sir etadi. Agar sterjenning og'irligi 5N bo'lib, $\overline{F}$ kuchi ta'sirida vertikal tekislikda muvozanatda bo'lsa, $\overline{F}$ kuchining qiymatini aniqlang. (2,5)



2.1.13. *O* nuqtada sharnir yordamida mahkamlangan richagga α=70° burchak ostida F_1=6N va F_2 kuchlar ta'sir etadi. Agar masofalar OA=0,3m va OB=0,4m bo'lib, richag muvozanatda bo'lsa, $\overline{F}_2$ kuchning qiymatini toping. (4,5)



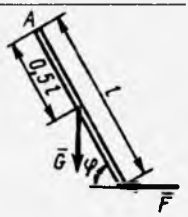
2.1.14. *O* nuqtada sharnir yordamida mahkamlangan richagga α=45° burchak ostida $\overline{F}$ kuch va momenti M=3Nm bo'lgan juft kuch ta'sir etadi. Agar richag muvozanatda bo'lib, masofa OA=0,3m bo'lsa, F kuchining miqdorini aniqlang. (14,1)



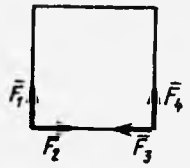
2.2. Tekislikda joylashgan kuchlar sistemasining bosh vektori va bosh momenti. Kuchlar sistemasini sodda holga keltirish

2.2.1. Tekislikda joylashgan kuchlar sistemasining bosh vektorining koordinata o'qlariga proyeksiyalari R_x=300N, R_y=400N bo'lsa, uning modulini toping. (500)

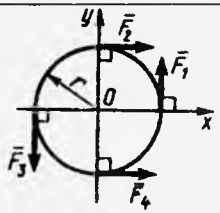
2.2.2. Uzunligi ℓ=0,2m bo'lgan jismga ikkita kuch G=1N va F=5N ta'sir etsa, kuchlar sistemasining bosh momentini A nuqtaga nisbatan hisoblang. Bunda φ=60°. (-0,916)



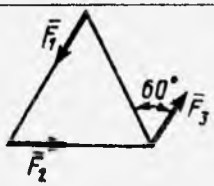
2.2.3. Kvadratning uchlariga to'rtta F_1=F_2=F_3=F_4=1N kuchlar ta'sir etsa, ularning bosh vektori miqdori nechaga teng? (2,0)



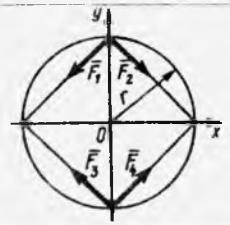
2.2.4. To'rtta F_1=F_2=F_3=1N va F_4=2N kuchlar sistemasi radiusi r=1m bo'lgan aylana bo'ylab joylashgan bo'lsa, ularning bosh momen-ti nolga teng bo'lgan nuqtaning Oy o'qidagi koordinatasini aniqlang. (-1,0)



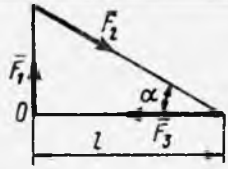
2.2.5. Uchta F_1=F_2=F_3=1N kuch teng tomonli uchburchak uchlariga joylashgan bo'lib, ularning teng ta'sir etuvchisining modulini aniqlang. (1,0)



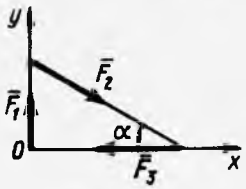
2.2.6. To‘rtta $F_1=F_2=F_3=12$N va $F_4=14$N kuchlar sistemasi radiusi $r=0,2$m bo‘lgan aylana bo‘ylab joylashgan bo‘lsa, O markazga nisbatan kuchlarning bosh momentini toping. (0,283)



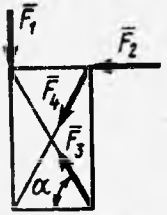
2.2.7. Uchta F_1, $F_2=4$kN, F_3 kuchlar sistemasi to‘g‘ri burchakli uchburchakning uchlari bo‘yicha joylashgan bo‘lib, sistemaning bosh momenti $M_O=-2$kN·m bo‘lsa, $\ell=1$m deb hisoblab, α burchakning qiymatini toping. (30,0)



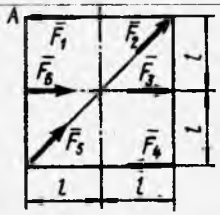
2.2.8. Uchta $F_1=3$N, $F_2=6$N, $F_3=14$N kuchlar sistemasi to‘g‘ri burchakli uchburchakning uchlari bo‘yicha joylashgan bo‘lib, sistemaning bosh vektori Ox o‘qiga parallel bo‘lsa, α burchakning qiymatini toping. (30,0)



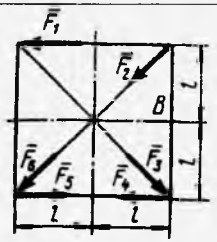
2.2.9. Miqdorlari 10N dan bo‘lgan to‘rtta kuch sistemasi to‘g‘ri to‘rtburchakning uchlariga joylashgan bo‘lib, $\alpha=60^\circ$ bo‘lsa, shu kuchlar sistemasining bosh vektorining miqdorini toping. (22,4)



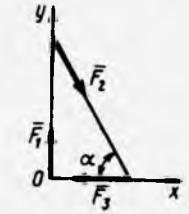
2.2.10. Miqdorlari 6N dan bo‘lgan oltita kuch sistemasi tomonlari 2ℓ ($\ell=0,5$m) bo‘lgan kvadratning turli nuqtalariga ta’sir etsa, A nuqtaga nisbatan kuchlar sistemasining bosh momentini toping. (8,48)



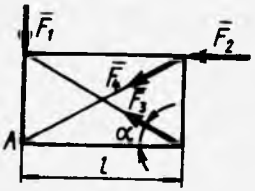
2.2.11. Miqdorlari 4N dan bo'lgan oltita kuchlar sistemasi tomonlari 2ℓ (ℓ=0,4m) bo'lgan kvadratning nuqtalariga ta'sir qilsa, B nuqtaga nisbatan kuchlar sistemasining bosh momentini toping. (4,99)



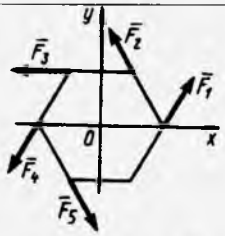
2.2.12. Uchta F_1=12N, F_2=4N, F_3=2N kuchlar sistemasi to'g'ri burchakli uchburchakning uchlariga ta'sir etib, sistemaning bosh vektori Oy o'qiga parallel bo'lsa, α burchakning qiymatini aniqlang. (60,0)



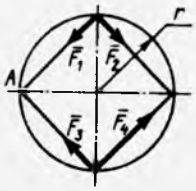
2.2.13. To'rtta F_1=4N, F_2=5N, F_3=8N va F_4=2N kuchlar sistemasi to'g'ri to'rtburchakning uchlariga ta'sir qiladi. Agar uning tomonlari ℓ=1m va α=30° bo'lsa, A nuqtaga nisbatan kuchlar sistemasining bosh momentini toping. (6,89)



2.2.14. Miqdorlari o'zaro teng bo'lgan beshta kuchlar sistemasi muntazam olti burchakning uchlariga joylashgan bo'lsa, sistema bosh vektorining Ox o'qi bilan hosil bo'lgan burchakning qiymatini aniqlang. (180)



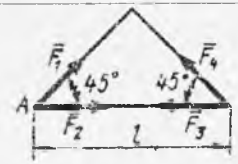
2.2.15. To'rtta F_1=F_2=F_3=2N va F_4=10N kuchlar sistemasi radiusi r=1m bo'lgan aylana bo'ylab joylashgan bo'lsa, kuchlar sistemasining A nuqtaga nisbatan bosh momentini aniqlang. (11,3)



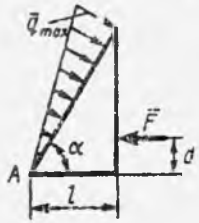
2.2.16. Uchta F_1=3,46N, F_2=2N va F_3 4N kuchlar sistemasi kvadratning uchlariga joylashgan bo'lib, ularning teng ta'sir etuvchisi vertikal yo'nalgan bo'lsa, α burchakning qiymatini toping. (60,0)

2.2.17. Beshta F_1 F_2 F_3 F_4 4N va F_5 5N kuchlar sistemasi shaklda ko'rsatilgandek joylashgan bo'lsa, kuchlar sistemasi bosh vektorining miqdorini toping. (5,0)

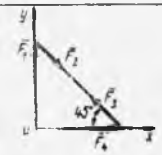
2.2.18. To'rtta kuchlar sistemasi F_1=F_2= F_3 F_4 1N ikkitadan qilib, ℓ=0,1m masofada qo'yilsa, ularning teng ta'sir etuvchisi-ning ta'sir chizig'i A nuqtadan qanday eng yaqin masofadan o'tadi? (0,05)



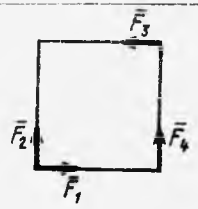
2.2.19. O'lchamlari ℓ=10m va α=60° bo'lgan uchburchak shaklidagi jismga F=100N kuch va intensivligi q_{max} 3N/m li taqsimlangan kuch ta'sir etsa, ularning teng ta'sir etuvchisining ta'sir chizig'i A nuqtadan o'tishi uchun $\bar{F}$ kuchi qanchalik d masofadan ta'sir qilishi lozim? (4,0)



2.2.20. To'rtta F_1=F_2=F_3=F_4 kuchlar sistemasining teng ta'sir etuvchisi Ox o'qi bilan qanday gradus burchak tashkil etadi? (45,0)



2.2.21. Kvadratning uchlariga ta'sir qiluvchi to'rtta $F_1=F_2=F_3=1$N va F_4 kuchlar sistemasining teng ta'sir etuvchisi $R=2$N bo'lsa, $\overline{F}_4$ kuchning miqdorini aniqlang. (1,0)

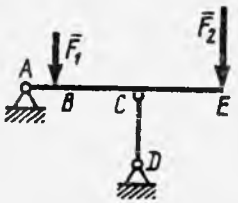


2.3. Tekislikda joylashgan parallel kuchlar sistemasining muvozanati

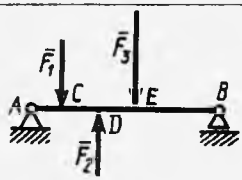
2.3.1. Mahkamlangan to'singa ta'sir qiluvchi tekislikda joylashgan parallel kuchlar sistemasi uchun bir-biriga bog'liq bo'lmagan nechta muvozanat tenglamalarini tuzish mumkin? (2)

2.3.2. *A* sharnir yordamida mahkamlangan *BC* brusga $F_1=4$kN va F_2 kuchlar ta'sir etib, u muvozanatda bo'lsa, masofalarni $AC=2$m, $AB=6$m hisoblab, $\overline{F}_2$ kuchning miqdorini kN larda aniqlang. (12,0)

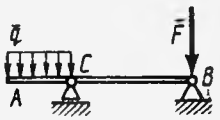
2.3.3. *AE* to'sin qo'zg'almas *A* sharnir va vertikal *CD* sterjen yordamida mahkamlangan bo'lib, unga $F_1=2$kN va $F_2=4$kN kuchlar ta'sir etadi. Agar to'sinning o'lchamlari $AB=1$m, $BC=CE=2$m bo'lsa, *CD* sterjenda hosil bo'layotgan zo'riqishni kN larda aniqlang. (7,33)



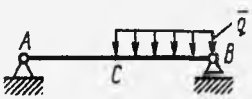
2.3.4. *AB* to'singa vertikal $F_1=1$kN, $F_2=2$kN va $F_3=3$kN kuchlar ta'sir etadi. Agar uning o'lchamlari $AC=CD=DE=1$m, $BE=2$m bo'lsa, *B* tayanchning reaksiya kuchini kN larda aniqlang. (1,2)



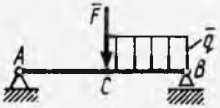
2.3.5. AB to'singa vertikal F=5kN kuch va intensivligi q=4kN/m bo'lgan taqsimlangan kuchlar ta'sir etadi. Agar uning o'lchamlari AC=3m va BC=6m bo'lsa, B tayanchdagi reaksiya kuchini kN da toping. (2.0)



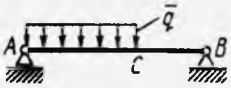
2.3.6. Og'irligi G=20kN bo'lgan bir jinsli AB to'singa intensivligi q=0,5kN/m bo'lgan taqsimlangan kuchlar ta'sir etadi. Agar uning o'lchamlari AB=6m, AC=BC bo'lsa, A tayanch reaksiyasini kN da toping. (10,4)



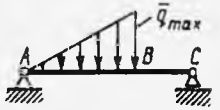
2.3.7. AB to'singa F=9kN kuch va intensivligi q=3kN/m bo'lgan taqsimlangan kuch-lar ta'sir etadi. Agar uning o'lchamlari AB=5m, BC=2m bo'lsa, A tayanch reaksiyasini kN da toping. (10,2)



2.3.8. Uzunligi AB=9m li to'singa intensivligi q=5kN/m bo'lgan taqsimlangan kuchlar ta'sir etib, B tayanch reaksiyasi 10 kN bo'lishi uchun, taqsimlangan kuchning ta'sir etish masofasi AC qancha bo'lishi lozim? (6,0)

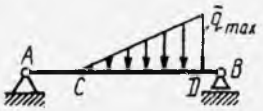


2.3.9. O'lchamlari AB=4,5m, BC=1,5m bo'lgan to'singa intensivligi q_{max}=120 N/m li taqsimlangan kuchlar ta'sir etsa, C tayanchdagi reaksiya kuchini hisoblang. (135)

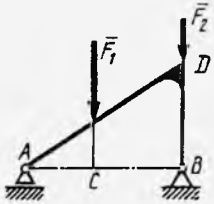


2.3.10. O'lchamlari AB=4m, BC=2m bo'lgan to'singa intensivligi q=40N/m li taqsimlangan kuchlar ta'sir etsa, B tayanch reaksiya kuchini hisob-lang. (100)

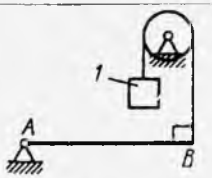
2.3.11. O'lchamlari AC=2m, CD=3m va DB=1m bo'lgan to'singa intensivligi q_{max} li taqsimlangan kuchlar ta'sir etib, B tayanch reaksiyasi 200N bo'lishi uchun q_{max} ning miqdori qancha bo'ladi? (200)



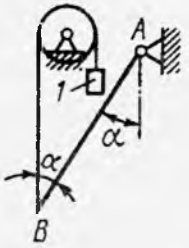
2.3.12. O'lchamlari AC=2,5m, AB=6m bo'lgan ADB ramaga F_1=9kN va F_2=4kN kuchlar ta'sir etsa, B tayanchdagi reaksiya kuchini kN da toping. (7,75)



2.3.13. Og'irligi 340N bo'lgan bir jinsli gorizontal AB to'singa blok yordamida 1 yuk osilgan bo'lib, ular muvozanatda qolishi uchun 1 yukning miqdori qancha bo'lishi lozim? (170)

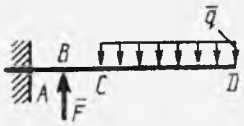


2.3.14. Og'irligi 140N bo'lgan bir jinsli AB to'sinni osilgan 1 yuk yordamida muvozanatda ushlab turishi uchun yukning miqdori qancha bo'lishi lozim? (70)

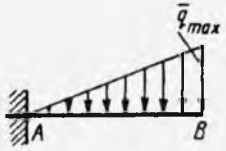


2.3.15. O'lchamlari AB=2m, BC=4m bo'lgan, devorga qistirib mahkamlangan konsol to'singa intensivligi qancha miqdorli q taqsim-langan kuchlar ta'sir etsa, A tayanchning reaktiv momenti 400N·m bo'ladi? (25)

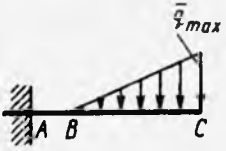
2.3.16. O'lchamlari CD=3m, AB=BC=1m bo'lgan devorga qistirib mahkamlangan konsol to'singa $\bar{F}$ kuchi va intensivligi q=40N/m li taqsimlangan kuchlar ta'sir etib, A tayanch reaktiv momenti 240N·m bo'lishi uchun $\bar{F}$ kuchining qiymati qancha bo'lishi lozim? (180)



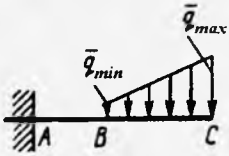
2.3.17. Uzunligi 3 m bo'lgan AB to'sin devorga qistirib, konsol holatda mahkamlangan bo'lib, unga intensivligi q_{max} 100N/m li taqsimlangan kuchlar ta'sir etsa, A tayanchdagi reaktiv momentning qiymatini toping. (300)



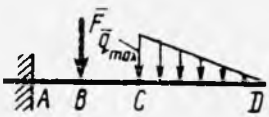
2.3.18. O'lchamlari AB=1m, AC=4m bo'lgan to'sin devorga qistirib mahkamlangan bo'lib, unga intensivligi q_{max} qanday miqdordagi taqsimlangan kuchlar ta'sir etsa, A tayanchdagi reaktiv momentning miqdori 270N·m bo'ladi? (60)



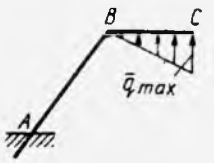
2.3.19. O'lchamlari AB=2m, BC=6m bo'lgan to'sin devorga qistirib mahkamlangan bo'lib, unga intensivliklari q_{max}=30N/m va q_{min}=10N/m bo'lgan taqsimlangan kuchlar ta'sir etsa, A tayanchdagi reaktiv momentning miqdorini toping. (660)



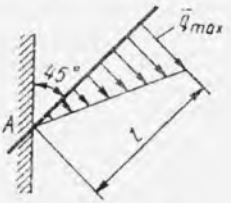
2.3.20. O'lchamlari AB=1m, BC=2m, CD=3m bo'lgan to'sin devorga qistirib mahkamlangan bo'lib, unga $\bar{F}$ kuchi va intensivligi q_{max}=20N/m bo'lgan taqsimlangan kuchlar ta'sir etib, A tayanchdagi reaktiv moment 300N·m ga teng bo'lishi uchun $\bar{F}$ kuchining miqdori qancha bo'lishi lozim? (180)



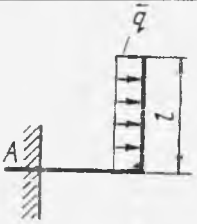
2.3.21. Qistirib mahkamlangan ABC ramkaning BC=3m qismiga intensivligi q_{max} qancha miqdorli taqsimlangan kuchlar ta'sir etsa, A tayanchning vertikal reaksiya kuchi 60N bo'ladi? (40)



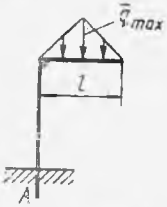
2.3.22. Qistirib mahkamlangan to'sinning qancha ℓ qismiga intensivligi q_{max}=10N/m li taqsimlangan kuchlar ta'sir etsa, A tayanchning reaksiya kuchi R_A=10N ga teng bo'ladi? (2.0)



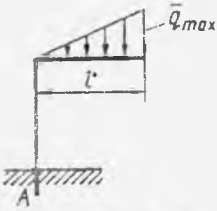
2.3.23. Qistirib mahkamlangan ramaning ℓ=1m li qismiga intensivligi q qancha bo'lgan taqsimlangan kuchlar ta'sir etsa, A tayanchning reaktiv momenti M_A=200N·m ga teng bo'ladi? (400)



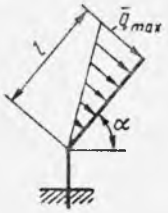
2.3.24. Qistirib mahkamlangan ramaning qancha qismiga intensivligi q_{max}=1N/m bo'lgan taqsimlangan kuchlar ta'sir etsa, A tayanchning reaksiya kuchi R_A=2N bo'ladi? (4,0)



2.3.25. Qistirib mahkamlangan kronshteynda intensivligi q_{max}=1N/m li taqsimlangan kuchlar ta'sir etsa, qistirib mahkamlangan joydagi reaktiv mometning qiymati M_A=3N·m bo'lishi uchun kronshteynning uzunligi ℓ qancha bo'lishi shart? (3,0)



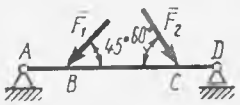
2.3.26. Kronshteynga intensivligi q_{max}=4N/m bo'lgan taqsimlangan kuchlar qo'yilgan. ℓ=1m bo'lsa, α burchakning qanday qiymatida qistirib mahkamlangan kronshteynning A nuqtasidagi vertikal reaksiya kuchi 1N bo'lishi mumkin? (60,0)



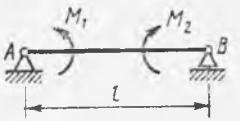
2.4. Tekislikda ixtiyoriy joylashgan kuchlar sistemasining muvozanati

2.4.1. Mahkamlangan to'singa tekislikda ixtiyoriy joylashgan kuchlar sistemasi ta'sir qilsa, ularning muvozanat shartlarini tuzishda bir-biriga bog'liq bo'lmagan nechta tenglama tuzish mumkin? (3)

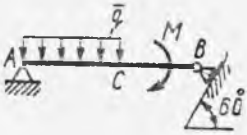
2.4.2. O'lchamlari AB=1m, BC=3m, CD=2m bo'lgan to'singa F_1=84,6N va F_2=208N kuchlar ta'sir etsa, D tayanch reaksiya kuchini hisoblang. (130)



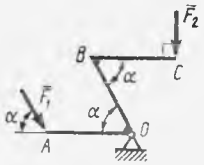
2.4.3. Uzunligi ℓ=3m bo'lgan AB to'singa momentlari M_1=2kN·m va M_2=8kN·m bo'lgan juft kuchlar ta'sir etsa, B tayanchda hosil bo'ladigan reaksiya kuchini kN larda hisoblang. (2,0)



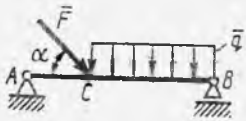
2.4.4. O'lchamlari AC=CB=2m bo'lgan to'singa intensivligi q=150N/m li taqsimlangan kuchlar va momenti M bo'lgan juft kuch ta'sir etib, B tayanchning reaksiyasi 250N bo'lishi uchun M momentning miqdorini toping. (200)



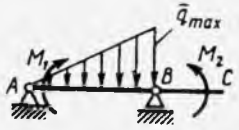
2.4.5. O'lchamlari AO=3m, OB=BC=4m, α=60° bo'lgan richagga F_1=50kN va F_2 kuchlari ta'sir etib, muvozanatda ushlab turilgan bo'lsa, F_2 kuchining miqdorini kN da aniqlang. (65,0)



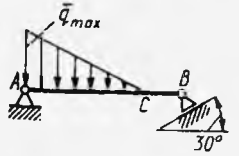
2.4.6. AB to'singa intensivligi q=2N/m bo'lgan taqsimlangan kuchlar va α=45° burchak ostida yo'nalgan F=6N kuch ta'sir etadi. Agar AC=AB/3, AB=2m bo'lsa, B tayanchdagi reaksiya kuchini aniqlang. (4,08)



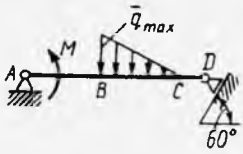
2.4.7. O‘lchamlari AB=4m, BC=0,5AB bo‘lgan AC to‘singa intensivligi q_{max}=2,5N/m taqsimlangan kuchlar va momentlari M_1=4N·m, M_2=2N·m li juft kuchlar ta’sir etsa, B tayanch reaksiyasini toping. (3,83)



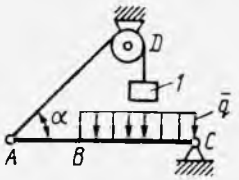
2.4.8. O‘lchamlari AB=8m, AC=6m li to‘singa intensivligi q_{max} qancha bo‘lgan taqsimlangan kuchlar ta’sir etsa, B sharnirda 346N reaksiya kuchi hosil bo‘ladi? (400)



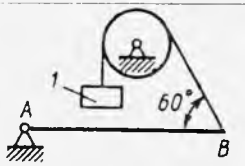
2.4.9. O‘lchamlari AB=BC=3m, CD=1m bo‘lgan AD to‘singa momenti M=13kN·m li juft kuch va intensivligi q_{max}=8kN/m li taqsimlangan kuchlar ta’sir etsa, D tayanch reaksiyasini kN da hisoblang. (10,0)



2.4.10. O‘lchamlari BC=5m, AC=8m bo‘lgan AC to‘sin C sharnir yordamida mahkamlangan bo‘lib, ikkinchi uchiga α=45° burchak ostida 20N li yuk osilgan. To‘sinni gorizontal holatda muvozanatda ushlab turish uchun intensivligi q qancha bo‘lgan taqsimlangan kuchlar qo‘yish lozim? (9,05)

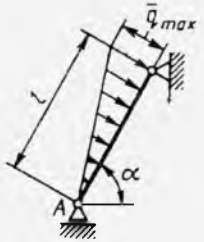


2.4.11. Og‘irligi 346N bo‘lgan bir jinsli AB to‘sinni gorizontal holatda muvozanatda ushlab turish uchun 1 yukning miqdori qancha bo‘lishi lozim? (200)

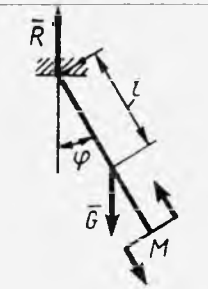


2.4.12. Agar to‘singa sim arqonning taranglik kuchi F=35kN ta’sir etsa, A qo‘zg‘almas sharnirda hosil bo‘ladigan reaksiya kuchining gorizontal tashkil etuvchisi qancha bo‘ladi? (35,0)

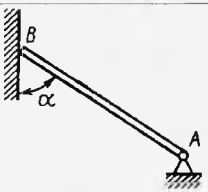
2.4.13. Uzunligi ℓ=0,3 m bo‘lgan to‘sin gorizontdan α=60° burchak ostida bo‘lib, unga intensivligi q_{max}=20N/m li taqsimlangan kuchlar ta’sir etsa, A tayanch reaksiyasini aniqlang. (2,0)



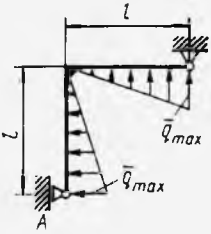
2.4.14. Og‘irligi G=10N bo‘lgan mayatnik vertikaldan φ burchak ostida momenti M=0,5N·m li juft kuch yordamida muvozanatda ushlab turilibdi. Agar masofa ℓ=0,1m berilgan bo‘lib, tayanch reaksiya kuchi R bo‘lsa, mayatnikning og‘ish burchagi φ ning qiymatini graduslarda aniqlang. (30,0)



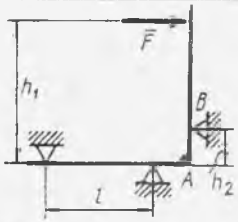
2.4.15. Og‘irligi 100 kN bo‘lgan bir jinsli brus bir uchi bilan A qo‘zg‘almas sharnirga mahkamlangan bo‘lib, ikkinchi uchi bilan α=60° burchak ostida vertikal silliq devorga tiralgan. Brusning devorga bosim kuchini kN da hisoblang. (86,6)



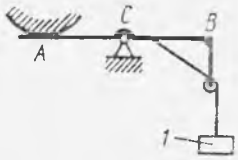
2.4.16. O‘lchamlari ℓ=0,3m bo‘lgan ramaga intensivligi q_{max}=20N/m li taqsimlangan kuchlar ta’sir etsa, A tayanchning reaksiya kuchini toping. (3,0)



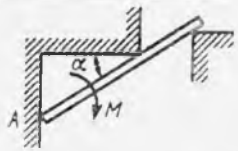
2.4.17. O'lchamlari ℓ=0,3m va h_1=0,4m bo'lgan to'g'ri burchak shaklidagi rama $\overline{F}$ gorizontal kuch ta'sirida muvozanatda turibdi. A va B tayanchlarning reaksiya kuchlari miqdor jihatdan teng bo'lishlari uchun B tayanchini qanday h_2 masofaga joylashtirish lozim? (0,10)



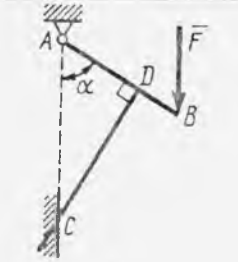
2.4.18. Gorizontal joylashgan AB to'sin og'irligi 18kN li 1 yuk yordamida muvozanatda ushlab turilgan bo'lsa, C tayanch reaksiya kuchining gorizontal tashkil etuvchisini kN da toping. (0)



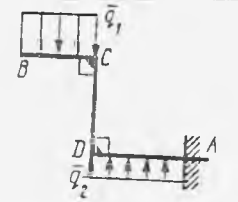
2.4.19. Gorizontdan α=30° burchak qiyalikda joylashgan sterjen momenti M=25kN·m juft kuch ta'sirida muvozanatda ushlab turilgan bo'lsa, A tayanch reaksiya kuchini kN da hisoblang. (0)



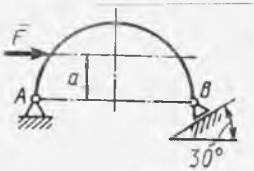
2.4.20. AB to'sin devorga qistirib mahkamlangan CD sterjenga tiralgan. Agar to'sinning uchiga F=4N bo'lgan kuch ta'sir etsa, masofa va burchaklarini AB=2m; BD=1/3 AB, α=60° hisob-lab, CD sterjenda hosil bo'luvchi reaksiya kuchini toping. (5,20)



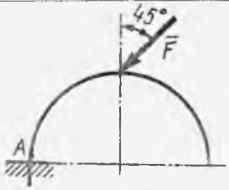
2.4.21. Devorga qistirib mahkamlangan Z shaklidagi AB to'singa intensivliklari q_1= 5N/m va q_2= 3N/m bo'lgan taqsimlangan kuchlar ta'sir etadi. Masofalarni BC= 3m, AD= 5m hisoblab, A tayanch-dagi reaktiv momentni toping. (-60,0)



2.4.22. AB arkaga qanday miqdordagi gorizontal F kuchi ta'sir etsa, B tayanchdagi reaksiya kuchi 200N ga teng bo'ladi. Bunda masofalar a=1m, AB=4M. (693)

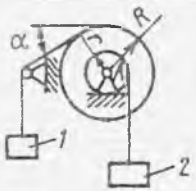


2.4.23. Yarım aylana shaklidagi arka A nuqtasi bilan qistirib mahkamlangan bo'lib, unga F=100N kuch ta'sir etsa, tayanchdagi reaktiv momentni toping. (0)

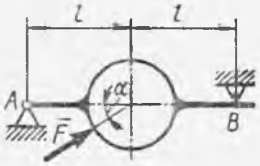


2.4.24. Ikkita yuk 1 va 2 iplar yordamida barabanga o'ralgan holda muvozanatda turibdi. Agar 1 yukning og'irligi 30kN va α=60° bo'lsa, A tayanchning gorizontal reaksiya kuchini toping. (15,0)

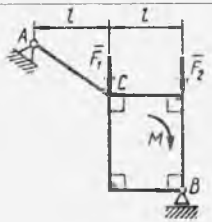
2.4.25. Ikkita yuk 1 va 2 iplar yordamida barabanga o'ralgan holda muvozanatda turibdi. Agar 1 yukning og'irligi 20kN va R=2r. α=30° bo'lsa, A tayanch reaksiyasining vertikal tashkil etuvchisini kN da toping. (50,0)



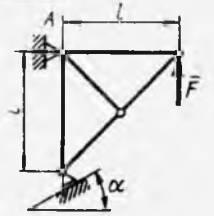
2.4.26. AB sterjenga mahkamlangan diskka α=30° ostida F=24kN kuch ta'sir etayotgan bo'lsa, B tayanchning reaksiya kuchini kN da toping. (6,0)



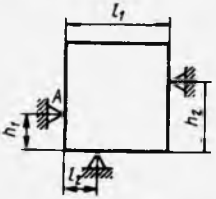
2.4.27. AC sterjen to'rtburchak shaklidagi ramaga bikr mahkamlangan. Agar unga F_1=F_2=20kN kuchlar va momenti M=80kN·m juft kuch ta'sir etib, muvozanatda tursa, B tayanchning reaksiya kuchini toping. Bunda ℓ=2m. (50,0)



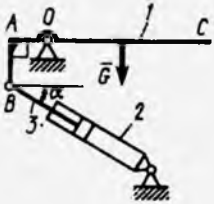
2.4.28. Tekis fermaga F vertikal kuch ta'sir etayotgan bo'lsa, α burchakning qanday qiymatida $R_A=2F$ bo'ladi? (30,0)



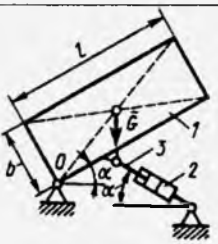
2.4.29. Bir jinsli kvadrat shaklidagi plastinkaning og'irligi 1N bo'lib, 3ta tayanch yordamida muvozanatda turibdi. Agar o'lchamlari l_1=0,3m; l_2=0,1m; h_1=0,1m va h_2=0,2 m bo'lsa, A tayanchning reaksiya kuchini toping. (0,50)



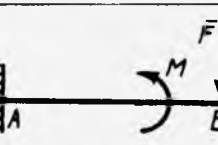
2.4.30. Og'irligi G=2kN bo'lgan 1 narvon 2 kuch gidrosilindiri yordamida gorizontal holatda ushlab turiladi. Agar O tayanchga nisbatan momenti $m_O(G)$=2kN·m ga teng juft kuch ta'sir etsa va masofalar $AO=AB$=0,5m bo'lsa, α=30° burchak ostida joylashgan gidrosilindr 3 dastagida hosil bo'layotgan kuchni kN da aniqlang. (2,93)



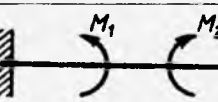
2.4.31. Avtomashinaning kuzovi G=10kN og'irlikka ega bo'lib, 2 kuch gidrosilindr yordamida muvozanatda ushlab turibdi. Agar masofa va burchaklar ℓ=3m, b=1,2m, AO=1m, α=30° bo'lsa, gidrosilindr 3 dastagiga ta'sir etuvchi kuchni aniqlang. (11,5)



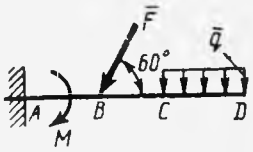
2.4.32. Uzunligi AB=4m bo'lgan to'sin devorga qistirib mahkamlangan bo'lib, unda F=4N kuch va momenti M=2N·m juft kuch ta'sir etayotgan bo'lsa, A tayanchdagi reaksiya momentini toping. (14,0)



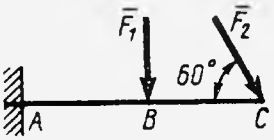
2.4.33. Qistirib mahkamlangan to'singa momentlari M_1=1790N·m va M_2=2135N·m bo'lgan juft kuchlar ta'sir etayotgan bo'lsa, tayanchdagi reaktiv momentni aniqlang. (-345)



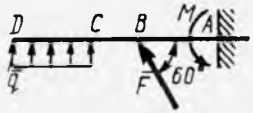
2.4.34. Qistirib mahkamlangan AD to'singa momenti M=200N·m bo'lgan juft kuch, F kuchi va intensivligi q=20N/m li taqsimlangan kuchlar ta'sir etib, A tayanchning reaktiv momenti 650 N·m ga teng bo'lsa, $\bar{F}$ kuchining qiymatini aniqlang. (144)



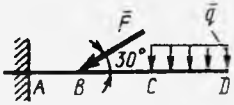
2.4.35. O'lchamlari AB=BC=2m bo'lgan, qistirib mahkamlangan to'singa F_1=50N va F_2=100N kuchlar ta'sir qilayotgan bo'lsa, A tayanchdagi reaksiya momentini toping. (446)



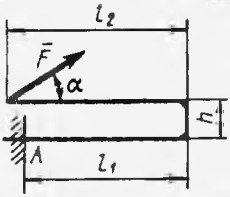
2.4.36. O'lchamlari AB=CD=2m, BC=1m bo'lgan to'sin devorga qistirib mahkamlangan bo'lib, F=173N kuch, momenti M=42N·m li juft kuch va intensivligi q taqsimlangan kuch ta'sir etadi. Agar A tayanchdagi reaksiya momenti M_A=546N·m bo'lsa, taqsimlangan kuchning intensivligini aniqlang. (36,0)



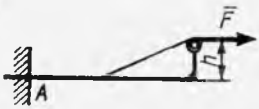
2.4.37. O'lchamlari AB=BC=2m, CD=3m bo'lgan to'sin devorga qistirib mahkamlangan bo'lib, unda F kuchi va intensivligi q=200N/m li taqsimlangan kuch ta'sir etsa, A tayanchning reaksiya momenti M_A=3700N·m bo'lishi uchun F kuchining qiymatini toping. (400)



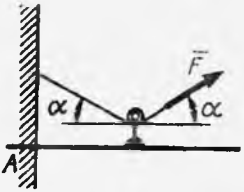
2.4.38. Devorga qistirib mahkamlangan ramaga α=30° burchak ostida F=80kN kuch ta'sir etadi. Agar masofalar ℓ_1=1,8m; ℓ_2=2m va h=0,4m bo'lsa. A tayanchdagi reaksiya momentini kN·m da aniqlang. (35,7)



2.4.39. Devorga qistirib mahkamlangan to‘singa sim arqon yordamida F=50kN qiymatli gorizontal kuch ta’sir etib, h=0,5m bo‘lsa, A tayanchdagi momentning qiymatini kN·m da toping. (25,0)

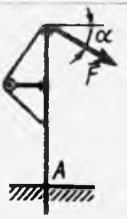
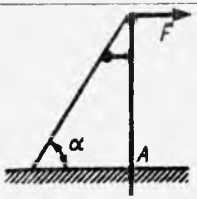
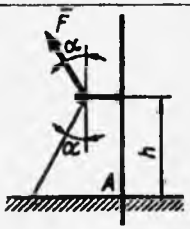
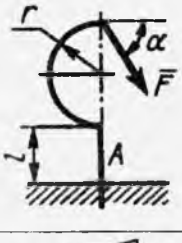
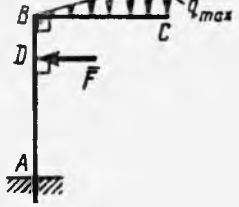


2.4.40. Devorga qistirib mahkamlangan to‘sinning o‘rtasiga tros yordamida F=25kN kuch ta’sir etadi. Agar burchak α=30° bo‘lsa, A tayanchdagi reaksiya kuchining gorizontal tashkil etuvchisini kN da aniqlang. (0)

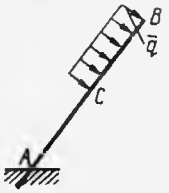


2.4.41. Yerga qistirib mahkamlangan, uzunligi AB=5,66m bo‘lgan to‘sinning uchiga F kuchi ta’sir etayotgan bo‘lsa, A tayanchdagi reaksiya momenti M_A=56kN·m ga teng bo‘lsa, F kuchining qiymatini kN da toping. (14,0)

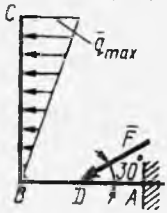
2.4.42. Yerga qistirib mahkamlangan, uzunligi AB=3m bo‘lgan to‘sinning BC=2m qismiga intensivligi q bo‘lgan taqsimlangan kuchlar ta’sir etib, A tayanchdagi reaksiya momenti 480 N·m ga teng bo‘lsa, uning intensivligini hisoblang. (60,0)

2.4.43. Yerga qistirib mahkamlangan to'singa sim arqon yordamida F=10kN kuch ta'sir etib, α=30° bo'lsa, A tayanchdagi reaksiya kuchining vertikal tashkil etuvchisini kN da toping. (5,0)	
2.4.44. Yerga qistirib mahkamlangan to'singa sim arqon yordamida F=4kN kuch α=60° burchak ostida ta'sir qilsa, A tayanch reaksiya kuchining vertikal tashkil etuvchisini kN da hisoblang. (3,46)	
2.4.45. Yerga qistirib mahkamlangan to'singa h=3m balandlikda sim arqon yordamida F=40kN kuch α=30° burchak ostida ta'sir qilsa, A tayanchdagi reaksiya momentini kN·m da aniqlang. (120)	
2.4.46. Yerga qistirib mahkamlangan kronshteynga α=60° burchak ostida F=10N kuch ta'sir etib, yarim doira radiusi r=0,05m bo'lsa, A tayanchdagi juft kuch momenti 1N·m dan ortmasligi uchun uzunlik ℓ ning maksimal qiymatini toping. (0,10)	
2.4.47. Yerga qistirib mahkamlangan ramaga intensivligi q_{max}=400N/m bo'lgan taqsimlangan kuchlar va F kuchi ta'sir etib, A tayanchdagi moment 300 N·m ga teng. Agar o'lchamlari AB=3m; BC=2,4m; BD=1m bo'lsa, F kuchining modulini aniqlang. (2,34)	

2.4.48. Yerga qistirib mahkamlangan AB to'singa intensivligi q=30N/m bo'lgan taqsimlangan kuchlar ta'sir etadi. Agar AC=2m va A tayanchning reaksiya momenti M_A=180N·m bo'lsa, BC uzunlikning qiymatini toping. (2.0)



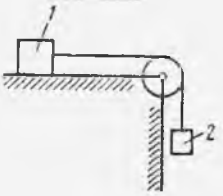
2.4.49. Devorga qistirib mahkamlangan ramaga F=150N kuch va intensivligi q_{max}=40N/m bo'lgan taqsimlangan kuch ta'sir etib, to'sinning o'lchamlari $AD=BD$=1m; BC=3m bo'lsa, A tayanchdagi reaksiya momentning miqdorini toping. (195)



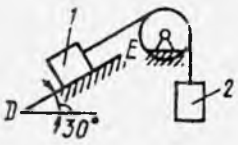
2.5. Sirpanib ishqalanish kuchi ta'siridagi jismlarning muvozanati

2.5.1. Og'ir jism qiya tekislikda muvozanat holatda turibdi. Agar sirpanib ishqalanish koeffitsiyenti 0.6 ga teng bo'lsa, jism muvozanat holatda qolishi uchun qiyalik burchagining eng katta qiymatini graduslarda hisoblang. (31)

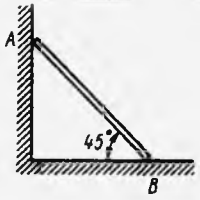
2.5.2. Og'irligi 200 N bo'lgan 1 yuk blok orqali ip yordamida 2 yukka bog'langan. Agar 1 yuk va tekislik orasidagi ishqalanish koeffitsiyenti f=0,2 bo'lsa, 1 yuk o'rnidan qo'zg'alishi uchun 2 yukning eng kam miqdorini toping. (40,0)



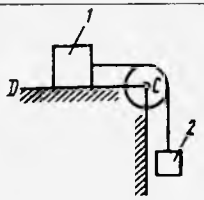
2.5.3. Qiya tekislikda 1 yuk blok orqali ip yordamida og'irligi 320 N li 2 yukga bog'langan. Agar 1 yuk va qiya tekislik orasidagi ishqalanish koeffitsiyenti 0,2 bo'lsa, 1 yuk DE tekislik bo'ylab pastga tushishi uchun uning eng kam og'irligi qancha bo'ladi? (979)



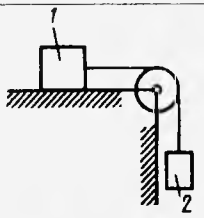
2.5.4. Bir jinsli AB brus silliq devor va yerga tiralgan. Shaklda ko‘rsatilgan holatda to‘sin muvozanatda qolishi uchun brus bilan yer orasidagi ishqalanish koeffitsiyentining eng kam miqdorini toping. (0,50)



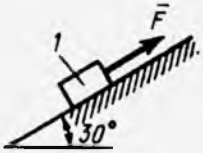
2.5.5. Og‘irliklari 400 N va 96 N bo‘lgan 1 va 2 yuklar ip yordamida blok orqali bog‘langan. 1 yuk 2 yuk tomonidan tortilib, harakatga kelmasligi uchun tekislik va 1 yuk orasidagi ishqalanish koeffitsiyentining eng kam miqdorini toping. (0,24)



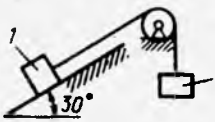
2.5.6. Og‘irligi 140 N bo‘lgan 2 yuk ip yordamida blok orqali 1 yukga bog‘langan. Agar 1 yuk va tekislik orasidagi ishqalanish koeffitsiyenti 0,2 bo‘lsa, 1 yuk muvozanat holatda qolishi uchun uning eng kam og‘irligini toping. (700)



2.5.7. Qiya tekislikdagi 1jismga F=90 N kuch ta’sir etadi. Agar jism va tekislik orasidagi ishqalanish koeffitsiyenti f=0,3 bo‘lsa, yuk o‘z o‘rnidan yuqoriga qo‘zg‘alishi uchun uning og‘irligi qancha bo‘lishi lozim? (118)



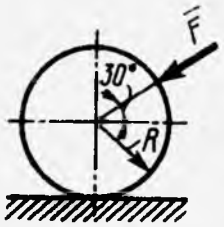
2.5.8. Og‘irligi 100 N bo‘lgan 1 yuk ip yordamida 2 yuk bilan blok orqali bog‘langan. Agar 1 yuk va tekislik orasidagi ishqalanish koeffitsiyenti f=0,3 bo‘lib, 1 yuk o‘z joyida qolishi uchun 2 yukning maksimal qiymatini toping? (76,0)



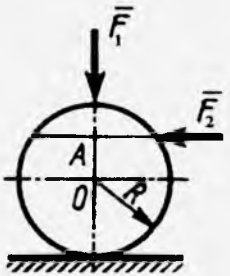
2.6. Dumalab ishqalanish kuchi ta'siridagi jismlarning muvozanati

2.6.1. Og'irligi 520 N bo'lgan silindr gorizontal tekislikda joylashgan bo'lib, dumalab ishqalanish koeffitsiyenti δ=0,007m bo'lsa, silindrni dumalatish uchun qanday minimal juft kuch qo'yish lozim? (3,64)

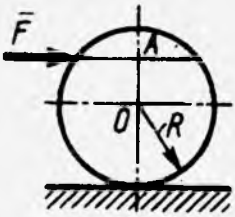
2.6.2. Og'irligi 700 N bo'lgan bir jinsli g'ildirakka $\bar{F}$ kuchi ta'sir etib, sirpanib dumalanishi uchun kuchning eng kam miqdori qancha bo'ladi? Bunda g'ildirak radiusi R=1m, sirpanib va dumalab ishqalanish koeffitsiyent-lari: f=0,2 va δ=0,008m. (183)



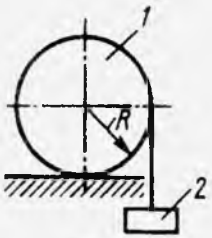
2.6.3. Og'irligi 2 kN bo'lgan bir jinsli g'ildirakka gorizontal F_2=10N va vertikal F_1 kuchlar ta'sir etib, g'ildirak dumalanishni boshlanishi uchun F_1 kuchining eng katta qiymati qancha bo'lishi lozim? Bunda g'ildirakning radiusi R=0,8m va o'lchami OA=0,4m. Dumalab ishqala-nish koeffitsiyentini δ=0,005 m deb oling. (400)



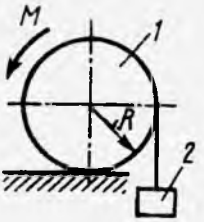
2.6.4. Og'irligi 2 kN bir jinsli g'ildirakka gorizontal $\bar{F}$ kuchi ta'sir etib, g'ildirak sirpanmay va dumalamay turishi uchun kuchning eng katta qiymatini toping. Bunda g'ildirakning radiusi R=0,6m va o'lchamlari OA=0,4m. Sirpanib va dumalab ishqalanish koeffitsiyent-larini f=0,2 va δ=0,006 m deb oling. (12,0)



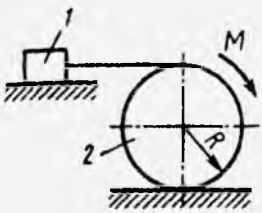
2.6.5. Og'irligi 3,2 kN, radiusi R=32,4 sm bo'lgan g'ildirakka cho'zilmaydigan ip yordamida 2 yuk osilgan. Agar dumalab ishqalanish koeffitsiyenti δ=0,004m bo'lsa, 2 yukning qanday eng katta qiymatida g'ildirak o'zining muvozanat holatini saqlab qoladi? (40,0)



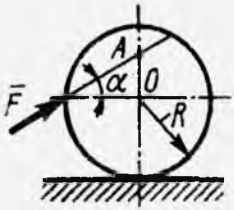
2.6.6. Og'irligi 5 kN, radiusi R=0,453m bo'lgan bir jinsli g'ildirakka momenti M=210N·m li juft kuch ta'sir etadi. Shuningdek unga 2 yuk osilgan. Agar dumalab ishqalanish koeffitsiyenti δ=0,003m bo'lsa, 2 yukning qanday eng katta qiymatida g'ildirak chap tomonga dumalaydi? (428)



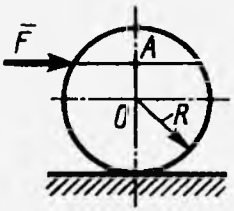
2.6.7. Og'irligi 4 kN, radiusi R=0,5 m bo'lgan bir jinsli 2 g'ildirakka momenti M=50N·m li juft kuch ta'sir etadi. G'ildirakka ip yordamida 1 yuk bog'langan bo'lib, yuk va g'ildirak uchun tekislik bilan sirpanib ishqalanish koeffitsiyenti f=0,2 ga teng. Agar dumalab ishqalanish koeffitsiyenti δ=0,005 m bo'lsa, 1 yukning qanday eng katta qiymatida g'ildirak dumalay boshlaydi? (150)



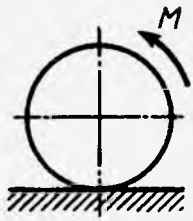
2.6.8. Radiusi R=0,3m bo'lgan g'ildirakka α=30° burchak ostida $\overline{F}$ kuchi ta'sir etib, uni dumalata boshlashi uchun kerak bo'lgan chegaraviy dumalash momenti 3,46 N·m bo'lsa, $\overline{F}$ kuchining eng kam miqdorini toping. Bunda OA=0,2m ga teng deb oling. (7,99)



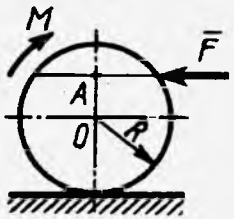
2.6.9. Radiusi R=0,4m bo'lgan g'ildirakka gorizontal F=12N kuch ta'sir etib, u muvozanat holatda qolishi uchun g'ildirakning eng kam og'irligini toping. Bunda dumalab ishqalanish koeffitsiyenti δ=0,008m va o'lchamini OA=0,2m deb oling. (0,9)



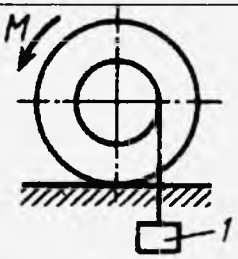
2.6.10. Og'irligi 4 kN bo'lgan bir jinsli g'ildirakka momenti M=20N·m li juft kuch ta'sir etib, u muvozanat holatda qolishi uchun dumalab ishqalanish koeffitsiyentining eng kam miqdorini toping. ($5\cdot10^{-3}$)



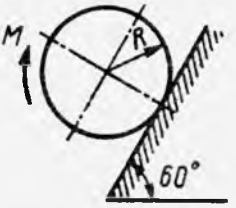
2.6.11. Og'irligi 4 kN bo'lgan bir jinsli g'ildirakka gorizontal F=50 N kuch va momenti M=20 N·m li juft kuch ta'sir etadi. Agar dumalab ishqalanish koeffitsiyenti δ=0,005 m va OA=0,6R bo'lsa, g'ildirak chap tomonga dumalay boshlashi uchun g'ildirakning radiusi R ning eng kam miqdorini toping. (0,50)



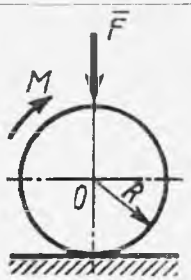
2.6.12. Kichik radiusi 0,2m bo'lgan g'ildirakka og'irligi 200 N li yuk osilgan bo'lib, momenti M=57,6 N·m juft kuch ta'sir etadi. Agar dumalab ishqalanish koeffitsiyenti δ=0,008 m bo'lsa, g'ildirak chap tomonga dumalashi uchun uning og'irligining eng katta miqdorini kN da aniqlang. (2,0)



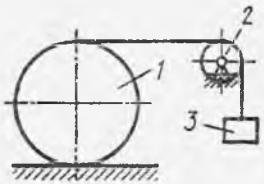
2.6.13. Radiusi R=0,4m bo'lgan bir jinsli g'ildirak momenti M=210N·m li juft kuch ta'sirida qiya tekislikdan yuqoriga dumalashi uchun uning og'irligining eng katta qiymatini toping. Dumalab ishqalanish koeffitsiyenti δ=0,006 m deb hisoblang. (601)



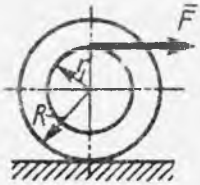
2.6.14. Bir jinsli g'ildirakka momenti M=18N·m bo'lgan juft kuch va F=600N kuch ta'sir etadi. Agar dumalab ishqalanish koeffitsiyenti δ=0,006m bo'lsa, g'ildirak dumalashni boshlashi mumkin bo'lgan eng katta og'irligini kN da toping. (2,40)



2.6.15. Og'irligi 10 kN, radiusi 0,5m bo'lgan bir jinsli g'ildirak ip yordamida 2 blok yordamida og'irligi 80N li 3 yukka bog'langan. G'ildirak muvozanat holatida qolishi uchun dumalab ishqalanish koeffitsiyentining eng kam miqdori qancha bo'lishi lozim? (0,008)



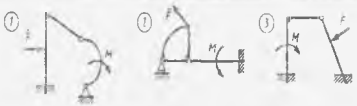
2.6.16. Radiuslari r=0,5m va R=1m bo'lgan g'altakka F=20 N li kuch ta'sir qilib, gorizontal tekislikda bir tekisda dumalaydi. Agar dumalab ishqalanish koeffitsiyenti δ=0,01m bo'lsa, g'altakning og'irligini (kN) da aniqlang. (3,0)



3.1. Tekislikda joylashgan kuchlar ta'siridagi jismlar sistemasining statik aniqligi

3.1.1. Bir tekislikda joylashgan kuchlar sistemasi ta'siridagi uchta jismdan iborat sistema uchun nechta bir-biriga bog'liq bo'lmagan kattaliklarni aniqlash mumkin? (9)

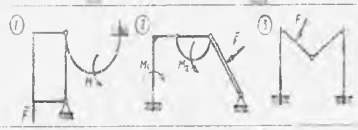
3.1.2. Statik aniq bo'lgan konstruksiya raqamini ko'rsating. (2)



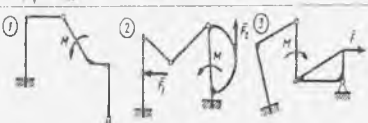
3.1.3. Statik aniq bo'lgan konstruksiya raqamini ko'rsating. (1)

3.1.4. Statik aniq bo'lgan konstruksiya raqamini ko'rsating (3)

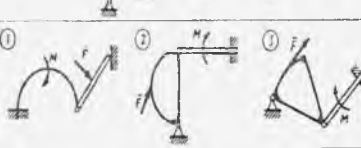
3.1.5. Statik aniq bo'lgan konstruksiya raqamini ko'rsating. (2)



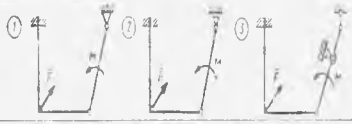
3.1.6. Statik aniq bo'lgan konstruksiya raqamini ko'rsating. (3)



3.1.7. Statik aniq bo'lgan konstruksiya raqamini ko'rsating. (1)



3.1.8. Statik aniq bo'lgan konstruksiya raqamini ko'rsating. (2)

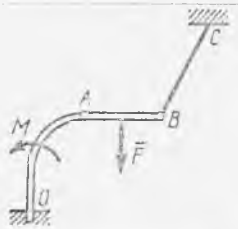


3.1.9. Statik aniq bo'lmagan konstruksiya raqamini ko'rsating. (3)

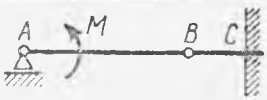
3.2. Tekislikda joylashgan kuchlar sistemasi ta'siridagi statik aniq jismlar sistemasining muvozanati

3.2.1. Bir tekislikda joylashgan kuchlar sistemasi ta'sirida i to'rtta jismdan iborat sistema uchun bir-biriga bog'liq bo'lmagan nechta muvozanat tenglamalari tuzish mumkin? (12)

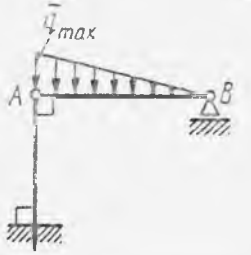
3.2.2. Sistema OA va AB sterjenlardan hamda BC sim arqondan iborat. O tayanchdagi, A sharnirdagi va sim arqondagi taranglik kuchlarini aniqlash uchun eng kamida nechta muvozanat tenglamalarini tuzish lozim bo'ladi? (6)



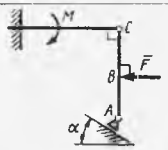
3.2.3. O'lchamlari AB=2m va BC=0,5m bo'lgan sterjenlardan iborat sistemaga momenti M=800N·m li juft kuch ta'sir etsa, C tayanchdagi reaksiya momentini aniqlang. (200)



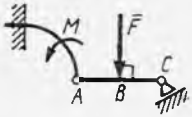
3.2.4. Uzunligi AB 2m bo'lgan to'singa intensivligi q_{max}=3kN/m li taqsimlangan kuch ta'sir etsa, B tayanch reaksiyasini kN da aniqlang. (1)



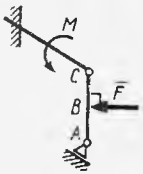
3.2.5. O'lchamlari $AB=BC$ sterjenlardan iborat sistemaga F=3 kN li kuch ta'sir qilsa va $\alpha=30°$ bo'lsa, A tayanchda reaksiya kuchini kN da toping. (3)



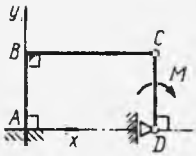
3.2.6. O'lchamlari $AB=BC$ bo'lgan sterjenga F=900N li kuch ta'sir etsa, A sharnir reaksiya kuchini vertikal tashkil etuvchisini hisoblang. (450)



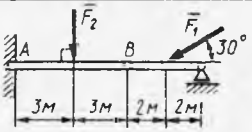
3.2.7. O'lchamlari $AB=BC$ bo'lgan sterjenga F=800 N li kuch ta'sir etsa, C sharnir reaksiyasini gorizontal tashkil etuvchisini aniqlang. (400)



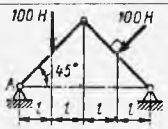
3.2.8. Uzunligi CD=2m bo'lgan sterjenga momenti M=400N·m li juft kuch ta'sir qilsa, C sharnirdagi reaksiya kuchining gorizontal tashkil etuvchisi X_C ni toping. (200)



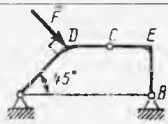
3.2.9. B sharnir orqali bog'langan sterjenlarga F_1=60N va F_2=50N li kuchlar ta'sir etsa, A tayanchdagi moment miqdorini aniqlang. (240)



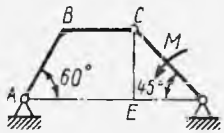
3.2.10. A tayanch reaksiya kuchining vertikal tashkil etuvchisini toping. (110)



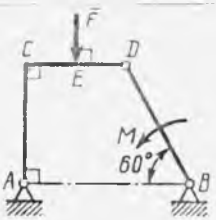
3.2.11. O'lchamlari $DC=CE=BE$ bo'lgan sistemaga F=850N kuch ta'sir etsa, B tayanch reaksiya kuchining vertikal tashkil etuvchisini hisoblang. (401)



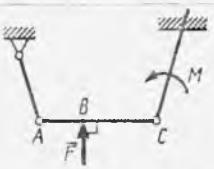
3.2.12. O'lchamlari $BC=CE$=1m bo'lgan sistemaga momenti M juft kuch ta'sir etib, A tayanch reaksiyasining vertikal tashkil etuvchisi 10 kN bo'lsa, juft kuch momentining miqdori kN·m da qancha bo'lishi lozim? (25,8)



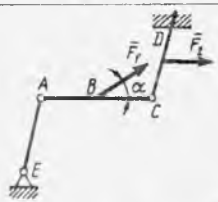
3.2.13. O'lchamlari AB, BD - 1m, CE, DE bo'lgan sterjenlarga F kuchi va momenti M 6 kN·m li juft kuch ta'sir etadi. A sharnirdagi reaksiya kuchining vertikal tashkil etuvchisi 9 kN bo'lishi uchun F kuchning qiymati kN da qanchaga teng bo'ladi? (4)



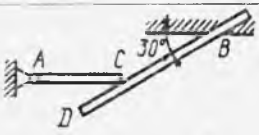
3.2.14. O'lchamlari $BC=2AB$ bo'lgan AC sterjenga $F=600$ N kuch ta'sir etsa, C sharnir reaksiya kuchining vertikal tashkil etuvchisini toping. (200)



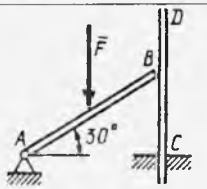
3.2.15. O'lchamlari $AC=BC$ bo'lgan AC va CD sterjenlarga $\alpha=30°$ burchak ostida $F_1=800$N va F_2 kuchlar ta'sir qilsa, C sharnir reaksiya kuchining vertikal tashkil etuvchisini toping. (200)



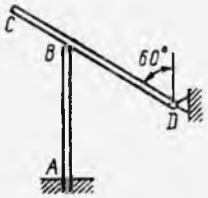
3.2.16. Devorga qistirib mahkamlangan BD sterjenga og'irligi 180N bo'lgan bir jinsli gorizontal AC sterjen erkin tiralib turibdi. BD sterjenning AC sterjenga bosim kuchini toping. (104)



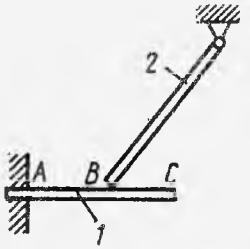
3.2.17. Yerga qistirib mahkamlangan vertikal CD sterjenga AB sterjen erkin tiralgan bo'lib, uning o'rtasiga $F=2$ kN kuch ta'sir etsa, B nuqtadagi reaksiya kuchini kN da hisoblang. (1,73)



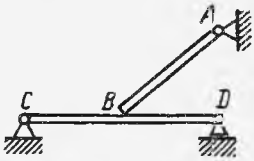
3.2.18. Uzunligi $AB=2$m bo'lgan, yerga qistirib mahkamlangan vertikal AB ustunga o'lchamlari $BD=2$m, $BC=1$m va og'irligi 346N li bir jinsli CD sterjen erkin tiralib turibdi. A tayanchdagi reaksiya momentini aniqlang. (225)



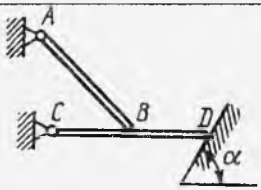
3.2.19. O'lchamlari AB=1m, BC=0,8m bo'lgan qistirib mahkamlangan bir jinsli sterjenga og'irligi 400 N li bir jinsli 2 sterjen erkin tiralib turadi. A tayanchdagi moment 265N·m bo'lishi uchun 1 sterjenning og'irligi qancha bo'lishi lozim? (72,2)



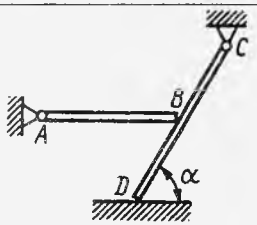
3.2.20. O'lchamlari $CB=BD$ bo'lgan vaznsiz gorizontal CD sterjenga og'irligi 4 kN li, bir jinsli AB to'sin erkin tiralsa, D silindrik qo'zg'aluvchi sharnirdagi reaksiya kuchini kN da hisoblang. (1)



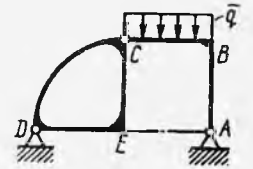
3.2.21. Vaznsiz va gorizontal joylashgan CD to'sinning o'rtasiga og'irligi 200N li bir jinsli AB to'sin erkin tiralgan bo'lsa, D nuqtaga CD to'sin qanday kuch bilan bosim hosil qiladi? Bunda $\alpha=60^0$. (100)



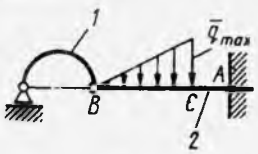
3.2.22. O'lchamlari $BC=BD$, burchagi $\alpha=60°$ bo'lgan, vaznsiz CD to'singa og'irligi 3 kN li, bir jinsli gorizontal AB to'sin erkin tiralgan bo'lsa, CD to'sinning D nuqtadagi yerga bosim kuchini kN da toping. (3)



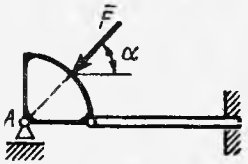
3.2.23. O'lchamlari $DE=AE=CE=BC$ bo'lgan konstruksiyaga intensivligi q=6kN/m li taqsimlangan kuch ta'sir etib, D sharnirning vertikal tashkil etuvchisi 6kN reaksiya kuchi hosil qilishi uchun BC masofa qancha bo'lishi lozim? (4)



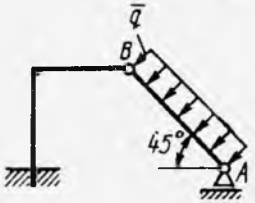
3.2.24. Og'irligi 100 N, yarim aylana shaklidagi bir jinsli 1 arkaga B sharnir orqali o'lchamlari $BC=3AC=0{,}5$m bo'lgan vaznsiz 2 to'sin bog'langan. Agar to'singa intensivligi q_{max} li taqsimlangan kuch ta'sir etib, A tayanchdagi moment 70 N·m bo'lishi uchun q_{max} qancha bo'lishi lozim? (440)



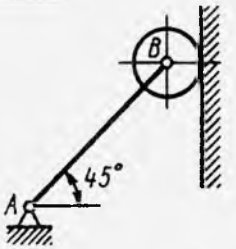
3.2.25. Og'irligi hisobga olinmaydigan konstruksiyaga $\alpha=45°$ burchak ostida $F=400$N kuch ta'sir etayotgan bo'lsa, A tayanch reaksiya kuchini aniqlang. (283)



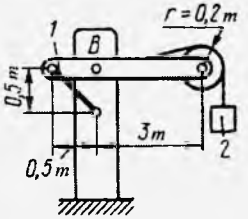
3.2.26. Uzunligi 2m bo'lgan AB sterjenga intensivligi q 100 N/m li taqsimlangan kuch ta'sir etayotgan bo'lsa, A tayanch reaksiya kuchini aniqlang. (141)



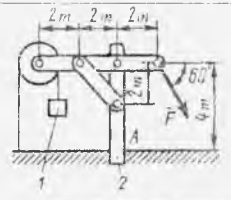
3.2.27. Og'irligi 80 N bo'lgan, bir jinsli AB sterjenning uchiga B sharnir orqali vazni 200 N li disk o'rnatilgan. Disk silliq vertikal devorga tiralgan. Diskning devorga ko'rsatgan bosim kuchini aniqlang. (240)



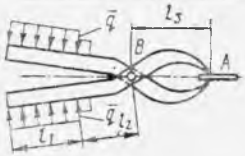
3.2.28. Konstruksiya 1 sterjen, 2 yuk va boshqa qismlardan iborat bo'lib, uning 2 qismi 100N ga teng. Boshqa qismlarning vaznlarini hisobga olmay, 1 sterjenda hosil bo'layotgan zo'riqish kuchini hisoblang. (905)



3.2.29. Konstruksiyaga osilgan 1 yukning og'ir-ligi 10 kN bo'lib, 2 ustun qistirib mahkam-langan A tayanchdagi moment nolga teng bo'lishi uchun tortib turuvchi $\bar{F}$ kuchining qiymati kN da qancha bo'lishi lozim? Konstruksiyaning boshqa qismlarining og'irliklarini hisobga olmang. (21,4)



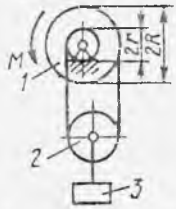
3.2.30. O'lchamlari ℓ_1=6sm, ℓ_2=10sm, ℓ_3=2sm, bo'lgan qisqichning dastagiga intensivligi q=5kN/m taqsimlangan kuch ta'sir qilsa, A nuqtada qistirilgan jismga qancha kN vertikal bosim kuchi ta'sir etadi? (1,95)



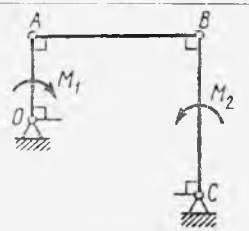
3.3. Tekislikda joylashgan kuchlar sistemasi ta'siridagi tekis mexanizmlarning muvozanati

3.3.1. Ikki jismdan iborat mexanizmga tekislikda joylashgan kuchlar sistemasi ta'sir qilib, muvozanat holatda bo'lsa bir-biriga bog'liq bo'lmagan, noma'lum miqdorlarining maksimal soni nechta bo'lishi mumkin? (6)

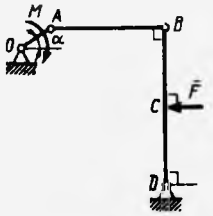
3.3.2. Radiuslari R=15sm va r=10sm bo'lgan 1 barabanga momenti M li juft kuch ta'sir etib, og'irligi $2\cdot10^3$N li 3 yukni bir tekisda yuqoriga ko'taradi. 2 blokning og'irligini hisobga olmay, juft kuch momenti M ning miqdorini toping. (50)



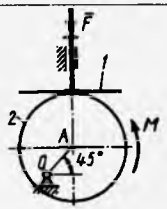
3.3.3. O'lchamlari $BC=2\cdot OA=400$ mm bo'lgan to'rt bo'g'in mexanizmning bo'g'inlariga moment-lari M_1 va M_2=200 N·m li juft kuchlar ta'sir etib, mexanizm muvozanat holatda bo'lishi uchun M_1 ning qiymati qancha bo'lish lozim? (100)



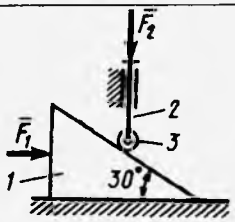
3.3.4. O'lchamlari OA=10 sm, BC=CD bo'lgan, vaznsiz to'rt zvenoli mexanizmga F kuch va momenti M=10 N·m li juft kuch ta'sir etib, mexanizm muvozanatda bo'lishi uchun F kuchining miqdorini aniqlang. Bunda $\alpha=30^0$. (400)



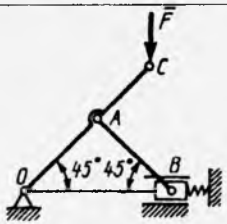
3.3.5. O'lchamlari OA=10sm bo'lgan kulachokli mexanizmning 1 tirsagiga F=100N li kuch ta'sir etib, mexanizm muvozanat holatda qolishi uchun 2 kulachokka qancha qiymatli juft kuch momenti ta'sir qilishi lozim? (7,07)



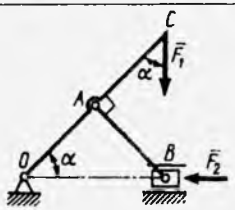
3.3.6. Mexanizmning 1 prizmasiga F_1=100N kuch ta'sir etib, mexanizm muvozanatda qolishi uchun, uning 3 g'ildirakli 2 sterjeniga qanday qiymatli F_2 kuch ta'sir etishi lozim? (1,73)

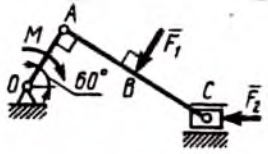
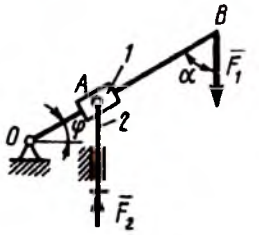


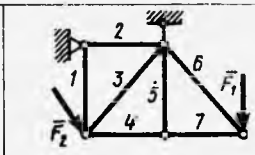
3.3.7. Mexanizmning OAC krivoshipiga F kuchi ta'sir etib, polzuniga biriktirilgan prujina yordamida mexanizm muvozanatda bo'ladi. Shatun AB va krivoshipni birlashtirib turuvchi A sharnirda 1kN li bosim kuchi hosil bo'lsa, prujinaning elastiklik kuchi qancha kN bo'ladi? (0,707)



3.3.8. Krivoship-polzunli mexanizm F_1=1 kN va F_2 kuchlar ta'sirida muvozanatda bo'lsa, OA=AC=0,3m va α=45° deb, OAC krivoship va AB shatunning o'zaro ta'sir kuchini kN da aniqlang. (1,41)

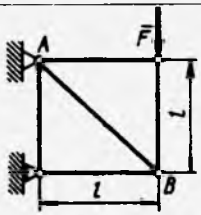
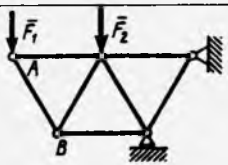
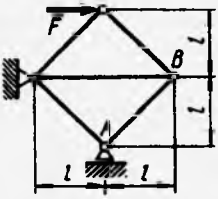
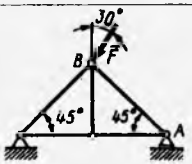


3.3.9. Krivoship-polzunli mexanizm F_1=200N, F_2=500N va momenti M bo'lgan juft kuch ta'sirida muvozanat holatida bo'lsa, AB=BC=30sm deb, porshenning uning yo'naltiruvchilariga qiladigan bosimini toping. (404)	
3.3.10. Kulisali mexanizm F_1=1kN va $\bar{F}_2$ kuchlar ta'sirida muvozanat holatida bo'lib, OA=0,5m, OB=1,2m, φ=30°, α=60° bo'lsa, 1 vtulkaning 2 vertikal sterjenga bosim kuchini kN da aniqlang. (2,08)	

4.1.9. Fermadagi qaysi sterjen Yuklanmagan hisoblanadi? (5)	

4.2. Tugunlarni kesish usuli

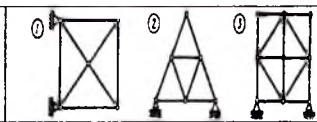
4.2.1. Ferma sterjenlaridagi zo'riqishlarni tugun kesish usuli bilan aniqlashda kesilayotgan tugunda noma'lum reaksiya kuchlarining maksimal soni nechta bo'lishi mumkin? (2)

4.2.2. Agar fermaga F=600N kuch ta'sir etsa, AB sterjendagi zo'riqishni hisoblang. (849)	
4.2.3. Bir xil uzunlikdagi sterjenlardan iborat fermaga F_1=100N va F_2=200N kuchlar ta'sir etsa, AB sterjendagi zo'riqishni toping. (-115)	
4.2.4. O'lchami ℓ=0,4m sterjenli fermaga F=30N kuch ta'sir etadi. AB sterjendagi zo'riqishni aniqlang. (-21,2)	
4.2.5. Fermaga F=40 N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (-10,4)	

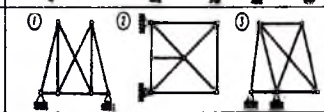
4.1. Statik aniq va statik noaniq fermalar. Yuklanmagan sterjenlar

4.1.1. 29 sterjenlardan iborat statik aniq, bir tekislikda joylashgan fermani hosil qilish uchun nechta sharnir kerak bo'ladi? (16)

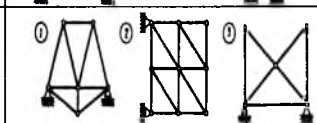
4.1.2. Ko'rsatilgan qaysi ferma statik aniq hisoblanadi? (2)



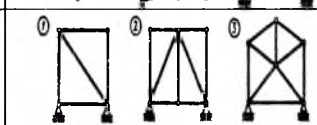
4.1.3. Ko'rsatilgan qaysi ferma statik aniq hisoblanadi? (1)



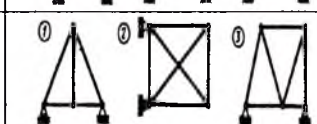
4.1.4. Ko'rsatilgan qaysi ferma statik aniq hisoblanadi? (3)



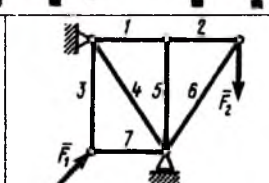
4.1.5. Ko'rsatilgan qaysi ferma statik noaniq hisoblanadi? (3)



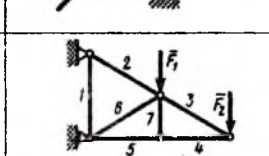
4.1.6. Ko'rsatilgan qaysi ferma statik noaniq hisoblanadi? (2)

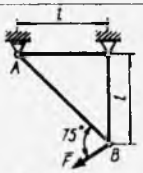
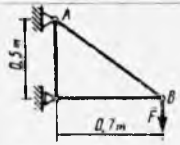
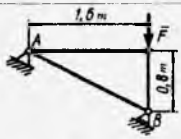
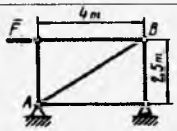
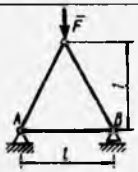
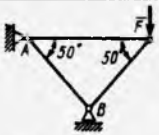
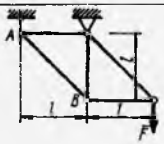


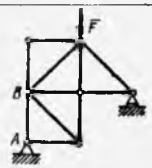
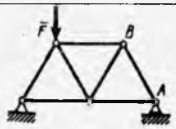
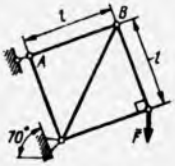
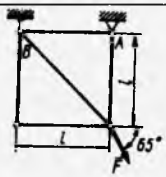
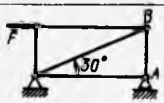
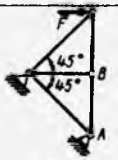
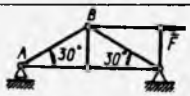
4.1.7. Fermadagi qaysi sterjen yuklanmagan hisoblanadi? (5)



4.1.8. Fermadagi qaysi sterjen yuklanmagan hisoblanadi? (7)



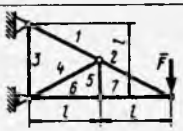
4.2.6. Fermaga F=700N kuch ta'sir etsa, AB sterjendagi zo'riqishni hisoblang. (-857)	
4.2.7. Fermaga F=580N kuch ta'sir etsa, AB sterjendagi zo'riqishni aniqlang. (998)	
4.2.8. Fermaga F=750 N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (335)	
4.2.9. Fermaga F=450 N kuch ta'sir etsa, AB sterjendagi zo'riqishni hisoblang. (551)	
4.2.10. Fermaga F=400N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (100)	
4.2.11. Fermaga F=60N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (78,0)	
4.2.12. Fermaga F=60N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (-78,3)	
4.2.13. Fermaga F=300N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (-424)	

4.2.14. Vertikal va gorizontal sterjenlari o'zaro teng bo'lgan fermaga F=600N kuch ta'sir etsa, AB sterjendagi zo'riqishni aniqlang. (-300)	
4.2.15. Sterjenlari bir xil uzunlikdagi fermaga F=80N kuch ta'sir etsa, AB sterjendagi zo'riqishni aniqlang. (-23,1)	
4.2.16. Fermaga F=500N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (470)	
4.2.17. Fermaga F=550N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (232)	
4.2.18. Fermaga F=346N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (-200)	
4.2.19. Fermaga F=400N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (-400)	
4.2.20. Fermaga F=346N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (-200)	

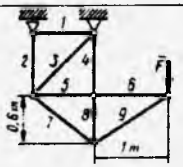
4.3. Kesimlar usuli (Rittyer usuli)

4.3.1. Tekis fermani hisoblashda sterjenlarni qirqish usulida ko'rilayotgan kesimdagi noma'lum zo'riqishlarning maksimal soni nechtadan ortmasligi shart? (3)

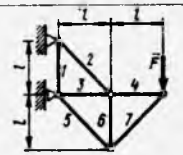
4.3.2. Fermaga F=360N kuch ta'sir etsa, 6 sterjendagi zo'riqishni toping. (-720)



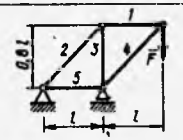
4.3.3. Fermaga F=480N kuch ta'sir etsa, 5 sterjendagi zo'riqishni toping. (800)



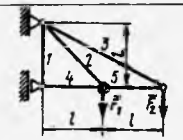
4.3.4. Fermaga F=460N kuch ta'sir etsa, 3 sterjendagi zo'riqishni toping. (-460)



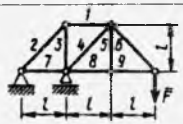
4.3.5. Fermaga F=540N kuch ta'sir etsa, 3 sterjendagi zo'riqishni toping. (-540)

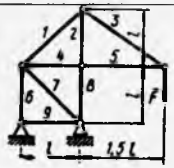
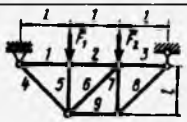
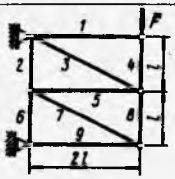
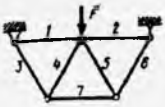
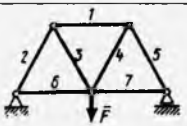
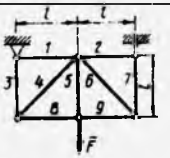
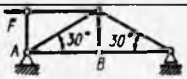


4.3.6. Fermaga F_1=F_2=520N kuchlar ta'sir etsa, 2 sterjendagi zo'riqishni toping. (735)



4.3.7. Fermaga F=340 N kuch ta'sir etsa, 4 sterjendagi zo'riqishni toping. (-481)

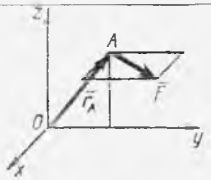


4.3.8. Fermaga F=380 N kuch ta'sir etsa, 1 sterjendagi zo'riqishni toping. (806)	
4.3.9. Fermaga $F_1=F_2$=380 N kuchlar ta'sir etsa, 6 sterjendagi zo'riqishni toping. (0)	
4.3.10. Fermaga F=260 N kuch ta'sir etsa, 8 sterjendagi zo'riqishni toping. (-130)	
4.3.11. Uzunliklari bir xil bo'lgan sterjenli fermaga F=160 N kuch ta'sir etsa, 5 sterjendagi zo'riqishni toping. (-92,4)	
4.3.12. Bir xil uzunlikdagi sterjenlardan iborat fermaga F=120 N kuch ta'sir etsa, 1 sterjendagi zo'riqishni toping. (-69,3)	
4.3.13. Fermaga F=220 N kuch ta'sir etsa, 6 sterjendagi zo'riqishni toping. (-156)	
4.3.14. Fermaga F=180 N kuch ta'sir etsa, 2 sterjendagi zo'riqishni toping. (-90)	
4.3.15. Fermaga F=346N kuch ta'sir etsa, AB sterjendagi zo'riqishni toping. (173)	

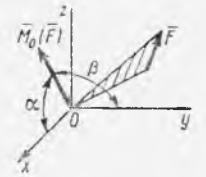
5.1. Nuqtaga va o'qqa nisbatan kuch momenti

5.1.1. O nuqtaga nisbatan olingan $\bar{F}$ kuchining momenti vektori $\bar{M}_O(\bar{F}) = \bar{i} - \bar{j} - 2\bar{k}$ berilgan bo'lsa, uning moment miqdorini toping. (2,45)

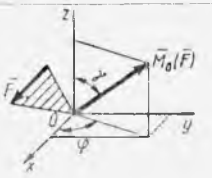
5.1.2. Radius vektor $\bar{r}_A = 6\bar{j} + 8\bar{k}$ (m) bilan aniqlanuvchi fazodagi A nuqtaga $\bar{F} = 3\bar{i} + 4\bar{j}$ (N) kuch ta'sir etsa, kuchning O nuqtaga nisbatan momentini hisoblang. (43,9)



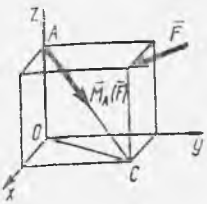
5.1.3. F kuchining O markazga nisbatan momenti $M_O(\bar{F}) = 10$N·m miqdorga teng bo'lib, vektori esa Ox va Oy koordinata o'qlari bilan $\alpha = 120°$ va $\beta = 120°$ burchaklar tashkil qilsa, kuchning Ox o'qiga nisbatan momenti qanchaga teng bo'ladi? (-5)



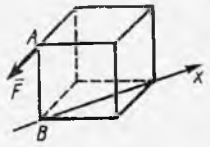
5.1.4. $\bar{F}$ kuchining O markazga nisbatan momenti miqdori $M_O(\bar{F}) = 100$N·m bo'lib, vektori esa koordinata o'qlari bilan $\gamma = 30°$ va $\varphi = 30°$ burchaklar tashkil qilsa, kuchning Oy o'qiga nisbatan momentini hisoblang. (25)



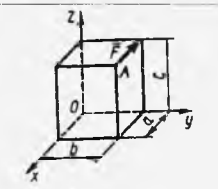
5.1.5. O'lchamlari $OA = 0{,}3$m va $AC = 0.5$m bo'lgan parallelepipedning uchiga ta'sir etayotgan $\bar{F}$ kuchining A nuqtaga nisbatan momenti $M_A(\bar{F}) = 50$N·m ga teng bo'lib, vektori esa AC diagonal bo'yicha yo'nalgan bo'lsa, kuchning Oz o'qiga nisbatan momentini aniqlang. (-30)



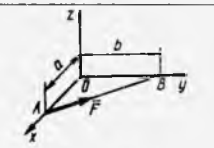
5.1.6. Tomonlari 5m bo'lgan kubning A uchiga F=6kN kuch qo'yilgan bo'lsa, $\overline{F}$ kuchining Bx o'qiga nisbatan momentini toping (Masalani yechish uchun avval $\overline{M}_B(\overline{F})$ moment vektorini aniqlab, keyin Bx o'qiga proyeksiyalash kerak). ($212 \cdot 10^4$)



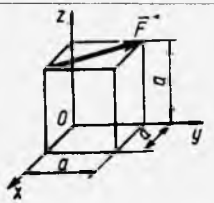
5.1.7. O'lchamlari a=10m, b=6m, c=20m bo'lgan parallelepipedning A nuqtasiga qo'yilgan F=4 kN kuchning Oy o'qiga nisbatan momentini hisoblang. ($-8 \cdot 10^4$)



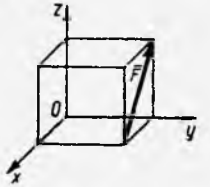
5.1.8. Agar F=20 N kuch Ox va Oy o'qlarini a=2m va b=3m masofalarda kesib o'tsa, kuchning Ox o'qqa nisbatan momentini toping. (0)



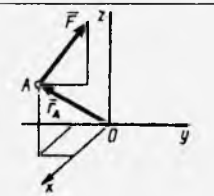
5.1.9. Tomoni a=0,75 m li kubning kichik diagonali bo'ylab yo'nalgan F=16N kuchning Ox o'qiga nisbatan momentini aniqlang. (-8,49)



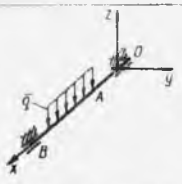
5.1.10. Qirralari 0,2m li kubning kichik diagonali bo'ylab yo'nalgan F=5 N li kuchning Oz o'qiga nisbatan momentini aniqlang. (0,707)



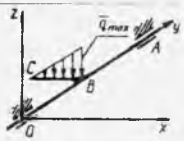
5.1.11. Radius vektori $\vec{r}_A=3\vec{i}-\vec{j}+2\vec{k}$ bo'lgan A nuqtaga qo'yilgan $\vec{F}=3\vec{j}+4\vec{k}$ kuchning Oz o'qiga nisbatan momentini hisoblang. (9)



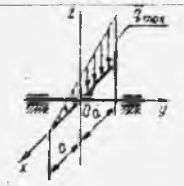
5.1.12. Agar q=3 N/m, OA=2 m, AB=3 m qiymatlar berilgan bo'lsa, taqsimlangan kuchning Oy o'qiga nisbatan momentini toping ($\overline{q} \parallel Oz$). (31,5)



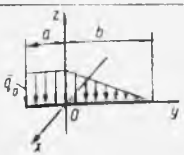
5.1.13. Agar q_{max}=1,6 N/m, AB=BO=6m, BC=3m va $BC \parallel Ox$ qiymatlar berilgan bo'lsa, taqsimlangan kuchning Oy o'qiga nisbatan momentini toping. Bunda ($\overline{q} \parallel Oz$). (-2,4)



5.1.14. Agar q_{max}=10N/m, a=3m qiymatlar berilgan bo'lsa, taqsimlangan kuchning Oy o'qiga nisbatan momentini aniqlang. (-30)



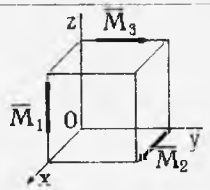
5.1.15. Agar q_0=200N/m, a=3m va b=6m qiymatlar berilgan bo'lsa, taqsimlangan kuchning Ox o'qiga nisbatan momentini toping. (-300)



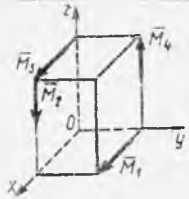
5.2. Fazodagi juft kuchlar sistemasi

5.2.1. Proyeksiyalari M_{1x}=9N·m, M_{1y}=9N·m, M_{1z}=0; M_{2x}=5N·m, M_{2y}=-5N·m, M_{2z}=0 bo'lgan ikki juft kuchlar sistemasining teng ta'sir etuvchi juft kuchi momentining modulini hisoblang. (14,6)

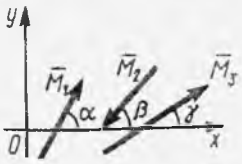
5.2.2. Kubga momentlari M_1=M_2=M_3=2N·m bo'lgan uchta juft kuchlar ta'sir etsa, teng ta'sir etuvchi juft kuch momentining modulini aniqlang. (3,46)



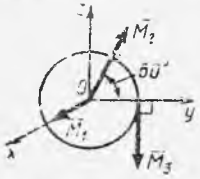
5.2.3. Parallelepipedga momentlari $M_1=M_2=M_3=M_4=100$ N·m bo'lgan to'rtta juft kuch ta'sir qilsa, ularning teng ta'sir etuvchisi momentining miqdorini toping. (200)



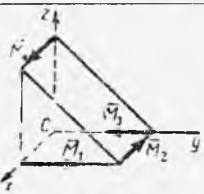
5.2.4. Momentlari $M_1=2$ N·m, $M_2=1{,}41$ N·m va $M_3=2$ N·m bo'lgan uchta juft kuch sistemasi berilgan bo'lib, ularning vektorlari Oxy tekisligida $\alpha=60°$, $\beta=45°$ va $\gamma=30°$ burchaklar orqali aniqlangan, juft kuchlarning teng ta'sir etuvchisi momentining modulini toping. (2,45)



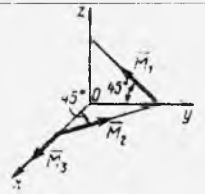
5.2.5. Momentlari $M_1=2$ N·m, $M_2=M_3=3$ N·m bo'lgan juft kuchlar sistemasi berilgan bo'lib, M_2 va M_3 vektorlar Oyz tekislikda joylashgan va $\bar{M}_1 \parallel Ox$ bo'lsa, ularning teng ta'sir etuvchisining momentini hisoblang. (2,53)



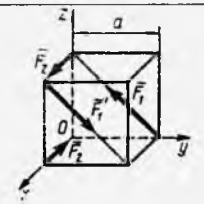
5.2.6. Momentlari $M_1=M_2=M_3=M_4=20$ N·m bo'lgan fazoviy juft kuchlar sistemasi berilgan bo'lsa. ularning teng ta'sir etuvchisi momentining miqdorini aniqlang. (0)



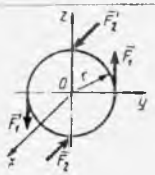
5.2.7. Momentlari $M_1=M_2=1$N·m va $M_3=0{,}707$N·m bo'lgan juft kuchlar sistemasi berilgan bo'lsa, ularning teng ta'sir etuvchisi momentining miqdorini toping. (0,707)



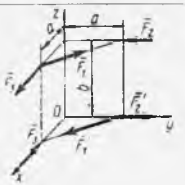
5.2.8. Tomonlari $a=0{,}1$ m bo'lgan kubga $F_1=F_1'=10$ N va $F_2=F_2'=50$N li ($\bar{F}_1$, $\bar{F}_1'$) va ($\bar{F}_2$, $\bar{F}_2'$) juft kuchlar ta'sir etsa, ularning teng ta'sir etuvchisining momentini hisoblang. (5,75)



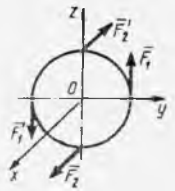
5.2.9. Radiusi r=0,5 m bo'lgan diskka kuch qiymatlari teng 2 N dan bo'lgan ikkita juft kuchlar ($\overline{F}_1$, $\overline{F}_1'$) va ($\overline{F}_2$, $\overline{F}_2'$) ta'sir etadi. Bunda $\overline{F}_1 \| Oz$, $\overline{F}_2 \| Ox$. Juft kuchlar teng ta'sir etuvchisining momentini toping. (2,83)



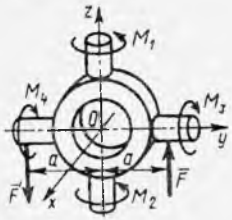
5.2.10. Qiymatlari $F_1=F_1'=1$N, $F_2=F_2'=2$N va $F_3=F_3'=1,5$N bo'lgan juft kuchlarni muvozanatlovchi juft kuchning momentining modulini aniqlang. Bunda $a=1$m, $b=1,2$m. (1,82)



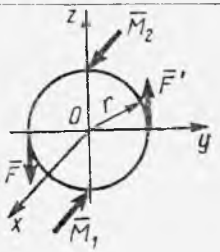
5.2.11. Diskning gardishiga ($\overline{F}_1$, $\overline{F}_1'$) va ($\overline{F}_2$, $\overline{F}_2'$) juft kuchlar ta'sir etadi. Ularning yo'nalishlari $\overline{F}_1 \| Oz$, $\overline{F}_2 \| Ox$ va qiymatlari o'zaro teng bo'lsa, teng ta'sir etuvchi juft kuchning momenti vektori Ox o'qi bilan qanday burchak tashkil etadi? (45)



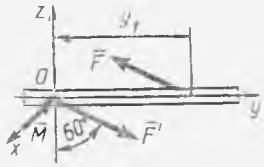
5.2.12. Mashina detalining to'rt tomoniga miqdorlari teng $M_1=M_2=M_3=M_4=5$N·m momentli juft kuchlar va Oyz tekisligida qiymati $F=F'=100$N bo'lgan ($\overline{F}$,$\overline{F}'$) juft kuch ta'sir etsa, juft kuchlar sistemasining teng ta'sir etuvchisining momentini toping. Bunda a=0,05m va $F \| Oz$ $F' \| Oz$ deb oling. (17,3)



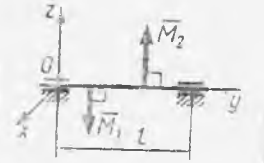
5.2.13. Radiusi r=1m bo'lgan diskka momentlari M_1=24N·m va M_2=12N·m juft kuchlar ta'sir etib, ($\overline{F}$,$\overline{F}'$) juft kuch bilan muvozanatlashadi. Agar $\overline{M}_1$ va $\overline{M}_2$ vektorlar Ox o'qiga parallel va ($\overline{F}$,$\overline{F}'$) juft kuch Oyz tekisligida joylashgan bo'lsa, F kuchining miqdorini aniqlang. (6)



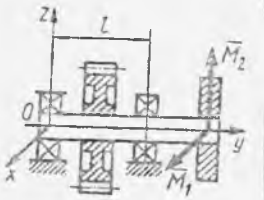
5.2.14. Momenti M=8N·m bo'lgan juft kuch Oyz tekislikda joylashgan, qiymati $F = F' = 24$N li $(\bar{F}, \bar{F}')$ juft kuch bilan muvozanatlashadi. F kuchining qo'yilish nuqtasi y_1 koordinatasini toping. (0,667)



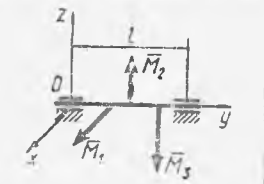
5.2.15. Uzunligi ℓ=0,125m bo'lgan valga momentlari M_1=260N·m va M_2=325N·m li juft kuchlar ta'sir qiladi. Agar $\bar{M}_1$ va $\bar{M}_2$ vektorlar Oyz tekisligida joylashgan bo'lsa, O podshipnikda hosil bo'layotgan reaksiya kuchining modulini toping (520)



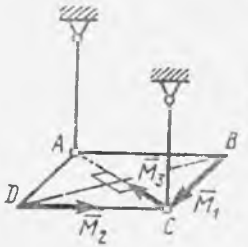
5.2.16. Shesternya vali flanesiga (markaziga) momentlari M_1=4N·m va M_2=5N·m bo'lgan juft kuchlar ta'sir etadi. Agar podshipniklar orasi ℓ=0,1m va $\bar{M}_1 \| Ox$, $\bar{M}_2 \| Oz$ bo'lsa, O podshipnikdagi reaksiya kuchining modulini aniqlang. (64.0)



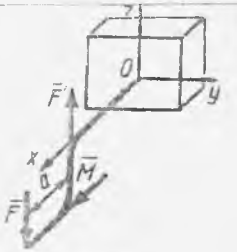
5.2.17. Uzunligi ℓ=0,1m bo'lgan valga momentlari M_1=4N·m, M_2=2N·m, M_3=5N·m ga teng juft kuchlar ta'sir etadi. Agar juft kuch momentlari vektori $\bar{M}_1 \| Ox$ va $\bar{M}_2 \| Oz$, $\bar{M}_3 \| Oz$ bo'lsa, O podshipnik reaksiya kuchini hisoblang. (50)



5.2.18. Bir jinsli $ABCD$ kvadrat platforma ikkita vertikal sterjenlar yordamida gorizontal holatda mahkamlangan bo'lib, unga momentlari M_1=3,2N·m; M_2=2,5N·m va M_3 bo'lgan juft kuchlar ta'sir etadi. Agar platforma muvozanat holatida bo'lsa, M_3 ning qiymatini toping (Moment vektorlarining AC o'qqa proyeksiyalari yig'indisi orqali aniqlash qulayroq). (4,03)



5.2.19. O nuqtasida qistirib mahkamlangan dastakka momenti M=3N·m bo'lgan juft kuch va qiymati $F=F'$=4N ga teng bo'lgan juft kuch ta'sir qiladi. Agar masofa a=1m va vektorlarning yo'nalishi $\bar{M}\|Ox$, $\bar{F}\|\bar{F}'\|Oz$ bo'lsa, O tayanchdagi reaktiv moment M_0 ning modulini hisoblang. (5)



5.3. Fazoda joylashgan ixtiyoriy kuchlar sistemasining bosh momenti

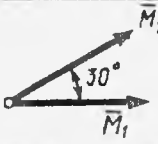
5.3.1. Agar kuchlar sistemasining O koordinata boshiga nisbatan bosh momenti vektorining dekart koordinata o'qlardagi proyeksiyalari M_x=-20N·m; M_y=12 N·m; M_z=0 berilgan bo'lsa, uning miqdorini aniqlang. (23,3)

5.3.2. Berilgan kuchning koordinatalar boshiga nisbatan momenti $\bar{M}_0(\bar{F}) = 2\bar{i} + 1{,}73\bar{j} + 3\bar{k}$ ma'lum bo'lsa, $\bar{M}_0$ vektor bilan Ox o'qi orasidagi burchak kosinusini hisoblang. (0,5)

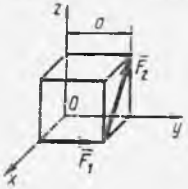
5.3.3. Jismga qo'yilgan kuchlarning koordinata boshiga nisbatan momenti M_O=170 N·m ga teng, moment vektorining Oy o'qiga nisbatan proyeksiyasi M_y=85N·m bo'lsa, $\bar{M}_0$ bilan Oy o'qi orasidagi burchakning gradus qiymatini toping. (60)

5.3.4. Bosh momentning dekart koordinata o'qlaridagi proyeksiyalari M_x=12N·m; M_y=14N·m va M_z=9N·m ga teng. $\overline{M}_0$ bilan Oz o'qi orasidagi burchakning kosinusini hisoblang. (0,439)

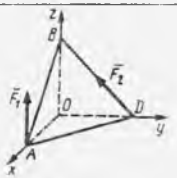
5.3.5. Miqdorlari M_1=29 N·m va M_2=14 N·m bo'lgan ikki juft kuchlar bosh momentining modulini aniqlang. (41,7)



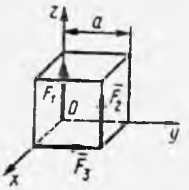
5.3.6. Tomonlari a=4m bo'lgan kubga miqdorlari F_1=8N va F_2=16N bo'lgan kuchlar ta'sir etadi. O nuqtaga nisbatan kuchlarning bosh momentining modulini toping. (100)



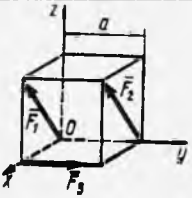
5.3.7. Qirralari OA=OB=OD=5m bo'lgan tetraedrga miqdorlari F_1=2N va F_2=8,6N bo'lgan kuchlar ta'sir etadi. Agar $\overline{F}_1$ vertikal joylashgan bo'lsa, O nuqtaga nisbatan kuchlar sistemasi bosh momentining miqdorini aniqlang. (32)



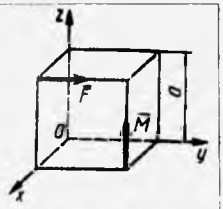
5.3.8. Tomonlari a=0,9m li kubga miqdorlari teng F_1=F_2=F_3=8N bo'lgan kuchlar ta'sir etadi. Kuchlarning O nuqtaga nisbatan bosh momentining miqdorini hisoblang. (12,5)



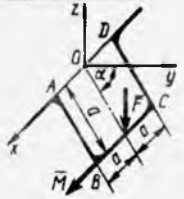
5.3.9. Tomonlari a=0,8m bo'lgan kubga miqdorlari F_1=F_2=6N va F_3=3N li kuchlar ta'sir etadi. Kuchlarning O nuqtaga nisbatan bosh momentining miqdorini toping. (3,54)



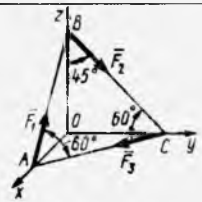
5.3.10. Tomonlari a=2m bo'lgan kubga miqdori F=0,5kN kuch va momenti M=5kN·m bo'lgan juft kuch ta'sir etadi. Ularning O nuqtaga nisbatan bosh momentining modulini kN larda hisoblang. (6,08)



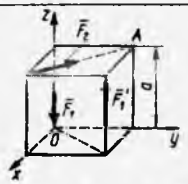
5.3.11. O'lchamlari a=1m va α=60° bo'lgan ramaga miqdori F=100N kuch va momenti M=50N·m li juft kuch ta'sir etadi. Ularning O nuqtaga nisbatan bosh momentining modulini toping. Bunda $\overline{F} \| Oz$ va $\overline{M} \| Ox$. (100)



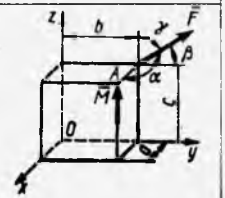
5.3.12. Qirralari AB=BC=AC=2m bo'lgan $OABC$ tetraedrga miqdorlari F_1=F_2=F_3=10 N li kuchlar ta'sir etadi. B nuqtaga nisbatan kuchlarning bosh momentining modulini hisoblang. (17,3)



5.3.13. Tomonlari a=1,5m bo'lgan kubga miqdori F_2=50N kuch va F_1=$\overline{F}'_1$=45N juft kuchlar qo'yilgan. Keltirish markazini kubning A uchida deb hisoblab, kuchlar sistemasining bosh momentini toping. (95,5)



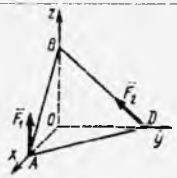
5.3.14. O'lchamlari b=2a=c=2m bo'lgan parallelepipedga β=γ=60°burchak ostida F=26N kuch va M=13N·m momentli juft kuchlar qo'yilgan. A nuqtani keltirish markazi deb, kuchlar sistemasining bosh momentini aniqlang. (13)



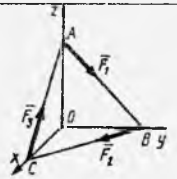
5.4. Ixtiyoriy kuchlar sistemasini berilgan markazga va sodda holga keltirish

5.4.1. Agar kuchlar sistemasi koordinata boshiga nisbatan bosh vektorga $\bar{R} = 4\bar{i} + 3\bar{j}$ va bosh momentga $\bar{M}_O = 8\bar{j} + 10\bar{k}$ ega bo‘lsa, bu kuchlar sistemasini bitta teng ta’sir etuvchiga almashtirsa bo‘ladimi? (Yo‘q)

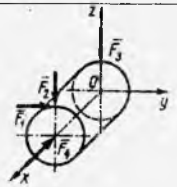
5.4.2. Qirralari $OA=OB=OD=5$m bo‘lgan tetraedrga qiymatlari $F_1=2$N va $F_2=8{,}6$N kuchlar qo‘yilgan bo‘lsa, shu kuchlar sistemasining bosh vektorini hisoblang. Bunda $\bar{F}_1 \| Oz$. (10,1)



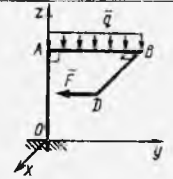
5.4.3. Muntazam uchburchak ABC ning $AB=BC=AC=0{,}5$m tomonlari bo‘yicha yo‘nalgan, miqdorlari o‘zaro teng $F_1=F_2=F_3=1$N kuchlar sistemasining bosh vektorini toping. (0)



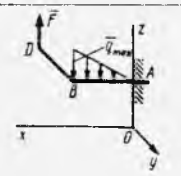
5.4.4. Silindrga ta’sir qiluvchi miqdorlari $F_1=F_2=5$N va $F_3=F_4=3$N kuchlar sistemasining bosh vektori modulini aniqlang. (9,90)



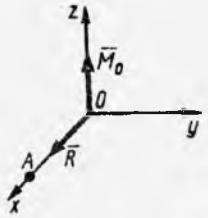
5.4.5. O‘lchami AB=1,5m bo‘lgan, bukilgan to‘singa miqdori $F=4$kN kuch va intensivligi $q=2$ kN/m li taqsimlangan kuch ta’sir etayotgan bo‘lsa, kuchlar sistemasi bosh vektorining modulini hisoblang. ($5\cdot10^3$)



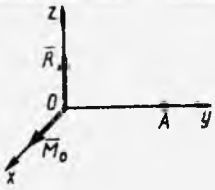
5.4.6. O‘lchamlari $AB=3$m, $AB \| Ox$, $BD \perp AB$, $BD \| Oy$ bo‘lgan bukilgan to‘singa miqdorlari $F=10$N kuch va intensivligi $q_{max}=20$N/m li taqsimlangan kuchlar ta’sir etadi. Kuchlar sistemasining bosh vektorining miqdorini aniqlang. (20)



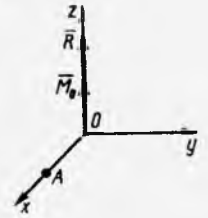
5.4.7. O keltirish markazida bosh vektor R=5N va bosh moment M_O=25N·m berilgan. OA=1m masofada joylashgan A nuqtani keltirish markazi deb, bosh momentning miqdorini aniqlang. (25)



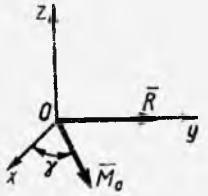
5.4.8. O keltirish markazida bosh vektor R=10N va bosh moment M_O=20 N·m berilgan. OA=2m masofada joylashgan A nuqtani keltirish markazi deb, bosh momentning miqdorini hisoblang. (0)



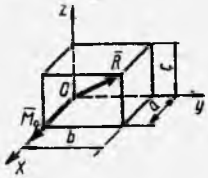
5.4.9. Koordinatalar markazidagi bosh vektor $\bar{R}$ va bosh moment $\bar{M}_0$ dinamik vintni hosil qiladi. Agar R=30N, M_O=40 N·m bo'lsa, OA=1m masofadagi A nuqtasiga nisbatan bosh momentning qiymatini toping. (50)



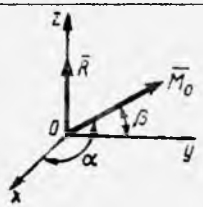
5.4.10. Koordinatalar boshini keltirish markazi deb hisoblanib, topilgan bosh vektor R=9 N va bosh moment M_O=12N·m berilgan. Agar $\bar{R}$ va $\bar{M}_0$ Oxy tekisligida joylashib, γ=30° bo'lsa, $\bar{R}$ va $\bar{M}_0$ vektorlarning skalar ko'paytmasini toping. (54)



5.4.11. Kuchlar sistemasining bosh vektori R=1N va bosh momenti M_O=1N·m o'lchamlari a=5m, b=4m, c=3m bo'lgan parallelepiped diagonali va Ox o'qi bo'ylab yo'nalgan bo'lsa, $\bar{R}$ va $\bar{M}_0$ vektorlarning skalar ko'paytmasini hisoblang. (0,707)



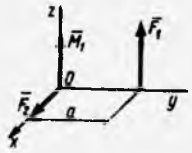
5.4.12. Koordinata boshiga nisbatan hisoblangan bosh vektor R=1N va bosh moment M_O=6N·m berilgan. Agar $\overline{R}$ Oz bo'ylab, $\overline{M}_0$ esa Ox va Oy o'qlari bilan α=60°, β=45° burchaklarni tashkil etsa, vektorlarning skalar ko'paytmasini aniqlang. (3)



5.4.13. Koordinata boshini keltirish markazi deb olingan holda, bosh vektor $\overline{R}$ va bosh moment $\overline{M}_O$ ning koordinata o'qlardagi proyeksiyalari R_x=1N, R_y=3N, R_z=0, M_x=5N·m, M_y=4N·m va M_z=1N·m berilgan. $\overline{R}$ va $\overline{M}_0$ vektorlarning skalar ko'paytmasini hisoblang. (17)

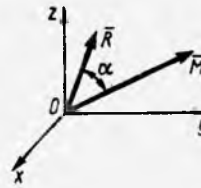
5.4.14. Agar berilgan kuchlar sistemasining bosh vektori $\overline{R}=3\vec{i}+10\vec{j}+7\vec{k}$ va A nuqtaga nisbatan bosh momenti $\overline{M}_A=7\vec{j}-3\vec{k}$ ga teng bo'lsa, bu kuchlar sistemasini bitta teng ta'sir etuvchiga keltirish mumkinmi? (Ha)

5.4.15. Qiymatlari o'zaro teng $F_1=F_2$=1N kuchlar va momenti M_1=1N·m bo'lgan juft kuchlar sistemasi berilgan. Agar a=1m bo'lsa, kuchlar sistemasi bosh vektori va O nuqtaga nisbatan bosh momenti vektorlari orasidagi burchakni aniqlang. (0)



5.4.16. Agar bosh vektor R=15N va bosh moment M_O=20 N·m berilgan bo'lsa, ularning skalar ko'paytmasini $\overline{R}\cdot\overline{M}_0=150N^2\cdot m$ deb olib, ular orasidagi α burchakning gradus qiymatini toping. (60)

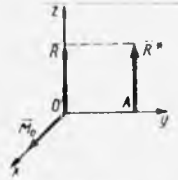
5.4.17. Berilgan kuchlar sistemasining O keltirish markaziga nisbatan bosh vektori R=15N va bosh momenti M_O=60N·m o'zaro α=60° burchak tashkil etadi. Ular hosil qilgan dinamik vintning momentini aniqlang. (30)



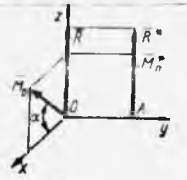
5.4.18. O keltirish markaziga nisbatan bosh vektor va bosh momentning skalar ko'paytmasi $\overline{R}\cdot\overline{M}_0 = 240N^2\cdot m$ va R=40N bo'lsa, dinamik vint momentining qiymatini toping. (6)

5.4.19. Bosh vektor $\overline{R} = 4\overline{j} + 3\overline{k}$ va bosh moment $\overline{M}_0$ $6\overline{i}+5\overline{j}-5\overline{k}$ uchun dinamik vint momentini hisoblang. (1)

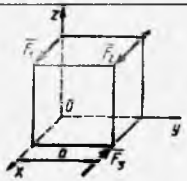
5.4.20. Berilgan kuchlar sistemasining O keltirish markaziga nisbatan bosh vektori va bosh momenti o'zaro perpendikulyar bo'lib, qiymatlari R=8 N va M_0=26 N·m bo'lsa, ularni qancha OA masofada joylashgan bitta teng ta'sir etuvchiga $\overline{R}^*$ keltirish mumkin (3,25)



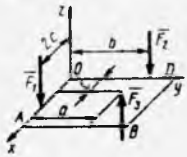
5.4.21. Berilgan kuchlar sistemasining bosh vektori R va bosh momenti M_0 Oxz tekisligida joylashgan bo'lib, ularning miqdori R=6N, M_0=7,2N·m va burchak α=60° bo'lsa, dinamik vintning o'qigacha bo'lgan OA masofani toping. (0,6)



5.4.22. Tomonlari a=1m bo'lgan kubga F_2=2 F_1=10 N va $\overline{F}_3$ kuchlar ta'sir qilib, ular juft kuchga keltirilishi uchun $\overline{F}_3$ ning qiymati qancha bo'lishi lozim? (15)



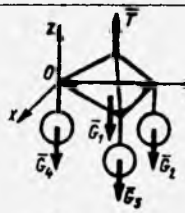
5.4.23. O'lchamlari a, b=2m, c=1m bo'lgan, vaznsiz $OABD$ plastinaga Oz o'qiga parallel bo'lgan $\overline{F}_1$, $\overline{F}_2$ va $\overline{F}_3$ kuchlar ta'sir etadi. Agar kuchlarning miqdorlari F_3=2F_1=2F_2=2N bo'lsa, sistema muvozanatda bo'lishi uchun a masofa nechaga teng bo'ladi? (1)



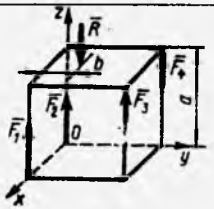
5.5. Fazoda joylashgan parallel kuchlar sistemasining muvozanati

5.5.1. Jismga Ox o'qiga parallel bo'lgan to'rtta kuch $\overline{F}_1$, $\overline{F}_2$, $\overline{F}_3$ va $\overline{F}_4$ ta'sir qiladi. Agar $\overline{F}_1=\overline{F}_2=-5\overline{i}$ va $\overline{F}_3=\overline{i}$ bo'lsa, $\overline{F}_4$ kuchning qanday qiymatida kuchlar sistemasi muvozanatda bo'ladi? (9)

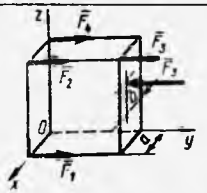
5.5.2. Sim arqonga osilgan uchburchakli platformaga uchta yuk bog'langan. Agar platforma va yuklarning og'irliklari mos ravishda G_1=0,5kN; G_2=10kN; G_3=6kN va G_4=8kN bo'lsa, sim arqonning $\overline{T}$ taranglik kuchini kN da aniqlang. (24,5)



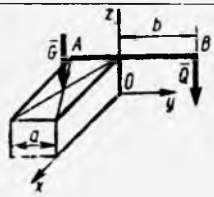
5.5.3. Tomonlari a=1m bo'lgan kubga to'rtta kuch ta'sir etib, ular $\overline{R}$ kuch bilan muvozanatlashadi. Agar kuchlarning qiymatlari $F_1=F_2$=15N, $F_3=F_4$=5N va R=40N bo'lsa, $\overline{R}$ kuch bilan Oxz tekislik orasidagi b masofani aniqlang. (0,25)



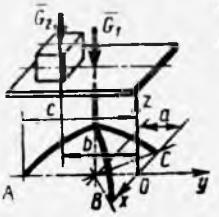
5.5.4. Qirrasi a=0,4m bo'lgan parallelepipedning tomonlariga Oy o'qiga parallel bo'lgan o'zaro muvozanatlashuvchi kuchlar sistemasi $F_1=F_2=F_3=F_4$=10N va F_5=40N ta'sir etadi. F_5 kuchning qo'yilish nuqtasidan bo'lgan masofa, b ni aniqlang. (0,3)



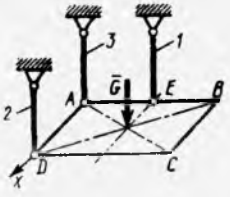
5.5.5. Eni a=0,5m bo'lgan, og'irligi G=100 kN li poydevorga AB to'sin mahkamlangan. AB to'singa qo'yilgan $\overline{Q}\|Oz$ kuch ta'sirida poydevor Ox o'qi atrofida ag'anashi uchun $\overline{Q}$ kuchning eng minimal qiymatini kN da aniqlang. To'sinning uzunligi AB=5,5m (b=5m) deb hisoblang. (5)



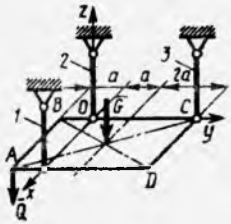
5.5.6. O'lchamlari a=0,5m va b=1m, c=1,5m, og'irligi G_1=500 N bo'lgan uch oyoqli platformaning ustida vazni G_2=50 N yuk muvozanatda turadi. Agar $\overline{G}_1$, $\overline{G}_2$ kuchlar va A tayanch nuqtasi bir vertikal tekislikda joylashgan bo'lsa, A tayanch reaksiya kuchini aniqlang. Bunda $AB=BC=AC$. (200)



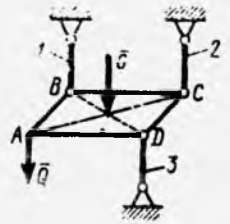
5.5.7. Kvadrat shaklidagi bir jinsli, gorizontal $ABCD$ plitaning og'irligi G=500N bo'lib, A, D va E nuqtalaridan uchta vertikal sterjenlar 1, 2, 3 orqali osilgan. Agar $AD=2AE$ bo'lsa, 1 sterjenning zo'riqishini toping. (500)



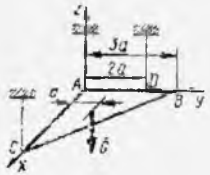
5.5.8. O'lchamlari a=1m bo'lgan bir jinsli kvadrat shaklidagi $ABCD$ plitaning og'irligi G=100 N bo'lib, 1, 2 va 3 vertikal sterjenlar vositasida osib qo'yilgan. Plitaning A nuqtasiga qo'yilgan $\overline{Q}$ kuchning qanday qiymatida 3 sterjendagi zo'riqish nolga teng bo'ladi? (100)



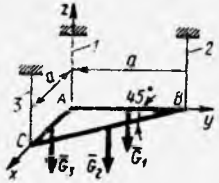
5.5.9. Kvadrat shaklidagi $ABCD$ plitaning og'irligi G=115N bo'lib, gorizontal holatda 3 ta vertikal sterjenlar vositasida mahkamlangan. Agar plitaning A nuqtasiga vertikal Q=185N kuch ta'sir qilsa, muvozanat tenglamalarining BD o'qqa nisbatan olingan momentidan foydalanib, 2 sterjenning zo'riqishini aniqlang. (-185)



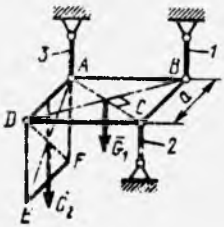
5.5.10. To'g'ri burchakli uchburchak shaklidagi *ABC* bir jinsli plastina G=500N og'irlikka ega bo'lib, uchta arqon yordamida gorizontal holatda osilgan. Agar masofa a=1m bo'lsa, *D* nuqtada bog'langan arqonning taranglik kuchini toping. (250)



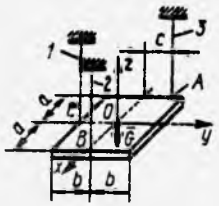
5.5.11. Og'irliklari G_1=G_3=101N va G_2=143N bo'lgan bir jinsli qismlardan iborat *ABC* uchburchak rama 1, 2 va 3 vertikal po'lat arqonlar yordamida gorizontal holatda mahkamlangan. 3 arqondagi zo'riqishni aniqlang. (122)



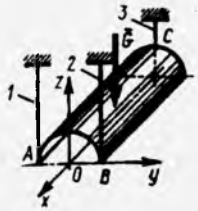
5.5.12. O'lchamlari a=0,4m va *EF*=*AD* bo'lgan, og'irliklari G_1=10N va G_2=8N li ikki plastinalar sharnirlar yordamida bir-biriga hamda sterjenlar vositasida tayanchlarga mahkamlangan. Agar *ABCD* gorizontal tekislikda, *ADEF* vertikal tekislikda joylashgan bo'lsa, 1 sterjendagi reaksiya kuchini toping. (-4)



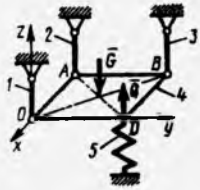
5.5.13. O'lchamlari a=0,2m va b=0,1m bo'lgan, og'irligi G=3N li to'rt burchakli bir jinsli plastina gorizontal holatda 3 ta arqon vositasida ushlab turiladi. Uchala arqonlardagi zo'riqishlar bir xil bo'lishi uchun 3 arqonning mahkamlangan nuqtasi *A* simmetriya o'qidan qanday c masofada bo'lishi lozim? (0,1)



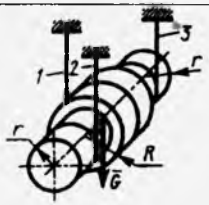
5.5.14. Og'irligi G=40 kN, bir jinsli yarim silindr shaklidagi obolochka (yupqa qobiq) A, B va C nuqtalaridan vertikal po'lat arqonlar yordamida mahkamlangan. Agar 3 arqonning zo'riqishi 20 kN bo'lsa, 1 arqondagi reaksiya kuchini kN da toping. (10)



5.5.15. O'lchamlari OA=1,5 AB va og'irligi G=1kN bo'lgan to'rtburchak shaklidagi 4 platforma 1, 2, 3 uchta vertikal sterjenlar yordamida gorizontal holatda ushlab turiladi. Agar uning D nuqtasiga 5 prujina Q=0,5 kN kuch bilan bossa, 2 sterjenning reaksiya kuchini kN da aniqlang. (0,5)



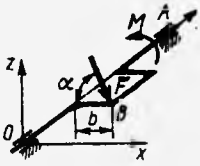
5.5.16. Radiuslari r=0,1m va R=0,14m, og'irligi G=6 kN bo'lgan val 1,2 va 3 vertikal po'lat arqonlar yordamida gorizontal holatda ushlab turiladi. Agar 2 va 3 arqonlardagi taranglik kuchlari T_2=T_3=1,75kN bo'lsa, 1 arqonning taranglik kuchini hisoblang. ($2{,}5\cdot10^3$)



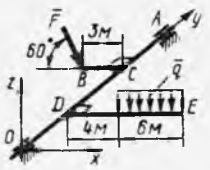
5.6. Fazoda joylashgan ixtiyoriy kuchlar sistemasining muvozanati

5.6.1. Fazoda joylashgan ixtiyoriy kuchlar sistemasining muvozanat shartlari nechta tenglamadan iborat? (6)

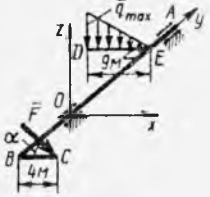
5.6.2. Richagli val OA ga F=10 N li kuch va uni muvozanatlovchi momenti M bo'lgan juft kuch ta'sir etadi. Agar α=60°, $\overline{F}\|Oxz$ va b=0,9 m bo'lsa, momentning qiymatini hisoblang. (7,79)



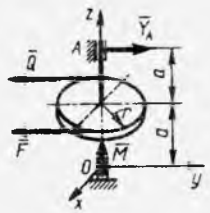
5.6.3. *OA* valga to'g'ri burchak ostida *BC* va *DE* sterjenlar mahkamlangan bo'lib, *DE* ga intensivligi q=0,5 N/m taqsimlangan kuch, *BC* ga esa $\overline{F}$ kuchi ta'sir etadi. Agar $\overline{F} \| Oxz$ bo'lsa, val yuqoridagi kuchlar ta'sirida muvozanatda bo'lishi uchun $\overline{F}$ ning qiymatini aniqlang. (8,08)



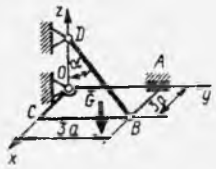
5.6.4. *AOB* valga to'g'ri burchak ostida *BC* va *DE* sterjenlar mahkamlangan bo'lib, *BC* ga α=30° burchak ostida $\overline{F}$ kuchi va *DE* ga intensivligi q=0,5N/m bo'lgan taqsimlangan kuch ta'sir etadi. Agar $\overline{F} \| Oxz$ bo'lsa, val yuqoridagi kuchlar ta'sirida muvozanatda bo'lishi uchun $\overline{F}$ kuchining qiymatini toping. (6,75)



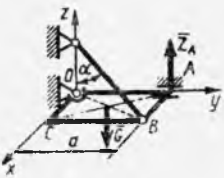
5.6.5. Radiusi r=0,3 m li shkiv o'lchamlari a=0,3 m bo'lgan vertikal o'qqa o'rnatilgan bo'lib, F=2Q=120N kuchlar va momenti M=18N·m juft kuch ta'sirida muvozanatda bo'ladi. *A* podshipnikning $\overline{Y}_A$ reaksiya kuchini, *Ox* o'qiga nisbatan momentlar tenglamasini tuzib, toping. Bunda $\overline{F} \| \overline{Q} \| Oy$. (90)



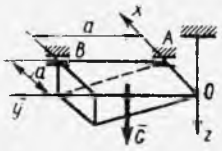
5.6.6. O'lchamlari a=2m, og'irligi G=30N bo'lgan bir jinsli *OABC* plita po'lat arqon *BD* vositasida va *O*, *A* sharnirlar orqali gorizontal mahkamlangan. *BD* arqonning taranglik kuchini aniqlang. Bunda α=60^0. (30)



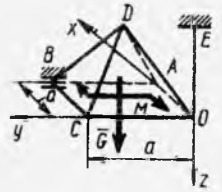
5.6.7. Tomonlari a=0,5m bo'lgan kvadrat shaklidagi *OABC* bir jinsli ramaning og'irligi G=140N bo'lib, gorizontal holatda muvozanatda ushlab turiladi. Agar α 60° bo'lsa, *A* sharnirning $\overline{Z}_A$ reaksiya kuchini, *OB* chiziqqa nisbatan moment tenglamasini tuzib, hisoblang. (0)



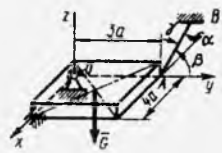
5.6.8. O'lchamlari a=0,1m bo'lgan bir jinsli jismning og'irligi G=60N bo'lib, shaklda ko'rsatilgan bog'lanishlar vositasida muvozanatda ushlab turiladi. Kuchlarning Ox o'qiga nisbatan momenti tenglamalarini tuzib, B sharnir reaksiya kuchining vertikal tashkil etuvchisini toping. (40)



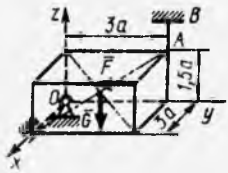
5.6.9. O'lchamlari a=3m bo'lgan, bir jinsli $OABCD$ piramidaning og'irligi G=60N bo'lib, unga momenti M=150N·m li juft kuch ta'sir etadi. Agar piramida shaklda ko'rsatilgan bog'lanishlar yordamida muvozanatda bo'lsa, B sharnir reaksiya kuchining Ox o'qiga parallel tashkil etuvchisini toping. (50)



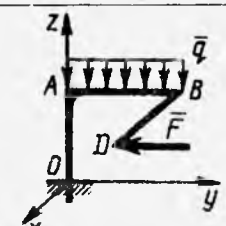
5.6.10. O'lchamlari a=20sm bo'lgan bir jinsli plita G=400N og'irlikka ega. Agar plita shaklda ko'rsatilgan bog'lanishlar vositasida muvozanatda bo'lib, α=61°, β=44° va γ=60° bo'lsa, AB arqonning taranglik kuchini, Ox o'qiga nisbatan moment tenglamasini tuzib toping. (400)



5.6.11. Tomonlari a=0,2m bo'lgan jism G=11kN og'irlikka ega bo'lib, F=3kN kuch ta'sirida va shaklda ko'rsatilgan bog'lanishlar yordamida muvozanatda ushlab turiladi. AB arqonning taranglik kuchini, Ox o'qiga nisbatan moment tenglamasini tuzib toping. ($4\cdot10^3$)



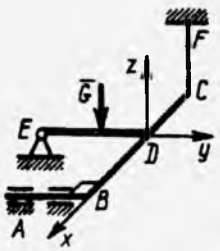
5.6.12. O'lchamlari OA=1,7m; AB=2m; BD=3,4m bo'lgan $OABD$ bukilgan to'sin O nuqtasida yerga qistirib mahkamlangan. Unga F=1kN kuch va intensivligi q=2kN/m li taqsimlangan kuchlar ta'sir qiladi. Agar $BD \| Ox$ bo'lsa, O tayanch reaksiya kuchining Oz o'qidagi tashkil etuvchisini aniqlang (kN). (4)



5.7. Fazoviy kuchlar ta'siridagi jismlar sistemasining muvozanati

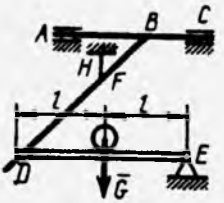
5.7.1. Fazoda joylashgan ikkita jismdan iborat sistema uchun bir-biriga bog'liq bo'lmagan nechta muvozanat tenglamalarini tuzish mumkin? (12)

5.7.2. Og'irligi G=3kN bo'lgan bir jinsli gorizontal DE sterjen o'lchami BD=2DC li ABC bukilgan sterjenga tiralgan. Agar bukilgan sterjenning bir uchi CF vertikal po'lat arqonga osilgan bo'lsa, uning taranglik kuchini aniqlang (kN). (1)

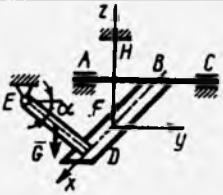


5.7.3. Og'irligi G=6 kN bo'lgan bir jinsli DE to'sin gorizontal joylashgan, ABC bukilgan to'singa tiralgan. Agar BD=1m bo'lsa, vertikal po'lat arqon CF taranglik kuchini 1kN deb, CD masofani toping. (2)

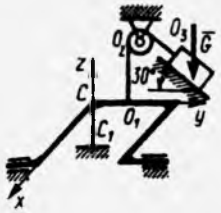
5.7.4. Og'irligi G=800 N li yuk gorizontal DE to'singa o'rnatilgan. DE to'sin esa gorizontal joylashgan vertikal FH sim arqon yordamida osib qo'yilgan $ABCD$ konstruksiyaga erkin tiralgan. Agar masofalar DF=2FB va AB=BC bo'lsa, A podshipnikning reaksiya kuchini aniqlang. (400)



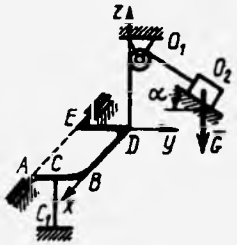
5.7.5. Og'irligi 4 kN bo'lgan bir jinsli DE to'sin vertikal tekislikda joylashgan bo'lib, gorizontal holatdagi silliq plastinaga D nuqtada tiralgan. Agar plastina AC o'q va FH sim arqon bilan mahkamlangan bo'lsa, sim arqonning tarangligini kN da toping. Bunda FB=2DF, $AC \perp BD$, $ED \perp DB$. (3)



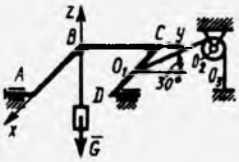
5.7.6. Og'irligi G=10kN bo'lgan yuk sim arqon vositasida richagli valga osib qo'yilgan. Richagli val esa podshipniklar va CC_1 sim arqon yordamida mahkamlangan. Agar Cxy tekislik gorizontal, $O_1O_2O_3$ tekislik esa Cyz tekislikda joylashgan bo'lsa, CC_1 vertikal sim arqonda hosil bo'layotgan taranglik kuchini toping (kN). (5)



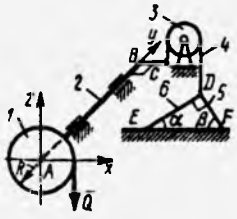
5.7.7. Og'ir yuk sim arqon vositasida richagli valga osib qo'yilgan. Richagli val esa podshipniklar va CC_1 sim arqon yordamida mahkamlangan. Agar α=30° va CC_1 vertikal sim arqonning tarangligi 20kN bo'lsa, AC=BC deb olib, yukning og'irligini toping (kN). Bunda $ABDE$ tekislik gorizontal, DO_1O_2 esa vertikal deb oling. (20)



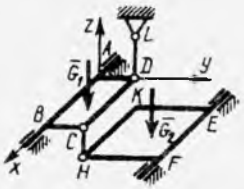
5.7.8. Og'irligi G=2,5 kN bo'lgan yuk sim arqon yordamida richagli valga osib qo'yilgan. Richagli val esa podshipniklar va $O_1O_2O_3$ sim arqon vositasida mahkamlangan. Agar $ABCD$ gorizontal holatda, $O_1O_2O_3$ tekislik Byz tekislikka parallel va DO_1=O_1C bo'lsa, O_2 sharnirda hosil bo'lgan reaksiya kuchini aniqlang (kN). (17,3)



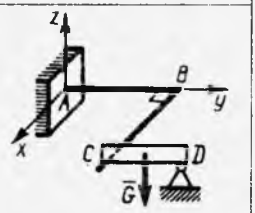
5.7.9. Uchiga 1 disk o'rnatilgan 2 gorizontal val $BC\|Ax$ dastakka ega bo'lib, 4, 5, 6 iplar vositasida muvozanatda ushlab turiladi. Agar 1 diskka vertikal Q=100N kuch ta'sir etsa va o'lchamlari R=2BC, β=2α=60° bo'lsa, 5 ipning taranglik kuchini toping. 4, 5, 6 iplar sistemasi vertikal tekislikda joylashgan. (173)



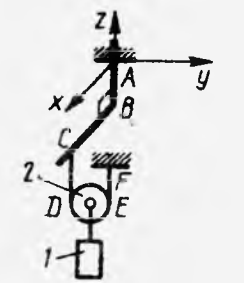
5.7.10. Bir jinsli *ABCD* va *EFHK* platformalar gorizontal o'qlar *AB*||*EF*||*Ax* va vertikal sterjenlar yordamida gorizontal holatda ushlab turiladi. Agar platformalarga $G_2=2G_1=200$N kuchlar ta'sir etsa, masofalarni $FH=2BC=2$m deb, *DL* sterjenning zo'riqishini aniqlang. (150)



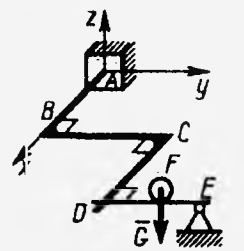
5.7.11. Og'irligi $G=10$ kN bo'lgan bir jinsli gorizontal *CD* to'sin *C* nuqtasi bilan gorizontal tekislikda joylashgan bukilgan sterjen *ABC* ga tiralgan. *A* tayanch reaksiya kuchi R_A ning miqdorini aniqlang. ($5\cdot10^3$)



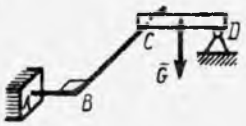
5.7.12. Og'irligi 10kN li 1 yuk osilgan 2 blok sim arqonlar yordamida muvozanatda ushlab turiladi. Sim arqonning bir uchi devorga mahkamlagan bo'lib, ikkinchi uchi esa bukilgan *ABC* sterjenga bog'langan. Agar *CD*||*EF*, *BC*=1m bo'lsa, *A* tayanchda hosil bo'ladigan momentning *Ay* o'qidagi proyeksiyasini hisoblang (kN · m). (-5)



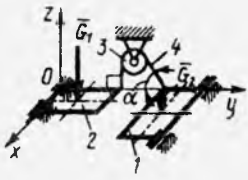
5.7.13. Og'irligi $G=5$kN bo'lgan yuk *DE* gorizontal sterjenga o'rnatilgan bo'lib, sterjen esa *D* nuqtasi bilan *ABCD* gorizontal bukilgan sterjenga tiralgan. Agar o'lchamlari $AB=BC=CD=2$m, $DF=FE$ bo'lsa, *A* tayanchdagi momentning *Ax* o'qiga proyeksiyasini kN da aniqlang. (5)



5.7.14. Og'irligi G=2 kN bo'lgan gorizontal CD to'sin C nuqtasi bilan ABC bukilgan gorizontal sterjenga tiraladi. Agar AB=1m bo'lib, A tayanchdagi moment 2,24 kN· m bo'lsa, BC ning uzunligini toping. (2,00)



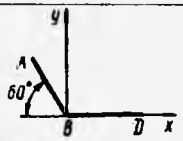
5.7.15. Og'irliklari G_1=100 N va G_2=86,6 N bo'lgan bir jinsli platformalar 1 va 2 Oyz tekisligida joylashgan 3 blok va 4 sim arqon vositasida muvozanatda ushlab turiladi. Agar sim arqonning chap tomoni vertikal joylashgan bo'lsa, o'ng tomonining qiyalik burchagi α ning gradus qiymatini toping. (60)



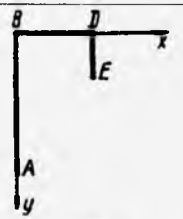
6.1. Uzunlikka ega bo'lgan jismlarning og'irlik markazi

6.1.1. Bir jinsli to'g'ri chiziqli AB sterjenning A va B nuqtalarining koordinatalari: x_A=10sm va x_B=40sm berilgan. Uning og'irlik markazi x_C (sm) koordinatasini toping. (25)

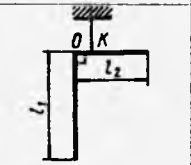
6.1.2. Ikkita bir jinsli bir xil chiziqli og'irlikdagi sterjendan iborat kronshteyn ABD bo'lib, BD=20sm bo'lsa, uning og'irlik markazi x_C=0 bo'lishi uchun AB ning uzunligi (sm) qancha bo'lishi lozim? (28,3)



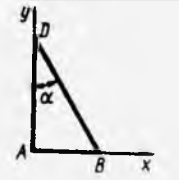
6.1.3. Uzunliklari AB=0,2m; BD=0,1m va DE=0,06m bo'lgan, bir jinsli, bir xil chiziqli og'irlikka ega sterjenlardan iborat kronshteynning og'irlik markazi y_C (sm) koordinatasini toping. (6,06)



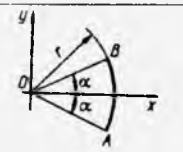
6.1.4. Uzunliklari l_1 va l_2 bo'lgan bir jinsli bukilgan sim shaklda ko'rsatilgan holda osib qo'yilgan. Agar OK=0,2 l_2 bo'lsa, l_2 qismi gorizontal holda qolishi uchun l_1/l_2 nisbat qancha bo'lishi lozim? (1,5)



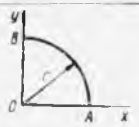
6.1.5. Uchta bir jinsli sterjenlardan iborat ABD konturning og'irlik markazining x_C koordinatasini toping. Konturning o'lchamlari AB=2m va α=30°. Sterjenlarning chiziqli og'irliklarini bir xil deb hisoblansin. (0,634)



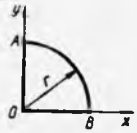
6.1.6. Radiusi r=0,2m bo'lgan AB yoy shaklidagi jismning og'irlik markazi C ning koordinatasini x_C ni aniqlang. Yoyning burchagi α=30° deb hisoblang. (0,191)



6.1.7. Radiusi r=20sm bo'lgan AB yoydan va OA to'g'ri kesmadan iborat bir jinsli simning og'irlik markazi y_C (sm) koordinatasini aniqlang. (7,78)



6.1.8. Radiusi r=10sm bo'lgan AB yoydan va OA, OB to'g'ri kesmadan iborat $OABD$ konturning Ox o'qiga nisbatan statik momentini sm^2 larda hisoblang. (150)

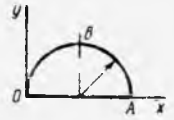


6.1.9. Yarim aylana ko'rinishida bukilgan, bir jinsli sim shaklda ko'rsatilgan holda osib qo'yilgan. Vertikal va aylana diametri orasidagi burchak α ning gradus qiymatini aniqlang. (32,5)

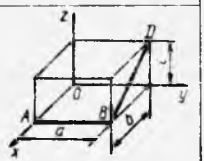
6.1.10. Ikki xil simdan yarim aylanalar shaklida bukilgan bir jinsli kontur berilgan. Agar OAB qismining chiziqli vazni 6N/m, BDE qisminiki - 10 N/m bo'lsa, konturning og'irlik markazi x_C koordinatasini aniqlang. (0,673)

6.1.11. Radiusi r=1,2m bo'lgan yarim aylana va to'g'ri kesmalardan iborat $ABDEA$ konturning og'irlik markazi y_C koordinatasini toping. (0,360)

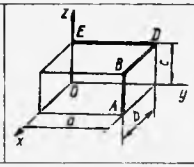
6.1.12. Radiusi r bo'lgan yarım aylanadan va OA kesmadan iborat konturning og'irlik markazi koordinatasi y_C=0,4m bo'lsa, kontur radiusi r ni hisoblang. (1,03)



6.1.13. O'lchamlari a=1m, b=0,5m va c=0,8m bo'lgan ABD bukilgan simning og'irlik markazi x_C koordinatasini aniqlang. (0,379)



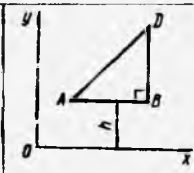
6.1.14. O‘lchamlari $a=b=2$m va $c=1$m bo‘lgan $ABDE$ bukilgan simning og‘irlik markazi y_C koordinatasini toping. (1,60)



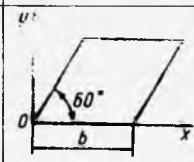
6.2. Tekis shakllarning og‘irlik markazi

6.2.1. Uchlarining koordinatalari $x_A=x_B=3$sm, $x_D=9$sm bo‘lgan to‘g‘ri burchakli uchburchak shakldagi ABD plastinaning og‘irlik markazi x_C koordinatasini hisoblang. (5)

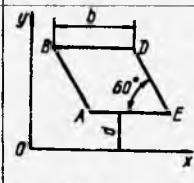
6.2.2. Tomoni $BD=0,3$m bo‘lgan uchburchak shaklidagi bir jinsli ABD plastina og‘irlik markazining y_C koordinatasi 0,3m bo‘lsa, plastina Ox o‘qidan qancha h masofada joylashishi lozim? (0,2)



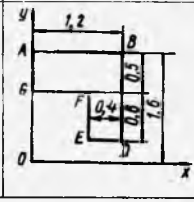
6.2.3. Tomoni $b=8$sm bo‘lgan romb yuzining Ox o‘qiga nisbatan statik momentini sm^3 larda hisoblang. (192)



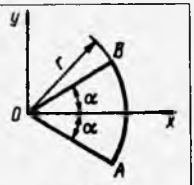
6.2.4. Tomoni $b=0,2$m bo‘lgan bir jinsli romb shaklidagi $ABDE$ plastina Ox o‘qidan $d=0,1$m masofada turgan bo‘lsa, uning og‘irlik markazi y_C koordinatasini toping. (0,187)



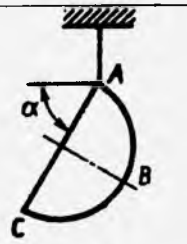
6.2.5. O‘lchamlari shaklda ko‘rsatilgan $ABDEFG$ ko‘pburchak yuzaning og‘irlik markazi y_C (m) koordinatasini hisoblang. (1,19)



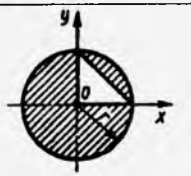
6.2.6. Radiusi r=0,6m va markaziy burchagi $2\alpha=60^\circ$ bo'lgan doiraviy sektor OAB ning og'irlik markazi x_C koordinatasini toping. (0,382)



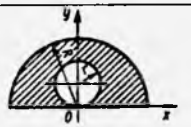
6.2.7. Yarim doira ko'rinishidagi bir jinsli ABC plastina shaklda ko'rsatilgan holda osib qo'yilgan. Yarim doira diametri va gorizontal o'q orasidagi α burchakning graduslardagi qiymatini hisoblang. (67,0)



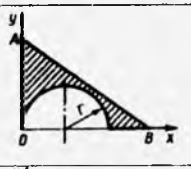
6.2.8. Radiusi r=2m bo'lgan shtrixlangan shaklning og'irlik markazi x_C koordinatasini aniqlang. (-0,126)



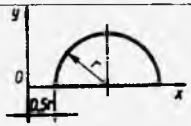
6.2.9. Radiuslari R=0,99m va r=0,33m bo'lgan shtrixlangan shaklning og'irlik markazi y_C koordinatasini toping. (0,446)



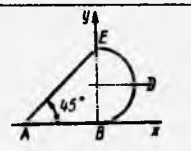
6.2.10. Asosi OB=60sm va balandligi OA=45sm bo'lgan OAB uchburchak shaklidagi jismdan radiusi r=20sm li yarim doira kesib olingan. Uchburchakning qolgan qismining og'irlik markazi x_C koordinatasini toping. (20)



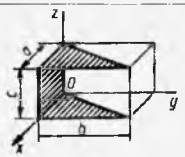
6.2.11. Radiusi r=5sm bo'lgan bir jinsli yarim doira shaklidagi yassi jism yuzining Oy o'qiga nisbatan statik momentini sm^3 larda hisoblang. (295)



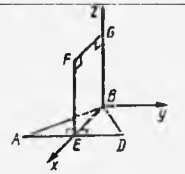
6.2.12. $ABDE$ yassi jism BDE yarim doira va ABE to'g'ri burchakli uchburchaklardan iborat. Agar ularning yuza og'irliklari γ_1 va γ_2 bo'lsa, yassi jismning og'irlik markazi By o'qida deb olib, γ_1/γ_2 nisbatni aniqlang. (2)



6.2.13. Yassi jism shunday bukilganki, uni bitta to'rtburchak va ikkita uchburchakdan iborat deb qarash mumkin. Agar jismning o'lchamlari a=0,6m, b 0,8m va c=0,5m bo'lsa, uning og'irlik markazi y_c koordinatasini hisoblang. (0,164)



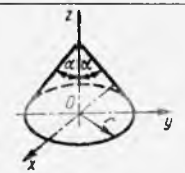
6.2.14. Bir jinsli bir xil yassi jismdan tayyorlangan *ABDEFG* devorining og'irlik markazi koordinatasi $z_C=BG/3$ ga teng. Agar devorning asosidagi uchburchaklar *Bxy* tekislikda joylashib, *ABE* va *BDE* uchburchaklar o'zaro teng bo'lsa, *AE/BG* nisbat nechaga teng? (0,5)



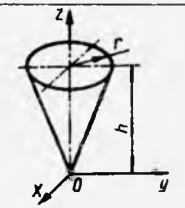
6.3. Hajmga ega bo'lgan jismlarning og'irlik markazi

6.3.1. Balandligi 0,8m bo'lgan bir jinsli to'rtburchakli muntazam piramidaning og'irlik markazidan uning asosigacha bo'lgan masofa qanchaga teng? (0,2)

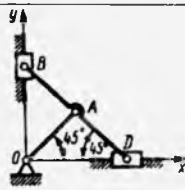
6.3.2. Asosining radiusi r=0,4m va burchagi α=45° bo'lgan bir jinsli konusning og'irlik markazi z_c koordinatasini toping. (0,1)



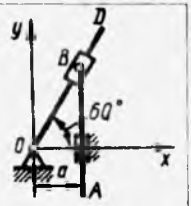
6.3.3. Balandligi h=0,8m, asosining radiusi r=0,4m bo'lgan bir jinsli doiraviy konusning *Oxy* koordinata tekisligiga nisbatan statik momentini aniqlang. ($8{,}04\cdot10^{-2}$)



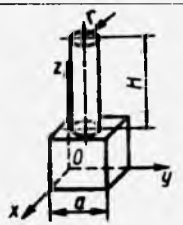
6.3.4. Uzunligi OA=0,4m bo'lgan ellipsograf lineykasining bir jinsli sterjenlari *OA* 8N va *BD* 12N polzunlari *B* va *D* esa 5N dan og'irlikka ega bo'lsa, uning og'irlik markazi y_c koordinatasini hisoblang. (0,245)



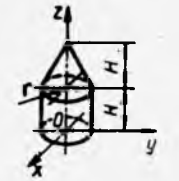
6.3.5. Uzunliklari OD=0,5m va a=0,2m bo'lgan kulisali mexanizmning richagi OD, sterjeni AB va polzuni B, og'irliklari mos ravishda 12, 10 va 6N ga teng. Shaklda ko'rsatilgan holat uchun mexanizmning statik momentini aniqlang. (4,7)



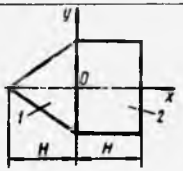
6.3.6. O'lchamlari a=0,4m, r=0,5a; H=2a bo'lgan kub va silindrdan iborat bir jinsli jismning Oxy koordinata tekisligiga nisbatan statik momentini hisoblang. ($9{,}32\cdot10^{-2}$)



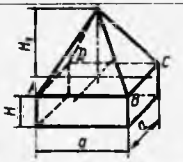
6.3.7. Radiusi r=0,4m, balandligi H=0,6m bo'lgan silindr va konusdan iborat bir jinsli jismning Oxy tekislikka nisbatan statik momenti 0,166m^4 bo'lsa, uning og'irlik markazi z_C koordinatasini aniqlang. (0,413)



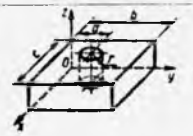
6.3.8. Jism bir jinsli konus 1 va silindr 2 dan iborat. Agar konus va silindrning solishtirma og'irliklari γ_1 va γ_2 bo'lsa, og'irlik markazi x_C koordinatasi nolga teng bo'lishi uchun γ_1/γ_2 nisbat qancha bo'lishi lozim? (6)



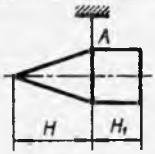
6.3.9. Balandliklari H_1=1,2 va H bo'lgan bir jinsli parallelepiped va piramidadan iborat jismning og'irlik markazi $ABCD$ tekisligida yotishi uchun parallelepipedning balandligi H qancha bo'lishi lozim? (0,490)



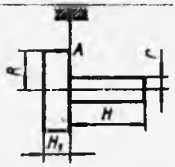
6.3.10. O'lchamlari r=0,2m, a=0,5m, b=1,5m va c=1,8m bo'lgan bir jinsli jismning og'irlik markazi y_C koordinatasini aniqlang. (0,762)



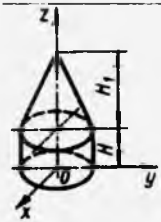
6.3.11. Balandliklari H va H_1=0,3m bo'lgan bir jinsli konus va silindrdan iborat jism ip vositasida gorizontal osilib turishi uchun konusning balandligi H qancha bo'lishi lozim? (0,735)



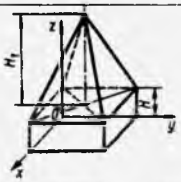
6.3.12. Ikkita bir jinsli silindrlardan iborat bo'lgan jism A nuqtasidan shunday osilganki, simmetriya o'qlari gorizontal holatda joylashgan. Agar silindrning balandligi H_1=0,5m va radiusi R=3r bo'lsa, silindrning H balandligini aniqlang. (1,5)



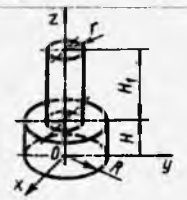
6.3.13. Balandliklari H_1=2H=0,4m bo'lgan konus va silindrdan iborat bir jinsli jismning og'irlik markazi z_C koordinatasini aniqlang. (0,18)



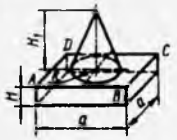
6.3.14. Balandliklari H_1=3H=1,2m bo'lgan parallelepiped va piramidadan iborat bir jinsli jismning og'irlik markazi z_C koordinatasini hisoblang. (0,45)



6.3.15. Balandliklari H_1=2H, H=0,5m radiuslari R=2r bo'lgan ikki silindrdan iborat bo'lgan bir jinsli jismning og'irlik markazi z_C ni aniqlang. (0,5)



6.3.16. Balandliklari H_1=3H, o'lchami a=2m bo'lgan parallelepiped va konusdan iborat bir jinsli jismning og'irlik markazi $ABCD$ tekislikda joylashishi uchun konus radiusi R qancha bo'lishi lozim? (0,92)



VII BOB. NUQTA KINEMATIKASI

7.1. To‘g‘ri burchakli koordinatalar sistemasida nuqtaning trayektoriyasi va holati

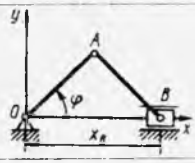
7.1.1. Nuqtaning harakati tenglamalari $x=1+2\sin 0{,}1t$; $y=3t$ berilgan. Nuqtaning ordinatasi $y=12$m bo‘lgan paytidagi uning abssissasi x ni toping. (1,78)

7.1.2. Nuqtaning harakati $\vec{r}=3t\vec{i}+4t\vec{j}$ radius-vektor orqali berilgan bo‘lsa, $r=5$m bo‘lgan paytdagi y koordinatasini hisoblang. (4)

7.1.3. Nuqtaning harakati koordinatalar ko‘rinishida: $x=3t$, $y=t^2$ berilgan bo‘lsa, $t=2$s paytida nuqta koordinata boshidan qancha masofaga uzoqlashadi? (7,21)

7.1.4. Nuqtaning harakati koordinatalar ko‘rinishida $x=\cos t$, $y=2\sin t$ berilgan bo‘lsa, $t=2{,}5$s paytida nuqta koordinata boshidan qancha masofaga uzoqlashadi? (1,44)

7.1.5. Krivoshipning harakat qonuni $\varphi=0{,}2t$ rad burchak funksiya orqali berilgan bo‘lsa, $t=3$s paytda polzunning x_B koordinatasini toping. Bunda $OA=AB=0{,}5$m. (0,825)



7.1.6. Nuqtaning harakati koordinatalar usulida $x=2t$; $y=t$ berilgan bo‘lsa, qancha t vaqtdan keyin u koordinata boshidan 10m masofaga uzoqlashadi? (4,47)

7.1.7. Nuqtaning harakati koordinatalar usulida $x=2t$, $y=1-2\sin 0,1t$ berilgan bo'lsa, qancha t vaqtdan keyin nuqta Ox o'qini kesib o'tadi. (5,24)

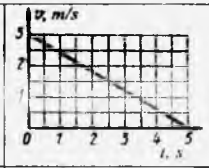
7.1.8. Nuqtaning harakat qonuni koordinata usulida: $x=\sin t$, $y=\cos t$ ko'rinishida berilgan bo'lsa, qancha vaqtdan keyin nuqtaning radius-vektori Ox o'qidan 45° burchak hosil qiladi? (0,785)

7.1.9. A nuqtaning harakati koordinatalar usulida $x=2\cos t$, $y=3\sin t$ berilgan bo'lsa, $t=1,5$s paytda Ox o'qi bilan $\overline{OA}$ radius-vektori qanday burchak tashkil qiladi? (1,52)

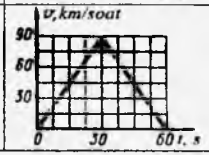
7.2. To'g'ri burchakli koordinatalar sistemasida nuqtaning tezligi

7.2.1. Nuqtaning harakati $\vec{r}=t^2\vec{i}+2t\vec{j}+3\vec{k}$ radius-vektor orqali berilgan bo'lsa, $t=2$s paytida nuqtaning tezligini toping. (4,47)

7.2.2. Nuqtaning tezlik grafigi $\upsilon=f(t)$ berilgan bo'lsa, t 5s dagi bosib o'tgan yo'lini hisoblang. (7,5)



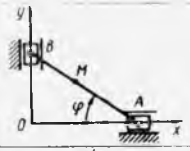
7.2.3. Nuqtaning tezlik grafigi $\upsilon=f(t)$ berilgan bo'lsa, $t=60$s dagi bosib o'tgan yo'lini toping. (750)



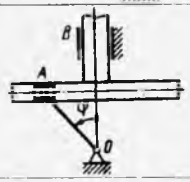
7.2.4. Nuqta harakatining qonuni koordinata usulida: $x=t^2$, $y=\sin\pi t$, $z=\cos\pi t$ berilgan bo'lsa, $t=1$s paytda uning tezligini hisoblang. (3,72)

7.2.5. Nuqtaning tezligi $\vec{\upsilon}=2t\vec{i}+3\vec{j}$ berilgan bo'lsa, $t=4$s paytda tezlik vektori va Ox o'qi orasidagi burchak graduslarda toping. (20,6)

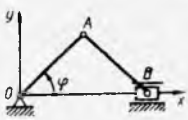
7.2.6. AB chizg'ichning holati $\varphi=0{,}5t$ burchak funksiya orqali aniqlanadi. Agar $t=2$s paytida M nuqta $BM=0{,}2$m bo'lsa, M nuqta tezligining Ox o'qidagi proyeksiyasini aniqlang (sm/s). (-8,41)



7.2.7. Agar krivoship harakat qonuni $\varphi=6t$ bo'lib, $OA=0{,}1$m bo'lsa, $t=6$s paytda B nuqtaning tezligini aniqlang. (0,595)



7.2.8. Krivoshipning harakat qonuni $\varphi=0{,}5t$ funksiya orqali berilgan. Agar $OA=AB=1{,}5$m bo'lsa, $t=4$s paytda B polzunning tezligini aniqlang. (-1,36)



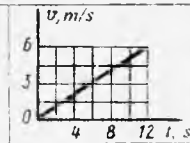
7.2.9. Nuqta tezligining proyeksiyasi $\upsilon_x=2\cos\pi t$ bo'lib, boshlang'ich paytda, $t_0=0$ da $x_0=0$ bo'lsa, $t=1$s da nuqtaning x koordinatasini toping. (0)

7.2.10. Nuqtaning harakat qonuni $x=\sin\pi t$ bo'lib, $x=0{,}5$m bo'lgan eng yaqin t vaqtda uning tezligini hisoblang. (2,72)

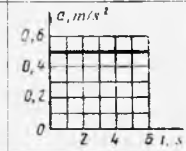
7.3. To'g'ri burchakli koordinatalar sistemasida nuqtaning o'zgarmas tezlanishi

7.3.1. Avtomobilning tezligi 12s mobaynida bir tekisda noldan 60km/soatgacha o'zgarsa, uning tezlanishini aniqlang. (1,39)

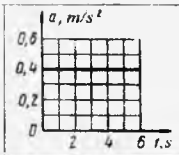
7.3.2. Nuqtaning to'g'ri chiziqli harakatida tezlik grafigi $\upsilon=f(t)$ berilgan bo'lsa, $t=12$s paytdagi uning tezlanishini aniqlang. (0,5)



7.3.3. To'g'ri chiziqli harakat qilayotgan nuqtaning tezlanish grafigi $a=f(t)$ berilgan bo'lib, boshlang'ich paytida, $t=0$ da, $\upsilon_0=0$ bo'lsa, $t=6$s paytda nuqtaning tezligini aniqlang. (3)



7.3.4. To‘g‘ri chiziqli harakat qilayotgan nuqtaning tezlanish grafigi $a=f(t)$ berilgan bo‘lib, boshlang‘ich paytida, $t_0=0$ da, $\upsilon_0=0$ bo‘lsa, $t_1=5$s mobaynida nuqtaning bosib o‘tgan yo‘lini toping. (5)



7.3.5. To‘g‘ri chiziqli harakatdagi nuqtaning tezlanishi $a=0,5\text{m/s}^2$ bo‘lib, boshlang‘ich paytida, $t_0=0$ da, $\upsilon_0=0$ bo‘lsa, 9m masofa bosib o‘tishi uchun qancha vaqt o‘tadi? (6)

7.3.6. To‘g‘ri chiziqli harakatdagi nuqtaning tezlanishi o‘zgarmas $a=0,3\text{m/s}^2$ bo‘lib, 6 s o‘tgandan keyin 3 m/s tezlikka erishsa, boshlang‘ich paytda nuqtaning tezligi qancha bo‘lgan? (1,2)

7.3.7. To‘g‘ri chiziqli harakatdagi raketa tezligi 3 km/s dan 5km/s ga yetishi uchun unga 3g tezlanish berish kerak bo‘lsa, buning uchun raketaning dvigateli qancha sekund ishlashi lozim? (68,0)

7.3.8. Qo‘nayotgan samolyot yerga 180 km/soat tezlik bilan tushadi va 1000m masofa bosib o‘tib to‘xtaydi. Samolyotning o‘rtacha sekinlanish modulini hisoblang. (1,25)

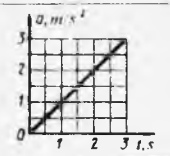
7.3.9. Avtomobilning tezligi 90 km/soat bo‘lib, 3 m/s^2 sekinlanish bilan to‘xtayotgan bo‘lsa, uning tormoz yo‘lini aniqlang. (104)

7.3.10. Nuqta to‘g‘ri chiziq bo‘ylab $a=0,2\text{m/s}^2$ tezlanish bilan harakatni boshladi. Nuqtaning $t_1=4$s dan $t_2=10$s gacha bo‘lgan vaqtdagi bosib o‘tgan yo‘lini toping. (8,4)

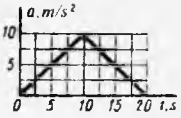
7.4. Nuqtaning o‘zgaruvchan tezlanishini to‘g‘ri burchakli koordinatalar sistemasida aniqlash

7.4.1. Tezlanishi $\bar{a}=0,5t\bar{i}+0,2t^2\bar{j}$ vektor orqali berilgan nuqtaning tezlanish modulini $t=2$s payt uchun hisoblang. (1,28)

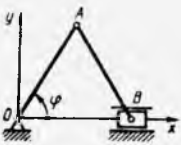
7.4.2. To'g'ri chiziqli harakat qilayotgan nuqtaning tezlanish $a=f(t)$ grafigi berilgan. Agar boshlang'ich paytda, t_0 0da, nuqta $\upsilon_0=0$ tezlikka ega bo'lsa, $t=2$s dagi tezligi qancha bo'ladi? (2)



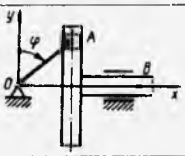
7.4.3. To'g'ri chiziqli harakat qilayotgan nuqtaning tezlanish $a=f(t)$ grafigi berilgan. Agar boshlang'ich paytda, $t=0$ da, nuqta $\upsilon_0=0$ tezlikka ega bo'lsa, $t=20$s dagi tezligi qancha bo'ladi? (100)



7.4.4. Krivoship-polzunli mexanizmda $OA=AB=20$ sm bo'lib, krivoship OA $\varphi=3t$ qonun bo'yicha aylansa, φ 60° holati uchun polzun B ning tezlanishini toping. (-1,8)



7.4.5. Agar $OA=15$sm li krivoship $\varphi=4t$ qonun bo'yicha aylansa, $t=5$s vaqt uchun B nuqtaning tezlanishini aniqlang. (-2,19)



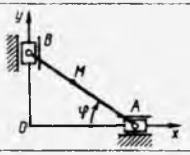
7.4.6. Nuqtaning tezlik vektori $\vec{\upsilon}=0,9t\vec{i}+t^2\vec{j}$ bo'lsa, $t=1,5$s vaqtdagi tezlanishni aniqlang. (3,13)

7.4.7. Uzunligi $OA=1$m bo'lgan krivoshipning holati $\varphi=2t$ burchak funksiyasi bilan aniqlansa, $t=1$s paytdagi A nuqta tezlanishining Ox o'qidagi proyeksiyasi a_x ni aniqlang. (1,66)

7.4.8. Moddiy nuqta tezligining koordinata o'qlaridagi proyeksiyalari: $\upsilon_x=3t$, $\upsilon_y=2t^2$, $\upsilon_z=t^3$ berilgan. $t=1$s paytdagi tezlanish modulini aniqlang. (5,83)

7.4.9. Moddiy nuqta harakat qonuni $dx/dt=0,3t^2$, $y=0,2t^3$ berilgan. $t=7$s paytda uning tezlanishini toping. (9,39)

7.4.10. Ellipsograf chizgichi aylanish holati $\varphi=0,2t$ qonun asosida berilgan bo'lib, $MA=50$sm bo'lsa, $t=3$s paytdagi M nuqta tezlanishining Oy o'qidagi proyeksiyasini aniqlang (sm/s^2). (-1,03)



7.4.11. Nuqta harakat qonuni $x=0,3t^3$, $y=2t^2$ berilgan (x,y - sm). Qanday paytda uning tezlanishi 7sm/s^2 ga teng bo'ladi? (3,19)

7.4.12. Nuqtaning tekislikdagi holati $\bar{r}=0,3t^2\bar{i}+0,1t^3\bar{j}$ radius - vektor orqali aniqlansa, $t=2$s paytda uning tezlanishining miqdori nechaga teng? (1,34)

7.4.13. Nuqtaning harakat qonuni $x=\cos\pi t$, $y=\sin\pi t$ ko'rinishda berilgan bo'lsa, $t=1$s paytdagi uning tezlanish modulini aniqlang. (9,87)

7.4.14. Nuqtaning tezlanish vektori $\bar{a}=2t\bar{i}+t^2\bar{j}$ berilgan bo'lsa, $t=1$s paytdagi tezlanish vektori $\bar{a}$ bilan Ox o'qi orasidagi burchakni toping. (26,6)

7.4.15. Nuqtaning trayektoriyasi $x=0,1y^2$ ko'rinishda bo'lib, Oy o'qi bo'ylab uning harakat qonuni $y=t^2$ bo'lsa, $t=2$s paytda nuqta tezlanishining a_x tashkil etuvchisini toping. (4,8)

7.4.16. Nuqtaning harakat qonuni $x=0,01t^3$, $y=200-10t$ berilgan bo'lsa, nuqta Ox o'qni kesib o'tgan paytda qanday tezlanishga ega bo'ladi? (1,2)

7.4.17. Nuqtaning harakat qonuni $x=8-t^2$, $y=t^2$-cost berilgan bo'lsa, nuqta $x=0$ koordinataga ega bo'lganda uning tezlanishi proyeksiyasi a_y qancha bo'ladi? (1,05)

7.4.18. To'g'ri chiziqli harakat qilayotgan nuqtaning tezlanishi $a=t$ bo'lib, boshlang'ich paytda, $t_0=0$ da, uning tezligi $\upsilon_0=2$m/s bo'lsa, $t=3$s paytdagi tezligi qancha bo'ladi? (6,5)

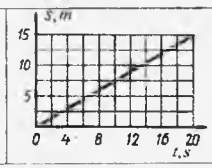
7.4.19. To'g'ri chiziqli harakat qilayotgan nuqtaning tezlanishi $a=0,2t$ bo'lib, boshlang'ich paytda, $t_0=0$ da, uning tezligi $\upsilon_0=0$m/s bo'lsa, qancha vaqtdan keyin tezligi 2m/s bo'ladi? (4,47)

7.4.20. Ox o'qi bo'ylab harakatlanayotgan nuqtaning tezlanishi $a=0,7t$ bo'lib, boshlang'ich paytda, $t_0=0$ da, uning o'rni $x_0=0$ va tezligi $\upsilon_0=0$ bo'lsa, $t=5$s da qancha masofa x ga siljiydi? (14,6)

7.5. Nuqta harakat qonunining va tezligining tabiiy o'qlarda berilishi

7.5.1. $s=15+4\sin\pi t$ trayektoriya bo'ylab harakat qilayotgan nuqta harakat boshlanganda qanday eng yaqin vaqt ichida $s_1=17$m yo'lni bosib o'tadi? (0,167)

7.5.2. Nuqtaning harakat grafigi $s=s(t)$ bo'yicha uning tezligini aniqlang. (0,75)



7.5.3. $s=0,5t^2+4t$ trayektoriya bo'ylab harakat qilayotgan nuqta qancha vaqtda 10m/s tezlikka erishadi? (6)

7.5.4. Berilgan trayektoriya bo'ylab $\upsilon=5$m/s tezlik bilan harakat qilayotgan nuqta boshlang'ich paytda, $t_0=0$ da, $s_0=26$m yo'l bosib o'tgan bo'lsa, $t=18$ s da egri chiziqli koordinata S ni toping. (116)

7.5.5. Egri chiziq bo'ylab harakatlanayotgan nuqtaning tezligi $S=0,5t$ bo'lib, boshlang'ich paytda, $t_0=0$ da, bosib o'tgan yo'li $s_0=0$ bo'lsa, $t=10$s da nuqta qancha yo'l bosib o'tadi? (25)

7.5.6. Egri chiziqli harakatdagi nuqtaning tezligi $\upsilon=0,2t$ bo'lib, boshlang'ich holatida, $t_0=0$ da, bosib o'tgan yo'li $s_0=0$ bo'lsa, $t=10$s da qancha yo'l bosadi? (10)

7.5.7. Nuqtaning harakat qonuni koordinatalar usulida $x=3t^2$, $y=4t^2$ ko'rinishida berilgan bo'lib, boshlang'ich paytda, $t_0=0$ da, $s_0=0$m yo'l bosib o'tsa, $s=110$m yo'lni qancha vaqtda bosib o'tadi? (4,69)

7.5.8. Nuqtaning harakat qonuni koordinatalar usulida $x=3\cos t$, $y=3\sin t$ ko'rinishida berilgan bo'lib, boshlang'ich paytda, $t_0=0$ da, $s_0=0$ m yo'l bosib o'tgan bo'lsa. s 7m yo'lni qancha vaqtda bosib o'tadi? (2,33)

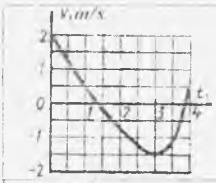
7.5.9. Nuqtaning harakat qonuni koordinatalar usulida: $x=2t$, $y=3t$, $z=5t$ berilgan bo'lib, boshlang'ich paytda, $t_0=0$ da, $s_0=14$m bo'lsa, $t=10$s da nuqtaning S yo'li koordinatasini aniqlang? (75,6)

7.5.10. Nuqtaning harakat qonuni koordinatalar usulida $x=2\sin t$, $y=2\cos t$ berilgan bo'lib, boshlang'ich paytda, $t_0=0$ da, $s_0=0$ bo'lsa, $t=5$s vaqtda nuqtaning S yo'li koordinatasini aniqlang. (10)

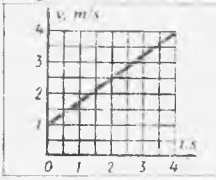
7.6. Nuqtaning urinma tezlanishi

7.6.1. Aylana bo'ylab $s=t^3+2t^2+3t$ qonun bo'yicha harakat qilayotgan nuqtaning urinma tezlanishi a_t 16m/s^2 ga teng bo'lgan paytdagi bosib o'tgan yo'li s ni aniqlang. (22)

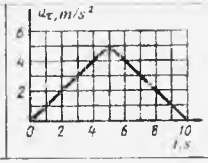
7.6.2. Harakatlanayotgan nuqtaning tezlik grafigi υ $\upsilon(t)$ berilgan bo'lsa, qancha paytdan keyin uning tangensial tezlanishi $a_t=0$ bo'ladi? (3)



7.6.3. Harakatlanayotgan nuqtaning tezlik grafigi $\upsilon=\upsilon(t)$ bo'yicha uning urinma tezlanishini aniqlang. (0,75)



7.6.4. Nuqta urinma tezlanishining o'zgarish grafigi $a_\tau = f(t)$ berilgan bo'lib, boshlang'ich paytda, t_0 0 da, υ_0 0 bo'lsa, t_1=10s dan keyin uning tezligi qanchaga teng bo'ladi? (25)



7.6.5. Nuqta o'zgarmas urinma tezlanish a_τ=0,5m/s^2 bilan harakatlanadi. Agar boshlang'ich paytda, t_0=0 da, uning koordinatasi s_0=0, tezligi υ_0=0 bo'lsa, t=4c dan keyingi s koordinatasini aniqlang. (4)

7.6.6. Nuqtaning urinma tezlanishi a_τ=0,2t ga teng. Agar boshlang'ich paytda, t_0=0 da, tezligi υ_0=2m/s bo'lsa, qancha vaqtdan keyin uning tezligi 10m/s teng bo'ladi? (8,94)

7.6.7. Harakatlanayotgan nuqta tezligining proyeksiyalari υ_x=0,2t^2, υ_y=3m/s bo'lsa, t=2,5s vaqtda uning urinma tezlanishi nimaga teng? (0,385)

7.6.8. Nuqtaning tezlik vektori $\vec{\upsilon}$=1,5$\vec{i}$+1,5$t\vec{j}$+0,5$t^2\vec{k}$ berilgan bo'lsa, t=2s vaqt uchun uning urinma tezlanishini aniqlang. (2,18)

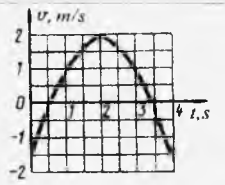
7.6.9. Nuqtaning tezlanish vektori $\vec{a}$=0,1$t\vec{i}$+0,9$\vec{j}$ berilgan bo'lib, boshlang'ich paytda, t_0=0 da, uning tezligi υ_0=0 bo'lsa, t=10s dagi urinma tezlanishini aniqlang. (1,27)

7.6.10. Harakatlanayotgan nuqtaning tezlanishi a_x=0,8t[m/s^2], a_y=0,8m/s^2 berilgan bo'lib, boshlang'ich paytda, t_0=0 da, tezligi υ_0=0 bo'lsa, t=2s da uning urinma tezlanishini toping. (1,70)

7.7. Nuqtaning normal tezlanishi

7.7.1. Nuqta radiusi r=2m li aylana yoyi bo'ylab o'zgarmas υ=30sm/s tezlik bilan harakatlansa, uning normal tezlanishini (sm/s^2) aniqlang. (4,5)

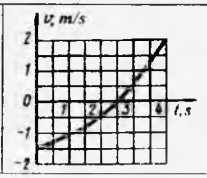
7.7.2. Nuqta radiusi R bo'lgan aylana yoyi bo'ylab harakatlanib, tezlik grafigi $\upsilon=\upsilon(t)$ berilgan bo'lsa, t vaqtning 0 dan 4s gacha bo'lgan oralig'ida normal tezlanish maksimal miqdorga ega bo'lgan qiymatini toping. (2)



7.7.3. Nuqta aylana yoyi bo'ylab $s=5t-0{,}4t^2$ tenglama asosida harakat qilsa, qanday vaqtda uning normal tezlanishi nolga teng bo'ladi? (6,25)

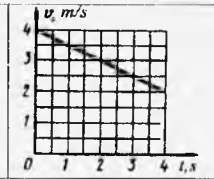
7.7.4. Pastga sirpanib tushayotgan chananing tezligi $\upsilon=120$km/soat va normal tezlanishi $a_n=2g$ bo'lsa, chana yo'lining egrilik radiusini aniqlang. (56,6)

7.7.5. Radiusi R bo'lgan aylana yoyi bo'ylab harakat qilayotgan nuqtaning tezlik grafigi $\upsilon=\upsilon(t)$ berilgan. Normal tezlanish nolga teng bo'lgan vaqtni toping. (2,5)



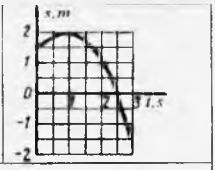
7.7.6. Avtomobil gorizontal yo'l bo'ylab o'zgarmas $\upsilon=90$km/soat tezlik bilan harakatlanadi. Avtomobil normal tezlanishi $a_n=2{,}5\text{m/s}^2$ ga teng bo'lgan paytda yo'lning egrilik radiusini toping. (250)

7.7.7. Radiusi 5m bo'lgan aylana bo'ylab harakatlanayotgan nuqtaning tezlik grafigi $\upsilon=\upsilon(t)$ berilgan bo'lsa, 3 sekunddagi nuqtaning normal tezlanishini aniqlang. (1,25)



7.7.8. Nuqtaning trayektoriya bo'ylab harakati $s=5t$ qonun bilan berilgan bo'lsa, normal tezlanishi $a_n=3\text{m/s}^2$ paytdagi yo'lning egrilik radiusini toping. (8,33)

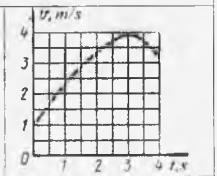
7.7.9. Radiusi R bo'lgan aylana bo'ylab harakat qilayotgan nuqtaning harakat qonuni $s=s(t)$ berilgan bo'lib, normal tezlanishi nolga teng bo'lgan vaqtni aniqlang. (1)



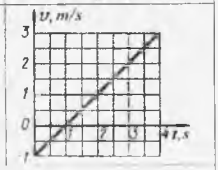
7.7.10. Elektrovoz radiusi R=300m bo'lgan aylana bo'ylab harakat qiladi. Elektrovozning normal tezlanishi 1m/s^2 dan ortmaydigan paytdagi uning maksimal tezligini km/soat da aniqlang. (62,4)

7.7.11. Uchuvchilarni mashq qildiruvchi uskuna – sentrifuga kabinasi aylanish o'qidan r=5m masofada aylanadi. Kabina markazining normal tezlanishi a_n 5g bo'lganda uning tezligi qanday miqdorga teng bo'ladi? (70)

7.7.12. Radiusi 6m bo'lgan aylana bo'ylab harakat qilayotgan nuqtaning tezlik grafigi $\upsilon=\upsilon(t)$ berilgan bo'lsa, t 3s paytdagi nuqtaning normal tezlanishini toping. (2,67)



7.7.13. Radiusi 8m bo'lgan aylana bo'ylab harakat qilayotgan nuqtaning tezlik grafigi $\upsilon=\upsilon(t)$ berilgan bo'lsa, uning normal tezlanishi a_n 0,5m/s^2 ga teng bo'lgan vaqtni aniqlang. (3)



7.7.14. Radiusi r 10km aylana bo'ylab harakatlanayotgan samolyot a_n=0,9m/s^2 normal tezlanishga ega bo'lsa, uning tezligi qancha bo'ladi (km/soat)? (900)

7.7.15. Nuqtaning harakat qonuni $s=0,1t^2+0,2t$ berilgan. Agar harakat vaqtining t 6s da trayektoriya egrilik radiusi ρ=0.6m bo'lsa, nuqtaning normal tezlanishini toping. (3,27)

7.7.16. Nuqta $\upsilon=\ln t$ tezlik bilan radiusi r=30sm li aylana bo'ylab harakat qilsa, t 12s dagi normal tezlanishini toping. (20,6)

7.7.17. Nuqta trayektoriya bo'ylab $s=0,6t^2$ qonuniga mos harakat qiladi. Koordinatasi $S=30$m bo'lganda egrilik radiusi $\rho=15$m bo'lsa, uning normal tezlanishini toping. (4,80)

7.7.18. Nuqta $s=0,3t^2$ qonun bo'yicha radiusi $r=7$m bo'lgan aylana bo'ylab harakat qilsa, qancha vaqtdan keyin uning normal tezlanishi $a_n=1,5m/s^2$ teng bo'ladi? (5,40)

7.7.19. Nuqta $\upsilon=e^t$ tezlik bilan radiusi $r=20$m li aylana bo'ylab harakat qilsa, qancha vaqtdan keyin uning normal tezlanishi $a_n=3$m/s^2 ga teng bo'ladi? (2,05)

7.7.20. Nuqta $s=0,7t^2$ qonun bilan radiusi $R=7$m bo'lgan aylana bo'ylab harakat qilsa, normal tezlanish $a_n=3$m/s^2 ga teng bo'lgan paytda nuqtaning s koordinatasi qanday qiymatga erishadi? (7,50)

7.8. Harakat qonuni tabiiy usulda berilgan nuqtaning tezlanishi

7.8.1. Nuqtaning normal $a_n=2,5$s/m^2 va urinma $a_\tau=1,5$m/s^2 tezlanishlari berilgan bo'lsa, uning to'la tezlanishini toping. (2,92)

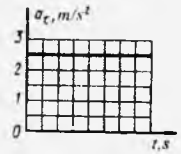
7.8.2. Agar nuqtaning tezlanish vektori $\bar{a}=2,5\bar{n}+3,5\bar{\tau}$ berilgan bo'lsa, uning to'la tezlanishi miqdori qanchaga teng? Bunda - $\bar{n}$, $\bar{\tau}$ tabiiy o'qlarning birlik vektorlari. (4,30)

7.8.3. Egri chiziq bo'ylab harakatlanayotgan nuqtaning urinma tezlanishi $a_\tau=1,4$m/s^2 bo'lsa, to'la tezlanishi $a=2,6$m/s^2 bo'lgan paytda nuqtaning normal tezlanishi qanchaga teng? (2,19)

7.8.4. Nuqtaning to'la tezlanishi $a=1,5$m/s^2 bo'lib, tezlik va tezlanish vektorlari orasidagi burchak 65° bo'lsa, nuqtaning normal tezlanishini toping? (1,36)

7.8.5. Aylana bo'ylab harakat qilayotgan nuqtaning tezligi υ 10m/s va tezlanishi a 1,2m/s^2 ga teng bo'lib, ularning vektorlari 30° burchak tashkil qilsa, aylana radiusini hisoblang. (164)

7.8.6. Nuqta radiusi 9m li aylana bo'ylab harakat qilib, $a=a(t)$ urinma tezlanish grafigiga ega bo'lsa, boshlang'ich paytda, $t_0=0$ da, $\upsilon_0=0$ deb, $t=2$s dagi to'la tezlanishini aniqlang. (3,74)



7.8.7. Egri chiziqli harakat qilayotgan nuqtaning tezlanishi a=1m/s^2 bo'lib, tezlik va tezlanish vektorlari o'zaro 45° burchak tashkil qilsa, egrilik radiusini ρ=300m hisoblab, nuqtaning tezligini toping (km/soat). (52,4)

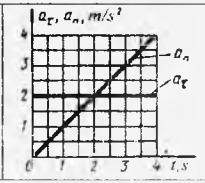
7.8.8. Nuqta a_τ=2m/s^2 urinma tezlanish bilan r=200m radiusli aylana bo'ylab harakat qilsa, tezligi υ=10m/s ga teng bo'lgan paytdagi tezlik va tezlanish vektorlari orasidagi burchakning qiymatini toping. (14,0)

7.8.9. Nuqta $\upsilon=2t$ tezlik bilan r=50m radiusli aylana bo'ylab harakat qilsa, t=5s paytda to'la tezlanishi qancha bo'ladi? (2,83)

7.8.10. $s=0{,}2t^2+0{,}3t$ qonun bo'yicha egri chiziqli harakat qilayotgan nuqta t=3s da qanday to'la tezlanishga ega bo'ladi? Shu paytda egrilik radiusini ρ=1,5m deb oling. (1,55)

7.8.11. Egri chiziqli harakat qilayotgan nuqtaning urinma tezlanishi a_τ 2m/s^2, egrilik radiusi ρ 5m bo'lgan paytdagi tezligini toping. Tezlik va tezlanish vektorlari orasidagi burchakni tgβ=3 qiymatga ega deb hisoblang. (5,48)

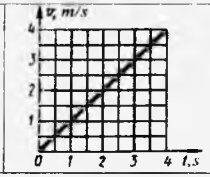
7.8.12. Agar nuqtaning tezlanish grafiklari $a_\tau=a_\tau(t)$ va $a_n=a_n(t)$ lar berilgan bo'lsa, t=3s paytdagi tezlik va tezlanish vektorlari orasidagi burchakning qiymatini toping. (56,3)



7.8.13. Nuqta $\upsilon=3t$ tezlik bilan $r=6$m radiusli aylana bo'ylab harakat qilsa, $t=1$s vaqtda tezlik va tezlanish vektorlari orasidagi burchaklarni toping. (26,6)

7.8.14. Nuqta radiusi $r=9$m li aylana bo'ylab $a_t=2\text{m/s}^2$ urinma tezlanishga erishganda uning tezligi qancha bo'ladi? Bu paytda trayektoriya urinmasi va tezlanish vektorini o'zaro 70° burchak tashkil qiladi deb hisoblang. (7,03)

7.8.15. 8m radiusli aylana bo'ylab harakatlanayotgan nuqtaning $\upsilon=\upsilon(t)$ tezlik grafigi bo'yicha $t=4$s dagi to'la tezlanishini toping. (2,24)



7.8.16. Nuqta tinch holatdan harakatlana boshlab, radiusi $r=200$m bo'lgan aylana bo'ylab o'zgarmas urinma tezlanish $a_t=1\text{m/s}^2$ ga ega bo'lsa, $t=20$s paytdagi to'la tezlanishini toping. (2,24)

7.8.17. Radiusi $r=2$m li aylana bo'ylab harakat qilayotgan nuqtaning normal tezlanishi $a_n=2t^2$ qonun bo'yicha o'zgarsa, $t=1$s vaqtda tezlik va tezlanish vektorlari orasidagi burchakning gradus qiymati qancha bo'ladi? (45)

7.8.18. Egri chiziq bo'ylab $s=0{,}5t^2$ qonun asosida harakatlanayotgan nuqtaning $t_1=3$s vaqtdagi tezlik va tezlanish vektorlari orasidagi burchakning gradus qiymatini toping. Bu paytda chiziqning egrilik radiusini $\rho=4$m deb oling. (66,0)

7.8.19. Radiusi $r=1$m bo'lgan aylana bo'ylab $s=0{,}1t^3$ qonun bo'yicha harakatlanayotgan nuqta $t=2$s da qancha to'la tezlanishga erishadi? (1,87)

7.8.20. Egri chiziqli harakat qilayotgan nuqtaning urinma tezlanishi a_τ=2m/s^2 bo'lib, boshlang'ich paytda t_0=0, υ_0=0 bo'lsa, t=2s paytdagi nuqtaning tezlik va tezlanish vektorlari orasidagi burchakning gradus qiymatini aniqlang. Shu paytda chiziqning egrilik radiusi ρ=4m deb oling. (63,4)

7.9. Nuqta harakat qonunining qutb koordinatalarda berilishi

7.9.1. Nuqtaning radial tezligi υ_r=2m/s va tezlik vektori qutb radiusi bilan 45° burchak tashkil etsa, uning tezligining miqdorini hisoblang. (2,83)

7.9.2. Nuqtaning transversal tezligi 3m/s bo'lib, tezlik vektori qutb radiusi bilan 30° burchak tashkil etsa, uning radial tezligini toping. (5,20)

7.9.3. Nuqtaning to'la tezligi 20m/s bo'lib, radial tezligi 10m/s bo'lsa, transversal tezligi qancha bo'ladi? (17,3)

7.9.4. Nuqtaning harakat qonuni qutb koordinatalarda $\varphi=t$, $r=t^2$ berilgan bo'lib, φ=180° bo'lgan paytdagi uning qutb radiusini aniqlang. (9,87)

7.9.5. Nuqtaning harakat qonuni qutb koordinatalarda $\varphi=2\sin t$, $r=t^2$ berilgan bo'lib, qutb radiusi r=4m bo'lgan paytdagi qutb burchagi φ ni toping. (1,82)

7.9.6. Nuqtaning harakat qonuni qutb koordinatalarda $\varphi=0{,}5t^2$, $r=0{,}5t$ berilgan bo'lib, qutbiy radiusi r=2m bo'lgan t_1 paytdagi transversal tezligini (sm/s da) toping. (8)

7.9.7. Nuqtaning harakat qonuni qutb koordinatalarda $\varphi=t^2$, $r=0{,}5t^2$ berilgan bo'lib, qutbiy burchagi φ=2,25rad. bo'lgan paytdagi radial tezligini aniqlang. (1,5)

7.9.8. Nuqtaning harakat qonuni qutb koordinatalarda $\varphi=2t$, $r=t^2$ berilgan bo'lib, $t_1=2$s da uning tezligini toping. (8,94)

7.9.9. Nuqta tekislikda harakat qiladi. Qutbiy burchakning tenglamasi $\varphi=0{,}3t$ bo'lsa, boshlang'ich paytda, $t_0=0$ da, $r_0=0$ deb hisoblab, nuqtaning qutbiy burchagi 3 rad. ga teng bo'lgan paytdagi qutbiy radiusini aniqlang. Uning radial tezligi $dr/dt=0{,}4$m/s ga teng. (4)

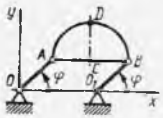
7.9.10. Nuqta tekislikda harakat qiladi. Uning qutbiy radiusi tenglamasi $r=\sin\pi t$ bo'lsa, $r=1$m bo'lgan paytdagi qutbiy burchagini toping. Bu paytda $d\varphi/dt=0{,}4$ rad/s deb oling. Boshlang'ich paytda, $t_0=0$ da, $\varphi_0=0$. (0,2)

VIII BOB. QATTIQ JISMNING ILGARILANMA VA AYLANMA HARAKATLARI

8.1. Qattiq jismning ilgarilanma harakati

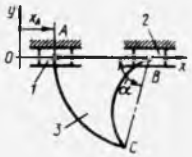
8.1.1. Jismning ilgarilanma harakatini nechta bir-biriga bog'liq bo'lmagan tenglamalar ifodalaydi? (3)

8.1.2. Uzunliklari $OA=O_1B=0{,}16$m bo'lgan ikki krivoshiplarning harakat qonuni $\varphi=\pi t$ bo'lib, yarim aylana shaklidagi ABD jismni ilgarilanma harakatga keltiradi. Agar $AB=0{,}25$m bo'lsa, $t=2$s da jismning D

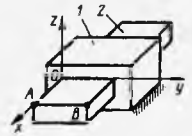


nuqtasi trayektoriyasining egrilik radiusini toping. (0,16)

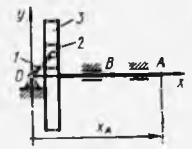
8.1.3. *Ox* o'qi bo'ylab harakat qilayotgan 1 va 2 polzunlarga yoy shaklidagi jism 3 mahkamlangan. Agar *A* nuqtaning harakat qonuni $x_A=0,1t^2$ bo'lsa, $t=10$s da *C* nuqtaning tezligini hisoblang. Bunda masofalar $AB=BC=0,3$m va burchakni $\alpha=75°$ deb oling. (2)



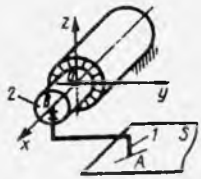
8.1.4. 1 g'ilof ichida 2 polzun harakat qiladi. Agar polzunning ilgarilanma harakat qonuni $x_A=0,1\cos t$, $y_A=0$, $z_A=0$ bo'lsa, $t=\pi$ (sek) paytda *B* nuqtaning tezligini aniqlang. Bunda masofa $AB=0,3$m. (0)



8.1.5. Krivoship 1 va polzun 2 yordamida ilgarilanma harakatga keluvchi 3 kulisali mexanizm $x_A=0,4-0,1\sin t^2$ qonun asosida siljisa, $t=2$s dagi *B* nuqtaning tezligini aniqlang. (0,261)



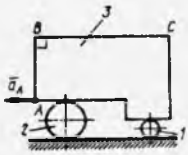
8.1.6. Harakatlarni yozib boruvchi uskunaning 1 perosi *Oxy* o'qiga parallel bo'lgan *S* tekislikda siljiydi. Uni harakatga keltiruvchi *B* qo'zg'aluvchan o'qning ilgarilanma harakat qonuni $x_B=0,1(1-e^{-0,1t})$, $y_B=0$; $z_B=0$ bo'lsa, $t=20$s da *A* pero nuqtasining tezligini toping. Bu paytda masofalar: $x_A=x_B$, $y_A=0,2$m; $z_A=-0,1$m. ($1,35\cdot10^{-3}$)



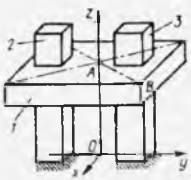
8.1.7. Beton qorishmasini zichlaydigan vibrolotok 1 ikkita yassi prujinalar yordamida ilgarilanma harakatga keltiriladi. Uning harakat qonuni $x_A=0,16\sin50\pi t$, $y_A=0,12\sin50\pi t$, x_A, y_A-sm larda. Agar masofa $AB=100$ sm bo'lsa, $t=1$s dagi *B* nuqtaning tezligini sm/s larda toping. (31,4)

8.1.8. Teplovoz g'ildiraklarini birlashtiruvchi tirsagi to'g'ri yo'lda $x_B=15t-0{,}25\cos 30t$, $y_B=0{,}5-0{,}25\sin 30t$ qonun asosida harakat qiladi. Agar masofa $BC=1{,}5$m bo'lsa, $t=\pi$ s da uning C nuqtasi qanday tezlikka erishadi? (16,8)

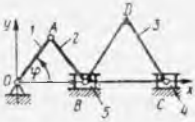
8.1.9. Ikkita 1 va 2 silindrik o'qlarga o'rnatilgan 3 jism ilgarilanma harakat qiladi. Agar masofalar $BC=2AB=1$m bo'lib, jismning A nuqtasi 2m/s^2 tezlanishga ega bo'lsa, C nuqtasining tezlanishini hisoblang. (2)



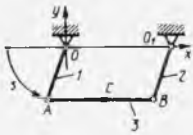
8.1.10. Ilgarilanma harakat qiluvchi 1 jism ikkita vertikal yo'naltiruvchi 2 va 3 bo'yicha sirpanadi. Uning harakat qonuni $x_A=0$, $y_A=0$ va $z_A=1+0{,}1\cos\pi t$ bo'lib, B nuqtasi $x_B=0{,}3$m; $y_B=0{,}6$m, $z_B=z_A$ koordinatalarga ega bo'lgan paytda shu nuqtaning tezlanishi a_B ni toping. (0,305)



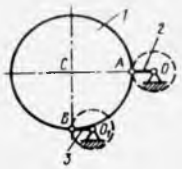
8.1.11. Mexanizmning krivoshipi 1 va shatuni 2 aylanish natijasida 3 plastinaga o'rnatilgan 4 va 5 polzunlarni harakatga keltiriladi. Agar krivoshipning harakat qonuni $\varphi=\pi t$, o'lchamlari $OA=AB=0{,}2$m va BC $CD=BD=0{,}26$m bo'lsa, $t=0{,}5$s da D nuqtaning tezlanishini aniqlang. (0)



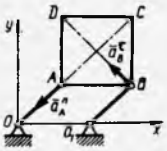
8.1.12. Bir xil uzunlikdagi $OA=O_1B=0{,}2$m 1 va 2 krivoshiplarga o'rnatilgan 3 sterjen Oxy tekisligida ilgarilanma harakat qiladi. Uning A nuqtasining harakat qonuni $s=0{,}2\pi t$ bo'lsa, $t=0$ paytdagi sterjen o'rtasidagi C nuqtaning tezlanishini aniqlang. Bunda masofa $AB=0{,}36$m. (1,97)



8.1.13. Dumaloq stol 1 ikkita krivoshiplar 2 va 3 yordamida ilgarilanma harakatga keltiriladi. Agar krivoship A nuqtasining normal tezlanishi a_A^n=5m/s^2 bo'lib, krivoshiplarning uzunligi $OA=O_1B$=0,2 m bo'lsa, stol markazi C nuqtaning tezligini toping. (1)



8.1.14. $ABCD$ kvadrat plastina Oxy tekisligida ilgarilanma harakat qiladi. Agar uning A nuqtasi a_A^n=4m/s^2 normal tezlanishga va B nuqtasi a_B^τ=3m/s^2 urinma tezlanishga ega bo'lsa, C nuqtasining tezlanishini toping. (5)



8.2. Qattiq jismning aylanma harakati. Jismning burchak tezligi va burchak tezlanishi

8.2.1. Tekis aylanayotgan g'ildirak bir sekundda 4 marta aylanadi. $\varphi=24\pi$ burchakka u qancha sekundda buriladi? (3)

8.2.2. Jismning burchak tezligi $\omega=-8t$ qonun bilan o'zgarsa, $t=3$s da uning burilish burchagi φ ni toping. Boshlang'ich paytda, $t=0$ da, $\varphi_0=5$rad. (-31)

8.2.3. Elektrodvigatel rotori tekis tezlanuvchan aylanma harakatda bo'lib, boshlang'ich 5s da 100 marta aylansa, uning burchak tezlanishini hisoblang. (50,3)

8.2.4. Maxovikning aylanish chastotasi $t_1=10$s da 3 marta kamayib, 30 ayl/min ga teng bo'lsa, aylanishni tekis sekinlanuvchan deb, uning burchak tezlanishini aniqlang. (-0,628)

8.2.5. Maxovikning burchak tezligi $\omega=\pi(6t-t^2)$ qonun bo'yicha o'zgarsa, $t>0$ dagi uning to'xtash vaqtini toping. (6)

8.2.6. Jism qo'zg'almas o'q atrofida $\varphi=t^3+2$ qonun bo'yicha aylansa, burilish burchagi $\varphi=10$rad ga teng bo'lgan paytdagi uning burchak tezligini toping. (12)

8.2.7. Jism qo'zg'almas o'q atrofida $\varphi=4+2t^3$ qonun bo'yicha aylansa, burchak tezligi $\omega=6$rad/s bo'lgan paytda jismning burchak tezlanishini aniqlang. (12)

8.2.8. Agar jismning burchak tezligi $\omega=2-8t^2$ qonun bo'yicha o'zgarsa, u to'xtaguncha qancha vaqt o'tadi? (05)

8.2.9. Jismning burchak tezlanishi $\varepsilon=2t$ qonun bilan o'zgarib, boshlang'ich paytda, $t_0=0$ da, burchak tezligi $\omega_0=0$ bo'lsa, $t=4$s dagi burchak tezligini toping. (16)

8.2.10. Jism $\varepsilon=3t^2$ burchak tezlanish bilan qo'zg'almas o'q atrofida aylanadi. Agar boshlang'ich, $t_0=0$ paytda, uning burchak tezligi $\omega_0=2$rad/s bo'lsa, $t=2$s paytdagi burchak tezligini toping. (10)

8.2.11. Jism $\varphi=\sin 0{,}5\pi t$ qonun bo'yicha qo'zg'almas o'q atrofida aylanib tebransa, $t=1$s paytda uning burchak tezlanishini toping. (-2,47)

8.2.12. Jism $\varphi=0{,}5\pi\sin 2\pi t$ qonun bo'yicha qo'zg'almas o'q atrofida aylanib tebransa, $t=0{,}125$s paytdagi burchak tezligini toping. (6,98)

8.2.13. Jism $\varphi=2\pi\cos\pi t^2$ qonun asosida qo'zg'almas o'q atrofida aylansa, $t=2$s dan keyin uning burilish burchagini toping. (6,28)

8.2.14. Elektrodvigatelning rotori uni yoqishda $\varphi=\pi t+\pi e^{-t}$ qonun bo'yicha aylansa, $t=2$s da uning burchak tezligini toping. (2,72)

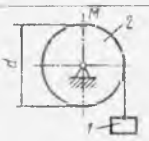
8.2.15. Rotor aylanma harakat qilganida uning burchak tezligi $\omega=6\pi(4t+e^{-0.01t}\sin\pi t)$ qonuniyat bilan o'zgaradi. $t=100$s bo'lganda rotorning burchak tezlanishini aniqlang. (97,2)

8.3. Qattiq jismning aylanma harakati. Jism nuqtalarining tezligi va tezlanishi

8.3.1. Jism qo'zg'almas o'q atrofida $\varphi=t^2$ qonun bilan aylanadi. Agar biror vaqtdan keyin jism $\varphi=25$rad burchakka burilsa, jismning aylanish o'qidan $r=0{,}5$m uzoqlikdagi nuqtasining shu ondagi tezligini toping. (5)

8.3.2. Jism qo'zg'almas o'q atrofida $\varepsilon=5\text{rad/s}^2$ burchak tezlanish bilan aylanadi. Boshlang'ich paytda, $t_0=0$ da, jismning burchak tezligi $\omega_0=0$ bo'lsa, $t=2$s da uning aylanish o'qidan $r=0.2$m masofadagi nuqtasining tezligini aniqlang. (2)

8.3.3. Diametri $d=0{,}6$m bo'lgan 2 baraban $\varphi=5+2t^3$ qonun bo'yicha aylanib, 1 yukni yuqoriga tortadi. $t=1$s paytdagi baraban M nuqtasining tezligini toping. (1,8)



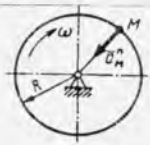
8.3.4. Soat mexanizmining balansiri $\omega=\pi\sin 4\pi t$ burchak tezlik bilan harakatlansa, $t=0{,}125$s paytdagi uning aylanish o'qidan $h=6$mm masofadagi nuqtasining tezligini toping (sm/s). (1,88)

8.3.5. Qo'zg'almas o'q atrofida aylanayotgan jismning aylanish o'qidan $r=0{,}2$m masofadagi nuqtasining tezligi $\upsilon=4t^2$ qonun bo'yicha o'zgarsa, $t=2$s dagi jismning burchak tezlanishini toping. (1,80)

8.3.6. Maxovik 90 ayl/min o'zgarmas chastota bilan aylanadi. Uning aylanish o'qidan 0,043m uzoqlikda bo'lgan nuqtasining tezlanishini aniqlang. (3,82)

8.3.7. Jism qo'zg'almas o'q atrofida $\varphi=2t^2$ qonun bo'yicha aylanadi. Jismning aylanish o'qidan $r=0{,}2$m masofada joylashgan nuqtasi normal tezlanishining $t=2$s paytdagi qiymatini aniqlang. (12,8)

8.3.8. Qo'zg'almas o'q atrofida aylanayotgan diskning M nuqtasi 6,4m/s^2 normal tezlanishga ega bo'lsa, uning radiusini R=0,4m deb, diskning burchak tezligini topıng. (4)



8.3.9. Jism qo'zg'almas o'q atrofida $\varphi=2t^3$ qonun bo'yicha aylansa, uning aylanish o'qidan r=0,2m masofadagi nuqtasi urinma tezlanishining t=2s paytdagi qiymatini aniqlang. (4,8)

8.3.10. Jism $\omega=2t^3$ burchak tezlik bilan aylanayotgan bo'lsa, uning aylanish o'qidan r=0,2m masofada joylashgan nuqtasi urinma tezlanishining t=2s dagi qiymatini aniqlang. (4,8)

8.3.11. Elektrodvigatelning rotori berilgan paytda $\omega=3\pi$ burchak tezlik va $\varepsilon=8\pi$ burchak tezlanish bilan aylanayotgan bo'lsa, rotorning aylanish o'qidan 0,04m masofadagi nuqtasining to'la tezlanishini toping. (3,69)

8.3.12. Jism $\varphi=1+4t$ qonun bo'yicha aylanadi. Uning aylanish o'qidan r=0,2m masofadagi nuqtasining tezlanishini hisoblang. (3,2)

8.3.13. Jismning burchak tezligi $\omega=1+t$ qonun bo'yicha o'zgarsa, t=1s paytda uning aylanish o'qidan r=0,2m masofadagi nuqtasining tezlanishini toping. (0,825)

8.3.14. G'ildirak o'z o'qi atrofida berilgan paytda $\varepsilon=20\pi$ burchakli tezlanishga ega. Uning aylanish o'qidan 5sm masofadagi nuqtasining tezlanishi $a=8\pi$ ga teng bo'lsa, bu nuqtaning normal tezlanishini toping. (24,9)

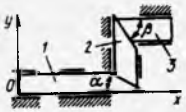
8.3.15. Qo'zg'almas o'q atrofida aylanayotgan diskning M nuqtasi 4m/s^2 tezlanishga ega bo'lsa, uning radiusini R=0,5m va $\gamma=60°$ deb, diskning burchak tezligini aniqlang. (2)

8.3.16. Qo'zg'almas o'q atrofida aylanayotgan diskning M nuqtasi $8m/s^2$ tezlanishga ega bo'lsa, uning radiusini R=0,4m va γ=30° deb, diskning burchak tezlanishini toping. (10)

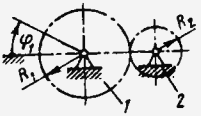
8.4. Jismlarning ilgarilanma va aylanma harakatlarini mexanizmlarda qo'llanilishi

8.4.1. Pona gorizontal yo'naltiruvchilar bo'yicha 1m/s tezlik bilan harakat qilib, boshqa ponani vertikal yuqoriga 1m/s tezlik bilan siljitadi. Ponalarning qiyalik burchagini aniqlang. (45)

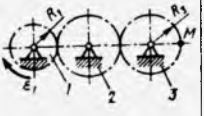
8.4.2. 1 va 3 ponalar parallel bo'lgan gorizontal yo'naltiruvchilar bo'yicha harakat qilib, 2 ponani vertikal yo'naltiruvchilar bo'yicha siljitadi. Agar 1 pona 0,12m masofaga siljib, qiyalik burchaklari α=30° va β=60° bo'lsa, 3 ponaning siljishini hisoblang. (0,04)



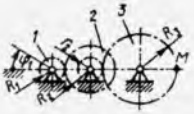
8.4.3. 1 g'ildirak $\varphi_1=20t$ qonun bo'yicha aylanib, 2 g'ildirakni harakatga keltiradi. Agar ularning radiuslari R_1=0,8m va R_2=0,5m bo'lsa, 2 g'ildirak t=3,14s vaqt ichida necha marta aylanishga ulguradi? (16)



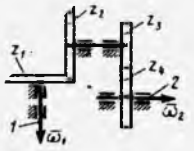
8.4.4. Radiuslari R_1=0,4m, R_3=0,5m bo'lgan tishli g'ildiraklar tinch holatdan tashqi kuchlar ta'sirida harakatga keladi. 1 g'ildirak tekis tezlanuvchan $\varepsilon_1=4rad/s^2$ burchak tezlanish bilan aylansa, t=2s da M nuqtaning tezligini aniqlang. (3,2)



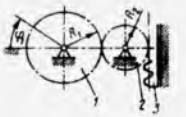
8.4.5. Radiuslari R_1=0,4m; R_2=0,8m; r_2=0,4m; R_3=1m bo'lgan tishli g'ildiraklar o'zaro bog'langan bo'lib, 1 g'ildirak $\varphi_1=4t^2$ qonun bo'yicha harakat qilsa, t=2s paytda 3 g'ildirakning M nuqtasi qanday tezlikka erishadi? (3,2)



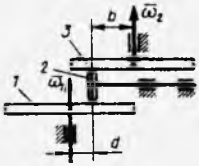
8.4.6. Reduktor silindrik va konus shaklidagi tishli g'ildiraklardan iborat bo'lib, ularning tishlari soni Z_1=18, Z_2=26, Z_3=28 va Z_4=40 ga teng. Agar 1 o'q $\omega_1=20(t+e^{-t})$ burchak tezlik bilan aylansa, t=10s da 2 o'qning burchak tezligini toping. (96,9)



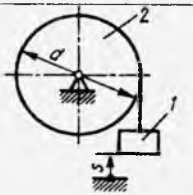
8.4.7. Radiuslari R_1=0,8m va R_2=0,4m bo'lgan tishli g'ildiraklar aylanib, 3 reykani harakatga keltiradi. Agar 1 g'ildirak $\varphi_1=4t^2$ qonun bo'yicha aylansa, 3 reykaning tezlanishini aniqlang. (6,4)



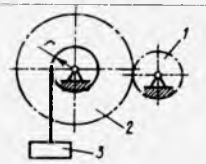
8.4.8. Variator – o'zgaruvchi (kuchaytiruvchi) qurilma yetaklovchi 1 disk, 2 rolik va 3 yetaklanuvchi disklardan iborat bo'lib, disklarning burchak tezliklari ω_1=10rad/s va ω_2=5rad/s bo'lsa, masofalar nisbati b/d ning qiymatini aniqlang. (2)



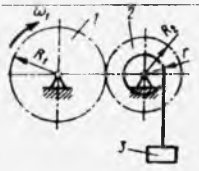
8.4.9. Diametri d=50sm li 2 baraban, 1 yukni $s=7+5t^2$ (sm) qonun bo'yicha yuqoriga tortadi. t=3s paytda 2 barabanning burchak tezligini aniqlang. (1,2)



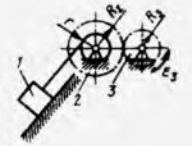
8.4.10. Tishlar soni Z_1=26 va Z_2=78, radiusi r=10sm bo'lgan g'ildiraklarga osilgan yukni υ=90sm/s tezlik bilan tortadi. 1 g'ildirakning aylanish chastotasi n_1(ayl/min)ni toping. (258)



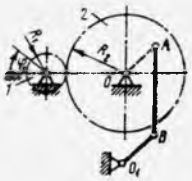
8.4.11. Radiuslari R_1=1m, R_2=0,8m va r_2=0,4m bo'lgan pog'onali g'ildiraklarga 3 yuk osilgan. Agar 1 g'ildirakning burchak tezligi $\omega_1=2t^2$ berilgan bo'lsa, t=2sda 3 yukning tezlanishini aniqlang. (4)



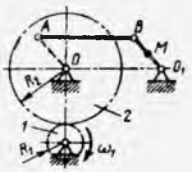
8.4.12. Radiuslari R_2=0,8m, R_3=0,6m va r=0,4m bo'lgan tishli g'ildiraklar yordamida 1 yuk yuqoriga tortiladi. Agar 3 g'ildirak $\varepsilon_3=8rad/s^2$ burchak tezlanish bilan tekis o'zgaruvchan aylanma harakat qilsa, 1 yukning boshlang'ich, tinch holatidan t=3s gacha bosib o'tgan yo'lini hisoblang. (10,8)



8.4.13. Radiuslari R_1=0,3m, R_2=0,9m bo'lgan tishli g'ildiraklarga mahkamlangan krivoshipning o'lchamlari $O_1B=OA$=0,6m va $OO_1=AB$ bo'lib, 1 g'ildirak $\varphi_1=2t^3$ qonun bo'yicha aylansa, t=2s paytda krivoship B nuqtasining tezligini aniqlang. (4,8)



8.4.14. Radiuslari R_1=0,3m, R_2=0,9m bo'lgan tishli g'ildiraklarga bog'langan krivoshipning o'lchamlari O_1M=0,3m, $OA=O_1B$ va $AB=OO_1$ bo'lib, 1 g'ildirak o'zgarmas ω_1=6rad/s burchak tezlik bilan aylansa, krivoship M nuqtasining tezlanishini toping. (1,2)



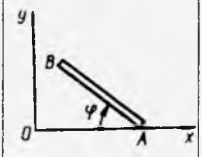
IX BOB. QATTIQ JISMNING TEKIS PARALLEL HARAKATI

9.1. Tekis shaklning harakat tenglamalari

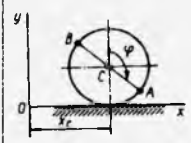
9.1.1. Qattiq jismning tekis parallel harakatida uning burilish burchagining qiymati va yo'nalishi qutbning tanlanishiga bog'liqmi? (Yo'q)

9.1.2. Qattiq jismning tekis parallel harakatida qutbning harakat tenglamasining ko'rinishi qutbning tanlanishiga bog'liqmi? (Ha)

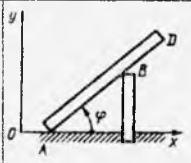
9.1.3. AB sterjen $x_A=2+t^2$, $y_A=0$, $\varphi=0{,}25\pi t$ tenglamalar asosida harakat qiladi. Agar $AB=3$m bo'lsa, $t_1=1$s paytda B nuqtaning abssissasini x_B hisoblang. (0,879)



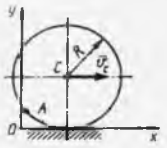
9.1.4. To'g'ri chiziqli yo'lda dumalayotgan g'ildirakning markazi $x_C=0{,}3t^2$, $y_C=0{,}15$m qonun bo'yicha harakat qiladi. Agar boshlang'ich paytda AB to'g'ri chiziq Oy o'qi bilan ustma-ust tushgan bo'lsa, $t_1=1$s paytda B nuqtaning ordinatasi y_B ni toping. (0,212)



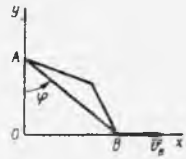
9.1.5. AD to'sin $x_A=t^2$, $y_A=0$, $\varphi=\arcsin[2/(4+(3{,}5-t^2)^2)^{0{,}5}]$ tenglama bo'yicha harakat qiladi. Uning burilish burchagi $\varphi=38^\circ$ bo'lgan paytda A nuqtasining abssissasini hisoblang. (0,940)



9.1.6. Radiusi R=0,2m bo'lgan g'ildirak zarba ta'sirida dumalaydi. Uning markazi C o'zgarmas υ_C=0,1m/s tezlikka ega. Agar boshlang'ich paytda, t_0=0 da, g'ildirakning A nuqtasi koordinata boshi bilan ustma-ust tushsa, t_1=1s paytda A nuqtaning abssissasini aniqlang. ($411 \cdot 10^{-3}$)

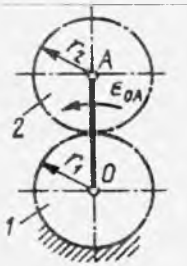


9.1.7. Uchburchakning A va B uchlari harakat paytida Ox va Oy o'qlari bo'yicha sirpanadi. Agar AB=4m va B nuqtasi $x_B(0)$=2m holatdan o'zgarmas υ_B=0,5m/s tezlik bilan harakat qilsa, t_1=2s paytda φ burchakning qiymatini aniqlang. (0,846)



9.1.8. Radiusi R=10sm bo'lgan g'ildirak to'g'ri chiziqli yo'lda dumalaydi. Uning markazi C o'zgarmas $a_C = 2\pi$ sm/s^2 tezlanishga ega. Agar harakat boshlangan paytda $\upsilon_C(0)$=0 bo'lsa, t_1=10s da g'ildirak necha marta dumalashga ulguradi? (5)

9.1.9. Radiuslari teng $r_1 = r_2$=10sm ikkita shesternyalarni bog'lab turuvchi OA krivoship tinch holatdan $\varepsilon_{OA} = 0{,}1\pi$ burchak tezlanish bilan tekis aylana boshlaydi. 2 shesternya 10s ichida necha marta aylanadi? (5)



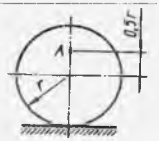
9.2. Tekis shaklning burchak tezligi

9.2.1. Qattiq jismning tekis parallel harakatida uning burchak tezligi qutbning tanlanishiga bog'liqmi? (Yo'q)

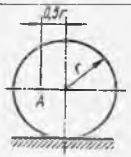
9.2.2. Qattiq jism $x_A=2t^2$, $y_A=0{,}2$m, $\varphi=10t^2$ tenglamaga asosan tekis parallel harakat qiladi. $t_1=1$s paytdagi jismning burchak tezligini toping. (20)

9.2.3. Jism berilgan onda tekislikka tegib turgan nuqtasi atrofida aylanadi. Agar jismning C nuqtasi 10m/s tezlikka ega bo'lib, AC =20sm bo'lsa, jismning burchak tezligini hisoblang. (50)

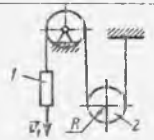
9.2.4. Sirpanmasdan dumalayotgan g'ildirakning A nuqtasi $\upsilon_A=10$m/s tezlikka ega bo'lib, radiusi $r=0{,}2$m bo'lsa, uning burchak tezligini toping. (33,3)



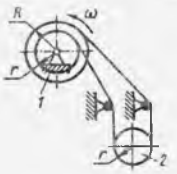
9.2.5. Sirpanmasdan dumalayotgan g'ildirakning A nuqtasi $\upsilon_A=2$m/s tezlikka ega bo'lib, radiusi $r=1$m bo'lsa, uning burchak tezligini aniqlang. (1,79)



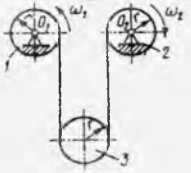
9.2.6. Agar 1 yukning tezligi $\upsilon=0{,}5$m/s bo'lsa, radiusi $R=0{,}1$m bo'lgan qo'zg'aluvchan 2 blokning burchak tezligi qancha bo'ladi? (2,5)



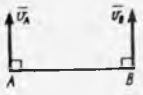
9.2.7. Mexanizmning 1 g'ildiragi $\omega=6$rad/s burchak tezlik bilan aylanadi. Agar g'ildirakning radiusi va mexanizm yordamida yuqoriga ko'tarilayotgan quvur 2 radiusi $r/R=2/3$ nisbatda bo'lsa, quvurning burchak tezligini toping. (1,5)



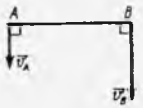
9.2.8. Radiuslari bir xil bo'lgan 1 va 2 bloklar $\omega_1=4$rad/s va $\omega_2=8$rad/s burchak tezliklar bilan aylanib, 3 qo'zg'aluvchan blokni yuqoriga tortadi. Agar $r=10$sm bo'lsa, 3 blokning burchak tezligini hisoblang. (2)



9.2.9. Uzunligi 60sm bo'lgan AB sterjen shakl tekisligida harakat qilib, A va B nuqtalari bir xil tezlikka $\upsilon_A=\upsilon_B=0{,}5$m/s ega bo'lsa, sterjenning oniy burchak tezligini toping. (0)

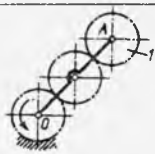


9.2.10. Uzunligi 80sm bo'lgan AB sterjen shakl tekisligida harakat qilib, A va B nuqtalari $\upsilon_A=0{,}2$m/s va $\upsilon_B=0{,}6$m/s tezlikka ega bo'lsa, sterjenning burchak tezligini aniqlang. (0,5)



9.2.11. Differensial mexanizmning ichki tishlashgan g'ildiragi 1 va $OA=20$sm krivoship bir-biriga bog'liq bo'lmagan holda $\omega_1=2$rad/s va ω_{OA} 4rad/s burchak tezliklar bilan aylansa, 1 g'ildirak radiusini $r_1=30$sm deb, 2 g'ildirak-ning burchak tezligini aniqlang. (2)

9.2.12. Planetar mexanizmning g'ildiraklari bir xil radiusli bo'lib, uzunligi $OA=0{,}2$m li krivoshipi yordamida $\varphi=0{,}5t$ qonun bo'yicha aylansa, 1 g'ildirakning burchak tezligini aniqlang. (0)

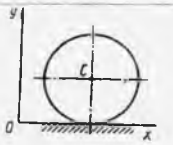


9.3. Tekis shaklning burchak tezlanishi

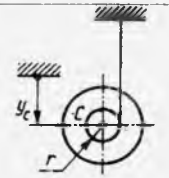
9.3.1. Qattiq jismning tekis parallel harakatida uning burchak tezlanishi qutbning tanlanishiga bog'liqmi? (Yo'q)

9.3.2. Jism $x_A=2\sin 4t$, $y_A=2\cos 4t$, $\varphi=4t^2$ qonun bo'yicha tekis parallel harakat qilsa, uning burchak tezlanishini toping. (8)

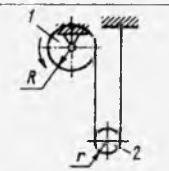
9.3.3. Sirpanmasdan dumalayotgan g'ildirak $x_C = 2t^2$, $y_C = 0{,}5$m qonun bo'yicha harakat qilsa, uning burchak tezlanishi ε qancha bo'ladi? (8)



9.3.4. Ip o'ralgan g'altakning C markazi $y_C = 0{,}33t^2$ qonun bo'yicha vertikal pastga harakat qiladi. Agar ip o'ramining radiusi $r = 0{,}066$m bo'lsa, g'altakning burchak tezlanishini toping. (10)

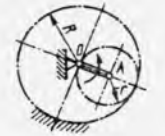


9.3.5. Radiusi $R = 0{,}1$m bo'lgan baraban $\varphi = 0{,}3t^2$ qonun bo'yicha aylanib, radiusi $r = 0{,}06$m li 2 blokni tortadi. Blokning burchak tezlanishini aniqlang. (0,5)

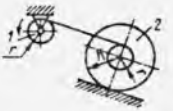


9.3.6. OA krivoship $\varphi = 0{,}5t^2$ qonun bo'yicha aylansa, 2 g'ildirakning burchak tezlanishini aniqlang. (2)

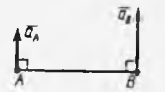
9.3.7. Radiuslari $R = 2r = 0{,}2$m bo'lgan g'ildiraklarni bog'lovchi OA krivoship $\varphi = 0{,}4t^2$ qonun bo'yicha aylansa, qo'zg'aluvchan g'ildirakning burchak tezlanishini toping. (0,8)



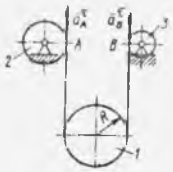
9.3.8. Radiusi $r = 0{,}1$m bo'lgan baraban 1 $\varphi = 0{,}5t^2$ qonun bo'yicha aylanib, radiusi $R = 0{,}3$ m li pog'onali 2 g'ildirakni tortadi. 2 g'ildirakning burchak tezlanishini toping. (0,25)



9.3.9. Uzunligi 80sm bo'lgan AB sterjen shakl tekisligida harakat qiladi. Berilgan onda sterjenning A va B nuqtalari $a_A = 5\text{m/s}^2$ va $a_B = 10\text{m/s}^2$ tezlanishga ega bo'lsa, sterjenning burchak tezlanishini toping. (6,25)



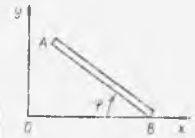
9.3.10. Qo'zg'almas 2 va 3 bloklarning A va B nuqtalari $a^{\tau}_{A}=5m/s^2$ va $a^{\tau}_{B}=10m/s^2$ tangensial tezlanishga ega bo'lsa, radiusi $R=0,5m$ li 1 qo'zg'aluvchi blokning burchak tezlanishini toping. (-2)



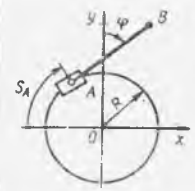
9.4. Tekis shakl nuqtalarining tezligi

9.4.1. Tekis shakl nuqtalari tezliklarining shu nuqtalardan o'tgan o'qdagi proyeksiyalari teng bo'ladimi? (Ha)

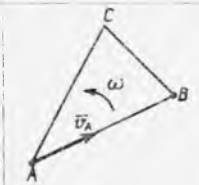
9.4.2. Uzunligi 2m bo'lgan AB sterjen Oxy tekisligida $x_B=1\cos 0,5\pi t$, $y_B=0$; $\varphi=0,5\pi t$ tenglamalar asosida harakat qiladi. Uning A nuqtasining tezlik vektori Ox o'qiga $t_1=0,5s$ paytda qanday proyeksiya beradi? (-2,22)



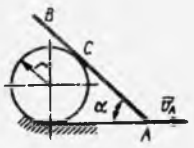
9.4.3. AB sterjenning A nuqtasi radiusi $R=1m$ bo'lgan aylana bo'ylab $s_A=1,05t$ qonun bo'yicha harakat qiladi. Bir vaqtning o'zida sterjen $\varphi=t$ qonun bilan aylanadi. Agar sterjenning uzunligi $AB=1m$ bo'lsa, $t_1=1s$ paytda uning B nuqtasi tezligining Oy o'qiga proyeksiyasini aniqlang. (-0,319)



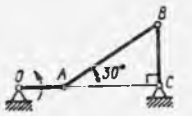
9.4.4. ABC tekis shakl A nuqtasining tezligi $\upsilon_A=2m/s$, burchak tezligi $\omega=2rad/s$ va AB masofa 1,5m bo'lsa, B nuqtaning tezligini toping. (3,61)



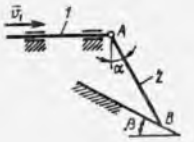
9.4.5. *AB* sterjen vertikal tekislikda shunday harakat qiladiki, uning *A* nuqtasi υ_A=0,2m/s tezlik bilan gorizontal to'g'ri chiziq bo'yicha harakatlansa, *C* nuqtasi bilan radiusi *r* li disk sirtida sirpanadi. *C* nuqtasining tezligini α=45° holat uchun aniqlang. (0,141)



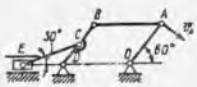
9.4.6. To'rt zvenodan iborat sharnirli mexanizmning ko'rsatilgan holati uchun *B* nuqtasining tezligini aniqlang, shu paytda uning *A* nuqtasi 1m/s tezlikka ega bo'lgan. (0,577)



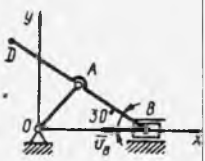
9.4.7. 1 sterjenning *A* nuqtasida sharnir yordamida mahkamlangan 2 sterjenning *B* uchi qiya tekislik bo'ylab sirpanadi. Agar 1 sterjenning tezligi 0,6m/s bo'lsa, burchaklarning $\alpha=\beta=30°$ holati uchun 2 sterjen *B* nuqtasining tezligini toping. (0,346)



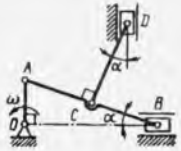
9.4.8. Sharnirli parallelogramm *OABD* ga *CE* shatun biriktirilgan bo'lib, uning uchida *E* polzun harakatlanadi. Agar *A* nuqtaning tezligi 0,4m/s va parallelogrammning o'lchamlari *OA*=*BD*=20sm, *BC*=*BD*/2 bo'lsa, *E* polzunning tezligini toping. (0,115)



9.4.9. Mexanizm shatunining uzunligi *BD*=0,5m bo'lib, *B* polzunning tezligi υ_B=0,4m/s va *D* nuqtasi tezlik vektorining *Ox* o'qidagi proyeksiyasi υ_{Dx} 0,2m/s bo'lsa, berilgan holat uchun *AB* shatunning oniy burchak tezligini toping. (2,4)



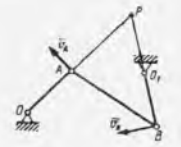
9.4.10. Uzunligi 0,2m bo'lgan OA krivoship ω=8rad/s burchak tezlik bilan tekis aylanadi. AB shatunning C nuqtasiga CD shatun biriktirilgan. Berilgan holat, α=20° uchun D polzunning tezligini aniqlang. (0,582)



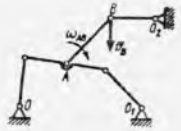
9.5. Tezliklar oniy markazi

9.5.1. Radiusi R=50sm bo'lgan disk tekislikda dumalaydi. Diskning geometrik markazidan tezliklar oniy markazigacha bo'lgan masofani hisoblang. (0,5)

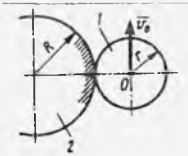
9.5.2. Mexanizmning berilgan holatida P nuqta AB zvenoning tezliklar oniy markazi bo'lib, A va B nuqtalarning tezliklari υ_A=10m/s, υ_B=15m/s bo'lsa, AP=60sm deb hisoblab, BP masofani toping. (0,9)



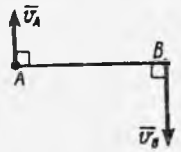
9.5.3. Berilgan paytda B nuqtaning tezligi 20m/s va AB zvenoning burchak tezligi 10rad/s bo'lsa, B nuqtadan AB zvenoning tezliklar oniy markazigacha bo'lgan masofani aniqlang. (2)



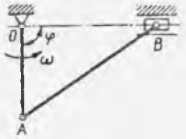
9.5.4. Radiusi r=13sm bo'lgan 1 silindr radiusi R=20sm li qo'zg'almas 2 silindr ustida dumalaydi. 1 silindr markazi 0 dan uning tezliklar oniy markazigacha bo'lgan masofani toping. (0,13)



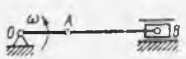
9.5.5. Uzunligi 60sm bo'lgan AB sterjen shakl tekisligida harakatlanadi. Berilgan paytda A va B nuqtalarining tezliklari υ_A=4m/s, υ_B=2m/s bo'lsa, A nuqtadan sterjen tezliklar oniy markazigacha bo'lgan masofani aniqlang. (0,4)



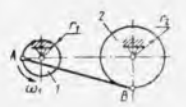
9.5.6. Mexanizmning OA krivoshipi tekis aylanma harakat qilib, OB yo'nalishga $\varphi=90°$ burchak tashkil qilgan paytda B polzundan AB zveno tezliklari oniy markazigacha bo'lgan masofani toping. (∞)



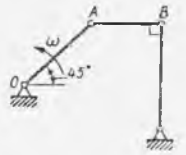
9.5.7. Mexanizmning OA krivoshipi o'zgarmas burchak tezlik ω bilan aylanadi. Agar krivoshipning uzunligi OA=80mm, shatunning uzunligi esa AB=160mm bo'lsa, A nuqtadan AB zvenoning tezliklar oniy markazigacha bo'lgan masofani toping. (0,16)



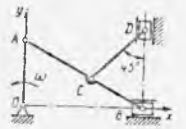
9.5.8. Radiuslari r_1=0,2m va r_2=0,5m bo'lgan 1 shkiv va 2 disk AB sterjen orqali bog'langan bo'lib, o'z o'qlari atrofida aylanadi. Shaklda ko'rsatilgan holat uchun B nuqtadan AB sterjenning tezliklar oniy markazigacha bo'lgan masofani aniqlang. (0,5)



9.5.9. Uzunligi AB=0,6m bo'lgan mexanizmning krivoshipi ω=10rad/s burchak tezlik bilan aylansa, shaklda ko'rsatilgan holat uchun A nuqtadan AB sterjenning tezliklar oniy markazigacha bo'lgan masofani toping. (0,849)



9.5.10. Mexanizmning berilgan holati uchun D nuqtadan uzunligi CD=0,6m li zvenoning tezliklar oniy markazigacha bo'lgan masofani aniqlang. (0,424).

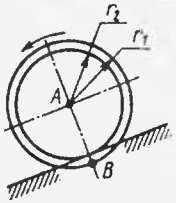


9.6. Tezliklar oniy markazi yordamida jism nuqtalarining tezliklarini aniqlash

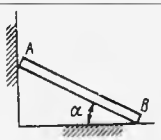
9.6.1. Radiusi 0,5m bo'lgan g'ildirakning markazi 5m/s tezlik bilan tekislik bo'ylab harakat qiladi. G'ildirakning tekislikka tegib turgan nuqtasining tezligi qancha bo'ladi? (0)

9.6.2. Tekislik bo'ylab sirpanmasdan dumalayotgan g'ildirakning *A* nuqtasi 2m/s tezlikka ega bo'lsa, *B* nuqtasining tezligini toping. (1,41)

9.6.3. Tekislik bo'ylab sirpanmasdan dumalayotgan pog'onali g'ildirakning radiuslari r_1=0,6m va r_2=0,5m bo'lib, *A* nuqtasining tezligi υ_A=2m/s bo'lsa, *B* nuqtasining tezligini aniqlang. (0,4)

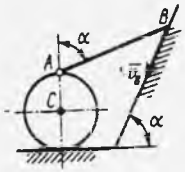


9.6.4. *AB* uzun jism qirralari bilan devorga va yerga tiralib pastga tushadi. α burchakning qanday qiymatida *A* nuqtaning tezligi *B* nuqtaning tezligidan 2 marta katta bo'ladi? (26,5)

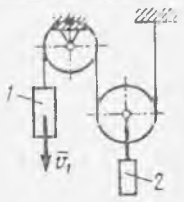


9.6.5. *AB* uzunlikdagi jism qirralari bilan β=60° qiyalikdagi devorga va yerga tiralib pastga tushadi. Jism va gorizontal tekislik orasidagi burchakning qanday qiymatida *A* va *B* nuqtalarining tezliklari teng bo'ladi? (30)

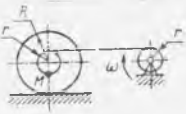
9.6.6. *AB* sterjenning bir uchi sirpanmasdan dumalayotgan g'ildirakka sharnir yordamida mahkamlangan bo'lib, ikkinchi uchi bilan α=60° qiya devorga sirpanib pastga tushadi. Agar *B* uchining tezligi υ_B=1m/s bo'lsa, g'ildirakning *C* markazining tezligini toping. (0,5)



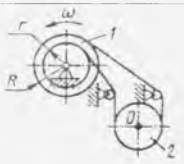
9.6.7. Bloklarga osilgan yuklarning birinchisi v_1 0.5m/s tezlikka ega bo'lsa, 2 yukning tezligini toping. (0,25)



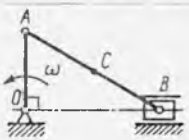
9.6.8. Radiusi r=0,1m bo'lgan baraban ω=1rad/s burchak tezlik bilan aylanib, radiuslari R=0,3 m va r=0,1m li pog'onali g'ildirakni tortadi. Pog'onali g'ildirak M nuqtasining tezligini toping. (0,05)



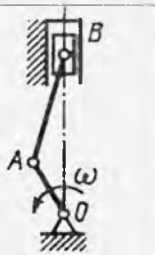
9.6.9. Radiuslari R 0,3m va r 0,2m bo'lgan g'ildirakli, quvurlarni yuqoriga ko'tarish moslamasi 1 n=30ayl/min chastota bilan aylansa, 2 quvurning markazi O ning tezligini hisoblang. (0,785)



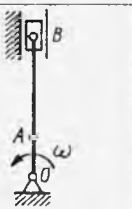
9.6.10. Krivoship-polzunli mexanizmning berilgan holati uchun AB shatunning o'rtasidagi C nuqtaning tezligini toping. Bunda ω=1rad/s va OA=0,3m; AB=0,5m deb olinsin. (0,3)



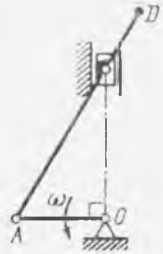
9.6.11. Dvigatel richagli valining aylanish chastotasi 4200 ayl/min. Agar OA krivoshipning uzunligi 0,04m bo'lib, AB shatunning tezliklar oniy markazi AP=0,18m va BP=0,1m masofada bo'lsa, shu holat uchun B porshenning tezligini aniqlang. (9,77)



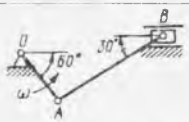
9.6.12. Uzunligi OA=0,5m bo'lgan krivoship va uzunligi AB=1,57m li shatun berilgan paytda bir to'g'ri chiziqda joylashgan bo'lib, krivoshipning burchak tezligi ω=120π bo'lsa, shatunning burchak tezligini hisoblang. (120)



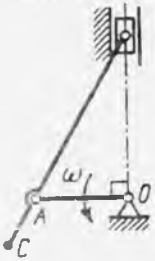
9.6.13. Krivoship-polzunli mexanizmning ko'rsatilgan holati uchun OA krivoshipining burchak tezligini hisoblang. Bunda υ_B 1m/s va OA=0,1m deb olinsin. (10)



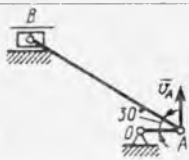
9.6.14. Krivoship-polzunli mexanizm shatunining uzunligi AB=1m bo'lib, A nuqtasining tezligi υ_A 3m/s bo'lsa, ko'rsatilgan holat uchun AB shatunning burchak tezligini aniqlang. (1,73)



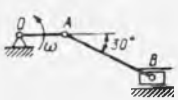
9.6.15. Krivoship-polzunli mexanizm shatunining uzunligi OA=0,2m bo'lib, shatunidagi C nuqtaning tezligi υ_C=4m/s bo'lsa, krivoshipning burchak tezligini toping. (20)



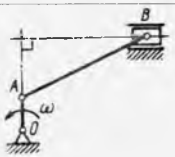
9.6.16. Krivoship-polzunli mexanizm shatunining uzunligi AB=1m bo'lib, A nuqtasining tezligi υ_A=3m/s bo'lsa, ko'rsatilgan holat uchun AB shatunning burchak tezligini hisoblang. (3,46)



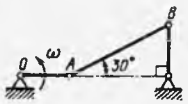
9.6.17. Krivoship-polzunli mexanizm shatunining uzunligi AB=3m bo'lib, A nuqtasining tezligi υ_A=3m/s bo'lsa, ko'rsatilgan holat uchun AB shatunning burchak tezligini toping. (1,15)



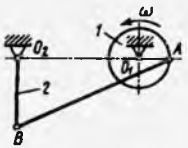
9.6.18. Krivoship-polzunli mexanizm shatunining uzunligi OA=0,1m bo'lib, polzunning tezligi υ_B=2m/s bo'lsa, OA krivoshipning burchak tezligini aniqlang. (20)



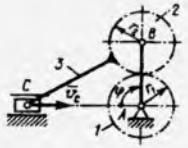
9.6.19. To‘rt zvenoli mexanizm *AB* zvenosining uzunligi 0,2m bo‘lib, *A* nuqtasining tezligi 1m/s bo‘lsa, ko‘rsatilgan holat uchun *AB* zvenoning burchak tezligini hisoblang. (5,77)



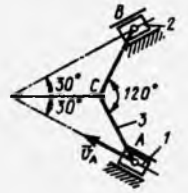
9.6.20. Mexanizm radiusi r=0,1m bo‘lgan 1 shkiv, uzunligi 0,25m li 2 sterjen va *AB* richagdan iborat. Agar 1 shkiv 120 ayl/min chastota bilan aylansa, ko‘rsatilgan holat uchun *AB* richagning burchak tezligini toping. Aylanish o‘qlari orasidagi masofa O_1O_2=0,45m ga teng. (2,28).



9.6.21. Mexanizm uzunligi *AB*=30sm li krivoship vositasida bog‘langan ikkita g‘ildiraklardan hamda 3 shatuniga o‘rnatilgan *C* polzundan iborat. Agar g‘ildiraklarning radiusi r_1=r_2=15sm, *C* polzunning tezligi 0,3m/s bo‘lsa, 1 g‘ildirakning burchak tezligini φ=90° holat uchun aniqlang. (2)



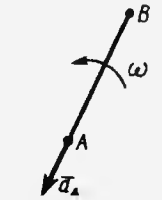
9.6.22. Uzunligi *AC*=*BC*=0,2m bo‘lgan 3 shatun vositasida mahkamlangan 1 va 2 polzunlar qo‘zg‘almas yo‘naltiruvchilar bo‘ylab harakatlanadi. Agar 1 polzunning tezligi υ_A=0,2m/s bo‘lsa, shatunning burchak tezligini toping. (1,0).



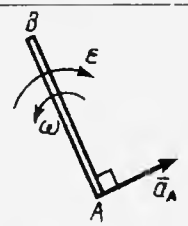
9.7. Tekis shakl nuqtalarining tezlanishlari

9.7.1. Radiusi 0,5m bo'lgan g'ildirak tekislik bo'ylab $s=2t$ qonun bo'yicha harakat qiladi. G'ildirakning tekislikka tegib turgan nuqtasining tezlanishini aniqlang. (8)

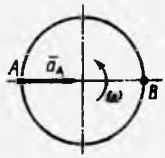
9.7.2. Uzunligi 2m bo'lgan AB sterjen tekis parallel harakat qiladi. Agar sterjenning burchak tezligi $\omega=1$rad/s, burchak tezlanishi $\varepsilon=0$ va A nuqtasining tezlanishi 1m/s^2 bo'lsa, B nuqtasining tezlanishini toping. (3)



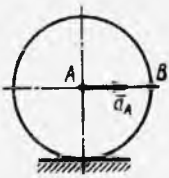
9.7.3. Uzunligi $AB=1$m bo'lgan sterjen tekislik bo'ylab harakatlanadi. Agar uning burchak tezligi $\omega=2$rad/s, burchak tezlanishi $\varepsilon=2\text{rad/s}^2$ va A nuqtasining tezlanishi $a_A=1\text{m/s}^2$ bo'lsa, B nuqtasining tezlanishini hisoblang. (5)



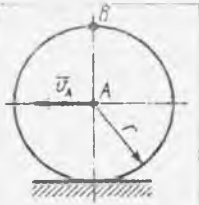
9.7.4. Doira shaklidagi jism tekis parallel harakat qiladi. Agar uning burchak tezligi $\omega=1$rad/s, burchak tezlanishi $\varepsilon=0$ va A nuqtasining tezlanishi 3m/s^2 bo'lsa, B nuqtasining tezlanishini toping. Bunda $AB=0,5$ m deb olinsin. (2,5)



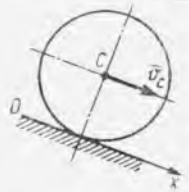
9.7.5. G'ildirak sirpanmasdan dumalaydi. Uning B nuqtasining tezlanishini A nuqtaning tezligi va tezlanishi: $\upsilon_A=0$ va $a_A=2\text{m/s}^2$ holat uchun hisoblang. (2,83)



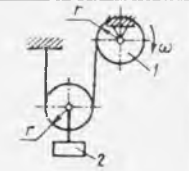
9.7.6. Radiusi r=0,1m bo'lgan g'ildirak sirpanmasdan dumalaydi. Agar A nuqtasi o'zgarmas v_A=2m/s tezlik bilan harakatlansa, B nuqtasining tezlanishini toping. (40)



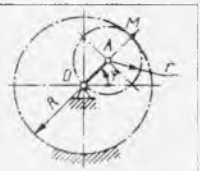
9.7.7. Sirpanmasdan dumalayotgan g'ildirakning markazi o'zgarmas tezlikka ega. G'ildirak tezliklar oniy markazi bo'lib hisoblangan nuqtaning tezlanish vektori Ox o'q bilan necha gradus burchak hosil qiladi? (90)



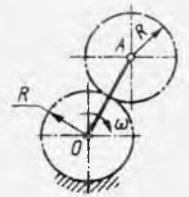
9.7.8. Radiusi r=0,2m bo'lgan 1 baraban $\varphi=0{,}1t^2$ qonun bilan aylanib, 2 yukni yuqoriga tortadi. Yukning tezlanishini hisoblang. (0,02)



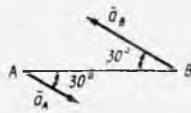
9.7.9. OA krivoship φ=0,5t qonun bo'yicha aylanadi. Agar qo'zg'aluvchi va qo'zg'almas g'ildiraklarning radiuslari $R=2r$=0,2m bo'lsa, qo'zg'aluvchi g'ildirak M nuqtasining tezlanishini aniqlang. (0,05)



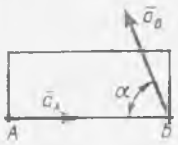
9.7.10. Planetar mexanizmning krivoshipi OA o'zgarmas burchak tezlik ω=1rad/s bilan aylanadi. Agar g'ildiraklarning radiuslari R=0,1m bo'lsa, qo'zg'aluvchi g'ildirak tezliklar oniy markazi bo'lgan nuqtaning tezlanishini toping. (0,2)



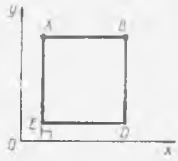
9.7.11. Uzunligi AB=40sm bo'lgan sterjen shakl tekisligida harakat qiladi. Biror vaqtdan keyin uning A va B nuqtalari a_A=2m/s^2 va a_B=6m/s^2 tezlanishlarga ega bo'lsa, sterjenning burchak tezlanishini aniqlang. (10)



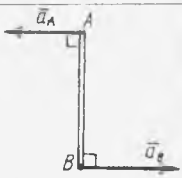
9.7.12. To'g'ri to'rtburchak shaklidagi jism tekis parallel harakat qiladi. Agar uning o'lchami AB 1m bo'lib, A va B nuqtalarining tezlanishlari mos ravishda 1m/s^2 va 6m/s^2 bo'lsa, $\alpha=60°$ uchun jismning burchak tezlanishini hisoblang. (2)



9.7.13. Kvadrat shaklidagi $ABDE$ plastina Oxy tekislikda harakat qiladi. Agar o'lchami $AB=0{,}5$m bo'lib, A va B nuqtalarining tezlanishlari Oy o'qqa nisbatan $a_{Ay}=3$m/s^2 va $a_{By}=6$m/s^2 proyeksiya bersa, plastinaning burchak tezlanishini toping. (4)

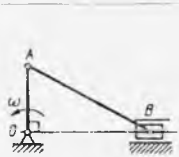


9.7.14. Uzunligi $AB=50$sm bo'lgan sterjen shakl tekisligida harakat qiladi. Biror vaqtdan keyin uning A va B nuqtalari $a_A=2$m/s^2 va $a_B=3$m/s^2 tezlanishlarga ega bo'lsa, sterjenning burchak tezlanishini aniqlang. (10)

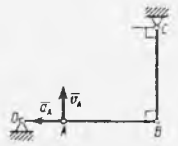


9.7.15. Krivoship-polzunli mexanizmning OA krivoshipi o'zgarmas $\omega=10$rad/s burchak tezlik bilan aylanadi. Shaklda ko'rsatilgan holat uchun AB shatunning burchak tezlanishini toping. (0)

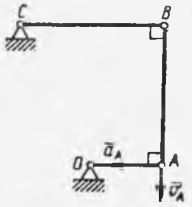
9.7.16. Krivoship-polzunli mexanizmning o'lchamlari $OA=0{,}3$m va $AB=0{,}5$m bo'lib, krivoship OA o'zgarmas $\omega=1$rad/s burchak tezlik bilan aylanadi. Shaklda ko'rsatilgan holat uchun B polzunning tezlanishini aniqlang. (0,225)



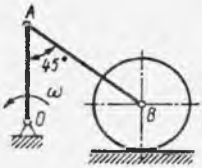
9.7.17. To'rt zvenoli sharnirli mexanizmning o'lchamlari $AB=BC=0{,}8$m bo'lib, A nuqtasining tezlik va tezlanishi berilgan: $\upsilon_A=2$m/s; $a_A=20$m/s^2. Shaklda ko'rsatilgan holat uchun AB shatun B nuqtasining tezlanishini hisoblang. (25)



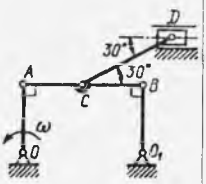
9.7.18. To‘rt zvenoli sharnirli mexanizmning o‘lchamlari $AB=BC=0,5$ m bo‘lib, krivoshipning A nuqtasi $\upsilon_A=2$m/s tezlikka va $a_A=40$m/s^2 tezlanishga ega. Shaklda ko‘rsatilgan holat uchun BC zvenoning burchak tezlanishini aniqlang. (0)



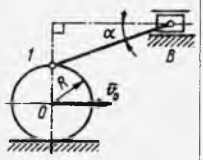
9.7.19. Krivoship-shatunli mexanizmning o‘lchamlari $OA=0,3$m va $AB=0,45$m bo‘lib, OA krivoship o‘zgarmas burchak tezlik $\omega=10$rad/s bilan aylanadi. AB shatunning burchak tezlanishini hisoblang. (94,3)



9.7.20. Sharnirli parallelogrammning OA krivoshipi o‘zgarmas burchak tezlik $\omega=4$rad/s bilan aylanadi. Agar mexanizmning o‘lchamlari $OA=20$sm, $CD=30$sm bo‘lsa, ko‘rsatilgan holat uchun CD shatunning burchak tezlanishini toping. (12,3)



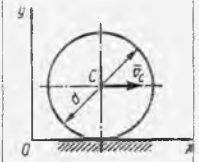
9.7.21. Mexanizmning polzuni B radiusi $R=50$sm li 1 g‘ildirakka sharnir yordamida bog‘langan bo‘lib, uning markazi o‘zgarmas $\upsilon_0=5$m/s tezlik bilan harakatlansa, B polzunning tezlanishini aniqlang. Bunda $\alpha=30°$. (28,9)



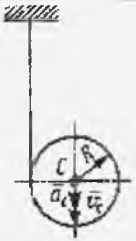
9.8. Tezlanishlar oniy markazi

9.8.1. Jism tekislikda $x_B=2\cos 0{,}5\pi t$; $y_B=0$; $\varphi=0{,}5\pi t$ qonun bo'yicha harakatlanadi. Vaqtning $t_1=0{,}5$s paytdagi B nuqtadan tezlanishlar oniy markazigacha bo'lgan masofani aniqlang. (1,41)

9.8.2. Diametri $d=90$sm bo'lgan g'ildirak gorizontal yo\ bo'ylab $x_C=20t$ qonun bo'yicha harakat qiladi. G'ildirakning tezliklar oniy markazi bilan tezlanishlar oniy markazlari orasidagi masofani toping. (0,45)

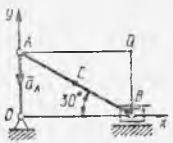


9.8.3. Radiusi $R=0{,}066$m bo'lgan, ip o'ralgan silindr pastga tushadi. Agar berilgan paytda uning markazi $\upsilon_C=0{,}66$m/s tezlikka va $a_C=6{,}6$m/s^2 tezlanishga ega bo'lsa, C markazdan tezlanishlar oniy markazigacha bo'lgan masofani toping. (0,047)

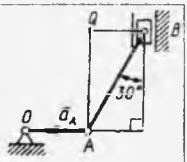


9.8.4. Uchburchak shaklidagi ABC jism tekis parallel harakat qiladi. Agar uning A nuqtasining tezlanishi $a_A=10$m/s^2, burchak tezligi $\omega=2$rad/s, burchak tezlanishi $\varepsilon=3$rad/s^2 bo'lsa, A nuqtadan tezlanishlar oniy markazigacha bo'lgan masofani toping. (2)

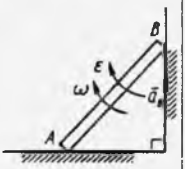
9.8.5. Krivoship-polzunli mexanizmning ko'rsatilgan holati uchun Q nuqta AB shatunning tezlanishlar oniy markazi hisoblanadi. Agar shatunning uzunligi $AB=0{,}6$m va A nuqtaning tezlanishi $a_A=10$m/s^2 berilgan bo'lsa, shatunning o'rtasida joylashgan C nuqtaning tezlanishini aniqlang. (5,77)



9.8.6. Krivoship-polzunli mexanizmning ko'rsatilgan holati uchun Q nuqta AB shatunning tezlanishlar oniy markazi bo'lsa, uning uzunligi AB=0,6m va A nuqtasining tezlanishi a_A=10m/s^2 deb, shatunning burchak tezlanishini hisoblang. (19,2)

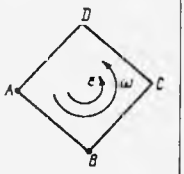


9.8.7. Uzun AB jism bir uchi bilan devorga, ikkinchi uchi bilan yerga tiralib, pastga tushadi. Agar berilgan paytda jismning burchak tezligi ω=0,6rad/s va burchak tezlanishi ε=0,36rad/s^2 ga teng bo'lsa, B nuqtaning tezlanish vektori $\bar{a}_B$ va B nuqtadan jism tezlanishlar oniy markazi -Q, ya'ni BQ kesma orasidagi burchakning radian qiymatini aniqlang. (0,785)

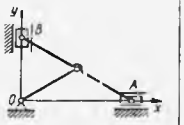


9.8.8. Kvadrat shaklidagi $ABCD$ jism tekis parallel harakat qilib, ω=1rad/s burchak tezlikka va ε=1rad/s^2 burchak tezlanishga ega. Agar A nuqta tezlanishlar oniy markazi bo'lsa, C nuqtaning tezlanishi $\bar{a}_C$ bilan Ox o'qi orasidagi burchakning gradus qiymatini aniqlang. (180)

9.8.9. Kvadrat shaklidagi $ABCD$ jism tekis parallel harakat qilib, ω=2rad/s burchak tezlik va ε=3rad/s^2 burchak tezlanishga ega. Agar uning tomoni 0,1m va A nuqta tezlanishlar oniy markazi bo'lsa, B nuqtaning tezlanishini toping. (0,5)



9.8.10. Ellipsograf chizg'ichining A polzuni a_A=4m/s^2 tezlanishga ega bo'lib, tezlanishlar oniy markazi Q dan A va B nuqtalargacha bo'lgan masofalari AQ=33sm, BQ=53sm bo'lsa, B polzunning tezlanishini hisoblang. (6,42)



X BOB. QATTIQ JISMNING SFERIK VA UMUMIY HARAKATLARI

10.1. Sferik harakat. Qattiq jismning burchak tezlik va burchak tezlanish vektorlari

10.1.1. Qattiq jism O nuqta atrofida $\psi=\pi/2$; $\theta=\pi t$ va $\varphi=\pi t$ qonun bo'yicha harakatlansa, $t=0{,}5$ s dagi uning burchak tezlik vektori $\bar{\omega}$ ning Ox o'qiga proyeksiyasini toping. (2,22)

10.1.2. Agar jism $\psi=\pi\sin t$; $\theta=\pi\cos t$ va $\varphi=\pi$ qonun bo'yicha sferik harakat qilsa, uning burchak tezligining miqdorini aniqlang. (3,14)

10.1.3. Jismning sferik harakati qonunlari $\psi=\pi t$; $\theta=\pi/3$ va $\varphi=\pi t$ tenglamalardan iborat. Uning burchak tezligi miqdorini toping. (5,44)

10.1.4. Jism sferik harakat qiladi. Agar jismning burchak tezlik vektori $\bar{\omega}=\pi\cos\pi t^2\,\bar{i}+\pi\sin\pi t^2\,\bar{j}+2\pi t\,\bar{k}$ ga teng bo'lsa, $t=2$s da aylanish oniy o'qi va Ox o'qi orasidagi burchakning kosinusini hisoblang. (0,408)

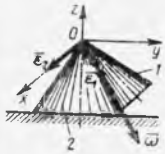
10.1.5. Jismning sferik harakatidagi burchak tezligi $\bar{\omega}=\pi\sin\pi t\,\bar{i}+$ $+\pi\cos\pi t\,\bar{j}+\pi\,\bar{k}$ bo'lsa, $t=1$s paytdagi uning burchak tezlanish vektorining Ox o'qidagi proyeksiyasini aniqlang. (-9,87)

10.1.6. Jismning sferik harakatidagi burchak tezligi $\bar{\omega}=\pi\sin t\,\bar{i}+$ $+\pi\cos t\,\bar{j}+100\pi e^{-t}\,\bar{k}$ bo'lsa, $t=10$s paytdagi uning burchak tezlanishi vektorining Oz o'qidagi proyeksiyasini toping. ($-1{,}43\cdot10^{-2}$)

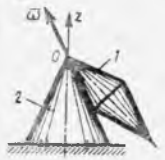
10.1.7. Jismning sferik harakatidagi burchak tezlik vektorining koordinata o'qlaridagi proyeksiyalari mos ravishda $\omega_x=\pi t$, $\omega_y=\pi t$ va $\omega_z=2\pi t^2$ bo'lsa, $t=3$s paytdagi uning burchak tezlanishi miqdorini aniqlang. (11,8)

10.1.8. Jismning sferik harakatidagi burchak tezligi $\bar{\omega} = 2\sin^2 t\,\bar{i} + \sin 2t\,\bar{j} + 5\bar{k}$ bo'lsa, $t=2$s paytdagi uning burchak tezlanishi miqdorini hisoblang (rad/s). (2)

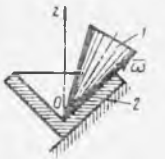
10.1.9. 1 konus 2 qo'zg'almas konus ustida dumalaydi. Berilgan paytda sferik harakat burchak tezlanishlari $\bar{\varepsilon}_1$ va $\bar{\varepsilon}_2$ tashkil etuvchilardan iborat bo'lib, $\bar{\varepsilon}_1 \| \bar{\omega}$ va $\bar{\varepsilon}_2 \perp \bar{\omega}$. Agar $\varepsilon_1 = 0{,}1\pi$; $\varepsilon_2 = 0{,}2\pi$ bo'lsa, burchak tezlanish $\bar{\varepsilon}$ ning qiymatini hisoblang. (0,702)



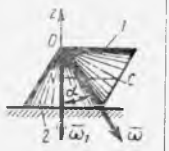
10.1.10. Ikki yoqlama 1 konus qo'zg'almas 2 konus ustida dumalaydi. Uning aylanish burchak tezligi $\omega = \pi\sin 0{,}1\pi t$ bo'lsa, $t=3$s paytdagi burchak tezlanishining aylanish oniy o'qiga proyeksiyasini toping. (0,580)



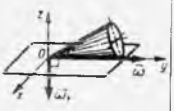
10.1.11. Qo'zg'aluvchan 1 konus qo'zg'almas 2 konusning ichki sirti bo'ylab dumalaydi. Uning burchak tezligi $\omega = 0{,}1\pi t^2$ qonun bo'yicha o'zgarsa, t 2s paytdagi burchak tezlanishning aylanish oniy o'qiga proyeksiyasini toping. (1,26)



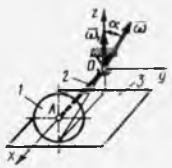
10.1.12. Qo'zg'aluvchan 1 konus qo'zg'almas 2 konusning sirti bo'ylab o'zgarmas tezlik $\omega = \pi$ bilan dumalaydi. 1 konus asosining markazi C dan Oz o'qiga o'tkazilgan perpendikulyar CN Oz o'qi atrofida $\omega_1 = 1{,}8$rad/s burchak tezlik bilan aylansa, $\alpha = 30°$ deb olib, 1 konusning burchak tezlanishini hisoblang. (2,83)



10.1.13. Konus gorizontal tekislik bo'ylab sirpanmasdan dumalaydi. Agar aylanish burchak tezligi vektori ($\omega = 2\pi$) aylanish oniy o'qi Oz ga nisbatan $\omega_1 = 2$rad/s burchak tezlik bilan aylansa, konusning burchak tezlanish miqdorini aniqlang. (12,6)



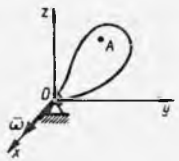
10.1.14. G'ildirak 1 gorizontal tekislik bo'ylab o'zgarmas burchak tezlik ω=10rad/s bilan sirpanmasdan dumalaydi. Uning aylanish o'qi 2 esa vertikal Oz o'q atrofida ω_1=1,7rad/s o'zgarmas burchak tezlik bilan aylanadi. Agar α=80° bo'lsa, g'ildirakning burchak tezlanishi qancha bo'ladi? (16,7)



10.2. Bir nuqtasi qo'zg'almas bo'lgan qattiq jism nuqtalarining tezligi va tezlanishi

10.2.1. Jism O nuqta atrofida aylanadi. Berilgan paytda aylanish oniy o'qi Ox o'qi bilan ustma-ust tushib, M nuqtaning koordinatalari x_M=0; y_M=0,2m; z_M=0 bo'lsa, M nuqta tezlik vektori bilan Oy o'qi orasidagi burchakning gradus qiymatini hisoblang. (90)

10.2.2. Jism qo'zg'almas O nuqta atrofida o'zgarmas ω=1rad/s burchak tezlik bilan aylanadi. Agar berilgan paytda aylanish oniy o'qi Ox o'qi bilan ustma-ust tushsa, koordinatalari x_A=0; y_A=0,3m; z_A=0,4m bo'lgan A nuqta tezligining miqdorini toping. (0,5)



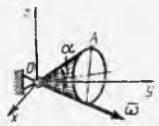
10.2.3. Jism qo'zg'almas O nuqta atrofida aylanadi. Biror paytda uning burchak tezligi $\vec{\omega}=0{,}3\vec{i}+0{,}4\vec{j}$ bo'lsa, koordinatalari x_A=0,1m; y_A=0; z_A=0,1m bo'lgan A nuqtasi tezlik vektorining Ox o'qidagi proyeksiyasini hisoblang. (0,04)

10.2.4. Sferik harakatdagi jismning burchak tezligi $\vec{\omega}=2\vec{i}+3\vec{j}+5\vec{k}$ bo'lsa, koordinatalari x_A=0m; y_A=0m; z_A=0,5m dan iborat bo'lgan A nuqtasining tezligini aniqlang. (1,80)

10.2.5. Sferik harakatdagi jismning burchak tezligi $\omega_x=\pi\sin t$; $\omega_y=\pi\cos t$; $\omega_z=0$ qonunlar bo'yicha berilgan bo'lsa, $t=\pi$ paytdagi koordinatalari $x_A=0{,}4$m; $y_A=0{,}5$m; $z_A=0{,}3$ m bo'lgan A nuqtasining tezligini hisoblang. (1,57)

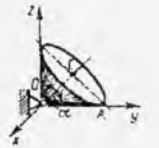
10.2.6. Sferik harakatdagi jismning oniy burchak tezligi proyeksiyalari $\omega_x=\pi$; $\omega_y=3\pi$; $\omega_z=2\pi$ berilgan bo'lsa, shu paytdagi jismning koordinatalari $x_A=0{,}1$m; $y_A=0{,}3$m; $z_A=0{,}2$m lar bilan aniqlanadigan A nuqtasining tezligini toping. (0)

10.2.7. Konus shaklidagi jism qo'zg'almas O nuqta atrofida aylanib, Oxy tekisligi ustida $\omega=2$rad/s burchak tezlik bilan dumalaydi. Agar $OA=0{,}2$m va $\alpha=30°$ bo'lsa, A nuqtaning tezligini aniqlang. (0,2)

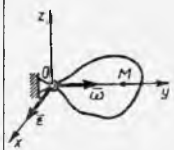


10.2.8. Jism qo'zg'almas O nuqta atrofida aylanib, Oxy tekisligi bo'ylab $\omega=1$rad/s burchak tezlik bilan dumalaydi. Agar jismning o'lchamlari $OA=0{,}5$m; $OB=AB$; $\alpha=60°$ bo'lsa, A nuqtaning tezligini toping. (0,25)

10.2.9. Balandligi $OC=0{,}1$m, uchidagi burchagi $\alpha=90°$ bo'lgan konus O nuqta atrofida aylanib, Oxy gorizontal tekisligida dumalaydi. Agar konus asosining markazi $\upsilon_C=0{,}1$m/s tezlikka ega bo'lsa, A nuqta markazga intilma (normal) a_A^n tezlanishining qiymatini aniqlang. (0)



10.2.10. Jism qo'zg'almas O nuqta atrofida o'zgarmas burchak tezlik bilan aylanadi. Agar biror paytda burchak tezlik vektori $\overline{\omega}$ Oy o'qi bilan ustma-ust tushsa, burchak tezlanish vektori $\overline{\varepsilon}$ esa Ox o'qiga parallel bo'lsa, jism M nuqtasining tezlanish vektori va Oz o'qi orasidagi burchak kosinusi nechaga teng? (1)



10.2.11. Jism qo'zg'almas O nuqta atrofida muntazam pretsessiya harakatida bo'ladi. Berilgan paytda aylanish oniy o'qi Ox o'qi bilan ustma-ust tushadi. Aylanish oniy o'qida yotgan, A nuqtaning tezlanish vektori va Oz o'qi orasidagi burchak kosinusini toping. (1)

10.2.12. Sferik harakatdagi jismning biror vaqtdagi oniy burchak tezlanishi $\vec{\varepsilon}=\vec{i}-\vec{j}+\vec{k}$ bo'lsa, radius-vektori $\vec{r}_A=\vec{i}+\vec{j}+\vec{k}$ bo'lgan A nuqtaning aylanma (urinma) tezlanish miqdorini aniqlang. (2,83)

10.2.13. Sferik harakatdagi jismning oniy burchak tezligi $\vec{\omega}=2\vec{i}+4\vec{j}+2\vec{k}$ bo'lib, A nuqtasining tezlik vektori $\vec{v}_A=4\vec{i}+8\vec{j}-4\vec{k}$ bo'lsa, shu nuqtaning aylanish o'qiga intilma (normal) tezlanishining Oy o'qidagi proyeksiyasini toping. (16)

10.2.14. Sferik harakat qilayotgan jismning biror vaqtdagi oniy burchak tezlik vektori $\vec{\omega}=\vec{i}+2\vec{j}+4\vec{k}$ ga teng bo'lib, A nuqtasining radius-vektori $\vec{r}_A=\vec{i}+2\vec{j}+\vec{k}$ ga teng bo'lsa, A nuqtaning o'qqa intilma (normal) tezlanish vektorining Ox o'qidagi proyeksiyasini toping. (-12)

10.2.15. Sferik harakatdagi jismning biror vaqtdagi burchak tezligi $\vec{\omega}=2\vec{i}+3\vec{k}$ va burchak tezlanishi $\vec{\varepsilon}=4\vec{j}+5\vec{k}$ bo'lsa, radius-vektori $\vec{r}_m=0,1\vec{i}+0,15\vec{k}$ bo'lgan M nuqtaning tezlanishini hisoblang. (0,877)

10.3. Qattiq jismning umumiy holdagi harakati

10.3.1. Jism fazoda $x_m=0$; $y_m=20t$; $z_m=20t-4,9t^2$; $\theta=0,5$rad, $\psi=3$rad; va $\varphi=12(1-e^{-0,25t})$ qonun bo'yicha harakat qilsa, $t=4$s paytdagi jismning burchak tezligi miqdorini toping. (1,10)

10.3.2. Motorli qayiq suv sathida x_m=100m; y_m=6t; z_m=0,2sin2πt; θ=0,1cos2πt, ψ=0 va φ=0 qonun bo'yicha harakat qilsa, t=1s paytdagi qayiqning burchak tezlanishini aniqlang. (1,26)

10.3.3. Jism x_0=0; y_0=0; z_0=5-0,3t, θ=0; ψ=0 va φ=8t qonun asosida vintsimon harakat qiladi. Agar oniy aylanish burchak tezligi vektori $\overline{\omega}$ qutb tezligi vektori $\overline{v}_0$ga parallel bo'lsa, aylanish oniy o'qidan 0,05m masofadagi nuqtaning tezligini toping. (0,5)

10.3.4. Jismlarni teshish uchun ishlatiladigan «sverlo» ni teshikdan qaytarib chiqarishdagi harakat qonuni x_0=0; y_0=0; z_0=4t; θ=0; ψ=0; va φ=25e^t bo'lib, bu yerda O nuqta uning simmetriya o'qida joylashgan. Vaqtning t=3s paytdagi «sverlo» ning aylanish o'qidan 0,6sm masofada joylashgan nuqtasining (sm/s) larda tezligini hisoblang. (4,07)

10.3.5. Erkin jismning umumiy harakatida uning A nuqtasining biror O qutbga nisbatan radius-vektori $\overline{OA}$=2$\vec{i}$ + $\vec{j}$ +2$\vec{k}$ bo'lib, aylanish oniy burchak tezligi $\overline{\omega}$= 2$\vec{i}$ - $\vec{j}$ +$\vec{k}$ bilan berilgan. Agar O qutb nuqtaning harakat qonuni x_O=2t, y_O=8t, va z_O=5t^2 bo'lsa, A nuqta tezligining Ox o'qidagi proyeksiyasini hisoblang. (-1)

10.3.6. Erkin jismning umumiy harakatida uning O nuqtasi x_0=5t; y_0=-5t va z_0=-2t^2 qonun bilan harakatlanadi. Jismning A nuqtasi $\overline{OA}$=$\vec{i}$ +4$\vec{j}$ -2$\vec{k}$ radius-vektorga va $\overline{\omega}$=2$\vec{i}$ +2$\vec{j}$ +$\vec{k}$ oniy burchak tezlikka ega bo'lsa, A nuqta tezligining Oy o'qiga proyeksiyasini aniqlang. (0)

10.3.7. Erkin harakatidagi jismning O qutbining tezlanishi $\overline{a}_O$ = $\overline{5}i$, burchak tezligi $\overline{\omega}$=π$\vec{k}$ va burchak tezlanishi $\overline{\varepsilon}$=0 ga teng. Agar jismning M nuqtasi O qutb nuqtaga nisbatan $\overline{OM}$=0,5$\vec{j}$ radius-vektorga ega bo'lsa, M nuqta tezlanishining Oy o'qidagi proyeksiyasini aniqlang. (4,93)

10.3.8. Jismning erkin harakatida qutb deb qabul qilingan O nuqtaning tezlanishi $\bar{a}_O=2\bar{i}+5\bar{j}+5\bar{k}$ bo'lgan paytda jismning burchak tezligi $\bar{\omega}=0$ va burchak tezlanishi $\bar{\varepsilon}=2\bar{i}-5\bar{k}$ ga teng. Shu paytdagi jismning $\overline{OM}=2\bar{i}-5\bar{k}$ radius-vektor orqali aniqlanuvchi M nuqtasining tezlanishini toping. (7,35)

10.3.9. Jismning vintsimon harakati $x_0=0$; $y_0=0$; $z_0=0{,}05t$; $\theta=O$; $\psi=0$; $\varphi=\pi t$ qonun bo'yicha berilgan bo'lsa, vint o'qidan $OM=0{,}012$m masofadagi M nuqtaning tezlanishini aniqlang. (0,118)

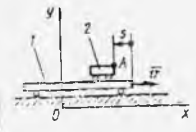
10.3.10. Jismning vintsimon harakat qonuni $x_0=1$m; $y_0=2$m; $z_0=t^2$; $\theta=0$; $\psi=0$; $\varphi=\pi t^2$ ko'rinishda bo'lsa, vint o'qidan $OM=0{,}1$m masofadagi M nuqtaning $t=1$s paytdagi tezlanishini toping. (4,47)

XI BOB. NUQTANING MURAKKAB HARAKATI

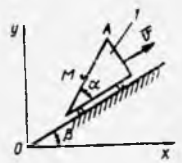
11.1. Nuqta murakkab harakati tenglamasi

11.1.1. Platforma gorizontal yo'l bo'ylab 1m/s tezlik bilan tekis harakatlanadi. Platforma ichidagi moddiy nuqta ham shu yo'nalish bo'yicha unga nisbatan $s=0{,}5t$ qonun asosida siljisa, boshlang'ich paytda $t=0$ va $x=0$ deb, $t=4$s paytdagi nuqtaning x koordinatasini hisoblang. (6)

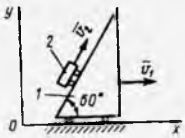
11.1.2. 1 platforma o'zgarmas $\upsilon_1=1$m/s tezlik bilan gorizontal yo'l bo'ylab harakatlanadi. Uning ustidagi 2 arava platformaga nisbatan $s=0{,}5t$ qonun asosida siljisa, boshlang'ich paytda, $t=0$ da, $x_A=0$ deb, 2 aravaning harakat qonunini aniqlang. (0,5t)



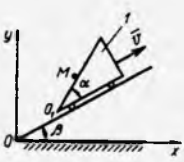
11.1.3. 1 jism o'zgarmas υ=2m/s tezlik bilan qiya tekislik bo'ylab yuqoriga ko'tarilmoqda. Uning ustidagi M nuqta jismga nisbatan $AM=0{,}5t$ qonun bo'yicha harakat qilsa, boshlang'ich paytda, t=0da, x_{M_0}=0 deb olib, t=2s dagi nuqtaning x_M koordinatasini hisoblang. Bunda $\alpha=\beta=30°$ deb oling. (2,96)



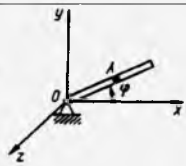
11.1.4. 1 jism o'zgarmas υ_1=2m/s tezlik bilan gorizontal tekislik bo'ylab harakat qiladi. Uning ustida esa 2 jism o'zgarmas υ_2=4m/s tezlik bilan yuqoriga ko'tarilmoqda. Agar boshlang'ich paytda, t=0 s. da x_2=0 bo'lsa, t=0,5s paytdagi 2 jismning x_2 koordinatasini aniqlang. 2 jism moddiy nuqta deb qaralsin. (2)



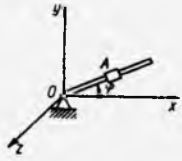
11.1.5. 1-jism o'zgarmas υ_1=2m/s tezlik bilan qiya tekislikda harakat qiladi. Uning ustidagi M nuqta $O_1M=0{,}5t$ nisbiy harakat qonuni bilan siljiydi. Agar boshlang'ich paytda, t=0 da, x_{M_0}=0 bo'lsa, t=1s paytdagi M nuqtaning koordinatasi x_M ni aniqlang. Bunda qiyalik $\alpha=\beta=30°$ deb olinsin. (1,98)



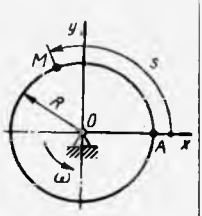
11.1.6. Oz o'qi atrofida $\varphi=4t$ qonun bo'yicha aylanayotgan naycha ichidagi A sharcha $OA=5t^2$ tenglama asosida harakat qilsa, t=0,25s paytdagi A nuqtaning x_A koordinatasini toping. (0,169)



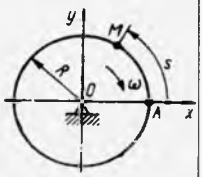
11.1.7. Oz o'qi atrofida $\varphi=2t$ qonun bo'yicha aylanayotgan sterjen bo'ylab A po'lzun $OA=3t^3$ tenglama asosida harakat qilsa, polzunning o'lchamlarini hisobga olmay, t=0,5s paytdagi uning y_A koordinatasini hisoblang. (0,316)



11.1.8. Radiusi R=0,5m bo‘lgan disk o‘zgarmas burchak tezlik ω=2rad/s bilan aylanadi. Diskning gardishida esa $s=2t^2$ tenglama asosida M nuqta harakat qiladi. Agar boshlang‘ich paytda M nuqta Ox o‘qida bo‘lgan bo‘lsa, t=0,5s paytdagi nuqtaning yoy koordinatasi s ni aniqlang. (1)



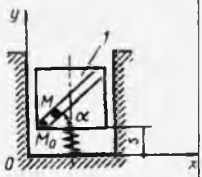
11.1.9. Radiusi R=0,5m bo‘lgan disk o‘zgarmas burchak tezlik ω=3rad/s bilan aylanadi. M nuqta esa diskning gardishi bo‘ylab $s=2t^2$ qonun asosida harakat qiladi. Agar boshlang‘ich paytda M nuqta Ox o‘qida bo‘lgan bo‘lsa, t=1s paytda nuqtaning yoy koordinatasi s ni hisoblang. (0,5)



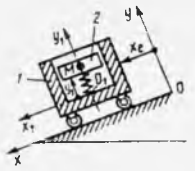
11.2. Murakkab harakatdagi nuqtaning tezligi

11.2.1. Arava to‘g‘ri chiziqli yo‘lda $s=2t$ qonun asosida harakat qiladi. M nuqtaning aravaga nisbatan nisbiy harakat tenglamasi x_M 3t va y_M $4t$ bo‘lsa, t=1s paytdagi M nuqtaning absolut tezligini toping. (6,40)

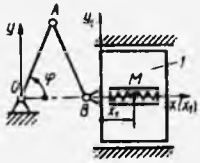
11.2.2. To‘g‘ri to‘rtburchak shaklidagi jism 1 shakl tekisligida $s=1+0{,}5\sin(\pi/2)t$ qonun bo‘yicha vertikal harakat qiladi. Uning diagonali bo‘ylab M nuqta $M_0M=0{,}3t^2$ tenglama bo‘yicha harakatlansa, t=2s paytdagi M nuqtaning absolut tezligini toping. Diagonalning qiyaligini α=45° deb oling. (0,851)



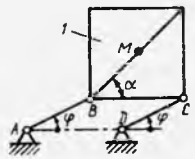
11.2.3. Qiya tekislik bo'ylab ketayotgan 1 aravachaning harakat qonuni $x_c=0,5t^2$ ga teng. Aravacha ichidagi 2 polzunning nisbiy harakat tenglamasi $y_1=1+0,05\sin 0,25\pi t$ bo'lsa, polzun M nuqtasining $t=0,1$s paytdagi absolut tezligini aniqlang. (0,107)



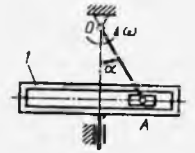
11.2.4. OA krivoship $\varphi=\pi t/3$ qonun bo'yicha aylanadi. Polzun ichidagi M nuqtaning nisbiy harakat tenglamasi $x_1=0,3+0,1\sin(\pi/6)t$ bo'lsa, $t=1$s paytagi M nuqtaning absolut tezlik miqdorini hisoblang. Mexanizm sterjenlarini o'zaro teng $OA=AB=0,25$m deb oling. (0,41)



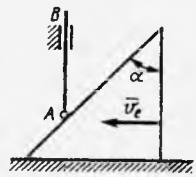
11.2.5. O'zaro teng krivoshiplar $AB=CD=0,5$m, $\varphi=0,25\pi t$ qonun bo'yicha aylanadi. Krivoshiplarga o'rnatilgan kvadrat plastina diagonali bo'ylab harakatlanayotgan M nuqtaning tenglamasi $BM=0,1t^2$ bo'lsa, $t=1$s paytdagi M nuqtaning absolut tezligini aniqlang. (0,438)



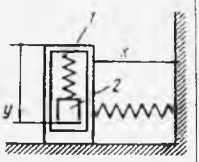
11.2.6. Uzunligi $OA=0,2$m bo'lgan krivoship O nuqta atrofida $\omega=2$rad/s burchak tezlik bilan aylanib, 1 kulisani ilgarilanma harakatga keltiradi. Burchak $\alpha=30°$ bo'lgan paytda kulisaning ilgarilanma harakat tezligini toping. (0,2)



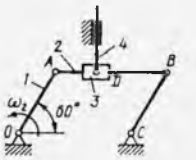
11.2.7. Gorizontal yo'lda υ_c tezlik bilan ketayotgan prizma qirrasi bo'ylab uchiga g'ildirak o'rnatilgan AB sterjen sirpanadi. Prizma qiyaligining necha gradus qiymatida A nuqtaning absolut va prizma tezliklarining qiymatlari o'zaro teng bo'ladi. ($\upsilon_c=\upsilon_A$)? (45)



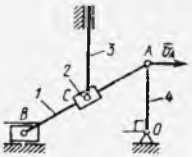
11.2.8. 1 jism gorizontal tekislikda $x=\sin\pi t$ qonun bo'yicha harakat qiladi. 2 jism esa unga nisbatan $y=\sin(\pi+\pi t)$ tenglama asosida tebranadi. $t=1$s dagi 2 jism absolut tezligini aniqlang. (4,44)



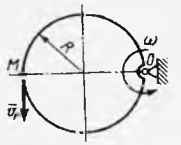
11.2.9. *OABC* sharnirli parallelogrammning 2 shatuni bo'ylab 3 halqasimon polzun (vtulka) harakat qiladi. O'z o'rnida 3 polzun 4 sterjenni harakatga keltiradi. Mexanizmning berilgan holati uchun 1 krivoship *A* nuqtasining tezligini 2m/s deb olib, 4 sterjenning tezligini toping. (1)



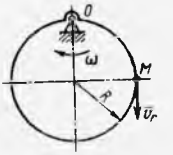
11.2.10. Krivoship-polzunli mexanizmning 1 shatuniga 2 halqasimon polzun (vtulka) o'rnatilgan bo'lib, u o'z navbatida 3 sterjenni harakatga keltiradi. Agar o'lchamlar $OA=0{,}5AB$ bo'lsa, mexanizmning berilgan holati uchun krivoship *A* nuqtasining tezligini $\upsilon_A=3$m/s hisoblab, 3 sterjenning tezligini toping. (1,73)



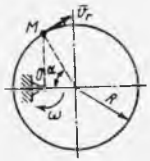
11.2.11. Radiusi $R=0{,}06$m bo'lgan disk *O* nuqta atrofida $\varphi=t$ qonun asosida aylanadi. Diskning gardishi bo'ylab *M* nuqta $\upsilon_r=0{,}04$m/s tezlik bilan harakatlansa, uning absolut tezligini hisoblang. (0,16)



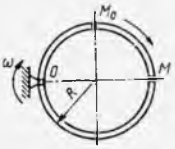
11.2.12. Radiusi $R=0{,}1$m bo'lgan disk *O* nuqta atrofida $\varphi=0{,}4t$ qonun asosida aylanadi. Diskning gardishi bo'ylab *M* nuqta $OM=0{,}3t$ tenglama bilan harakatlansa, uning absolut tezligini aniqlang. (0,342)



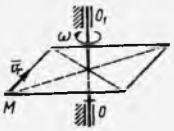
11.2.13. Radiusi R=0,04m bo'lgan disk O nuqta atrofida $\omega=0{,}5t$ burchak tezlik bilan aylanadi. Diskning gardishi bo'ylab M nuqta υ_r=0,3m/s nisbiy tezlik bilan harakat qiladi. Agar $\alpha=60°$ bo'lsa, t=2s paytdagi M nuqtaning absolut tezligini toping. (0,339)



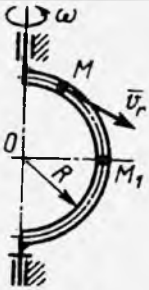
11.2.14. Radiusi R=0,1m bo'lgan halqa shakl tekisligida O nuqta atrofida o'zgarmas ω=4rad/s burchak tezlik bilan aylanadi. Halqadagi M shar esa $M_0M=0{,}1t$ qonun bo'yicha nisbiy harakat qilsa, ko'rsatilgan holat uchun M sharning absolut tezligini toping. (0,5)



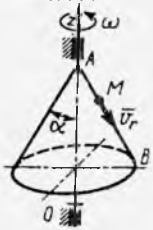
11.2.15. Kvadrat shaklidagi jism OO_1 o'q atrofida ω=3rad/s burchak tezlik bilan aylanadi. Kvadratning tomoni bo'ylab M nuqta o'zgarmas nisbiy tezlik υ_r=4m/s bilan harakat qiladi. Agar kvadratning tomoni 6m bo'lsa, M nuqtaning absolut tezligini toping. (17,5)



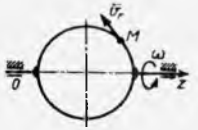
11.2.16. Radiusi R=1m bo'lgan yarim doira shaklidagi naycha ω=3rad/s burchak tezlik bilan aylanadi. Naycha ichidagi M sharcha o'zgarmas nisbiy tezlik υ_r=3m/s bilan harakatlansa, M sharchaning M_1 holatga kelgan paytdagi absolut tezligini aniqlang. (4,24)



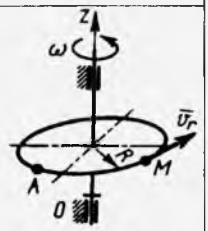
11.2.17. Konussimon jism Oz o'qi atrofida ω=3rad/s burchak tezlik bilan aylanadi. Uning yasovchisi bo'ylab M nuqta o'zgarmas υ_r=4m/s tezlikka ega bo'lgan holda A dan B ga qarab harakatlanadi. Agar $\alpha=30°$ bo'lsa, M nuqta AM=2m yo'l bosgan paytdagi uning absolut tezligini toping. (5)



11.2.18. Disk Oz o‘qi atrofida aylanadi. Uning gardishi bo‘ylab M nuqta o‘zgarmas nisbiy tezlik v_r=9m/s bilan harakatlanadi. M nuqtaning absolut tezligi 15m/s bo‘lgan paytda uning ko‘chirma tezligini toping. (12)

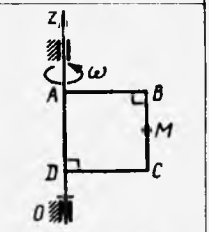


11.2.19. Radiusi R=1m bo‘lgan disk Oz o‘qi atrofida φ=4sin3t qonun bilan aylanadi. M nuqta esa diskning gardishi bo‘ylab AM=0,66sin6t+4 tenglama bo‘yicha harakatlanadi. Vaqtning t=0,35s paytda M nuqtaning absolut tezligini toping. (3,97)

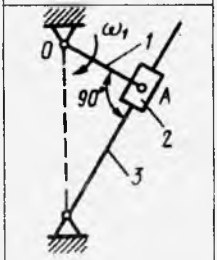


11.2.20. Konussimon jism φ=4sin0,4t qonun bo‘yicha Oz o‘qi atrofida aylanadi. Uning yasovchisi bo‘ylab AM=2t tenglama asosida harakatlanayotgan M nuqtaning t=2s paytdagi ko‘chirma tezligi miqdorini hisoblang. (2,19)

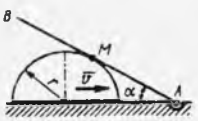
11.2.21. To‘g‘ri to‘rtburchak shaklidagi $ABCD$ plastina Oz o‘qi atrofida ω=4t burchak tezlik bilan aylanadi. Uning BC tomoni bo‘ylab M nuqta o‘zgarmas 9m/s tezlik bilan B dan C ga tomon harakatlandi. t=3s da nuqtaning absolut tezlik miqdorini toping. Bunda AB=1m deb oling. (15)



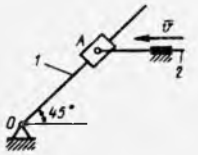
11.2.22. Uzunligi OA=0,1m bo‘lgan 1 krivoship O o‘q atrofida ω_1=5rad/s burchak tezlik bilan aylanadi. Shaklda ko‘rsatilgan holat uchun 2 polzunning 3 kulisaga nisbatan tezligini aniqlang. (0,5)



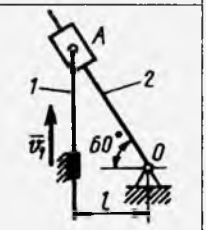
11.2.23. Yarim silindr shaklidagi jism υ=0,2m/s tezlik bilan gorizontal tekislikda harakatlanib, A nuqtasida sharnir orqali mahkamlangan AB sterjenni aylantiradi. Agar α=30° deb olinsa, sterjenning jismga tegib turgan M nuqtasining nisbiy tezligini aniqlang. (0,173)



11.2.24. Kulisali mexanizmning 2 sterjeni υ=1m/s tezlik bilan harakatlanib, 1 kulisani O nuqta atrofida aylantirsa, OA=1m holat uchun kulisaning burchak tezligini toping. (0,707)



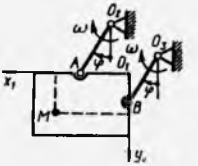
11.2.25. Kulisali mexanizmning 1 sterjeni υ_1=2m/s tezlik bilan harakatlanib, 2 kulisani O nuqta atrofida aylantirsa, berilgan holat uchun kulisaning burchak tezligini aniqlang. Bunda ℓ=40sm deb hisoblang. (1,25)



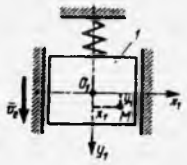
11.3. Ko‘chirma harakat ilgarilanma bo‘lgan holda nuqtaning tezlanishi

11.3.1. Arava gorizontal o‘q bo‘ylab harakatlanadi. Uning ichidagi M nuqta esa $x_1=0,3t^2$ va $y_1=0,5t^2$ tenglamalarga asosan siljiydi. Aravaning tezlanishi a_e=2m/s^2 bo‘lgan paytda nuqtaning absolut tezlanishini toping. (2,78)

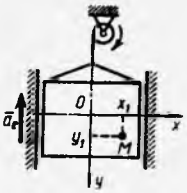
11.3.2. To‘rtburchak shaklidagi plastina uzunliklari $AO_2=BO_3$=1m bo‘lgan krivoshiplar yordamida harakatga keltiriladi. M nuqta esa plastina bo‘ylab $x_1=0,2t^3$ va $y_1=0,3t^2$ tenglama asosida harakatlanadi. Agar krivoshiplar o‘zgarmas $\omega=2\pi$ burchak tezlik bilan aylansa, t=1s paytda φ=30° holat uchun M nuqtaning absolut tezlanishini hisoblang. (38,3)



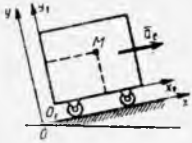
11.3.3. To'rtburchak shaklidagi plastina $\upsilon_e=(\pi/2)\sin(\pi/4)t$ tezlik bilan tebranadi. Uning yuzasi bo'ylab harakatlanayotgan M nuqtaning tenglamasi esa $x_1=0{,}2t^2$, $y_1=0{,}3t$ ga teng. Harakat boshlangandan 3s keyin M nuqtaning absolut tezlanishini aniqlang. (0,958)



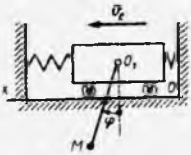
11.3.4. Lift kabinasi $a_e=5\text{m/s}^2$ o'zgarmas tezlanish bilan yuqoriga ko'tariladi. Uning ichida shakl tekisligi bo'ylab M nuqta $x_1=0{,}5t^2$ va $y_1=0{,}3t^2$ qonun bo'yicha harakat qiladi. Nuqtaning absolut tezlanishini toping. (4,51)



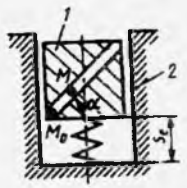
11.3.5. Arava qiya tekislikda $a_e=2\text{m/s}^2$ tezlanish bilan harakat qiladi. Aravadagi M nuqta esa shakl tekisligida $x_1=3t^2$ va $y_1=4t^2$ tenglamalar bo'yicha harakatlanadi. Nuqtaning absolut tezlanishini toping. (11,3)



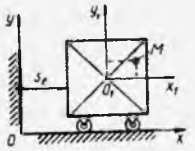
11.3.6. Arava gorizontal yo'lda $\upsilon_e=\sin(\pi/3)t$ tezlik bilan harakatlanadi. Uning markaziga mahkamlangan uzunligi $O_1M=1\text{m}$ li mayatnik $\varphi=0{,}5\pi t$ qonun bo'yicha tebranadi. Vaqtning $t=0{,}5\text{s}$ da M nuqtaning absolut tezlanishini toping. (1,93)



11.3.7. Kvadrat shaklidagi jism vertikal quvurda $s_e=-1+0{,}3\sin(\pi/3)t$ qonun bo'yicha harakat qiladi. Jism ichidagi kanalcha bo'ylab M nuqta $M_0M=0{,}1t^3$ qonun bilan harakatlanadi. Agar $\alpha=45°$ bo'lsa, nuqtaning $t=0{,}5\text{s}$ paytdagi absolut tezlanishini aniqlang. (0,484)

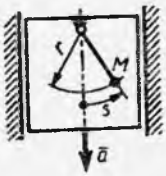


11.3.8. Arava gorizontal yo'lda $s_e=0{,}5t^3$ qonun bilan harakatlanadi. Aravadagi M nuqta esa vertikal shakl tekisligida $x_1=0{,}3t$ va $y_1=0{,}1t^2$ tenglamalar asosida harakat qiladi. $t=1$s paytdagi nuqtaning absolut tezlanishini toping. (3,01)

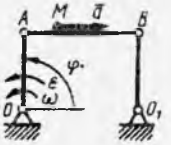


11.3.9. M nuqtaning nisbiy harakat tenglamasi $x_r=e^t$ va $y_r=2\sin t$, ko'chirma harakat tenglamasi esa $x_e=e^{-t}$ va $y_e=2\cos t$ bo'lsa, uning $t=0$ paytdagi absolut tezlanishini hisoblang. Bunda absolut va nisbiy koordinata o'qlarini o'zaro parallel deb oling. (2,83)

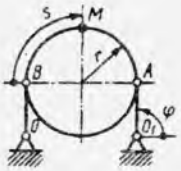
11.3.10. O'zgarmas $a=0{,}1\text{m/s}^2$ tezlanish bilan pastga tushayotgan liftdagi mayatnikning M nuqtasi $r=0{,}1$m radiusli aylananing yoyi bo'ylab $s=0{,}01\sin 10t$ qonun bo'yicha tebransa, $s=0$ holat uchun M nuqtaning absolut tezlanishini aniqlang. (0)



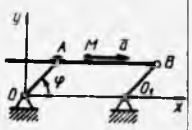
11.3.11. Uzunligi $OA=0{,}1$m bo'lgan sterjen $\omega=4$rad/s burchak tezlik va $\varepsilon=0{,}4\text{rad/s}^2$ burchak tezlanish bilan aylanib, $OABO_1$ sharnirli parallelogrammni harakatga keltiradi. M nuqta AB sterjen bo'ylab $a=0{,}4\text{m/s}^2$ tezlanish bilan harakat qiladi. M nuqtaning absolut tezlanish modulini $\varphi=0{,}5\pi$ holat uchun aniqlang. (1,64)



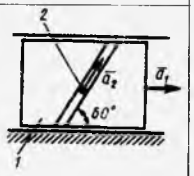
11.3.12. O_1A zveno $\varphi=2t$ qonun bilan aylanib, radiusi $r=0{,}5$m li diskni harakatga keltiradi. Diskning gardishi bo'ylab esa M nuqta $s=2rt$ tenglama asosida aylanadi. Nuqtaning $t=0{,}25\pi$ paytdagi absolut tezlanishi miqdorini toping. (4)



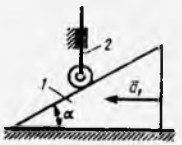
11.3.13. Uzunligi OA=2m bo'lgan sterjen φ=t qonun bilan aylanib, $OABO_1$ sharnirli parallelogrammni harakatga keltiradi. M nuqta AB sterjen bo'ylab esa a=cos$t$ tezlanish bilan harakat qilsa, M nuqtaning $t=\pi$ paytdagi absolut tezlanish miqdorini toping. (1)



11.3.14. 1 Polzun gorizontal yo'l bo'ylab o'zgarmas a_1=4m/s^2 tezlanish bilan harakat qiladi. M nuqta polzunga nisbatan a_2=3m/s^2 tezlanish bilan harakat qilsa, M nuqtaning absolut tezlanishini toping. (6,08)



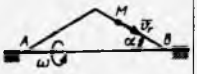
11.3.15. Uchburchak prizma 1 gorizontal tekislik bo'ylab a_1=0,6m/s^2 tezlanish bilan harakatlanadi. Uchiga g'ildirak o'rnatilgan 2 sterjen esa vertikal yuqoriga siljiydi. Agar α=30° bo'lsa, 2 sterjenning tezlanishini aniqlang. (0,346)



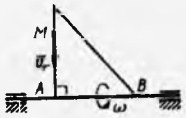
11.4. Koriolis tezlanishini aniqlash

11.4.1. Vertikal Oz o'qdan α=30° burchak ostidagi sterjen, shu o'q atrofida ω=4rad/s burchak tezlik bilan aylanadi. M nuqta esa sterjen bo'ylab, koordinata boshidan boshlab υ=2m/s tezlik bilan yuqoriga ko'tariladi. Sterjen Oyz tekisligida joylashgan paytda M nuqtaning Koriolis tezlanishining Ox o'qidagi proyeksiyasini toping. (-8)

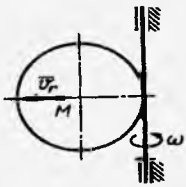
11.4.2. Uchburchak shaklidagi jism AB tomoni atrofida ω=4rad/s burchak tezlik bilan aylanadi. M nuqta esa uchburchakning tomoni bo'ylab υ_r=2m/s tezlik bilan harakatlanadi. Agar α=30° bo'lsa, M nuqtaning Koriolis tezlanishini aniqlang. (8)



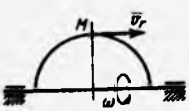
11.4.3. Uchburchak shaklidagi jism AB tomoni atrofida ω=8rad/s burchak tezlik bilan aylanadi. M nuqta esa uchburchakning AB ga perpendikular tomoni bo'ylab υ_r=4m/s nisbiy tezlik bilan harakat qiladi. M nuqtaning Koriolis tezlanishini toping. (64)



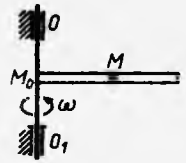
11.4.4. Vertikal o'q atrofida $\omega=2t$ burchak tezlik bilan aylanuvchi diskning diametri bo'ylab $\upsilon_r=4t$ nisbiy tezlikka ega bo'lgan M nuqta harakat qilsa, t=2s paytda M nuqtaning Koriolis tezlanishini toping. (64)



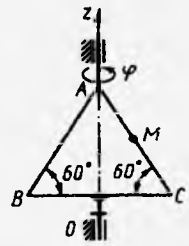
11.4.5. Yarim doira shaklidagi jism ω=4rad/s burchak tezlik bilan aylanadi. M nuqta esa uning yoyi bo'ylab $\bar{\upsilon}_r$ tezlik bilan harakat qilsa, M nuqtaning Koriolis tezlanishini toping. (0)



11.4.6. Naycha OO_1 o'q atrofida ω=1,5rad/s burchak tezlik bilan aylanadi. Uning ichida M nuqta $M_0M=4t$ qonun bo'yicha harakat qilsa, nuqtaning Koriolis tezlanishini aniqlang. (12)

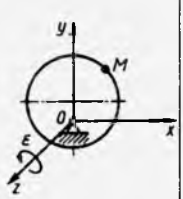


11.4.7. Teng tomonli uchburchak shaklidagi ABC jism Oz o'qi atrofida $\varphi=5t^2$ qonun bo'yicha aylanadi. Agar M nuqta $AM=4t^3$ tenglamaga asosan harakatlansa, t=0,5s paytdagi nuqtaning Koriolis tezlanishini toping. (15)



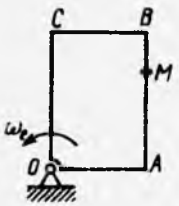
11.4.8. Radiusi R=0,4m bo'lgan disk Oz o'qi atrofida $\varphi=4\sin 0{,}25\pi t$ qonun bo'yicha aylanadi. Uning gardishi bo'ylab M nuqta $AM=0{,}25\pi Rt^2$ tenglama bilan harakatlansa, t=1s paytda nuqtaning Koriolis tezlanishini toping. (1,98)

11.4.9. Ekssentrikka ega bo'lgan disk Oz o'qi atrofida tinch holatdan tekis tezlanuvchan $\varepsilon=3\text{rad/s}^2$ burchak tezlanish bilan aylanadi. Uning gardishi bo'ylab M nuqta 0,1m/s tezlik bilan harakatlansa, t=3s paytdagi nuqtaning Koriolis tezlanishini aniqlang. (1,8)

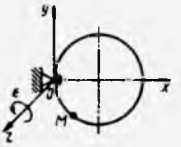


11.4.10. Doiraviy disk Oz o'qi atrofida $\varphi=1{,}28\sin\pi t$ qonun bo'yicha aylanadi. Uning gardishi bo'ylab M nuqta $AM=15t^2$ tenglama bilan harakat qilsa, t=1/3s paytda nuqtaning Koriolis tezlanishini toping. Ox va Oy o'qlari disk tekisligida joylashgan deb olinsin. (40,2)

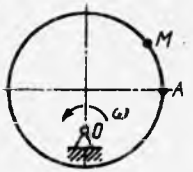
11.4.11. To'rtburchak shaklidagi plastina shakl tekisligida O nuqta atrofida aylanadi. M nuqta AB qirrasi bo'ylab $AM=3\sin(\pi/3)t$ qonun bo'yicha harakatlanadi. Agar t=2sek da M nuqtaning Koriolis tezlanishi $4\pi(\text{m/s}^2)$ bo'lsa, plastinaning ω_e ko'chirma burchak tezligini toping. (4)



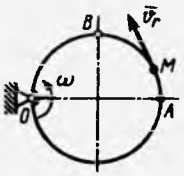
11.4.12. Disk Oz o'qi atrofida $\varepsilon=2\text{rad/s}^2$ burchak tezlanish bilan aylanadi. Uning gardishi bo'ylab M nuqta harakat qiladi. Agar diskning boshlang'ich burchak tezligi 3rad/s bo'lsa, t=1s paytdagi M nuqtaning Koriolis tezlanishi 20m/s^2 bo'lishi uchun uning nisbiy tezligi qancha bo'lishi lozim? (2)



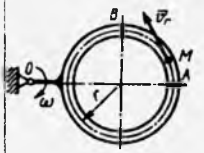
11.4.13. Ekssentrikka ega bo'lgan disk shakl tekisligida tekis aylanadi. Uning gardishi bo'ylab M nuqta $AM=4t^2$ qonun bilan harakat qiladi. $t=1$s paytda M nuqta Koriolis tezlanishi 24m/s^2 ga teng bo'lishi uchun disk qanday o'zgarmas burchak tezlikka ega bo'ladi? (1,5)



11.4.14. Shakl tekisligida $\omega=2$rad/s burchak tezlik bilan aylanuvchi diskning gardishi bo'ylab M nuqta $\upsilon_r=0{,}2$m/s nisbiy tezlik bilan harakat qiladi. M nuqta A holatdan B holatga o'tgan bo'lsa, uning Koriolis tezlanishining miqdori o'zgaradimi? (Yo'q)



11.4.15. Radiusi $r=0{,}5$m bo'lgan halqa shakl tekisligida Oz o'q atrofida $\omega=$const burchak tezlik bilan aylanadi. M nuqta esa halqa bo'ylab $\upsilon_r=$const nisbiy tezlik bilan harakat qiladi. Agar nuqta A holatdan B holatga o'tsa, uning Koriolis tezlanishining miqdori o'zgaradimi? (Yo'q)

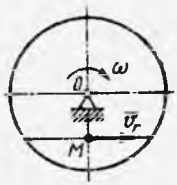


11.5. Murakkab harakatdagi nuqtaning tezlanishi

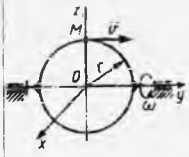
11.5.1. M nuqta koordinata boshidan sterjen bo'ylab harakatni boshlaydi. Uning tezligi o'zgarmas υ=1m/s ga teng. Sterjen esa o'zgarmas ω=2rad/s burchak tezlik bilan Oxy tekisligida aylanadi. M nuqtaning OM=0,5m paytdagi tezlanishini aniqlang. (4,47)

11.5.2. Radiusi r=0,5m bo'lgan halqa shakl tekisligida o'zgarmas ω=4rad/s burchak tezlik bilan aylanadi. M nuqta esa halqa bo'ylab o'zgarmas υ=2m/s tezlik bilan harakat qiladi. Ko'rsatilgan holat uchun M nuqtaning absolut tezlanishini toping. (40)

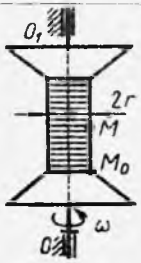
11.5.3. Disk shakl tekisligida O o'qi atrofida ω=0,5rad/s burchak tezlik bilan aylanadi. Uning vatari bo'ylab M nuqta υ_r=0,5t nisbiy tezlik bilan harakat qiladi. Agar t=2s paytda OM=0,02m bo'lsa, M nuqtaning absolut tezlanishini toping. (1,11)



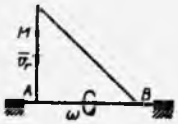
11.5.4. Oy o'qi atrofida o'zgarmas ω=4rad/s burchak tezlik bilan aylanayotgan halqa bo'ylab M nuqta o'zgarmas υ=2m/s tezlik bilan harakat qiladi. Agar halqaning radiusi r=0,5m bo'lsa, ko'rsatilgan holat uchun M nuqtaning absolut tezlanishini toping. (16)



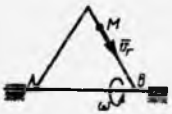
11.5.5. Radiusi r=0,02m bo'lgan g'altak OO_1 o'q atrofida ω=2rad/s burchak tezlik bilan aylanadi. M nuqta esa g'altakning chekkasi bo'ylab M_OM=0,04t^2 qonun bo'yicha harakatlanadi. M nuqtaning absolut tezlanishini hisoblang. (0,113)



11.5.6. Uchburchak shaklidagi jism AB tomoni atrofida ω burchak tezlik bilan aylanadi. M nuqta esa uning tomoni bo'ylab υ_r=3t^2 nisbiy tezlik bilan harakatlanadi. Nuqtaning t=2s paytdagi nisbiy tezlanishini aniqlang. (12)

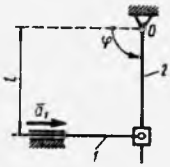


11.5.7. Uchburchak shaklidagi jism AB tomoni atrofida ω burchak tezlik bilan aylanadi. M nuqta esa, uchburchakning tomoni bo'ylab υ_r=2sin4t nisbiy tezlik bilan harakatlanadi. Nuqtaning t=π/8s paytdagi nisbiy tezlanishini hisoblang. (0)

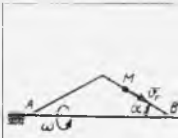


11.5.8. Disk Oz o'qi atrofida aylanadi. M nuqta esa υ_r=4t^3 nisbiy tezlik bilan diskning diametri bo'ylab harakatlanadi. Nuqtaning t=1s paytdagi nisbiy tezlanishini toping. (12)

11.5.9. Kulisali mexanizmning 1 sterjeni o'zgarmas a_1=2m/s^2 tezlanish bilan harakatlanadi. Agar ℓ=0,5m va φ=90° bo'lsa, 2 kulisaning burchak tezlanishini hisoblang. (4)



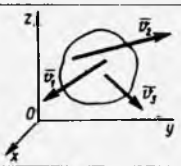
11.5.10. Uchburchak shaklidagi jism AB tomoni atrofida o‘zgarmas ω=4rad/s burchak tezlik bilan aylanadi. Uning bir tomoni bo‘ylab M nuqta υ_r nisbiy tezlikka ega bo‘lsa, MB=0,5m bo‘lgan paytda M nuqtaning ko‘chirma tezlanishini aniqlang. Bunda α=30°. (4)



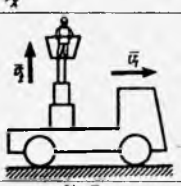
12.1. Ilgarilanma harakatlarni qo‘shish

12.1.1. Jism $\vec{v}_1=5\vec{i}+2\vec{j}$ va $\vec{v}_2=-2\vec{i}+3\vec{j}$ tezliklar bilan ikkita ilgarilanma harakatda ishtirok etadi. Uning absolut tezligini toping. (5,83)

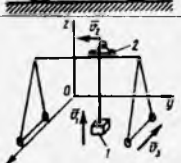
12.1.2. Jism $\vec{v}_1=4\vec{i}-3\vec{j}+\vec{k}$, $\vec{v}_2=-6\vec{i}+5\vec{j}+3\vec{k}$, $\vec{v}_3=2\vec{i}+2\vec{j}-\vec{k}$ tezliklar bilan uchta ilgarilanma harakatda ishtirok etadi. Uning absolut tezligini toping. (5)



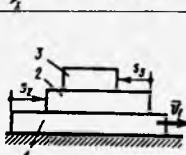
12.1.3. Avtomobil v_1=3,6km/soat tezlik bilan harakatlanadi. Unga o‘rnatilgan moslama v_2=0,5m/s tezlik bilan yuqoriga ko‘tariladi. Moslama ichida tinch turgan ishchining absolut tezligini toping. (1,12)



12.1.4. Chorpoyali kran v_3=0,2 m/s tezlik bilan harakat qiladi. Uning ustida esa aravacha v_2=0,3 m/s tezlik bilan yurib, 1 yukni v_1=0,4m/s tezlikda yuqoriga tortadi. Yukning absolut tezligini toping. (0,539)

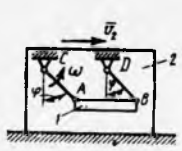


12.1.5. Uchta jism ilgarilanma harakatlarda ishtirok etadi. 1 jism v_1=3m/s tezlik bilan, 2 va 3 jismlar esa $s_2=2t^2$ va $s_3=3t^2$ qonun bo‘yicha harakat qiladi. t=1s paytda 3 jismning absolut tezligini hisoblang. (1)

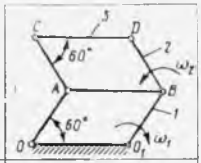


12.1.6. Radiuslari R=0,25m bo‘lgan bir-biriga AA_1 richag (koromislo) yordamida bog‘langan g‘ildiraklar v=36km/soat tezlik bilan harakatlanadi. $_1A_1=O_2A_2$=O,2m bo‘lgan kesimlar vertikal joylashgan paytda AA_1 richag (koromislo)ning absolut tezligini toping. (18)

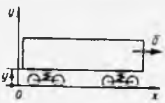
12.1.7. 1 jism 2 jismga nisbatan $AC=BD$=3m. sterjenlarga sharnirli bog‘langan holda harakat qiladi. Agar sterjenlar ω=1,5rad/s burchak tezlik bilan aylansa, 2 jismni mg gorizantal tekislik bo‘ylab tezligini v_2=10m/s deb, $\varphi=45^\circ$ holat uchun 1 jismning absolut tezligini toping. (13,6)



12.1.8. Sharnirli bog'langan, parallelogrammlar shaklidagi mexanizmning 1 va 2 zvenolari uzunligi 0,5m bo'lib, $\omega_1=\omega_2=2$rad/s absolut burchak tezlik bilan aylanadi. Ko'rsatilgan holat uchun 3 zvenoning ilgarilanma harakatdagi tezligini toping. (1)



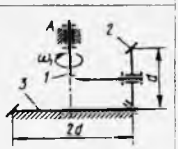
12.1.9. O'zgarmas $a=1$m/s^2 tezlanish bilan ketayotgan vagonning kuzovi $y=1+0{,}02\sin 2\pi t$ qonun bilan vertikal tekislikda tebranadi. Ikkita ilgarilanma harakatda qatnashayotgan kuzovning absolut tezlanishini hisoblang. (1,27)



12.2. Kesishuvchi o'qlar atrofida aylanuvchi jism harakatlarini qo'shish

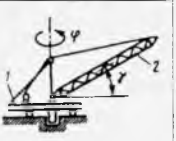
12.2.1. Jism bir vaqtning o'zida $\vec{\omega}_1=2\vec{i}+5\vec{j}$ va $\vec{\omega}_2=4\vec{i}+3\vec{j}$ burchak tezliklar bilan ikkita kesishuvchi o'qlar atrofida aylanma harakatda ishtirok etadi. Uning absolut burchak tezligini aniqlang. (10)

12.2.2. 1 bukilgan o'q A sharnir atrofida $\omega = 6$ rad/s burchakli tezlik bilan aylanadi. 2 tishli g'ildirak esa 3 qo'zg'almas tishli g'ildirakka bog'langan holda, 1 o'q atrofida erkin aylanadi. 2 g'ildirakning absolut burchak tezligini toping. (13,4)

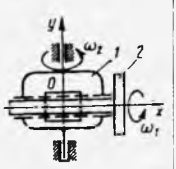


12.2.3. 1 disk ikkita aylanma harakatda ishtirok etadi. Birinchidan disk 2 dastak o'z o'qi atrofida 300ayl/min chastota bilan, 2 dastak esa 3 podshipnik atrofida $\omega_2=10$rad/s burchak tezlik bilan aylanadi. Diskning absolut burchak tezligini toping. (33,0)

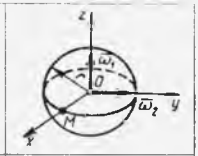
12.2.4. Ko'tarish kranining asosi 1 o'z o'qi atrofida $\varphi=0{,}2t$ qonun bo'yicha aylanadi. Uning qulochi (strelasi) esa $d\gamma/dt=0{,}3$ rad/s burchak tezlik bilan ko'tariladi. Kran qulochining absolut burchak tezligining qiymatini hisoblang. (0,361)



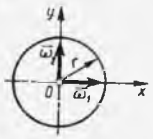
12.2.5. Mexanizmning g'ilofi 1 o'z o'qi atrofida $\omega_2=4$rad/s burchak tezlik bilan aylanadi. Mexanizmning vali 2 esa g'ilofga nisbatan $\omega_1=2$rad/s burchak tezlik bilan aylanadi. Mexanizm valining absolut burchak tezlik vektori va Ox o'qi orasidagi burchakning kosinusini aniqlang. (0,447)



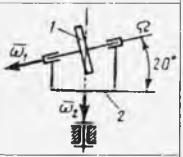
12.2.6. Radiusi r=0,5m bo'lgan sferik qobiq bir vaqtning o'zida ikkita aylanma harakatda ishtirok etadi. Bu aylanishlar ω_1=3rad/s va ω_2=4rad/s burchak tezliklarga teng bo'lsa, ko'rsatilgan holat uchun qobiqning M nuqtasi tezligi modulini toping. (2,5)



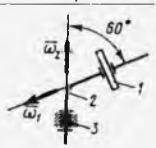
12.2.7. Radiusi r=0,5m bo'lgan disk bir vaqtining o'zida ikkita aylanma harakatda ishtirok etadi. Bu aylanishlarning burchak tezliklari ω_1=ω_2=2rad/s bo'lsa, disk nuqtalarning moduli eng maksimal bo'lishi mumkin bo'lgan tezligini toping. (1,41)



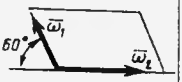
12.2.8. Disk 1 bir vaqtning o'zida vertikal va Ω o'qlar atrofida ω_1=20rad/s va ω_2=10rad/s burchak tezliklar bilan aylanadi. Disk absolut burchak tezligining miqdorini toping. (25,2)



12.2.9. Disk 1 bir vaqtning o'zida qiya joylashgan o'q 2 va 3 podshipnikka o'rnatilgan o'q atrofida aylanadi. Agar aylanishlarning burchak tezliklari ω_1=4rad/s va ω_2=4rad/s bo'lsa, diskning absolut burchak tezligi miqdorini hisoblang. (4)



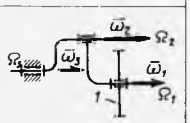
12.2.10. Parallelogramm shaklidagi plastinka bir vaqtning o'zida ikkita aylanma harakatda ishtirok etadi. Agar burchak tezliklari ω_1=2rad/s va ω_2=4rad/s bo'lsa, disk absolut burchak tezligi vektori va $\vec{\omega}_2$ orasidagi burchak necha gradus bo'ladi? (30)



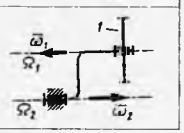
12.3. Parallel o'qlar atrofida aylanuvchi qattiq jism harakatlarini qo'shish

12.3.1. Jism bir vaqtning o'zida ikkita parallel o'qlar atrofida aylanadi. Aylanishlar burchak tezliklari bir tomonga yo'nalgan vektorlar ω_1=2 rad/s va ω_2=3 rad/s bo'lsa, jism harakatining absolut burchak tezligi qiymatini toping. (5)

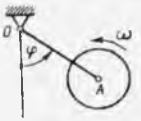
12.3.2. G'ildirak 1 bir vaqtning o'zida uchta parallel 1, 2, 3 o'qlar atrofida ω_1=5rad/s, ω_2=4 rad/s va ω_3=3rad/s burchak tezliklar bilan aylansa, uning absolut burchak tezlik qiymati qancha bo'ladi? (12)



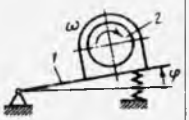
12.3.3. G'ildirak 1 bir vaqtning o'zida ikkita 1 va 2 parallel o'qlar atrofida ω_1=4 rad/s va ω_2=3rad/s burchak tezliklar bilan aylansa, uning absolut burchak tezligining qiymatini toping. (1)



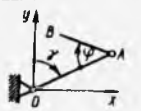
12.3.4. Mexanizmning g'ildiragi bir vaqtning o'zida o'z o'qi atrofida $\omega=3$rad/s burchak tezlik bilan, OA krivoshipga bog'langan holda $\varphi=\cos 2t$ qonun bo'yicha aylanadi. G'ildirakning absolut burchak tezligining $t=2$s vaqtdagi qiymatini toping. (4,51)



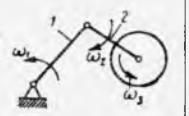
12.3.5. Dvigatelning 2 rotori $\omega=7$rad/s burchak tezlik bilan o'z o'qi atrofida aylanadi. Bundan tashqari dvigatel ham 1 platformaga mahkamlangan holda $\varphi=0,1\sin 10\pi t$ qonun bo'yicha harakatlanadi. Rotorning absolut burchak tezligining maksimal qiymatini toping. (10,1)



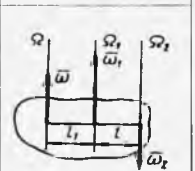
12.3.6. Tekis mexanizmning ikki sterjeni $\varphi=0,2t$ va $\gamma=0,1t^2$ qonunlar bo'yicha aylanasa, AB sterjenning absolut burchak tezligining $t=2$s paytdagi qiymatini toping. (1,2)



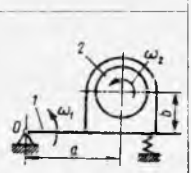
12.3.7. Tekis mexanizmning diski 2 sterjenga nisbatan $\omega_3=2$ rad/s burchak tezlik bilan, 2 sterjen esa o'z navbatida 1 sterjenga nisbatan $\omega_2=4$ rad/s burchak tezlik bilan aylansa, 1 sterjen burchak tezligi ω_1 ning qanday qiymatida diskning absolut harakati ilgarilanma harakatdan iborat bo'ladi? (2)



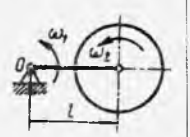
12.3.8. Jism bir vaqtning o'zida ikkita aylanma harakatda ishtirok etadi. 1 va 2 o'qlar atrofida aylanish burchak tezliklari $\omega_1=4$rad/s va $\omega_2=2$rad/s bo'lsa, jismning absolut burchak tezligi vektori $\overline{\Omega}$ ва $\overline{\Omega}_1$ aylanish oniy o'qi qancha $\ell_1(sm)$ masofada joylashgan? Bunda $\ell = 50sm$. (50)



12.3.9. Dvigatelning 2 rotori o'z o'qi atrofida ω_2 burchak tezlik bilan aylanadi. 1 Platforma esa O nuqta atrofida ω_1 burchak tezlik bilan aylanma harakatda bo'ladi. Agar $\omega_1=\omega_2$ bo'lib, o'lchamlari $a=40$ sm va $b=30$sm bo'lsa, O nuqtadan dvigatel rotori aylanish oniy o'qigacha bo'lgan masofani toping (sm). (25)



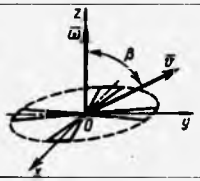
12.3.10. Uzunligi $\ell=0,5$m bo'lgan sterjen $\omega_1=4$ rad/s burchak tezlik bilan aylanadi. Uning o'qiga o'rnatilgan disk esa sterjenga nisbatan $\omega_2=2$rad/s burchak tezlik bilan aylanadi. O nuqtadan diskning aylanish oniy o'qigacha bo'lgan masofani toping. (0,127)



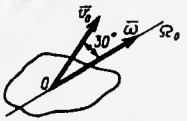
12.4. Qattiq jismning harakatlarini umumiy holatda qo‘shish

12.4.1. Jism υ=7m/s tezlik bilan ilgarilanma va ω burchak tezlik bilan aylanma harakat qilsa, $\bar{v}$ va $\bar{\omega}$ vektorlar orasidagi burchakni 70° deb, kinematik vint ilgarilanma harakati tezligining miqdorini aniqlang. (2,39)

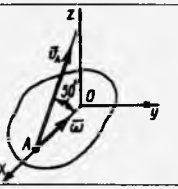
12.4.2. Vertolyotning tezligi υ=12m/s bo‘lib, uning tezlik vektori va vintining burchak tezlik vektori $\bar{\omega}$ orasidagi burchak β=80° ni tashkil qiladi. Vintning murakkab harakati kinematik vintga keltiriladi. Kinematik vint ilgarilanma tezligini hisoblang. (2,08)



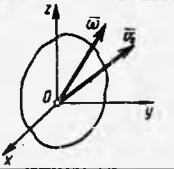
12.4.3. Qutb nuqta tezlik vektori $\bar{v}_0$ va burchak tezlik vektori $\bar{\omega}$ orasidagi burchak 30° ni tashkil etadi. Agar υ_0=6m/s va ω=6rad/s bo‘lsa, o‘qdan kinematik vint o‘qigacha bo‘lgan masofani toping. (0,5)



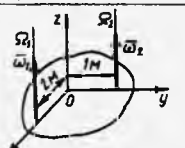
12.4.4. Jism murakkab harakatda bo‘lib, qutb nuqtasi υ_A=2m/s tezlikka, aylanish burchak tezligi ω=0,7 rad/s bo‘lsa, *Oxy* tekislik va kinematik vint o‘qi orasidagi masofani toping. (2,19)



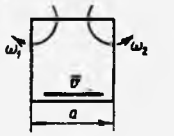
12.4.5. Erkin harakatdagi jismning qutb nuqtasining tezligi $\vec{\upsilon}_0=5\vec{i}+6\vec{j}+7\vec{k}$, qutb atrofidagi aylanishidagi burchak tezligi $\vec{\omega}=\vec{i}-2\vec{j}+3\vec{k}$ bo‘lsa, jism kinematik vint harakatidagi ilgarilanma tezlikning modulini toping.

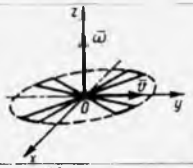
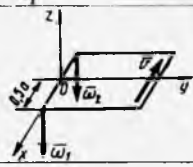
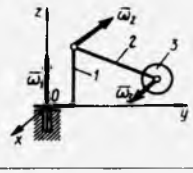


12.4.6. Jism bir vaqtning o‘zida ikkita aylanma harakatda ishtirok etadi. 1 va 2 parallel o‘qlar atrofida aylanma harakat burchak tezligi ω_1=1 rad/s va ω_2=3 rad/s bo‘lsa, jism O nuqtasining absolut tezligi modulini aniqlang. (3,74)



12.4.7. Tomoni a=0,5m bo‘lgan kvadrat plastina bir vaqtning o‘zida υ=3m/s tezlik bilan ilgarilanma va $\omega_1=\omega_2$=4 rad/s burchak tezliklar bilan aylanma harakatda ishtirok etadi. Plastinaning absolut ilgarilanma harakat tezligini toping. (3,61)



12.4.8. Vertolyotning tezligi υ=12m/s bo'lib, uni harakatga keltiruvchi vint ω=15 rad/s burchak tezlikka teng. Vertolyot vinti aylanish oniy o'qi bilan Oxy tekisligining kesishish nuqtasining x koordinatasini toping. (-0,8)	
12.4.9. Tomoni a=1m bo'lgan kvadrat plastina υ=4m/s tezlik bilan bitta ilgarilanma va $\omega_1=\omega_2$=2 rad/s burchak tezliklar bilan ikkita aylanma harakatlarda ishtirok etadi. Jismning O nuqtasidan plastina aylanishi oniy o'qigacha bo'lgan masofani hisoblang. (1)	
12.4.10. Mexanizmning 3 diski 2 dastakka nisbatan ω_3=0,5rad/s burchak tezlik bilan, 2 dastak esa 1 dastakka nisbatan ω_2=0,2 rad/s burchak tezlik va 1 dastakning burchak tezligi ω_1=0,1rad/s bilan aylansa, $\overline{\omega}_2 \parallel \overline{\omega}_3 \parallel Ox$ deb, 3 disk absolut burchak tezligining qiymatini toping. (0,316)	

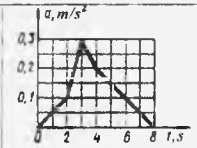
DINAMIKA

XIII BOB. NUQTA DINAMIKASI

13.1. Berilgan harakat qonuni bo'yicha kuchlarni aniqlash

13.1.1. Massasi m=4kg bo'lgan moddiy nuqta gorizontal tekislikdagi to'g'ri chiziq bo'ylab $a=0{,}3t$ tezlanishi bilan harakatlanmoqda. Nuqtaga ta'sir etayotgan kuchning qiymatini t=3s da aniqlang. (3,6)

13.1.2. Massasi m=27kg bo'lgan moddiy nuqta to'g'ri chiziq bo'ylab $a=a(t)$ tezlanish bilan harakatlanadi. Nuqtaga ta'sir etayotgan kuchlar bosh vektorining qiymatini t=5s da toping. (4,05)



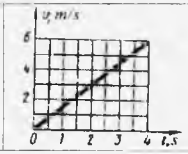
13.1.3. Massasi m=0,5kg bo'lgan jism qiya tekislikda joylashgan kanalcha bo'ylab pastga $a=2\text{m/s}^2$ tezlanish bilan tushishi uchun tekislikning qiyaligi gorizontdan necha gradus bo'lishi shart? (11,8)

13.1.4. Massasi m=14kg bo'lgan moddiy nuqta gorizontal Ox o'qi bo'ylab $a=\ln t$ tezlanish bilan harakat qilmoqda. Vaqtning t=5s da harakat yo'nalishi bo'yicha ta'sir etayotgan kuchning miqdori aniqlansin. (22,5)

13.1.5. Gorizontal yo'lda $a=1\text{m/s}^2$ tezlanish bilan harakatlanayotgan traktor massasi m=600 kg bo'lgan chanani tortadi. Agar chananing qor ustida sirpanish koeffitsiyenti f=0,04 bo'lsa, traktor chanani qanday kuch bilan tortishini hisoblang. (835)

13.1.6. Massasi m=50kg bo'lgan jism $a=0{,}5\text{m/s}^2$ tezlanish bilan sim arqon yordamida vertikal yuqoriga tortilsa, sim arqonning taranglik kuchini toping. (516)

13.1.7. Massasi m=24kg bo'lgan moddiy nuqta to'g'ri chiziq bo'ylab $\upsilon=\upsilon(t)$ tezlik bilan harakatlansa, teng ta'sir etuvchi kuchning miqdorini toping. (36)



13.1.8. Massasi m=12kg bo'lgan moddiy nuqta to'g'ri chiziq bo'ylab $\upsilon=e^{0,1t}$ tezlik bilan harakat qiladi. Vaqtning t=50s da teng ta'sir etuvchi kuchning miqdorini aniqlang. (178)

13.1.9. Massasi m=3kg bo'lgan moddiy nuqta to'g'ri chiziq bo'ylab $x=0,04t^3$ qonun bilan harakat qilsa, t=6s da teng ta'sir etuvchi kuchning miqdori qancha bo'ladi? (4,32)

13.1.10. Massasi m=1,4kg bo'lgan moddiy nuqta to'g'ri chiziq bo'ylab $x=6t^2+6t+3$ qonuni bilan harakat qilsa, teng ta'sir etuvchi kuchning miqdorini toping. (16,8)

13.1.11. Massasi m=10kg bo'lgan moddiy nuqta Ox o'qi bo'ylab $x=5\sin 0,2t$ qonun bilan harakat qilsa, t=7s vaqtdagi teng ta'sir etuvchi kuchning miqdorini aniqlang. (1,97)

13.1.12. Massasi m=2kg li M jism $\overline{F}$ kuchi ta'sirida $x=10\sin 2t$ qonun bilan to'g'ri chiziqli harakatlanadi. $\overline{F}$ kuchining eng katta miqdorini hisoblang. (80)

13.1.13. Massasi m=6kg bo'lgan moddiy nuqta Oxy tekislikda $\bar{a}=3\bar{i}+4\bar{j}$ tezlanish bilan harakatlanadi. Ta'sir etuvchi kuchlar bosh vektorining miqdori qancha bo'ladi? (30)

13.1.14. Massasi m bo'lgan moddiy nuqta Oxy tekislikda $x=bt$; $y=ct$ (b,c - o'zgarmas miqdorlar) qonun bilan harakatlansa, unga ta'sir etayotgan kuchlar bosh vektorining miqdorini aniqlang. (0)

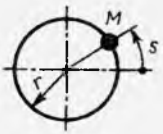
13.1.15. Massasi m=7kg bo'lgan moddiy nuqta Oxy tekislikda $\bar{\upsilon}=0,4t\bar{i}+0,5t\bar{j}$ tezlik bilan harakatlanadi. Nuqtaga harakat tekisligida ta'sir etuvchi kuchning modulini toping. (4,48)

13.1.16. Massasi m=9kg bo'lgan moddiy nuqta Oxy tekislikda $\vec{r}=0{,}6t^2\vec{i}+0{,}5t^2\vec{j}$ radius-vektor bo'yicha harakat qiladi. Nuqtaga ta'sir etuvchi barcha kuchlarning teng ta'sir etuvchisining modulini hisoblang. (14,1)

13.1.17. Massasi m=8kg bo'lgan moddiy nuqta Oxy tekislikda $x=0{,}05t^3$ va $y=0{,}3t^2$ qonun bilan harakat qiladi. Nuqtaga ta'sir etuvchi kuchlarning teng ta'sir etuvchisini t=4s dagi miqdorini aniqlang. (10,7)

13.1.18. Massasi m=16kg bo'lgan moddiy nuqta radiusi R=9m aylana bo'ylab o'zgarmas tezlik υ=0,8 m/s bilan harakatlanmoqda. Unga ta'sir qilayotgan kuchlar teng ta'sir etuvchisining trayektoriyaga bosh normal o'qiga proyeksiyasini hisoblang. (1,14)

13.1.19. Massasi m=1,2kg bo'lgan M moddiy nuqta radiusi r=0,6m aylana bo'ylab $s=2{,}4t$ qonun bo'yicha harakat qiladi. Unga ta'sir etuvchi kuchlarning teng ta'sir etuvchisini miqdorini aniqlang. (11,5)



13.1.20. Massasi m=18kg bo'lgan moddiy nuqta radiusi R=8m aylana bo'ylab $s=e^{0,3t}$ qonun bo'yicha harakat qiladi. t=10s da nuqtaga ta'sir qiluvchi kuchlarning teng ta'sir etuvchisining urinma tashkil etuvchisi nimaga teng? (32,5)

13.1.21. Massasi m=20kg bo'lgan moddiy nuqta radiusi R=6m aylana bo'ylab $s=\ln t$ qonun bo'yicha harakat qiladi. Nuqtaga ta'sir qiluvchi kuchlarning bosh vektorining normal tashkil etuvchisi, t=0,5s da qancha bo'ladi? (13,3)

13.1.22. Massasi m=14kg bo'lgan moddiy nuqta radiusi R=7m aylana bo'ylab $a_\tau=0{,}5\text{m/s}^2$ urinma tezlanish bilan harakatlanadi. Unga teng ta'sir etuvchi kuchlarning modulini t=4s da quyidagi boshlang'ich shartlarga bog'liq ravishda toping: t_0=0 da υ_0=0. (10,6)

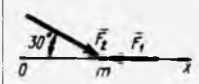
13.1.23. Massasi m=1 kg bo'lgan moddiy nuqta radiusi r=2m li aylana bo'ylab $\upsilon=2t$ tezlik bilan harakatlanadi. t=1s da ta'sir etuvchi kuchlarning bosh vektori qiymatini hisoblang. (2,83)

13.1.24. Massasi m=22kg bo'lgan moddiy nuqta radiusi R=10m li aylana bo'ylab $s=0{,}3t^2$ qonuni bilan aylanadi. t=5s da, shu nuqtaga ta'sir etuvchi kuchning modulini toping. (23,8)

13.2. Berilgan kuchlar bo'yicha nuqtaning to'g'ri chiziqli harakatini aniqlash

13.2.1. Gorizontga α=25° burchak ostida joylashgan silliq qiya tekislikdan tushayotgan og'ir jismning tezlanishini toping. (4,15)

13.2.2. Massasi m=5kg bo'lgan moddiy nuqta F_1=3N va F_2=10N kuchlar ta'sirida harakatlanadi. Nuqta tezlanishining Ox gorizontal o'qqa proyeksiyasini hisoblang. (1,13)

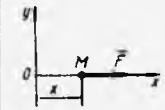


13.2.3. Og'ir jism gorizontga α=40° qiyalikdagi g'adir-budur tekislikdan pastga harakat qiladi. Agar sirpanishdagi ishqalanish koeffitsiyenti f=0,3 bo'lsa, jismning tezlanishini aniqlang. (4,05)

13.2.4. Massasi m=9kg bo'lgan moddiy jism fazoda $\vec{F}=5\vec{i}+6\vec{j}+7\vec{k}$ kuch ta'sirida harakatlanadi. Nuqtaning tezlanishini hisoblang. (1,17)

13.2.5. Massasi m=200 kg bo'lgan motorli qayiq motori o'chirilgandan keyin suvning qarshiligini yengib, to'g'ri chiziqli harakat qiladi. Agar suvning qarshiligi $R=4\upsilon^2$ bo'lsa qayiqning tezligi υ=5m/s bo'lgan paytda qayiqning sekinlanishi (tezlanishi) ni toping. (-05)

13.2.6. Massasi m bo'lgan M moddiy nuqta gorizontal Ox o'q bo'ylab $F=2m(x+1)$ kuch ta'sirida harakatlanadi. Nuqtaning x=0,5 metr yo'l bosib o'tgandagi tezlanish qiymatini toping. (3)



13.2.7. Massasi m=200kg bo'lgan moddiy nuqta gorizontal tekislikda joylashgan. Unga vertikal ko'taruvchi $F=10t^2$ kuch ta'sir qilsa, qancha t vaqtdan keyin u harakatini boshlaydi? (14,0)

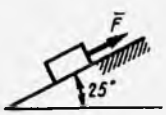
13.2.8. Massasi m=20kg bo'lgan jism vertikal pastga tushadi. Havoning qarshiligi $R=0{,}04\upsilon^2$ bo'lsa, uning maksimal tushish tezligini hisoblang. (70,0)

13.2.9. Massasi m=1kg bo'lgan jism tinch holatdan qiyaligi α=20° tekislik bo'ylab pastga harakat qiladi. Agar qarshilik kuchi R=0,08υ bo'lsa, jismning maksimal tezligini toping. (41,9)

13.2.10. Massasi m=50kg bo'lgan moddiy nuqta silliq gorizontal yo'naltiruvchi bo'ylab F=50N li kuch ta'sirida tinch holatdan harakatga keladi. Agar ta'sir etuvchi kuch vektori gorizont bilan α=20° burchak tashkil etsa, nuqta t=20s da qancha yo'l bosib o'tadi? (188)

13.2.11. Tinch holatda bo'lgan moddiy nuqta qiyaligi α=10° li silliq sirt bo'ylab pastga tushmoqda. Qancha vaqtda nuqta 30m masofani bosib o'tadi? (5,93)

13.2.12. Massasi m=200kg bo'lgan jism qiyaligi α=25° bo'lgan silliq yo'lda F=1KN kuch ta'sirida yuqoriga ko'tariladi. Qancha vaqtda u 8m masofani bosib o'tishi mumkin? (4,33)



13.2.13. Massasi m=900kg bo'lgan moddiy nuqta gorizontal tekislikdagi shu yo'nalishga ega bo'lgan kuch F=270t ta'sirida harakatlanmoqda. Agar boshlang'ich paytda, t_0 =0 da, υ_0=10m/s bo'lsa, 10 s vaqt o'tgandan keyin uning tezligi qancha bo'ladi? (25)

13.2.14. Massasi m=25 kg bo'lgan moddiy nuqta gorizontal tekislikda to'g'ri chiziq bo'ylab, shu yo'nalishdagi F=20t kuch ta'sirida tinch holatdan harakat qiladi. 4 sekundda nuqta qancha masofa bosib o'tadi. (8,53)

13.2.15. Massasi m=100kg bo'lgan moddiy nuqta gorizontal to'g'ri chiziq bo'ylab F=10t kuch ta'sirida harakat qiladi. Qancha vaqtda uning tezligi 5m/s dan 25m/s ga o'zgaradi. (20)

13.2.16. Massasi m=12 kg bo'lgan jism gorizontal tekislikda to'g'ri chiziq bo'ylab, shu yo'nalishdagi F=0,6t kuch ta'sirida tinch holatdan harakatga keladi. Harakat boshlangandan 10 sekund o'tganda jism qancha yo'l bosib o'tadi? (8,33)

13.2.17. Massasi m=0,2kg bo'lgan moddiy nuqta Ox o'qi bo'ylab F=-0,4t kuch ta'sirida harakat qiladi. Agar nuqtaning boshlang'ich tezligi υ_{x0}=6m/s bo'lsa, t=2s dan keyin qancha tezlikka ega bo'ladi? (2)

13.2.18. Massasi m bo'lgan moddiy nuqta Ox o'qi bo'ylab $F_x=12mt^2$ kuch ta'sirida quyidagi boshlang'ich shartlar: $t_0=0$ da $x_0=3$m va $\upsilon_0=6$m/s bo'yicha harakat qiladi. $t=1$s da nuqta qancha yo'l bosib o'tadi? (10)

13.2.19. Massasi 1kg bo'lgan jism $R=0,03\upsilon$ havoning qarshilik kuchi ostida vertikal pastga tushadi. Uning maksimal tezligini toping. (327)

13.2.20. Massasi $m=2$kg bo'lgan moddiy nuqta gorizontal Ox o'qi bo'ylab $F_x=5\cos 0,5t$ kuchi ta'sirida harakat qiladi. Agar $t_0=0$ da $\upsilon_0=0$ bo'lsa, $t=4$s da nuqta qancha tezlikka ega bo'ladi? (4,55)

13.2.21. Massasi m bo'lgan moddiy nuqta Ox o'qi bo'ylab $F_x=6m\sin 2t$ kuchi ta'sirida harakat qiladi. Agar boshlang'ich paytda uning tezligi $\upsilon_{0x}=3$m/s bo'lsa, tezlik tenglamasidagi integrallash doimiysi C ni toping. (6)

13.2.22. Massasi $m=7$kg bo'lgan moddiy nuqta Ox o'qi bo'ylab tinch holatdan $F_x=7e^t$ kuch ta'sirida harakatga keladi. $t=2$s da nuqtaning tezligi qancha bo'ladi? (6,39)

13.2.23. Massasi $m=20$kg bo'lgan moddiy nuqta gorizontal to'g'ri chiziq bo'ylab $R=0,2\upsilon^2$ qarshilik kuchi ta'sirida harakat qiladi. Qancha sekundda uning tezligi 10m/s dan 5m/s ga kamayadi? (10)

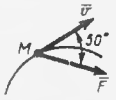
13.2.24. Massasi $m=250$kg bo'lgan moddiy nuqta gorizontal to'g'ri chiziq bo'ylab harakat qiladi. Unga $R=5\upsilon^2$ qarshilik kuchi ta'sir qiladi. Agar boshlang'ich paytda, $t_0=0$da, uning tezligi $\upsilon_0=20$m/s bo'lsa, $t=6$s da nuqtaning tezligini toping. (5,88)

13.2.25. Massasi $m=4$kg bo'lgan moddiy nuqta gorizontal to'g'ri chiziq bo'ylab harakat qiladi. Unga $R=0,8\upsilon$ qarshilik kuchi ta'sir qiladi. Qancha sekunddan keyin uning tezligi 10 barobar kamayadi? (11,5)

13.3. Moddiy nuqtaning berilgan kuchlar ta'siridagi egri chiziqli harakatini tekshirish

13.3.1. Massasi $m=10$kg bo'lgan moddiy nuqta $F=0,4t$ kuch ta'sirida egri chiziq bo'ylab harakatlanadi. Agar $\overline{F}$ kuchi va tezlik vektori orasidagi burchak 30° bo'lsa, $t=40$s da nuqta urinma tezlanishining qiymatini toping. (1,39)

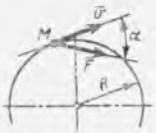
13.3.2. Massasi m=6kg bo'lgan M moddiy nuqta gorizontal tekislikda F=8N kuch ta'sirida egri chiziq bo'ylab harakat qiladi. Nuqtaning urinma tezlanishini aniqlang. (0,857)



13.3.3. Massasi m=30kg bo'lgan 1 moddiy nuqta R=12m radiusli doiraviy 2 egri naycha ichida harakatlanadi. Nuqtaning α=45° burchak bo'lgan holatdagi urinma tezlanishini aniqlang. (6,94)

13.3.4. Massasi m=42kg bo'lgan moddiy nuqta R=2m radiusli, gorizontal tekislikda joylashgan doiraviy silliq naycha ichida tinch holatdan boshlab F=21N kuch ta'sirida harakat qiladi. Agar kuch vektori bilan tezlik vektori ustma-ust tushsa, t=7s dagi naycha devorining gorizontal reaksiya kuchining miqdorini toping. (257)

13.3.5. Massasi m=8kg bo'lgan M moddiy nuqta gorizontal tekislikda joylashgan R 18m radiusli aylana bo'ylab $\overline{F}$ kuch ta'sirida harakat qiladi. Agar $\overline{F}$ kuch va $\overline{v}$ tezlik orasidagi burchak α bo'lsa, tezlik v=3m/s va urinma tezlanish a_τ=0.5m/s^2 bo'lgandagi α ning gradus qiymatini toping. (45)



13.3.6. Moddiy nuqta egri chiziqli trayektoriya bo'ylab urinma F_τ=0,2t^2 tashkil etuvchi va normal F_n=8N tashkil etuvchi kuchlar ta'sirida harakat qiladi. t=10s da uning tezlanishi a=0,7m/s^2 bo'lsa, nuqtaning massasini toping. (30,8)

13.3.7. Massasi m=5kg bo'lgan moddiy nuqta egri yo'l bo'ylab urinma F_τ=7N tashkil etuvchi va normal F_n=0,1t^2 tashkil etuvchi kuchlar ta'sirida harakat qiladi. t=12s da nuqtaning tezlanishini toping. (3.20)

13.3.8. Moddiy nuqta $\overline{F}=9\bar{\tau}+8\bar{n}$ kuch ta'sirida egri chiziq bo'ylab harakat qiladi. Agar moddiy nuqtaning tezlanishi a=0,5m/s^2 bo'lsa, uning massasini toping. (24,1)

13.3.9. Massasi m=2kg bo'lgan moddiy nuqta $\overline{F}=3\bar{\tau}+4\bar{n}$ kuch ta'sirida egri chiziq bo'ylab harakat qilsa, uning tezlanishini toping. (2,5)

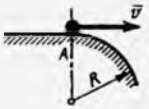
13.3.10. Moddiy nuqta $\bar{F}=15\bar{\tau}+0{,}3t\bar{n}$ kuch ta'sirida egri chiziq bo'ylab harakat qiladi. Agar t=20s da uning tezlanishi a=0,6m/s^2 bo'lsa, nuqtaning massasini toping. (26,9)

13.3.11. Massasi m=4kg bo'lgan moddiy nuqta $\bar{F}=0{,}4t\bar{\tau}+3\bar{n}$ kuch ta'sirida egri chiziq bo'ylab harakat qilsa, t=10s da uning tezlanishini toping. (1,25)

13.3.12. Massasi m=2kg bo'lgan moddiy nuqta Oxy tekislikda proyeksiyalari $F_x=2\sin 0{,}5\pi t$ va $F_y=5\cos\pi t$ kuchlar ta'sirida harakat qilsa, t=1s da uning tezlanishini modulini aniqlang. (2,69)

13.3.13. Massasi m=18kg bo'lgan moddiy nuqta F=25N kuch ta'sirida gorizontal tekislikda egri chiziq bo'ylab harakat qiladi. Agar tezlik vektori va kuch vektorlari orasidagi burchak 55° bo'lsa, tezlikning υ=4m/s paytdagi trayektoriyaning egrilik radiusini toping. (14,1)

13.3.14. Jism gorizontal tekislik bo'ylab harakat qilib, A nuqtada undan ajraladi. Agar doiraviy sirtning radiusi R=6m bo'lsa, jismning sirtdan ajralish paytidagi minimal tezligini toping. (7,67)



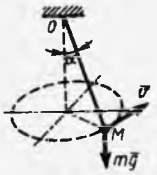
13.3.15. Jism gorizontal diskning aylanish o'qidan 2 metr masofada joylashgan bo'lib, disk bilan bir tekis aylanadi. Agar jism va disk orasidagi ishqalanish koeffitsiyenti f=0,3 bo'lsa, jism markazdan qochma kuch ta'sirida diskda siljishi uchun disk qanday o'zgarmas burchak tezlik bilan aylanishi lozim. (1,21)

13.3.16. Kosmik stansiya yer shari atrofida aylanma orbita bo'ylab $R=7\cdot10^6$m radius bo'yicha aylanadi. Agar yer massasi $5{,}976\cdot10^{24}$ kg va gravitatsion o'zgarmas $6{,}672\cdot10^{-11}$ N·m^2/kg^2 bo'lsa, kosmik stansiyaning tezligini km/s larda hisoblang. (7,55)

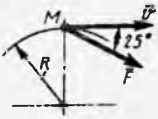
13.3.17. Massasi m=11kg bo'lgan moddiy nuqta, F=20N teng ta'sir etuvchi kuch ta'sirida egri chiziq bo'ylab harakatlanadi. Agar kuch va tezlik vektorlari orasidagi burchak 35^0 va egrilik radiusi ρ=15m bo'lgan paytda nuqtaning tezligini aniqlang. (3,96)

13.3.18. Massasi m=16kg bo'lgan moddiy nuqta tekislikdagi egri chiziq bo'ylab F=0,3t kg kuch ta'sirida harakat qiladi. Agar t=20s da kuch va tezlik vektorlari orasidagi burchak α=50° va egrilik radiusi ρ=12m bo'lsa, nuqtaning tezligini hisoblang. (1,86)

13.3.19. Qo'zg'almas O nuqtaga bog'langan, uzunligi OM=1m bo'lgan ipga osib qo'yilgan moddiy nuqta konus shaklidagi mayatnikni tasvirlaydi, ya'ni gorizontal tekislikda aylana chizadi. Agar ip vertikal bilan α=45° burchak tashkil qilsa, M nuqtaning tezligini aniqlang. (2,63)

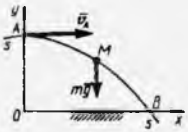


13.3.20. Massasi m=1,6 kg bo'lgan moddiy nuqta gorizontal tekislikda R=12m radiusli aylana bo'ylab tinch holatdan boshlab, F=0,2t kuch ta'sirida harakatlanadi. Agar kuch va tezlik vektorlari orasidagi burchak 25° ni tashkil qilsa, t=18s paytdagi nuqtaning tezligini aniqlang. (3,38)



13.3.21. Massasi m=12 kg bo'lgan moddiy nuqta tinch holatdan boshlab, gorizontal tekislikda joylashgan, radiusi R bo'lgan aylana bo'ylab harakatlanadi. Agar ta'sir qiluvchi kuch F=22N, trayektoriya urinmasiga α=40° burchak tashkil qilsa, t=4s dagi nuqtaning tezligini aniqlang. (5,62)

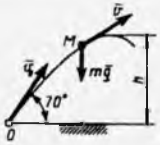
13.3.22. M moddiy nuqta vertikal tekislikda joylashgan s-s parabola bo'ylab og'irlik kuchi ta'sirida harakatlanadi. Agar A holatda nuqtaning tezligi υ_A=30m/s, balandligi OA=600m bo'lsa, B holatdagi tezligini toping. (113)



13.3.23. Massasi m=15kg bo'lgan moddiy nuqta gorizontal tekislikda R radiusli aylana shakldagi silliq kanalchada tinch holatdan boshlab, F=0,5t kuch ta'sirida harakat qilsa, t=30s dagi nuqtaning tezligini hisoblang. Bunda kuch va tezlik vektorlari o'zaro 50° burchak tashkil qilgan. (9,64)

13.3.24. Massasi m=14kg bo'lgan moddiy nuqta gorizontal tekislikda joylashgan R radiusli aylana shaklidagi silliq kanalchada tinch holatdan boshlab, o'zgarmas F=24N kuch ta'sirida harakatlanadi. Agar t=5s da kuch va tezlik vektorlari orasidagi burchak 45° ni tashkil qilsa, bosib o'tilgan yo'lni aniqlang. (15,2)

13.3.25. Moddiy nuqta M vertikal tekislikda og'irlik kuchi ta'sirida harakatlanadi. Agar nuqta gorizontga nisbatan $\alpha=70°$ burchak ostida boshlang'ich $\upsilon_0=600$ m/s tezlik bilan otilgan bo'lsa, uning h maksimal uchish balandligini hisoblang (km). (16,2)

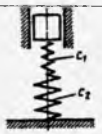


13.4. Moddiy nuqtaning erkin tebranma harakati

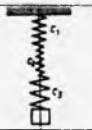
13.4.1. Massasi $m=25$ kg bo'lgan yuk bikrligi $c=800$N/m li prujinaga osilgan bo'lib, vertikal to'g'ri chiziq bo'ylab erkin tebranma harakat qiladi. Yukning og'irlik markazi statik muvozanat holatidan 5 sm masofada bo'lgan paytdagi uning tezlanishini aniqlang. (1,6)

13.4.2. Massasi $m=20$ kg bo'lgan yuk bikrligi $c=400$N/m li prujinaga osilgan holda vertikal to'g'ri chiziq bo'ylab tebranadi. Yukning tezlanishi 3 m/s^2 ga yetganda uning og'irlik markazi statik muvozanati holatidan qanchaga uzoqlashishini toping. (0,15)

13.4.3. Ketma-ket ulangan, bikrlik koeffitsiyentlari mos ravishda $c_1=2$N/sm, $c_2=18$N/sm bo'lgan prujinalarga ekvivalent prujinaning bikrlik koeffitsiyentini hisoblang. (1,8)

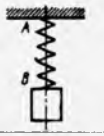


13.4.4. Ketma-ket ulangan uchta prujina $c_1=2$N/m, $c_2=4$N/m, $c_3=6$N/m bikirliklarga ega bo'lsa, keltirilgan bikrlikni toping. (1,09)



13.4.5. Massasi $m=0,5$ kg li yuk prujinaga osilgan holda $\ddot{y}+60y=0$ tenglama bo'yicha tebranma harakat qiladi. Prujinaning bikrlik koeffitsiyentini aniqlang. (30)

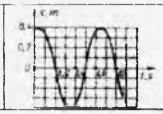
13.4.6. Og'ir yuk deformatsiyalanmagan vertikal prujinaga osilgan holda, tinch holatdan erkin tebranma harakatga keladi. Agar prujinaning statik cho'zilishi 2sm bo'lsa, AB prujinaning maksimal cho'zilishini toping (sm). (4)



13.4.7. Massasi $m=10$kg bo'lgan jism prujinaga osilgan holda davri $T=0,8$s ga teng vertikal erkin tebranma harakat qiladi. Prujinaning bikrlik koeffitsiyentini toping. (617)

13.4.8. Massasi $m=5$kg bo'lgan moddiy nuqta $x=x(t)$ qonun bo'yicha vertikal erkin tebranma harakat qiladi.

Prujinaning bikrlik koeffitsiyentini hisoblang. (548)

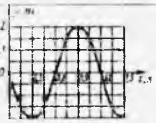


13.4.9. Massasi m=80kg bo'lgan yuk bikrlik koeffitsiyenti c=2KN/m ga teng prujina yordamida vertikal erkin tebranadi. Erkin tebranishlarning davrini aniqlang. (1,26)

13.4.10. Agar jism λ=20sm statik cho'zilishga ega bo'lgan prujina yordamida erkin tebranma harakatda bo'lsa, erkin vertikal tebranma harakat davri nimaga teng? (0,897)

13.4.11. Bikrlik koeffitsiyenti c=200N/m bo'lgan prujinaga osilgan jism T=0,5s davr bilan erkin vertikal tebranma harakat qilsa, uning massasini toping. (1,27)

13.4.12. Bikrlik koeffitsiyenti c=300N/m bo'lgan vertikal prujinaga osilgan jism $y=y(t)$ qonun bo'yicha erkin tebranma harakat qilsa, uning massasini aniqlang. (122)



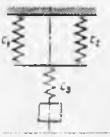
13.4.13. Bikrlik koeffitsiyenti c=2kN/m bo'lgan prujinaga osilgan yuk $T=\pi$ s davr bilan erkin vertikal tebranma harakat qilsa, uning massasini aniqlang. (500)

13.4.14. Bikrlik koeffitsiyenti c=150N/m bo'lgan vertikal prujinaga osilgan yuk $\ddot{x}+20x=0$ tenglama bo'yicha tebranma harakat qilsa, yukning massasini toping. (7,5)

13.4.15. Statik cho'zilishi 14sm bo'lgan vertikal prujinaga osilgan yuk erkin vertikal tebranma harakat qilsa, tebranma harakatning burchak chastotasini toping. (8,37)

13.4.16. Massasi m=5kg bo'lgan yuk bikrliklari teng $c_1=c_2=c_3$=490N/m bo'lgan ketma-ket ulangan prujinalarga osilgan holda erkin tebranma harakat qiladi. Uning tebranishlar chastotasini aniqlang. (5,72)

13.4.17. Massasi m=2kg bo'lgan yuk bikrlik koeffitsiyentlari teng $c_1=c_2=c_3$=300 N/m bo'lgan prujinalarga osilgan holda erkin tebransa, tebranishlar chastotasini hisoblang. (10)



13.4.18. Moddiy nuqta $\ddot{y}+9y=0$ differensial tenglama bo'yicha erkin tebranma harakat qilsa, tebranishlar chastotasini toping. (3)

13.4.19. Bikrlik koeffitsiyenti c=700N/m bo'lgan prujinaga osilgan yuk amplitudasi 0,2m li erkin vertikal tebranma harakat qiladi. Agar jism statik muvozanat holatidan υ_0=4m/s boshlang'ich tezlik bilan harakatni boshlasa, uning massasini hisoblang. (1,75)

13.4.20. Massasi m=0,3kg bo'lgan jism vertikal tekislikda joylashgan prujinada A=0,4m amplituda bilan tebranma harakat qiladi. Agar tebranish statik muvozanat holatidan υ_0=3m/s boshlang'ich tezlik bilan boshlansa, prujinaning bikrlik koeffitsiyentini aniqlang. (16,9)

13.4.21. Massasi m=10kg bo'lgan yuk ketma-ket ulangan ikkita prujinaga osilgan bo'lib, keltirilgan bikrlik koeffitsiyenti c=3,6N/sm bo'lsa, erkin tebranishlarning chastotasini toping. (0,955)

13.4.22. Moddiy nuqta $x=20\cos 4t+30\sin 4t$(sm), qonun bilan tebranma harakat qilsa, tebranish amplitudasini hisoblang (sm). (36,1)

13.4.23. Moddiy nuqtaning erkin tebranishlar qonuni $y=y(t)$ berilgan bo'lsa, boshlang'ich tezlik υ_0 qiymatini toping. (-1,05)

13.4.24. Massasi m=9kg bo'lgan yuk bikrligi c=90N/m li prujinada A=0,1m amplituda bilan erkin tebranadi. Agar harakat statik muvozanat holatidan boshlangan bo'lsa, boshlang'ich tezlikning qiymatini hisoblang. (0,316)

13.4.25. Massasi m=3kg bo'lgan yuk bikrligi c=300N/m bo'lgan vertikal prujina yordamida erkin tebranadi. Agar boshlang'ich, t_0=0 s paytda υ_0=2m/s va x_0=0,3m bo'lsa, erkin tebranishlar amplitudasini toping. (36,1)

13.5. Moddiy nuqtaning so'nuvchi tebranma harakati

13.5.1. Moddiy nuqtaning so'nuvchi tebranma harakati $x=e^{-0,2t}$ ($C_1\cos 3t+C_2\sin 3t$) qonun asosida bo'lib, t_0=0 da x_0=0,2 m bo'lsa, integrallash doimiysi C_1 ning miqdorini aniqlang. (0,2)

13.5.2. Moddiy nuqtanig so'nuvchi tebranma harakati $x=e^{-0,5t}$ ($C_1\cos 3t+$ $+C_2\sin 3t$) qonun asosida bo'lib, t_0=0 da υ_0=0 va C_1=1,5 bo'lsa, integral doimiysi C_2 ning miqdorini aniqlang. (0,25)

13.5.3. Moddiy nuqtaning harakat differensial tenglamasi $m\ddot{x}+4\dot{x}+2x=0$ ko'rinishida bo'lsa, harakat nodavriy (aperiodik) bo'lishi uchun nuqta massasining maksimal qiymatini toping. (2)

13.5.4. Agar yuk bikrligi C=200 N/m prujinada osilgan holda $y=Ae^{-0,9t}$ sin $(5t+\alpha)$ qonun bo'yicha tebranma harakatda bo'lsa, uning massasini aniqlang. (7,75)

13.5.5. Massasi m=6kg bo'lgan moddiy nuqta $\vec{R}=-\mu\vec{v}$ qarshilik kuchi ta'sirida tebranma harakat qiladi. Agar nuqtaning harakat qonuni $x=Ae^{-0,1t}\sin(7t+\alpha)$ bo'lsa, muhit qarshiligi koeffitsiyentini μ ni aniqlang. (1,2)

13.5.6. Massasi m=2kg bo'lgan yuk bikrlik koeffitsiyenti c=30N/m bo'lgan prujinaga mahkamlangan va statik muvozanat holatidan harakatga keltirilgan. Agar qarshilik kuchi $\vec{R}=-0,1\vec{v}$ bo'lsa, yukning harakati tebranma harakat bo'la oladimi? (Ha)

13.5.7. Moddiy nuqtaning harakat differensial tenglamasi $2\ddot{x}+\mu\dot{x}+50x=0$ bo'lsa, tebranma harakat nodavriy (aperiodik) bo'lishi uchun muhit qarshiligi koeffitsiyenti μ ning minimal qiymati qancha bo'lishi lozim? (20)

13.5.8. Moddiy nuqta harakat differensial tenglamasi $\ddot{x}+2\dot{x}+2x=0$ bo'lsa, uning harakati tebranma harakat bo'la oladimi? (Ha)

13.5.9. Moddiy nuqta harakat differensial tenglamasi $3\ddot{x}+12\dot{x}+cx=0$ bo'lsa, harakat nodavriy (aperiodik) bo'lishi uchun bikrlik koeffitsiyenti c ning maksimal qiymatini toping. (12)

13.5.10. Moddiy nuqta harakat differensial tenglamasi $\ddot{x}+5\dot{x}+5x=0$ bo'lsa, uning harakati tebranma harakat bo'la oladimi? (Yo'q)

13.5.11. Massasi m=10kg bo'lgan moddiy nuqta tebranma harakat qilmoqda. Agar u $\vec{R}=-\mu\vec{v}$ qarshilik kuchi ta'sirida T_1= 2s davr bilan so'nuvchi tebranma harakat qilib, maksimal bir tomonga og'ishlarning nisbati 0,85 bo'lsa, muhit qarshiligi koeffitsiyenti μ ning qiymatini toping. (1,63)

13.5.12. Moddiy nuqtaning harakat differensial tenglamasi $3\ddot{x}+\mu\dot{x}+48x=0$ bo'lsa, harakat aperiodik bo'lishi uchun muhit qarshilik koeffitsiyenti μ ning eng kichik qiymatini hisoblang. (24)

13.5.13. Massasi m=10kg bo'lgan jism prujinaga osilgan holda $x=Ae^{-0,8t}\sin(4t+\alpha)$ qonun bilan so'nuvchi tebranma harakat qilsa, prujinaning bikrlik koeffitsiyentini aniqlang. (166)

13.5.14. Moddiy nuqtaning harakat differensial tenglamasi $5\ddot{x}+20\dot{x}+cx=0$ bo'lsa, harakat aperiodik bo'lishi uchun prujinaning eng katta bikrlik koeffitsiyenti c nechaga teng bo'lishi lozim? (20)

13.5.15. Moddiy nuqtaning so'nuvchi tebranma harakat qonuni $x=Ae^{-0,2t}\sin(0,5t+\alpha)$ bo'lsa, qarshilik kuchini hisobga olinmagandagi erkin tebranishlar chastotasini aniqlang. (0,539)

13.5.16. Moddiy nuqtaning tebranma harakat differensial tenglamasi $\ddot{x}+8\dot{x}+25x=0$ bo'lsa, so'nuvchi tebranish chastotasini toping. (3)

13.5.17. Massasi $m=2$kg li yuk bikrlik koeffitsiyenti $c=30$ N/m bo'lgan prujinada tebranadi. Agar unga $\overline{R}=-4\overline{\upsilon}$ qarshilik kuchi ta'sir qilayotgan bo'lsa, so'nuvchi tebranma harakat chastotasini hisoblang. (3,74)

13.5.18. Moddiy nuqtaning harakat qonuni $x=e^{-0,05t}(0,3\cos 4t+0,5\sin 4t)$ bo'lsa, so'nuvchi tebranma harakat qonunidagi $x=Ae^{-nt}\sin(k_1t+\alpha)$ A amplitudani aniqlang. (0,580)

13.5.19. Moddiy nuqta tebranma harakat differensial tenglamasi $\ddot{x}+6\dot{x}+50x=0$ bo'lsa, so'nuvchi tebranish davrini hisoblang. (0,981)

13.5.20. Moddiy nuqta tebranma harakat differensial tenglamasi $\ddot{x}+8\dot{x}+25x=0$ bo'lsa, so'nuvchi tebranma harakat davrini toping. (2,09)

13.5.21. Moddiy nuqtaning tebranma harakat qonuni $x=0,7e^{-0,4t}\sin(1,5t+0,6)$ bo'lsa, qarshilik kuchini hisobga olmagan holdagi erkin tebranish davrini aniqlang. (4,05)

13.5.22. Moddiy nuqtaning tebranma harakati $y=6e^{-0,3t}\sin(8t+0,3)$ bo'lsa, so'nuvchi tebranma harakat davrini aniqlang. (0,785)

13.5.23. Agar so'nuvchi tebranma harakat differensial tenglamasi $\ddot{x}+0,6\dot{x}+16x=0$ bo'lsa, maksimal amplitudaning keyingi shu ishorali amplitudaga nisbatini toping. (0,621)

13.5.24. Moddiy nuqtaning so'nuvchi tebranma harakati $x=0,12e^{+0,1t}\sin(18t+0,2)$ qonun bilan berilgan bo'lsa, bir tomonlama maksimal amplitudalarning keyingisini oldingisiga nisbatini toping (0,966)

13.5.25. Moddiy nuqta tebranma harakatining differensial tenglamasi $\ddot{x}+4\dot{x}+20x=0$ bo'lsa, tebranish amplitudasining logarifmik dekrementini aniqlang. Bunda maksimal og'ishlarni yarim davr o'tgandan keyingi qiymati olinsin. (1,57)

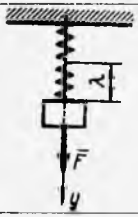
13.6. Majburiy tebranma harakat

13.6.1. Moddiy nuqta tebranma harakatining differensial tenglamasi $\ddot{x}+10x=1{,}5\sin(5t+0{,}4)$ berilgan. Uyg'otuvchi kuchning maksimal qiymati F_0=60N bo'lsa, nuqtaning massasini toping. (40)

13.6.2. Prujinaga osilgan jismga vertikal F=30sin20t uyg'otuvchi kuch ta'sir etadi. Erkin tebranishlar chastotasi k=25 rad/s bo'lsa, dinamiklik koeffitsiyentni aniqlang. (2,78)

13.6.3. Moddiy nuqta tebranma harakatining differensial teglamasi $\ddot{y}+36y=50\sin(5t+0{,}8)$ bo'lsa, dinamiklik koeffitsiyentni hisoblang. (3,27)

13.6.4. Biror yuk ta'siridagi prujinaning statik cho'zilishi λ=9,81sm. Agar yukka vertikal yo'nalgan F=15sin5t uyg'otuvchi kuch ta'sir etsa, dinamiklik koeffitsiyentini toping. (1,33)



13.6.5. Massasi m=3kg bo'lgan, yuk prujinaga osilgan. Unga F=10sin5t vertikal uyg'otuvchi kuch ta'sir etadi. Agar dinamiklik koeffitsiyenti η=4 bo'lsa, prujinaning bikrlik koeffitsiyenti c ni aniqlang. (100)

13.6.6. Prujinaga osilgan, massasi m=50kg bo'lgan jismga vertikal yo'nalgan F=200sin10t uyg'otuvchi kuch ta'sir etib, majburiy tebranishlar amplitudasi 0,04m bo'lsa, prujinaning bikrlik koeffitsiyenti c ni (kN/m) aniqlang. (10)

13.6.7. Jism vertikal tebranishlarining differensial tenglamasi $\ddot{x}+16x=20\sin(6t+0{,}7)$ ko'rinishda bo'lsa, prujinaning bikirlik koeffitsiyenti c ni toping. Uyg'otuvchi kuchning maksimal qiymatini F_0=80N deb oling. (64)

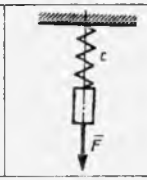
13.6.8. Moddiy nuqta tebranma harakatining differensial tenglamasi $5\ddot{x}+320x=90\sin 7t$ bo'lsa, erkin tebranishlarning chastotasini hisoblang. (8)

13.6.9. Prujinaga osilgan jismga vertikal uyg'otuvchi kuch $F=40\sin 10t$ ta'sir qilsa, dinamiklik koeffitsiyenti $\eta=3$ bo'lgandagi erkin tebranishlarning chastotasini aniqlang. (12,2)

13.6.10. Massasi $m=0{,}5$kg bo'lgan jism bikirligi $c=600$ N/m li prujinaga osilgan bo'lib, vertikal yo'nalgan $F=25\sin(pt)$ uyg'otuvchi kuch ta'sir qilsa, majburiy tebranishlar amplitudasi 0,05 m bo'lishi uchun uyg'otuvchi kuchlar chastotasi p qancha bo'lishi lozim? (14,1)

13.6.11. Moddiy nuqtaning tebranma harakati $\ddot{x}+81x=12\sin 5t$ differensial tenglama bilan ifodalansa, majburiy tebranma harakat amplitudasini hisoblang. (0,214)

13.6.12. Massasi $m=0{,}1$kg li yuk bikirlik koeffitsiyenti $c=0{,}5$ N/sm bo'lgan prujinaga osilgan holda $F=0{,}3\sin t$ uyg'otuvchi kuch ta'sirida tebransa, majburiy tebranishlar amplitudasini toping (mm). (6,01)



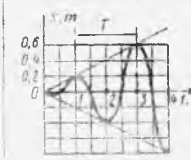
13.6.13. Massasi $m=18$kg bo'lgan jism bikirlik koeffitsiyenti $c=360$ N/m li prujinaga osilgan holda $F=36\sin 3t$ uyg'otuvchi kuch ta'sirida tebransa, majburiy tebranish amplitudasini aniqlang. (0,182)

13.6.14. Massasi $m=5$kg bo'lgan moddiy nuqta $y=0{,}4\sin kt+0{,}2\sin pt$ qonun bo'yicha $k=20$rad/s xususiy chastota va $p=10$rad/s chastotali uyg'otuvchi kuch bilan tebranma harakat qilsa, uyg'otuvchi kuchning maksimal qiymatini aniqlang. (300)

13.6.15. Bikirlik koeffitsiyenti $c=24$N/m bo'lgan prujinaga osilgan jism $\ddot{x}+8x=1{,}2\sin(4t+0{,}3)$ differensial tenglamaga ega bo'lgan tebranma harakat qilsa, uyg'otuvchi kuchning maksimal qiymatini toping. (3,6)

13.6.16. Massasi $m=4$kg bo'lgan moddiy nuqta $\ddot{x}+7x=0.5\sin(3t+0{,}6)$ tenglama bilan ifodalangan tebranma harakatda bo'lsa, uyg'otuvchi kuchning maksimal qiymatini hisoblang. (2)

13.6.17. Massasi $m=1$kg bo'lgan moddiy nuqta rezonans paytida shaklda ko'rsatilgan $x=x(t)$ funksiya ko'rinishidagi majburiy tebranishlarga ega bo'lsa, $F=F_0\sin pt$ uyg'otuvchi kuchning maksimal qiymatini hisoblang. (1,26)



13.6.18. Massasi m=0,5kg bo‘lgan jism bikirlik koeffitsiyenti c=200N/m li prujinaga osilgan holda F=15sinpt uyg‘otuvchi kuch ta’sirida tebransa, rezonans paytida uyg‘otuvchi kuchning chastotasi nechaga teng bo‘ladi? (20)

13.6.19. Agar moddiy nuqta $\ddot{x} + 6\dot{x} + 30x = 4\sin 2t$ differensial tenglama bilan majburiy tebranishda bo‘lsa, majburiy tebranish amplitudasini toping. (0,140)

13.6.20. Moddiy nuqtaning majburiy tebranma harakat differensial tenglamasi $\ddot{y} + 8\dot{y} + 250y = 6\sin 10t$ bo‘lsa, dinamiklik koeffitsiyenti η ni hisoblang. (1,47)

13.6.21. Massasi m=10kg bo‘lgan jism bikirlik koeffitsiyenti c=150N/m li prujinaga osilgan holda F=10sinpt uyg‘otuvchi kuch va $\overline{R} = -8\overline{v}$ qarshilik kuchlari ta’sirida majburiy tebranma harakat qilsa, uyg‘otuvchi kuchning chastotasini o‘zgartira borib, tebranishlar amplitudasi qanday maksimal qiymatga erishishi mumkin? (0,324)

13.6.22. Massasi m=5kg bo‘lgan jism bikirlik koeffitsiyenti c=50N/m li prujinaga osilgan holda $\overline{R} = -4\overline{v}$ qarshilik kuchi ta’sirida majburiy tebranishda bo‘lsa, uyg‘otuvchi kuchning chastotasi necha bo‘lganda dinamiklik koeffitsiyenti maksimal bo‘ladi. (3,11)

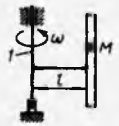
13.6.23. Massasi m=12kg bo‘lgan moddiy nuqta $\ddot{y} + 8\dot{y} + 60y = 15\sin 3t$ differensial tenglama bilan ifodalanuvchi tebranma harakat qilsa, $\overline{R} = -\mu\overline{\dot{y}}$ ko‘rinishdagi qarshilik kuchining koeffitsiyenti μ ni aniqlang. (96)

13.6.24. Massasi m=3kg bo‘lgan moddiy nuqta $\ddot{x} + 4\dot{x} + 30x = 15\sin 8t$ differensial tenglama bilan ifodalanuvchi tebranma harakatda bo‘lsa, uyg‘otuvchi kuchning maksimal qiymatini aniqlang. (45)

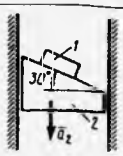
13.6.25. Massasi m=5kg bo‘lgan jism prujinaga osilgan holda differensial tenglamasi $\ddot{x} + 6\dot{x} + 40x = 5\sin 15t$ bilan ifodalanuvchi tebranma harakatda bo‘lsa, prujinaning bikirlik koeffitsiyentini toping. (200)

13.7.1. Massasi $m=8\cdot10^4$kg bo'lgan lokomotiv 20m/s tezlik bilan ekvator bo'ylab qurilgan relsda sharqdan g'arbga tomon harakat qilsa, yerning o'z o'qi atrofida aylanish burchak tezligini $\omega=0{,}0000729$ rad/s deb, lokomotivga ta'sir etuvchi koriolis inersiya kuchining qiymatini aniqlang. Lokomativ moddiy nuqta deb qarang. (233)

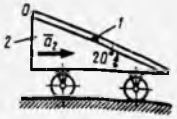
13.7.2. Massasi $m=0{,}2$kg bo'lgan M sharcha vertikal naychaga nisbatan $\upsilon=19{,}62$ m/s tezlik bilan harakat qiladi. O'z vaqtida naycha ham $l=0{,}5$m masofada joylashgan o'z o'qi atrofida $\omega=5$rad/s o'zgarmas burchak tezlik bilan aylansa, sharchaga ta'sir qilayotgan ko'chirma inersiya kuchini hisoblang. (2,5)



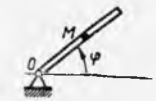
13.7.3. Massasi $m=1$kg bo'lgan 1 yuk 2 jismdagi qiyaligi $\alpha=30°$li tekislik ustida pastga harakat qiladi. 2 jism esa $a_2=2\text{m/s}^2$ tezlanish bilan vertikal pastga tushadi. 1 yukning 2 jismga ko'rsatayotgan bosimini aniqlang. (6,76)



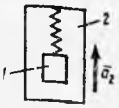
13.7.4. Massasi m_1 bo'lgan 1 sharcha 2 jismda joylashgan silliq silindrik kanalcha bo'ylab, O nisbiy muvozanat holatidan boshlab harakat qiladi. Agar 2 jism gorizontal tekislik bo'ylab $a_2=3{,}5\text{m/s}^2$ tezlanish bilan harakat qilayotgan bo'lsa, $t=5$s dagi nisbiy harakat tezligini aniqlang. (0,331)



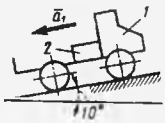
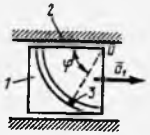
13.7.5. Massasi $m=0{,}1$kg bo'lgan M sharcha O nuqta atrofida $\varphi=t^2$ qonun bo'yicha aylanayotgan naychada $OM=0{,}2t^3$ qonun bo'yicha to'g'ri chiziqli harakat qilsa, sharchaga ta'sir qilayotgan $t=1$s paytdagi koriolis inersiya kuchining qiymatini toping. (0,24)



13.7.6. Lift kabinasi 2 yuqoriga $a_2=0{,}5g$ tezlanish bilan harakat qiladi. Og'irligi 100N li 1 yuk prujinaga osilgan holda nisbiy muvozanat holatida turgan bo'lsa, prujinada hosil bo'layotgan tortish kuchini aniqlang. (150)



13.7.7. $\alpha=20°$ qiyalikda harakat qilayotgan idishdagi suv sathi qiya tekislikka parallel qolishi uchun u qanday tezlanishga ega bo'lishi lozim? (3,36)

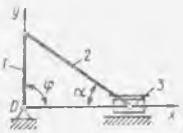
13.7.8. Yuk avtomobili 1 a_1=2m/s^2 o‘zgarmas sekinlanish bilan qiyalikka ko‘tarilayapti. Avtomobil yukxonasidagi massasi 200kg bo‘lgan 2 yuk avtomobil old kabina devoriga qanday bosim kuchi hosil qilishini aniqlang. (59,3)	
13.7.9. Jism 1 yonaltiruvchi 2 yordamida to‘g‘ri chiziqli harakat qiladi. m massali sharcha 3 esa jism ichidagi doiraviy kanalchada siljiydi. Sharcha φ=60° holatida nisbiy muvozanatda bo‘lishi uchun jism qanday a_1 tezlanish bilan harakatlanishi zarur? (5,66)	
13.7.10. Matematik mayatnik o‘rnatilgan shtativ qiyaligi α=10° tekislikdan a=gsinα tezlanish bilan pastga tushayotgan bo‘lsa, β burchak necha gradus bo‘lganda sharning nisbiy muvozanat holati yuz beradi? (0)	

XIV BOB. MEXANIK SISTEMA MASSALAR MARKAZINING HARAKATI HAQIDAGI, SISTEMANING HARAKAT MIQDORINING VA KINETIK MOMENTINING O'ZGARISHI HAQIDAGI TEOREMALAR

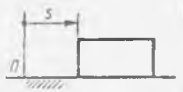
14.1. Mexanik sistema massalar markazining harakati haqidagi teorema

14.1.1. Massasi M=50kg bo'lgan mexanik sistemaning massalar markazi $\vec{r}_C = 3\vec{i} + 4\vec{j} + 5\vec{k}$ radius-vektor orqali aniqlanadi. Oxy tekisligiga nisbatan sistemaning statik momentini aniqlang. (250)

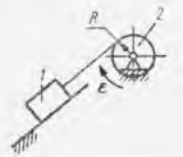
14.1.2. Krivoship-polzunli mexanizm krivoshipining massasi m_1=4kg, shatunning esa m_2=8kg. Polzun 3 ning massasini hisobga olmay, shatun 2 ni uzunligi $l_2 = 0{,}8m$ bo'lgan bir jinsli sterjen deb, φ=90° va α=30° holat uchun sistema massalar markazining x_C abssissasini aniqlang. (0,231)



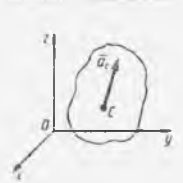
14.1.3. Massasi m=2 kg bo'lgan jism gorizontal yo'lda $s = 2t^2$ qonuni bo'yicha harakat qiladi. Jismga ta'sir qiluvchi kuchlarning bosh vektorining qiymatini hisoblang. (8)



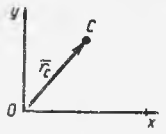
14.1.4. Massasi m 50kg bo'lgan 1 jism radiusi R=0,4m li 2 barabanga sim arqon yordamida o'raladi. Agar barabanning burchak tezlanishi ε=5rad/s^2 bo'lsa, 1 jismga ta'sir etuvchi tashqi kuchlar bosh vektorining qiymatini toping. (100)



14.1.5. Mexanik sistema fazoda shunday harakat qiladiki, uning massalar markazi tezlanishining koordinata o'qlaridagi proyeksiyalari mos ravishda a_{Cx}= 1m/s^2; a_{Cy}=2m/s^2 va a_{Cz}=4m/s^2. Agar sistemaning massasi M=40kg bo'lsa, ta'sir qiluvchi tashqi kuchlarning bosh vektori qanday qiymatga ega? (183)



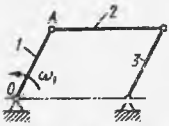
14.1.6. Mexanik sistemaning massalar markazi harakati $\vec{r}_c = 2\cos \pi t\vec{i} + 2\sin \pi t\vec{j}$ radius-vektor orqali aniqlanadi. Agar sistemaning massasi M=10kg bo'lsa, t=0,5s dagi ta'sir qiluvchi tashqi kuchlar bosh vektorining Oy o'qidagi proyeksiyasini hisoblang. (-197)



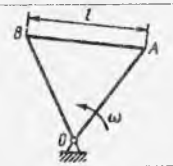
14.1.7. Massasi m=20kg bo'lgan disk qo'zg'almas o'q atrofida ω=10rad/s burchak tezlik bilan tekis aylanadi. Agar diskning og'irlik markazi aylanish o'qidan OC=0,5sm masofada joylashgan bo'lsa, diskka ta'sir qiluvchi kuchlarning bosh vektori qanday qiymatga ega bo'ladi? (10)

14.1.8. Radiusi R=1,3m bo'lgan g'ildirakning massa markazi C s=4t qonun bo'yicha harakat qilsa, uning massasini M=15kg deb, ta'sir qiluvchi tashqi kuchlar bosh vektorining modulini toping. (185)

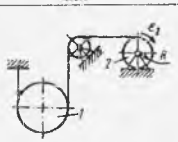
14.1.9. Shamirli parallelogrammning 1 krivoshipi o'z o'qi atrofida ω_1=5rad/s burchak tezlik bilan tekis aylanadi. Agar 2 zvenoning massasi m=8kg va 1 krivoshipning uzunligi OA=0,4m bo'lsa, 2 zvenoga ta'sir qiluvchi tashqi kuchlar bosh vektori modulini aniqlang. (80)



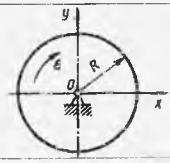
14.1.10. Bir jinsli, muntazam uchburchak shaklidagi, 5kg massali jism qo'zg'almas o'q atrofida tekis aylanadi. Agar AB=l=0,4m va ta'sir qiluvchi tashqi kuchlarning bosh vektori 300 N ga teng bo'lsa, uning burchak tezligi ω qanchaga teng bo'ladi? (16,1)



14.1.11. Radiusi R=0,2m bo'lgan 2 shkiv ε_2=10rad/s^2 burchak tezlanish bilan aylanib, massasi m=50kg li 1 silindrni yuqoriga tortadi. Silindrga ta'sir qiluvchi tashqi kuchlarning bosh vektori qanday kattalikka ega bo'ladi? (50)

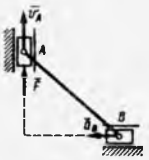


14.1.12. Radiusi R=0,5m bo'lgan, massasi m=20kg li bir jinsli disk o'zgarmas ε=10rad/s^2 burchak tezlanish bilan aylanma harakat qilsa, unga ta'sir qiluvchi tashqi kuchlar bosh vektorining miqdorini aniqlang. (0)

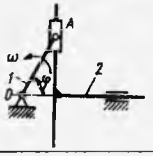


14.1.13. Massasi m=10kg bo'lgan bir jinsli OA sterjen ω=10rad/s burchak tezlik bilan tekis aylanadi. Sterjenning uzunligini OA=1m deb olib, unga ta'sir etuvchi tashqi kuchlar bosh vektorining qiymatini toping. (500)

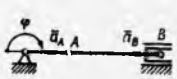
14.1.14. Ikki vaznsiz polzun A va B massasi 5kg bo'lgan bir jinsli sterjenga bog'langan holda $\vec{F}$ kuchi ta'sirida gorizontal va vertikal yo'naltiruvchilari bo'ylab o'zgarmas tezlik $\vec{v}_A$ bilan harakatlanadi. B polzunning tezlanishi 4m/s^2 bo'lganda A polzunga ta'sir qiluvchi reaksiya kuchini aniqlang. (10)



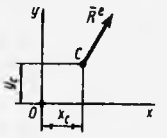
14.1.15. Uzunligi OA=0,25m bo'lgan krivoship 1 ω=10rad/s o'zgarmas burchak tezlik bilan aylanib, massasi m=5kg bo'lgan kulisani 2 harakatga keltiradi. φ=60° bo'lgan paytdagi kulisaga ta'sir qiluvchi tashqi kuchlar bosh vektorining modulini hisoblang. (62,6)



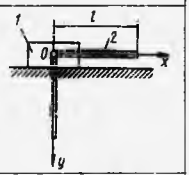
14.1.16. Krivoship-polzunli mexanizmning A va B nuqtalarining tezlanishi a_A=10m/s^2 va a_B=14m/s^2 bo'lib, massasi m=5kg bo'lgan, bir jinsli sterjen shaklidagi shatun AB ga ta'sir qiluvchi tashqi kuchlar bosh vektorining φ=180° holatdagi miqdorini toping. (60)



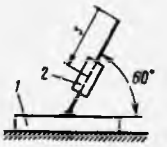
14.1.17. Massasi M=10kg bo'lgan mexanik sistema bosh vektori $\vec{R}^e=3\vec{i}+6t\vec{j}$ bo'lgan tashqi kuchlar ta'sirida muvozanat holatdan O nuqtadan harakatni boshlasa, ordinatasi y_C=0,8m bo'lgan paytda sistema massa markazi tezlanishining Oy o'qidagi proyeksiyasini hisoblang. (1,2)



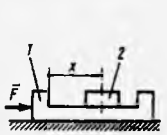
14.1.18. Massasi 4kg bo'lgan 1 jism gorizontal yo'lda harakat qilishi mumkin. Sharnir vositasida 1 jismga bog'langan massasi 2kg, uzunligi l=0,6m bo'lgan bir jinsli 2 sterjen gorizontal holatdan vertikal holatga o'tsa, 1 jism muvozanat holatdan qancha masofaga siljiydi? (0,1)



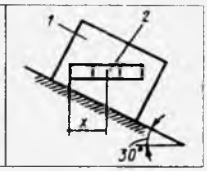
14.1.19. Massasi m_1=0,7kg bo'lgan 1 jism gorizontal tekislikda harakat qilishi mumkin. Agar 1 jism ustida harakatlanuvchi 2 jism ichki kuchlar ta'sirida s=sin4t qonun bo'yicha nisbiy harakatini boshlasa, 2 jism massasini m_2=0,1kg deb, t=0,25 s vaqtdan keyin 1 jismning tezlanishi modulini hisoblang. (0,841)



14.1.20. Massasi m_1=4kg bo'lgan 1 jism gorizontal yo'lda o'zgarmas F=10N kuch ta'sirida harakat qiladi. 1 jism ustidagi massasi m_2=1kg bo'lgan 2 jism unga nisbatan ichki kuchlar ta'sirida x=cosπt qonun bo'yicha gorizontal nisbiy harakatda bo'lsa, t=0,5s vaqtdagi 1 jismning tezlanishi miqdorini toping. (2)



14.1.21. Massasi m_1=1kg bo'lgan 1 jism silliq qiya tekislik bo'ylab pastga tushadi. 1 jism ichida joylashgan massasi m_2=1kg bo'lgan 2 jism ichki kuchlar ta'sirida $x=t^2$ qonun bo'yicha gorizontal nisbiy harakat qiladi. 1 jismning tezlanishini aniqlang. (4,04)

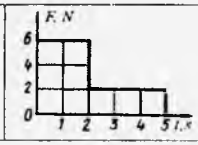


14.2. Kuchning impulsi. Harakat miqdori

14.2.1. Jismga 10 s mobaynida miqdori va yo'nalishi o'zgarmas, proyeksiyalari mos ravishda F_x=3N; F_y=4N bo'lgan kuch ta'sir qilsa, kuchning impulsi miqdorini hisoblang. (50)

14.2.2. Yo'nalishi o'zgarmas, miqdori $F=5+9t^2$ qonun bo'yicha o'zgaruvchi kuchning $t=t_2-t_1$ (t_2=2s, t_1=0) vaqt oralig'idagi impulsi modulini toping. (34)

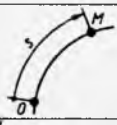
14.2.3. Yo'nalishi o'zgarmas bo'lgan kuchning miqdori shaklda ko'rsatilgan qonun bo'yicha o'zgarsa, $t=t_2-t_1$ (t_2=5s, t_1=0) vaqt oralig'idagi kuch impulsi miqdori qancha bo'ladi? (18)



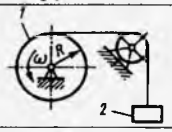
14.2.4. Moddiy nuqtaga $\bar{F}=3t^2\bar{i}+4t\bar{j}$ kuch ta'sir etsa, $t=t_2-t_1$ (t_2=2s, t_1=0) vaqt oralig'idagi kuch impulsining Ox o'qidagi proyeksiyasini aniqlang. (8)

14.2.5. Massasi m=1kg bo'lgan moddiy nuqta to'g'ri chiziq bo'ylab a=5m/s^2 tezlanish bilan harakat qilayotgan bo'lsa, $t=t_2-t_1$ (t_2=4s, t_1=2s) vaqt ichida ta'sir qilayotgan kuchlarning teng ta'sir etuvchisining impulsini toping. (10)

14.2.6. Massasi m=1kg bo'lgan moddiy nuqta $s=2+0,5e^{2t}$ qonun bo'yicha harakat qilsa, t=1s dagi harakat miqdorining modulini hisoblang. (7,39)



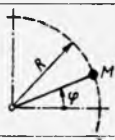
14.2.7. Radiusi R=0,4m bo'lgan 1 shkiv ω=2,5rad/s burchak tezlik bilan aylanib, massasi m=10kg li 2 yukni yuqoriga tortadi. Yukning harakat miqdorini aniqlang. (10)



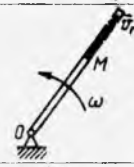
14.2.8. Massasi m=0,5kg bo'lgan moddiy nuqta $\bar{r}=2\sin\pi t\,\bar{i}+3\cos\pi t\,\bar{j}$ vektor tenglamasi bo'yicha harakat qilsa, t=0,5s dagi harakat miqdorining Ox o'qidagi proyeksiyasini toping. (0)

14.2.9. Massasi 2kg bo'lgan moddiy nuqta Oxy tekislikda $x=\sin\pi t$, $y=0{,}5t^2$ qonun bo'yicha harakat qilsa, $t=1{,}5$s dagi harakat miqdorining modulini hisoblang. (3)

14.2.10. Massasi 0,5kg bo'lgan moddiy nuqta radiusi $R=2$m li aylana bo'ylab harakat qilsa, $t=\pi s$ da $\varphi=5\sin 2t$ bo'lgandagi harakat miqdorini aniqlang. (10)

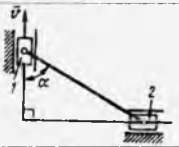


14.2.11. Naycha $\omega=10$rad/s burchak tezlik bilan aylanadi. Naycha ichida massasi $m=0{,}2$kg bo'lgan sharcha $\upsilon_r=4$m/s nisbiy tezlik bilan harakat qiladi. Sharcha aylanish o'qidan $OM=0{,}4$m bo'lgan paytdagi uning harakat miqdori modulini toping. (1,13)

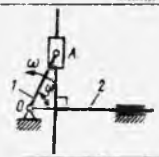


14.2.12. Radiusi $R=0{,}4$m bo'lgan disk $\omega=25$rad/s burchak tezlik bilan aylanadi. Diskning gardishi bo'ylab $s=1+2t^2$ qonun bo'yicha massasi $m=1$kg bo'lgan M nuqta harakat qilsa, $t=2$s dagi nuqtaning harakat miqdori modulini aniqlang. (18)

14.2.13. Sterjenga mahkamlangan ikki polzunning 1 si $\upsilon=2$m/s tezlik bilan vertikal yuqoriga harakat qilsa, 2 polzunning massasini $m=1$kg deb, $\alpha=60°$ holat uchun 2 polzunning harakat miqdori kattaligini hisoblang. (1,15)

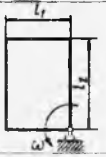


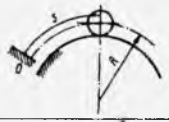
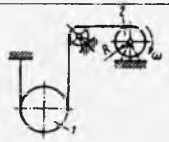
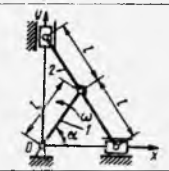
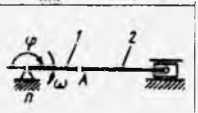
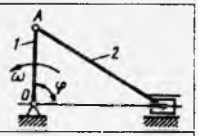
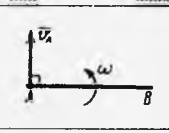
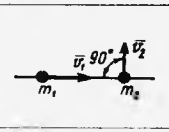
14.2.14. Uzunligi $OA=0{,}25$m bo'lgan krivoship 1 $\omega=10$rad/s burchak tezlik bilan aylanib, massasi 6kg li 2 kulisani harakatga keltiradi. $\varphi=60°$ holat uchun kulisaning harakat miqdori modulini toping. (13,0)



14.2.15. Massasi $m=10$kg, uzunligi $\ell=1m$ bo'lgan bir jinsli sterjen $\varphi=5t^2$ qonun bilan aylansa, $t=2$s dagi uning harakat miqdori modulini aniqlang. (100)

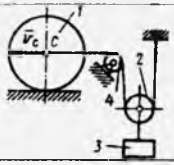
14.2.16. Massasi $m=12$kg bo'lgan to'g'ri to'rtburchak shaklidagi bir jinsli plastina $\omega=10$rad/s burchak tezlik bilan aylansa, $l_1=0{,}6$m va $l_2=0{,}8$m hisoblab, uning harakat miqdori modulini toping. (60)



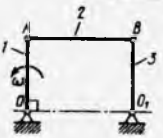
14.2.17. Massasi m=4kg bo'lgan g'ildirakning massalar markazi s=5sin2t qonun asosida radiusi R=2m li aylana bo'ylab harakatlansa, t=πs vaqt uchun uning harakat miqdori modulini hisoblang. (40)	
14.2.18. Radiusi R=0,2 m bo'lgan 2 shkiv ω=20 rad/s burchak tezlik bilan aylanib, massasi m=50kg bo'lgan bir jinsli 1 silindrni yuqoriga tortadi. Silindrning harakat miqdori modulini aniqlang. (100)	
14.2.19. Uzunligi $\ell = 0{,}2m$ bo'lgan 1 krivoship ω=10rad/s burchak tezlik bilan aylanib, massasi m_2=4kg bo'lgan 2 sterjen va polzunlarni harakatga keltiradi. α=60° holat uchun bir jinsli 2 sterjenning harakat miqdori vektorining Oy o'qidagi proyeksiyasini hisoblang. (4)	
14.2.20. Uzunligi OA=0,2m bo'lgan 1 krivoship ω=20rad/s burchak tezlik bilan aylansa, φ=180° holat uchun bir jinsli sterjendan iborat, massasi m=5kg bo'lgan 2 shatunning harakat miqdori modulini toping. (10)	
14.2.21. Uzunligi OA=0,2m bo'lgan 1 krivoship ω=20 rad/s burchak tezlik bilan aylansa, φ=90° holat uchun, massasi m=6kg bo'lgan, bir jinsli sterjendan iborat 2 shatunning harakat miqdori modulini aniqlang. (24)	
14.2.22. Uzunligi AB=1m, massasi m=5kg bo'lgan bir jinsli sterjen tekis parallel harakat qiladi. Uning burchak tezligi ω=4rad/s va A nuqtasining tezligi υ_A=4m/s paytdagi harakat miqdorini aniqlang. (30)	
14.2.23. Massalari m_1=1kg va m_2=2kg bo'lgan moddiy nuqtalardan iborat mexanik sistema harakatida υ_1=3m/s va υ_2=2m/s holat uchun harakat miqdori bosh vektorining modulini hisoblang. (5)	
14.2.24. Massalari m_1=4kg va m_2=2kg, tezliklari υ_1=2m/s va υ_2=1m/s bo'lgan moddiy nuqtalardan iborat mexanik sistemaning harakat miqdori bosh vektorining Oy o'qidagi proyeksiyasini toping. (7,07)	
14.2.25. ω=8rad/s burchak tezlik bilan aylanayotgan diskning radiusi bo'ylab s=0,2t qonun bo'yicha harakat qilayotgan 1kg massali M nuqtadan iborat mexanik sistemaning t=0,5 s dagi harakat miqdori modulini toping. (0,825)	

14.2.26. Massasi m_2=5kg, uzunligi OA=1m bo'lgan 2 krivoship ω_2=10rad/s burchak tezlik bilan aylanadi. Unga mahkamlangan massasi 10kg bo'lgan bir jinsli 1 disk o'z o'qi atrofida ω_1 burchak tezlik bilan aylanadi. Krivoshipni bir jinsli sterjen deb sistema harakat miqdorining modulini toping. (125)

14.2.27. Mexanik sistema massalari m_1=40kg, m_2=10kg va m_3=12kg bo'lgan 1 silindr, 2 va 4 bir jinsli disk va 3 yukdan iborat. υ_c=4m/s bo'lsa, sistema harakat miqdori qanchaga teng? (166)



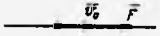
14.2.28. Mexanik sitema massalari teng $m_1=m_2=m_3$=4kg bo'lgan bir jinsli sterjenlardan iborat. Agar uzunligi OA=1m bo'lgan 1 sterjen ω=20rad/s burchak tezlik bilan aylansa, sistema harakat miqdori modulini aniqlang. (160)



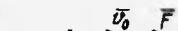
14.3. Harakat miqdorining o'zgarishi haqidagi teorema

14.3.1. Massasi 0,5kg bo'lgan moddiy nuqta to'g'ri chiziq bo'ylab $s=4t^3$ qonun bo'yicha harakat qilsa, 2s dan keyin unga ta'sir qiluvchi kuchlar teng ta'sir etuvchisining impulsini toping. (24)

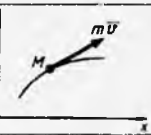
14.3.2. Massasi 1kg bo'lgan moddiy nuqta yo'nalishi o'zgarmas, miqdori esa F=5cosπt qonun bo'yicha o'zgaruvchi kuch ta'sirida υ_0=1,5m/s boshlang'ich tezlik bilan harakatni boshladi. t=0,5s paytda uning tezligi qancha bo'ladi? (3,09)



14.3.3. Massasi 2kg bo'lgan moddiy nuqta yo'nalishi o'zgarmas, miqdori esa $F=6t^2$ qonun bo'yicha o'zgaruvchi kuch ta'sirida υ_0=2m/s boshlang'ich tezlik bilan harakatni boshlasa, t=2s dagi tezligini aniqlang. (10)

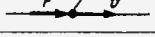


14.3.4. Moddiy nuqtaning harakat miqdori $m\vec{\upsilon}=5\vec{i}+12t\vec{j}$ bo'yicha o'zgarsa, unga ta'sir qiluvchi kuchlar teng ta'sir etuvchisining Oy o'qidagi proyeksiyasini toping. (12)



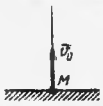
14.3.5. Massasi m=4kg bo'lgan moddiy nuqtaga $\vec{F}=4\vec{i}+t\vec{j}$ kuch ta'sir etadi. Muvozanat holatidan harakatni boshlagan nuqtaning t=2s dagi tezligining Oy o'qidagi proyeksiyasi qancha bo'ladi? (0,5)

14.3.6. Massasi m=1kg bo'lgan moddiy nuqta o'zgarmas $\vec{F}$ kuchi ta'sirida $t=t_2-t_1$(t_2=3s,t_1=0) vaqt

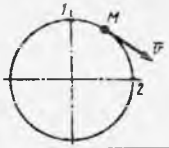


oralig'ida tezligini υ_0=2m/s dan υ=5m/s gacha o'zgartirgan bo'lsa, $\overline{F}$ kuchning qiymatini toping. (1)

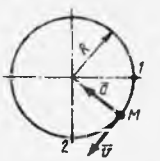
14.3.7. Moddiy nuqta faqat og'irlik kuchi ta'sirida υ_0=9,81m/s boshlang'ich tezlik bilan vertikal yuqoriga harakat qilsa, qancha vaqtdan keyin maksimal balandlikka ko'tariladi? (1)



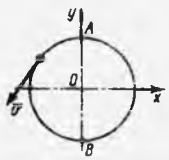
14.3.8. Massasi m=1kg bo'lgan moddiy nuqta υ=4m/s tezlik bilan aylana bo'ylab tekis harakat qiladi. 1 holatdan 2 holatga o'tgan paytdagi unga ta'sir qiluvchi kuchlar teng ta'sir etuvchisi impulsining miqdorini aniqlang. (5,66)



14.3.9. Massasi m=1kg bo'lgan moddiy nuqta radiusi R=0,5m li aylana bo'ylab $\bar{\upsilon}$ tezlik bilan tekis aylanadi. Agar nuqtaning tezlanishi a=8m/s^2 bo'lsa, 1 holatdan 2 holatga o'tish vaqtidagi unga ta'sir qiluvchi kuchlar teng ta'sir etuvchisi impulsining modulini aniqlang. (2,83)

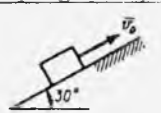


14.3.10. Massasi m=0,5kg bo'lgan moddiy nuqta o'zgarmas υ=2m/s tezlik bilan aylana bo'ylab harakat qiladi. Agar nuqta A holatdan B holatga o'tsa, shu vaqt ichida unga ta'sir qilayotgan kuchlar teng ta'sir etuvchisi impulsining Ox o'qiga proyeksiyasini aniqlang. (2)

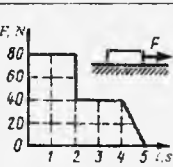


14.3.11. Poyezd gorizontal to'g'ri chiziqli yo'lda harakat qiladi. Agar boshlang'ich υ_0=20m/s tezlik va to'xtash paytidagi tormoz kuchi uning og'irligining 0,2 qismiga teng bo'lsa, tormozlanish vaqtini aniqlang. (10,2)

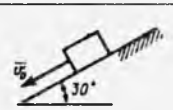
14.3.12. Qiyaligi α=30° bo'lgan silliq tekislikdan ko'tarilayotgan jismga υ_0=4m/s boshlang'ich tezlik berilsa, qancha vaqtdan keyin u eng yuqori balandlikka erishadi? (0,815)



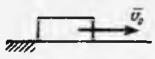
14.3.13. Massasi m=10kg bo'lgan jism yo'nalishi o'zgarmas, miqdori shaklda ko'rsatilgan qonun bo'yicha o'zgaruvchi $\overline{F}$ kuchi ta'sirida gorizontal tekislikda harakat qiladi. Agar uning boshlang'ich tezligi υ_0=0 va ishqalanish koeffitsiyenti f=0,2 bo'lsa, t=5 s dagi jismning tezligini aniqlang. (16,2)



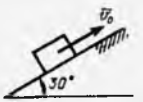
14.3.14. Qiyaligi α=30° bo'lgan silliq tekislikdan pastga tushayotgan jismga υ_0=5m/s boshlang'ich tezlik berilsa, qancha vaqtdan keyin uning tezligi 9,81m/s ga teng bo'ladi? (0,981)



14.3.15. G'adir-budur gorizontal tekislikda harakatlanuvchi jismga υ_0=5 m/s tezlik berilsa, 1s dan keyin to'xtaydi. Tekislik va jism orasida hosil bo'lgan ishqalanish koeffitsiyentini toping. (0,510)

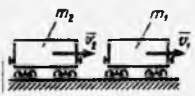


14.3.16. Qiyaligi α=30° bo'lgan g'adir-budur tekislikdan ko'tarilayotgan jismga υ_0=20m/s boshlang'ich tezlik berilsa, ishqalanish koeffitsiyentini f=0,1 deb, jism to'xtaguncha ketgan vaqtni hisoblang. (3,48)

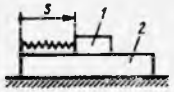


14.3.17. Mexanik sistemaning harakat miqdori vektorining moduli $Q=4t^2$ qonun bo'yicha o'zgarsa, t=2s da unga ta'sir qiluvchi tashqi kuchlar bosh vektorining modulini aniqlang. Bunda harakat miqdori vektori tashqi kuchlarining bosh vektoriga parallel deb qarang. (16)

14.3.18. Massalari $m_1=6\cdot10^4$kg va $m_2=2\cdot10^4$kg li ikki vagon υ_1=1m/s va υ_2=3m/s tezliklar bilan gorizontal temir yo'lda harakatlanadi. Bir qancha vaqtdan keyin 2 vagon 1 vagonga yetib olib, ular birgalikda harakatlansa, qarshilik kuchlarini hisobga olmay, ularning keyingi tezligini toping. (1,5)



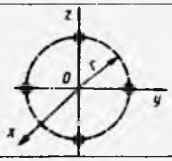
14.3.19. Massasi 2kg bo'lgan 1 jism 2 jismga nisbatan prujinaning kuchi ta'sirida $s=0,2+0,05\cos\pi t$ qonun bo'yicha harakat qiladi. Massasi 8kg bo'lgan 2 jism esa gorizontal tekislikda sirpanadi. Agar 2 jism tinch holatidan harakatini boshlasa, t=2s dan keyingi uning tezligini toping. (0)



14.4. Inersiya momentlari

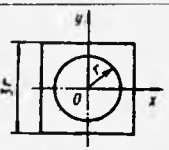
14.4.1. Massasi 2kg bo'lgan moddiy nuqtaning koordinatalari x=0,8m, y=0,6m, z=0,4m bo'lsa, Oxy tekislikka nisbatan uning inersiya momenti qancha bo'ladi? (0,32)

14.4.2. Massalari m=1,5kg dan bo'lgan to'rtta moddiy nuqtalar radiusi r=0,4 m li aylanada joylashgan va mexanik sistemani tashkil qilsa, sistemaning Oxy tekislikka nisbatan inersiya momentini hisoblang. (0,48)

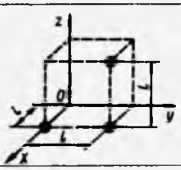


14.4.3. Massalari m=3 kg dan bo'lgan uchta moddiy nuqtalar radiusi r=0,6m li aylanada joylashgan va mexanik sistemani tashkil qilsa, sistemaning Oy o'qiga nisbatan inersiya momentini hisoblang. (1,62)

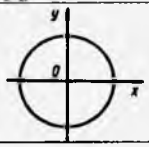
14.4.4. Massasi m=0,3 kg bo'lgan kvadrat shaklidagi yupqa plastinaning o'rtasidan radiusi r=0,04m li doira qirqib olingan bo'lsa, plastinaning markaziy - Oy o'qqa nisbatan inersiya momentini toping. ($4{,}89\cdot10^{-4}$)



14.4.5. Massasi m=0,5 kg dan uchta moddiy nuqtalar tomonlari l=0,3m li kubning uchlarida joylashgan bo'lib, mexanik sistemani tashkil qilsa, sistemaning koordinatalar boshiga nisbatan inersiya momentini hisoblang. (0,27)

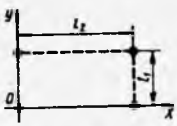


14.4.6. Ox o'qqa nisbatan inersiya momenti 3kg·m^2 bo'lgan bir jinsli diskning koordinatalar boshiga nisbatan inersiya momenti qancha bo'ladi? (6)

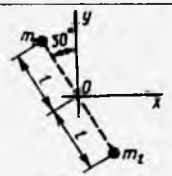


14.4.7. Massasi 0,5kg bo'lgan moddiy nuqtaning koordinatalari x=0,4m; y=-0,5m; z=0,4m bo'lsa, uning Ox va Oy o'qlariga nisbatan markazdan qochma inersiya momenti I_{xy} ni aniqlang. (-0,1)

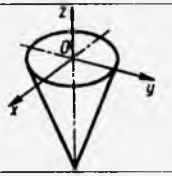
14.4.8. Massalari m=2kg dan bo'lgan to'rtta moddiy nuqtalar Ox va Oy o'qlarga nisbatan l_1=0,4m va l_2=0,8m masofalarda joylashgan bo'lib, mexanik sistemani tashkil qilsa, sistemaning I_{xy} markazdan qochma inersiya momentini toping. (0,64)



14.4.9. Massalari m_1=1kg va m_2=2kg bo'lgan ikki moddiy nuqtalar koordinata o'qlariga nisbatan α=30° va l=0,5m masofada joylashgan bo'lib, mexanik sistemani tashkil qilsa, sistemaning I_{xy} markazdan qochma inersiya momentini aniqlang. (-0,325)

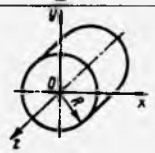


14.4.10. Bir jinsli bo'lgan konus shaklidagi jismning Oy, Oz o'qlariga nisbatan I_{yz} markazdan qochma inersiya momentining qiymatini hisoblang. (0)

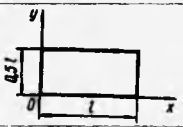


14.4.11. Massasi m=150kg bo'lgan jismning Oz o'qiga nisbatan inersiya momenti 1,5kg·m^2 bo'lsa, inersiya radiusini toping. (0,1)

14.4.12. Radiusi R=0,4m bo'lgan bir jinsli silindrning Oz o'qiga nisbatan inersiya radiusini aniqlang. (0,283)



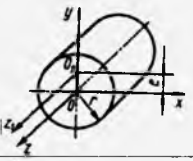
14.4.13. O'lchamlari ℓ va $\ell/2$ bo'lgan to'rtburchak shaklidagi plastinaning Oy o'qiga nisbatan inersiya radiusini aniqlang. (0,173)



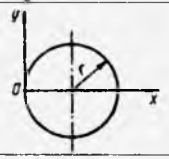
14.4.14. Massasi m=2kg, uzunligi $\ell = 1m$ bo'lgan bir jinsli sterjenning Oy o'qiga nisbatan inersiya momentini hisoblang. (0,292)

14.4.15. Massasi m=1kg, radiusi R=0,2m bo'lgan bir jinsli diskni uning tekisligiga perpendikular va to'g'inida joylashgan o'qqa nisbatan inersiya momentini aniqlang. (0,06)

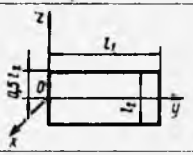
14.4.16. Massasi m=70kg, radiusi r=0,1m bo'lgan bir jinsli silindrning Oz markaziy o'qidan ℓ=0,05m masofada o'tuvchi markaziy o'qqa parallel O_1z_1 o'qqa nisbatan inersiya momentini toping. (0,525)



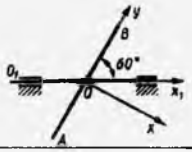
14.4.17. Massasi m=4kg, radiusi r=0,2m bo'lgan bir jinsli yupqa diskning Oy o'qqa nisbatan inersiya momenti nechaga teng? (0,2)



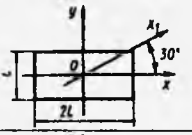
14.4.18. Massasi m=3kg, o'lchamlari l_1=0,4m va l_2=0,2m bo'lgan bir jinsli yupqa to'g'ri to'rtburchak plastinaning Ox o'qiga nisbatan inersiya momentini aniqlang. (0,17)



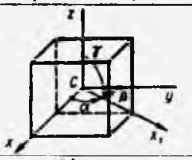
14.4.19. Markaziy Ox o'qiga nisbatan inersiya momenti 0,3kg·m^2 bo'lgan bir jinsli AB sterjenning α=60° burchak ostida joylashgan O_1x_1 o'qqa nisbatan inersiya momentini toping. (0,225)



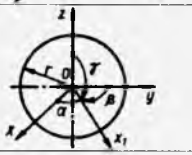
14.4.20. Massasi m=3kg, o'lchamlari l=0,2m bo'lgan bir jinsli yupqa plastinaning markaziy Ox_1 o'qqa nisbatan inersiya momentini hisoblang. (1,75·10^{-2})



14.4.21. Bir jinsli kubning Cx, Cy, Cz bosh markaziy o'qlarga nisbatan inersiya momentlari 0,1kg·m^2 ga teng bo'lsa, markaziy o'qlarga nisbatan α=45°, β=45°, γ=90° burchaklar ostida joylashgan Cx_1 o'qqa nisbatan kubning inersiya momentini aniqlang. (0,1)

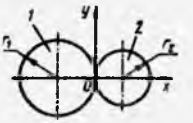


14.4.22. Massasi m=0,8kg, radiusi r=0,1m bo'lgan bir jinsli yupqa diskning $Oxyz$ o'qlarga nisbatan α=30°, β=60°, γ=90° burchaklar ostida yotuvchi Ox_1 o'qqa nisbatan inersiya momentini toping. (2,5)

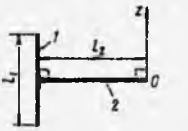


14.4.23. Mexanik sistema massalari m_1=0,4kg va m_2=2kg bo'lgan bir jinsli 1 sterjen va bir jinsli 2 yupqa diskdan iborat. Agar sterjenning uzunligi $\ell = 0{,}3m$, diskning radiusi r=0,1m bo'lsa, sistemaning Oy o'qqa nisbatan inersiya momentini aniqlang. (0,195)

14.4.24. Mexanik sistema massalari m_1=80kg va m_2=40kg, radiuslari r_1=0,6m va r_2=0,4m bo'lgan bir jinsli yupqa sferik qobiqlardan iborat bo'lsa, Oy o'qqa nisbatan sistemaning inersiya momentini hisoblang. (70,4)



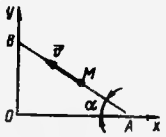
14.4.25. Konstruksiya massalari m_1=2kg va m_2=1kg, uzunliklari l_1=0,6m va l_2=0,9m bo'lgan bir jinsli sterjenlardan iborat bo'lsa, sistemaning Oz o'qiga nisbatan inersiya momentini toping. (1,89)



14.5. Harakat miqdori momenti

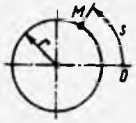
14.5.1. Massasi m=0,5kg bo'lgan moddiy nuqta $y=5t^2$ qonun bilan Oy o'qi bo'ylab harakat qilsa, t=2s da nuqtaning O markazga nisbatan harakat miqdori momentini toping. (0)

14.5.2. Massasi m=0,5kg bo'lgan moddiy nuqta υ=2m/s tezlik bilan AB to'g'ri chiziq bo'ylab harakat qiladi. Agar OA=1m va α=30° bo'lsa, nuqtaning koordinata boshiga nisbatan harakat miqdori momenti qancha bo'ladi? (0,5)



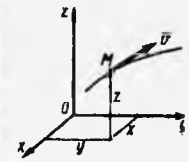
14.5.3. Massasi m=1kg bo'lgan moddiy nuqta υ=4m/s tezlik bilan aylana bo'ylab tekis harakat qiladi. Agar aylana radiusi r=0,5m bo'lsa, nuqtaning aylana markazi C ga nisbatan harakat miqdori momentini aniqlang. (2)

14.5.4. Massasi m=0,5kg bo'lgan M moddiy nuqta $s=0,5t^2$ qonun asosida radiusi r=0,5m li aylana bo'ylab harakat qiladi. Nuqtaning t=1s dagi harakat miqdori momentini aylana markaziga nisbatan aniqlang. (0,25)



14.5.5. Massasi m=1kg bo'lgan moddiy nuqtaning tezligi proyeksiyalari $\upsilon_x=\upsilon_y$=1m/s va o'rni $x=y$=1m bo'lsa, uning harakat miqdori momentini koordinata boshiga nisbatan hisoblang. (0)

14.5.6. Massasi m=0,5kg bo'lgan M moddiy nuqta fazoda egri chiziq bo'ylab harakat qiladi. Agar uning koordinatalari $x=y=z$=1m va tezligining proyeksiyalari mos ravishda υ_x=1m/s; υ_y=2m/s, υ_z=4m/s bo'lsa, nuqtaning harakat miqdori momentini Ox o'qiga nisbatan toping. (1)



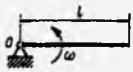
14.5.7. Massasi m=1kg bo'lgan moddiy nuqta fazoda $x=2t$, $y=t^3$ va $z=t^4$ qonun asosida harakat qilsa, uning t=2s dagi harakat miqdori momentini Oy o'qqa nisbatan aniqlang. (-96)

14.5.8. Massasi m=1kg bo'lgan moddiy nuqta $\vec{\upsilon}=2t\vec{i}+4t\vec{j}+5\vec{k}$ tezlik bilan harakatlansa, t=2s vaqtda x=2m, y=3m, z=3m koordinatalariga ega bo'lgan nuqtaning harakat miqdori momentining modulini aniqlang. (10,0)

14.5.9. Naycha ω=10rad/s burchak tezlik bilan tekis aylanadi. Naycha ichida massasi m=1kg bo'lgan shar υ_r=2m/s nisbiy tezlik bilan harakatlanadi. Sharning OM=0,5m masofada harakatlanayotgan paytdagi harakat miqdori momentini aylanish o'qiga nisbatan hisoblang. (2,5)

14.5.10. Konus ω=4rad/s burchak tezlik bilan tekis aylanadi. Massasi m=1kg bo'lgan M moddiy nuqta konusning yasovchisi bo'ylab harakatlansa, OM=1m va α=30° shartlar asosida nuqtaning O o'qiga nisbatan harakat miqdori momentini hisoblang. (1)

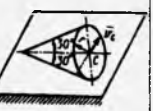
14.5.11. Uzunligi ℓ = 1m, massasi m=6kg bo'lgan bir jinsli sterjen ω=10rad/s burchak tezlik bilan tekis aylansa, sterjenning O markazga nisbatan kinetik momentini aniqlang. (20)



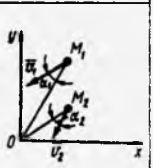
14.5.12. Massasi m=10 kg bo'lgan yupqa devorli quvur ω=10rad/s burchak tezlik bilan gorizontal tekislikda dumalaydi. Agar quvurning radiusi r=10sm bo'lsa, uning kinetik momentini aylanish oniy o'qiga nisbatan toping. (2)

14.5.13. OA krivoship o'zgarmas ω=6rad/s burchak tezlik bilan aylanib, 1 qo'zg'almas g'ildirak ustida 2 g'ildirakni aylantiradi. Agar g'ildiraklarning radiuslari r_1=r_2=0,15m va massalari m_1=m_2=3kg teng bo'lsa, 2 g'ildirakni bir jinsli silindr deb hisoblab, uning kinetik momentini aylanish oniy markazi K nuqtaga nisbatan hisoblang. (1,22)

14.5.14. Asosining radiusi r=30sm bo'lgan konus qo'zg'almas tekislik ustida sirpanmasdan dumalaydi. Agar konus asosining markazi C ning tezligi υ_C=0,9m/s va konusning oniy o'qqa nisbatan inersiya momenti 0,3kg·m^2 bo'lsa, shu o'qqa nisbatan uning kinetik momentini aniqlang. (1,04)



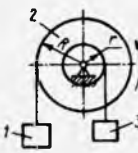
14.5.15. Massalari teng bo'lgan m_1=m_2=1kg ikki moddiy nuqta M_1 va M_2 mexanik sistemani tashkil qilib, Oxy tekisligida harakat qiladi. Agar nuqtalarning o'rni OM_1=2·OM_2=4m, α_1=α_2=30° va tezligi υ_1=2υ_2=4m/s bo'lsa, sistemaning kinetik momentini shu payt uchun koordinata boshiga nisbatan hisoblang. (6)



14.5.16. Massalari teng bo'lgan $m_1=m_2=m_3=2$kg uchta nuqta M_1, M_2, M_3 mexanik sistemani tashkil qilib, radiusi $r=0{,}5$m bo'lgan aylana bo'ylab harakat qiladi. Agar ularning tezliklari mos ravishda $\upsilon_1=2$m/s, $\upsilon_2=4$m/s, $\upsilon_3=6$m/s bo'lsa, sistemaning kinetik momentini aylana markaziga nisbatan toping. (12)

14.5.17. Radiusi $r=0{,}5$m bo'lgan 1 silindr $\omega=20$rad/s burchak tezlik bilan aylanib, massasi $m_2=1$kg bo'lgan 2 yukni yuqoriga tortadi. Agar silindrning inersiya momenti aylanish o'qiga nisbatan $J=2\text{kg}\cdot\text{m}^2$ bo'lsa, sistemaning kinetik momentini aylanish o'qiga nisbatan aniqlang. (45)

14.5.18. Radiuslari $R=2r=20$sm bo'lgan pog'onali 2 barabanga massalari $m_1=2m_3=2$kg bo'lgan yuklar osilgan bo'lib, baraban o'z o'qi atrofida $\omega=8$rad/s burchak tezlik bilan aylanadi. Agar barabanning inersiya momenti aylanish o'qiga nisbatan $J=0{,}05\text{kg}\cdot\text{m}^2$ bo'lsa, sistemaning kinetik momentini aylanish o'qiga nisbatan aniqlang. (1,12)



14.6. Kinetik momentning o'zgarishi haqidagi teorema

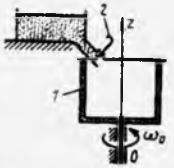
14.6.1. Massasi $m=0{,}5$kg bo'lgan moddiy nuqta $x=2t$, $y=4t^2$ qonun asosida tekislikda harakatlansa, $t=1$s paytdagi nuqtaga ta'sir qiluvchi barcha kuchlarning teng ta'sir etuvchisining koordinata boshiga nisbatan momentini aniqlang. (8)

14.6.2. Massasi $m=0{,}5$kg bo'lgan moddiy nuqta $\vec{r}=2\vec{i}+(4t^2+5)\vec{j}$ qonun bo'yicha harakatlansa, unga ta'sir qiluvchi barcha kuchlarning teng ta'sir etuvchisining koordinata boshiga nisbatan momentini toping. (8)

14.6.3. Massasi $m=1$kg bo'lgan moddiy nuqta $x=2t$, $y=t^4$, $z=t^4$ qonun asosida harakatlansa, $t=1$s paytdagi nuqtaga ta'sir qiluvchi barcha kuchlarning teng ta'sir etuvchisining Ox o'qiga nisbatan momentini aniqlang. (6)

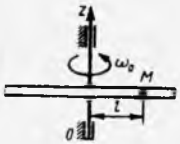
14.6.4. Inersiya momenti aylanish o'qiga nisbatan $J_1=1\text{kg}\cdot\text{m}^2$ bo'lgan 1 val $\omega_1=40$rad/s burchak tezlik bilan aylanadi. Muvozanat holatdagi 2 val ular qo'shilgandan keyin harakatga keladi. Agar 2 valning aylanish o'qiga nisbatan inersiya momenti $J_2=4\text{kg}\cdot\text{m}^2$ bo'lsa, 2 valning burchak tezligini toping. (8)

14.6.5. Vertikal Oz o'qiga nisbatan inersiya momenti $1kg \cdot m^2$ bo'lgan 1 idish $\omega_0=18rad/s$ burchak tezlik bilan aylanadi. Agar aylanishi paytida 2 idishdagi sochiluvchi modda bilan 1 idish to'ldirilsa, uning inersiya momenti $3kg \cdot m^2$ bo'lgan paytdagi burchak tezligi qancha bo'ladi? (6)



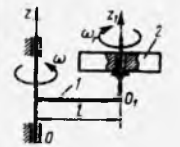
14.6.6. Tramplindan suvga sakrovchi sportchi havoda aylanma harakat qilishi uchun tramplinga tayanib, o'ziga massa markazidan o'tgan gorizontal o'qqa nisbatan $\omega_0=1,5rad/s$ burchak tezlik beradi. Bu paytda uning inersiya momenti $J_0=13,5kg \cdot m^2$ bo'lib, sportchi qo'l va oyog'ini yig'ib, inersiya momentini $J=5,4kg \cdot m^2$ ga chiqargandagi aylanish burchak tezligini aniqlang. (3,75)

14.6.7. Inersiya momenti $J_z=0,075kg \cdot m^2$ bo'lgan naycha Oz o'qi atrofida aylanadi. Agar naycha ichidagi massasi $m=0,1kg$ bo'lgan sharcha ichki kuchlar ta'sirida harakat qilib, Oz o'qi ostiga kelganda burchak tezlik $\omega_0=4rad/s$ bo'lsa, sharcha qanday masofa ℓ ga kelganda burchak tezlik 3rad/s ga tushib qoladi? (0,5)

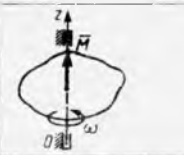


14.6.8. Bukilgan sterjen Oz o'qi atrofida $\omega_0=10rad/s$ boshlang'ich burchak tezlik bilan aylana boshlaydi. Sterjenning AB qismida massasi $m=1kg$ bo'lgan polzun $AC=0,2+1,2t$ qonun bo'yicha harakat qiladi. Agar sterjenning inersiya momenti aylanish o'qiga nisbatan $J_z=2,5kg \cdot m^2$ bo'lib, polzunni moddiy nuqta deb hisoblasak, $t=1s$ paytdagi sterjenning burchak tezligini aniqlang. (5,70)

14.6.9. Massasi 20kg bo'lgan 2 maxovik markaziy inersiya momenti Oz_1 o'qiga nisbatan $J_{z1}=1kg \cdot m^2$ bo'lib, ichki kuchlar ta'sirida $\omega_r=40rad/s$ nisbiy burchak tezlik bilan aylanadi. Bundan tashqari 2 maxovik 1 richag yordamida Oz o'qi atrofida ham aylanma harakatda ishtirok etadi. Agar richagning inersiya momenti $J_z=4kg \cdot m^2$ bo'lsa, uning uzunligini $\ell=1m$ deb olib, burchak tezligini hisoblang. (1,6)



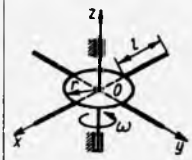
14.6.10. Jism Oz vertikal o'q atrofida momenti $M=16t$ bo'lgan juft kuch ta'sirida aylanma harakat qiladi. Agar jism muvozanat holatdan aylanishni boshlab, $t=3s$ da $\omega=2rad/s$ burchak tezlikka ega bo'lsa, uning Oz o'qiga nisbatan inersiya momentini aniqlang. (36)



14.6.11. Massasi m=3kg, uzunligi ℓ=1m bo'lgan bir jinsli sterjen Oz vertikal o'q atrofida ω_0=24rad/s burchak tezlik bilan aylanadi. Agar OA valga o'zgarmas tormozlash kuchi momenti ta'sir qilib, 4s da to'xtatilsa, bu moment modulini toping. (6)

14.6.12. Jism Oz vertikal o'q atrofida ikki juft kuchlar momentlari $\vec{M}_1=3\vec{i}+4\vec{j}+5\vec{k}$ va $\vec{M}_2=4\vec{i}+6\vec{j}+4\vec{k}$ ta'sirida aylanadi. Agar jismning Oz o'qqa nisbatan inersiya momenti 3kg·m^2 bo'lsa, muvozanat holatdan aylanishni boshlagan jismning t=2s dagi burchak tezligini aniqlang. (6)

14.6.13. Radiusi r=0,1m, massasi 5 kg bo'lgan bir jinsli diskka massalari 1 kg dan, uzunliklari ℓ=0,5m li to'rtta sterjenlar mahkamlangan. Sistema tashqi kuchlari ta'sirida $\omega=3t$ qonun bo'yicha aylana boshladi. Oz o'qiga nisbatan ta'sir etuvchi tashqi kuchlarning momentini aniqlang. (1,79)

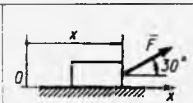


XV BOB. KINETIK ENERGIYANING O'ZGARISHI HAQIDAGI TEOREMA

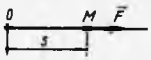
15.1. Kuchning bajargan ishi va quvvati

15.1.1. Bikirlik koeffitsiyenti c=100N/m bo'lgan prujinaning uchi 0,02m ga cho'zilgan bo'lsa, prujina elastiklik kuchining bajargan ishini hisoblang. (-0,02)

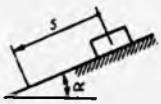
15.1.2. Gorizontal tekislikda harakatlanayotgan jismga $F=4x^3$ kuch ta'sir qilsa, uning $x=0$ dan $x=1$m holatga o'tib qolganda kuchning bajargan ishini hisoblang. (0,866)



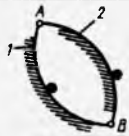
15.1.3. Massasi m bo'lgan M moddiy nuqta $F=12t^2$ kuch ta'sirida gorizontal tekislik bo'ylab, $s=t^4$ qonun bo'yicha harakat qilib, boshlang'ich $s_0=0$ holatdan $s_1=4$m holatga o'tgan paytdagi kuchning bajargan ishini aniqlang. (64)



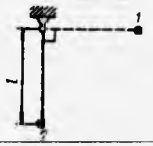
15.1.4. Jism g'adir-budur qiya tekislik bo'ylab pastga s masofaga tushsa, ishqalanish kuchining bajargan ishi tekislikning α qiyalik burchagining o'zgarishiga bog'liqmi? (Ha)



15.1.5. Moddiy nuqta vertikal tekislikda harakat qilib, A holatdan B holatga turli yo'llar orqali (1 yoki 2 aylana yoyi bo'ylab) o'tsa, og'irlik kuchining bajargan ishi bir xil bo'ladimi? (Ha)

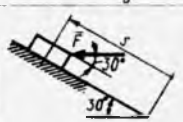


15.1.6. Massasi m=0,4kg bo'lgan yuk uzunligi ℓ=1m li ipga osib qo'yilgan bo'lib, 2 holatdan 1 holatga o'tsa, og'irlik kuchi qancha ish bajaradi? (-3,92)

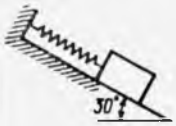


15.1.7. Massasi m=0,1kg bo'lgan M moddiy nuqta radiusi r=1m aylana yoyi bo'ylab A holatdan B holatga o'tsa (α=90°), og'irlik kuchining bajargan ishini hisoblang. (0,981)

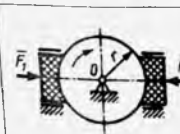
15.1.8. Og'ir jism qiyaligi α=30° bo'lgan qiya tekislikdan s=1m yuqoriga chiqadi. Jismni harakatga keltiruvchi o'zgarmas F=1N kuchning shu yo'lda bajargan ishini hisoblang. (0,866)



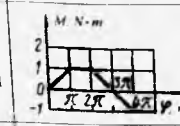
15.1.9. Massasi m=0,1kg li jism bikirlik koeffitsiyenti c=50N/m bo'lgan prujinaga osilgan bo'lib, qiya tekislikdan boshlang'ich tezliksiz qo'yib yuborilgan bo'lsa, og'irlik kuchining bajargan ishini tebranish davrining birinchi yarmi uchun hisoblang. ($9{,}62\cdot10^{-3}$)



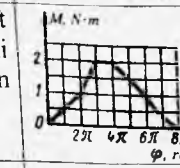
15.1.10. Radiusi r=0,1m bo'lgan disk Oz o'qi atrofida aylanadi. Agar diskka to'xtatish moslamasi orqali $F_1=F_2$=100N kuchlar ta'sir etib, 10 marta aylanib, to'xtasa, ishqalanish koeffitsiyentini f=0,3 deb, ishqalanish kuchlarining bajargan ishini hisoblang. (-377)



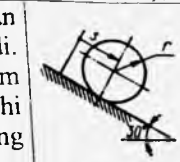
15.1.11. Mashina vali momenti $M=f(\varphi)$ bo'lgan juft kuch ta'sirida aylanadi. Agar momentning o'zgarishi shaklda ko'rsatilgandek bo'lsa, juft kuchning bajargan ishini boshlang'ich ikki aylanish uchun aniqlang. (4,71)



15.1.12. Mashina vali momenti $M=f(\varphi)$ bo'lgan juft kuch ta'sirida aylanadi. Agar momentning o'zgarishi shaklda ko'rsatilgandek bo'lsa, juft kuchning bajargan ishini boshlang'ich ikki aylanish uchun aniqlang. (14,1)

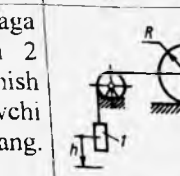


15.1.13. Massasi m=1kg radiusi r=0,173m bo'lgan silindr qiya tekislikdan sirpanmasdan pastga dumalaydi. Agar dumalab ishqalanish koeffitsiyenti δ=0,01m bo'lsa, silindr o'qining s=1m holati uchun og'irlik kuchi va dumalab ishqalanish kuchlarining bajargan ishlarining yig'indisini hisoblang. (4,41)

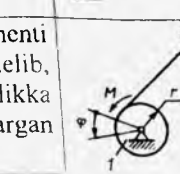


15.1.14. Massasi m_1=4kg bo'lgan 1 jism h=1m masofaga pastga tushib, massasi m_2=2kg 2 jismni yuqoriga tortadi. Og'irlik kuchlarining shu siljishdagi bajargan ishlarining yig'indisini aniqlang. (29,4)

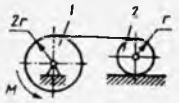
15.1.15. Massasi m_1=2kg li 1 yuk h=1m masofaga tushib, massasi m_2=1kg, radiusi R=0,1m bo'lgan 2 g'ildirakni harakatga keltiradi. Agar dumalab ishqalanish koeffitsiyenti δ=0,01m bo'lsa, sistemaga ta'sir qiluvchi tashqi kuchlar bajargan ishlarining yig'indisini hisoblang. (18,6)



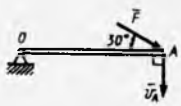
15.1.16. Radiusi r=0,1m bo'lgan 1 baraban momenti $M=40+\varphi^2$ bo'lgan juft kuch ta'sirida harakatga kelib, massasi m=40kg bo'lgan 2 yukni h=0,3m balandlikka tortsa, juft momenti va yukning og'irlik kuchlari bajargan ishlarining yig'indisini hisoblang. (11,3)



15.1.17. 1 baraban momenti M=10N·m bo'lgan juft kuch ta'sirida harakatga kelib, massasi m_2=10kg li 2 silindrni sirpanmasdan dumalatadi. Agar dumalab ishqalanish koeffitsiyenti δ=0,01m bo'lsa, sistemaga ta'sir qiluvchi tashqi kuchlarning bajargan ishlari yig'indisini 1 baraban 10 marta aylangan holat uchun hisoblang. (567)



15.1.18. Gorizontal O o'q atrofida aylanuvchi krivoshipning A uchiga F=100N kuch ta'sir qilib, A nuqtaga υ_A=4m/s tezlik bersa, $\overline{F}$ kuchining quvvatini aniqlang. (200)



15.1.19. Diametri D=100mm li gidrosilindr porsheniga yog'larning bosimi p=10N/mm^2 ta'sir qilib υ=0,2m/s tezlik bersa, bosim kuchining quvvatini kw*t* larda hisoblang. (15,7)

15.1.20. Dvigatelining tortish kuchi 3500N bo'lgan motorli qayiq 8m/s tezlik bilan harakat qilsa, dvigatel tortish kuchining quvvatini kwt larda hisoblang. (28)

15.1.21. Massasi 40 kg bo'lgan bir jinsli silindr ω=4rad/s burchak tezlik bilan gorizontal tekislikda to'g'ri chiziq bo'ylab sirpanmasdan dumalaydi. Agar dumalab ishqalanish koeffitsiyenti δ=0,01m bo'lsa, dumalashga qarshilik qiluvchi kuchning quvvatini hisoblang. (-15,7)

15.1.22. Diametri D=20sm bo'lgan disk ω=100rad/s burchak tezlik bilan aylanayotgan paytda ikkita to'xtatish moslamalari orqali F=200 N dan kuchlar ta'sir etadi. Agar ular orasidagi ishqalanish koeffitsiyenti f=0,2 bo'lsa, ishqalanish kuchining quvvati qancha bo'ladi? (-800)

15.1.23. Massasi m_1=200kg bo'lgan 1 yukni yuqoriga ko'taruvchi moslama elektrodvigatelning 3 tishli g'ildiragi va pog'onali barabandan iborat. Agar ularning tishlar soni Z_2=2Z_3 va barabanning radiusi r=0,1m bo'lsa, tishli g'ildirak ω=30rad/s burchak tezlik bilan tekis aylanganda elektrodvigatelning quvvatini kwt larda hisoblang. (2,94)

15.1.24. Dvigatelning valiga burovchi moment M=80·(1-ω/400) ta'sir etib, 200 rad/s burchak tezlik bilan aylantirsa, dvigatelning quvvati kwt larda qancha bo'ladi? (8)

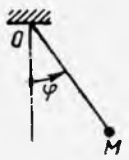
15.2. Moddiy nuqtaning kinetik va potensial energiyasi

15.2.1. Massasi m=1kg bo'lgan moddiy nuqta aylana bo'ylab υ=1m/s tezlik bilan harakat qilsa, uning kinetik energiyasi qancha bo'ladi? (0,5)

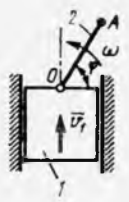
15.2.2. Massasi m=4kg bo'lgan moddiy nuqta $s=4t+2t^2$ qonun asosida to'g'ri chiziqli harakat qilsa, t=2s dagi kinetik energiyasini hisoblang. (288)

15.2.3. Massasi m=5kg bo'lgan yuk vertikal prujinaga osilgan holda $y=0{,}1\sin(14t+1{,}5\pi)$ qonun bo'yicha tebranma harakat qilsa, yukning kinetik energiyasini maksimal qiymatini aniqlang. (4,9)

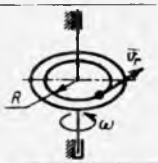
15.2.4. Massasi m=0,5kg li M moddiy nuqta uzunligi OM=2m bo'lgan ingichka cho'zilmaydigan ip vositasida osilgan bo'lib, vertikal tekislikda $\varphi=(\pi/6)\sin 2\pi t$ qonun bo'yicha tebranma harakat qilsa, nuqta eng pastki holatga tushganda uning kinetik energiyasi qancha bo'ladi? (10,8)



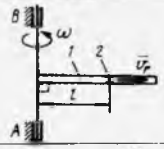
15.2.5. 1 jism υ_1=1m/s tezlik bilan vertikal yuqoriga harakatlanadi. Unga 2 sterjen vositasida massasi 0,1kg bo'lgan A sharcha mahkamlangan bo'lib, sharcha gorizontal Oy o'qi atrofida ω=10rad/s o'zgarmas burchak tezlik bilan aylanadi. Agar vaznsiz sterjenning uzunligi OA=0,2m bo'lsa, φ=60° holat uchun sharchaning kinetik energiyasini hisoblang. (0,35)



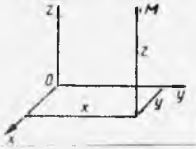
15.2.6. Gorizontal platforma vertikal o'q atrofida ω=2rad/s burchak tezlik bilan aylanadi. Aylanish o'qidan R=1m masofada massasi m=0,2kg nisbiy tezligi υ_r=3m/s bo'lgan moddiy nuqta aylana bo'ylab harakat qilsa, nuqtaning kinetik energiyasini toping. (2,5)



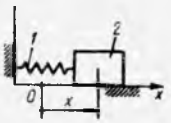
15.2.7. Naycha ω=2rad/s burchak tezlik bilan tekis aylanadi. Uning ichida massasi m_1=0,5kg, nisbiy tezligi υ_r=0,2m/s bo'lgan 2 sharcha l=0,5m masofada harakat qilsa, nuqtaning kinetik energiyasini aniqlang. (0,26)



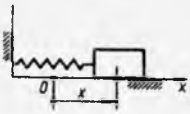
15.2.8. Massasi m=0,2kg bo'lgan moddiy nuqta og'irlik kuchi maydonida joylashgan, z=0 da, potensial energiyasi nolga teng bo'lsa, z=10m balanlikda qancha bo'ladi? (19,6)



15.2.9. Bikirligi 100N/m bo'lgan 1 prujinaga mahkamlangan, 2 yuk $x=0,1\sin 10t$ qonun bo'yicha tebranma harakat qiladi $x=0$ da yukning potensial energiyasi nolga teng bo'lsa, $x=0,05$m da potensial energiyasi qancha bo'ladi? (0.125)



15.2.10. Bikirligi $c=100$N/m bo'lgan prujinaga mahkamlangan, massasi 1kg bo'lgan yuk $x=0,1\sin 10t$ qonun bo'yicha tebranma harakat qilsa, $x=0$ da potensial energiyasi nolga teng deb olib, $x=0,05$m da potensial energiyasini hisoblang. (0,5)

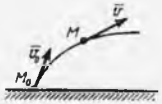


15.3. Moddiy nuqta va qattiq jismning ilgarilanma harakati uchun kinetik energiyaning o'zgarishi haqidagi teorema

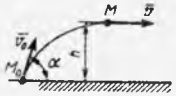
15.3.1. Agar moddiy nuqtaning kinetik energiyasi 50 jouldan 25 joulga o'zgarsa, unga ta'sir qiluvchi kuchlarning bajargan ishlari nechaga teng? (-25)

15.3.2. Massasi m bo'lgan moddiy nuqta tinch holatdan boshlang'ich tezliksiz vertikal pastga tushsa, tezligi 3 m/s paytda qancha yo'l bosadi? Havoning qarshiligini hisobga olmang. (0,459)

15.3.3. Massasi $m=0,5$kg bo'lgan moddiy nuqta yer sirtidan egri chiziq bo'ylab $\upsilon_0=20$m/s boshlang'ich tezlik bilan yuqoriga otildi. Agar u M nuqtaga kelib $\upsilon=12$m/s tezlikka ega bo'lsa, M_0M yo'lda og'irlik kuchining bajargan ishini hisoblang. (-64)



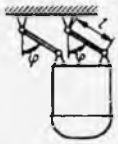
15.3.4. Massasi m bo'lgan moddiy nuqta yer sirtidan $\alpha=60°$ burchak ostida $\upsilon_0=30$m/s boshlang'ich tezlik bilan yuqoriga otildi. Uning yuqoriga maksimal ko'tarilish h balandligini aniqlang. (34,4)



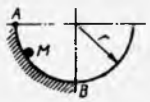
15.3.5. Massasi $m=2$kg bo'lgan jism qiya tekislikdan $\upsilon_0=2$m/s tezlik bilan yuqoriga harakatni boshlab, to'xtaguncha og'irlik kuchi qanday ish bajaradi? (-4)

15.3.6. Massasi m bo'lgan moddiy nuqta uzunligi $OM=0,4m$ li ipga osilgan holda turg'un holatdan $\alpha=90°$ burchak holatiga ko'tarilib, boshlang'ich tezliksiz qo'yib yuborilsa, turg'un holatidan o'tayotganda qanday tezlikka erishadi? (2,80)

15.3.7. Tebranuvchi kabina uzunligi l=0,5 m li ikki sterjen vositasida aylanish o'qiga osilgan bo'lib, turg'un holatidan φ=60° burchakka ko'tarilib, boshlang'ich tezliksiz qo'yib yuborilsa, turg'un holati joyidan o'tayotganda qanday tezlikka erishadi? (2,21)

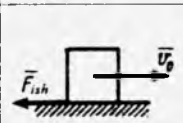


15.3.8. Massasi m bo'lgan moddiy nuqta radiusi r=0,2m bo'lgan yarim silindr ichki sirti bo'ylab og'irlik kuchi ta'sirida harakat qiladi. Agar A nuqtada uning tezligi nolga teng bo'lsa, B nuqtada qanday tezlikka erishadi? (1,98)



15.3.9. Massasi m bo'lgan halqa radiuslari r_1=1m va r_2=2m aylana yoylari shaklida bukilgan ABC sim bo'ylab, ishqalanishsiz sirpanadi. Agar A nuqtada halqaning tezligi nolga teng bo'lsa, B nuqtada uning tezligi qancha bo'ladi? (9,90)

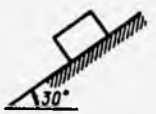
15.3.10. Massasi m=2kg bo'lgan jismga gorizontal tekislik bo'ylab υ_0=4m/s boshlang'ich tezlik berilgan va u 16m yo'l bosib o'tib to'xtaydi. Jism va tekislik orasida hosil bo'lgan ishqalanish kuchining modulini hisoblang. (1)



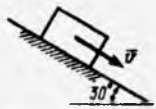
15.3.11. Massasi m=100kg bo'lgan jism tinch holatdan o'zgarmas $\vec{F}$ kuchi ta'sirida gorizontal g'adir-budur tekislik bo'ylab harakat qiladi. Agar u 5m yo'l bosib o'tgandan keyin, tezligi 5m/s bo'lsa, ishqalanish kuchining miqdorini F_{ish}=20N deb, $\vec{F}$ kuchining modulini aniqlang. (270)

15.3.12. Darvozadan 10m masofada turgan xokkeychi shaybaga 8m/s tezlik bergan va u darvozaga 7,7m/s tezlik bilan kirdi. Shayba va muz orasidagi ishqalanish koeffitsiyentini hisoblang. ($2{,}40\cdot10^{-2}$)

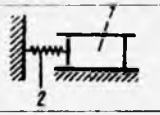
15.3.13. Massasi m=1kg bo'lgan jism tinch holatdan qiya tekislik bo'ylab boshlang'ich tezliksiz pastga tusha boshladi. Agar ishqalanish koeffitsiyenti f=0,2 bo'lsa, 3m masofa bosib o'tganda jismning kinetik energiyasi qancha bo'ladi? (9,62)



15.3.14. Massasi m bo'lgan jism boshlang'ich tezliksiz qiya tekislikdan pastga tushadi. Agar ishqalanish koeffitsiyenti f=0,15 bo'lsa, 4m masofa bosgan paytdagi jismning tezligini aniqlang. (5,39)

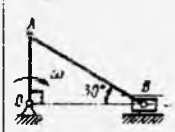
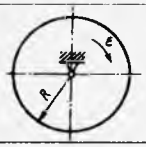
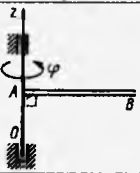
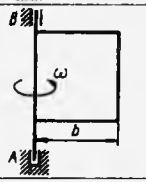
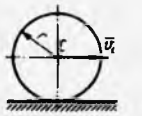
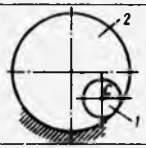


15.3.15. Massasi m=1kg bo'lgan jism prujinaga mahkamlangan bo'lib, erkin holatdan 0,1m masofaga qisib, boshlang'ich tezliksiz qo'yib yuborilsa, 0,1m yo'l

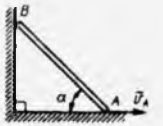


bosgandan keyin uning tezligi 1m/s bo'lgan. Prujinaning bikirligini hisoblang. (100)	

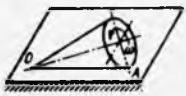
15.4. Qattiq jismning kinetik energiyasi

15.4.1. Ventilatorning ishchi g'ildiragi 90 ayl/min aylanish chastotasiga ega bo'lib, uning inersiya momenti 2,2kg·m^2 bo'lsa, kinetik energiyasi qancha bo'ladi? (97,7)	
15.4.2. Uzunligi 0,5m bo'lgan OA krivoship O o'q atrofida ω=2rad/s burchak tezlik bilan aylanadi. Agar AB shatunning massasi m=1kg bo'lsa, shaklda ko'rsatilgan holat uchun AB shatunning kinetik energiyasini aniqlang. (0,5)	
15.4.3. Massasi m=30kg, radiusi R=1m bo'lgan bir jinsli disk tinch holatdan tekis tezlanish ε=2rad/s^2 bilan aylana boshlasa, t=2s paytdagi diskning kinetik energiyasini hisoblang. (120)	
15.4.4. Massasi m=3kg, uzunligi AB=1m bo'lgan bir jinsli sterjen Oz o'q atrofida $\varphi=2t^3$ qonun bo'yicha aylansa, t=1s da uning kinetik energiyasini hisoblang. (18)	
15.4.5. Massasi m=18kg bo'lgan to'g'ri to'rtburchak shaklidagi plastina ω=4rad/s burchak tezlik bilan AB o'q atrofida aylansa, plastinaning uzunligini b=1m deb, uning kinetik energiyasini aniqlang. (48)	
15.4.6. Massasi m=2kg radiusi r=1m bo'lgan diskning massa markazidan o'tuvchi o'qqa nisbatan inersiya momenti J_C=2kg·m^2 bo'lsa, massa markazining tezligini υ_C=1m/s deb, diskning kinetik energiyasini hisoblang. (2)	
15.4.7. Massasi m=16kg bo'lgan bir jinsli 1 silindr 2 silindrik sirt ichida sirpanmasdan dumalaydi. Agar 1 silindr massa markazning tezligi υ_C=2m/s bo'lsa, uning kinetik energiyasini hisoblang. (48)	

15.4.8. Uzunligi AB=2m, massasi m=6kg bo'lgan bir jinsli sterjen o'zining A va B uchlari bilan gorizontal va vertikal tekisliklarda sirpanadi. Agar A uchining tezligi υ_A 1m/s va α=45° bo'lsa, sterjenning kinetik energiyasini aniqlang. (2)



15.4.9. To'g'ri doiraviy konus gorizontal tekislikda ω=5rad/s burchak tezlik bilan oniy o'q atrofida sirpanishsiz dumalaydi. Agar konusning OA o'qqa nisbatan inersiya momenti 0,04kg·m^2 bo'lsa, uning kinetik energiyasi qancha bo'ladi? (0,5)

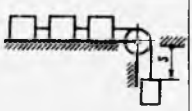


15.4.10. Massasi m=5kg bo'lgan shar markazi C ning tezligi 4m/s bo'lib, fazoda erkin harakatlanadi. Agar sharning oniy Cz o'qqa nisbatan aylanish burchak tezligi ω=10rad/s va inersiya momenti 0,5kg·m^2 bo'lsa, sharning kinetik energiyasini hisoblang. (65)

15.5. Mexanik sistemaning kinetik energiyasi

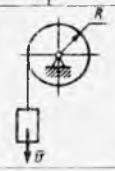
15.5.1. Aylanish o'qiga nisbatan inersiya momentlari J_2=2J_1=2kg·m^2 bo'lgan tishli uzatmaning ikki silindrik g'ildiraklari tishlari soni Z_2=2Z_1 bo'lsa, 1 g'ildirakning burchak tezligi 10rad/s uchun sistemaning kinetik energiyasini aniqlang. (75)

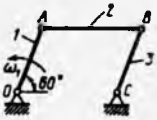
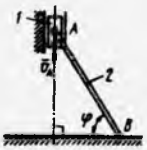
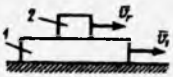
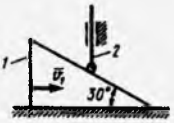
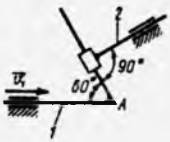
15.5.2. Massalari m=1kg dan bo'lgan to'rtta yuklar cho'zilmaydigan ingichka ip yordamida bog'langan bo'lib, vaznsiz blok orqali osilgan. Agar osilgan yukning harakat qonuni s=1,5t^2 bo'lsa, t=2s dagi sistemaning kinetik energiyasini hisoblang. (72)



15.5.3. Massalari m=1kg dan bo'lgan ikkita bir xil tishli g'ildiraklar ω=10rad/s burchak tezlik bilan aylanib, har birining aylanish o'qiga nisbatan inersiya radiusi 0,2m bo'lsa, sistemaning kinetik energiyasini hisoblang. (4)

15.5.4. Massasi m=4kg bo'lgan yuk pastga tushadi. Radiusi R=0,4m li silindrning aylanish o'qiga nisbatan inersiya momenti J=0,2kg·m^2 bo'lsa, yuk υ=2m/s tezlikka ega bo'lgan paytda sistemaning kinetik energiyasi qanchaga teng? (10.5)



15.5.5. Aylanish o'qiga nisbatan inersiya momenti 0,1kg·m^2 bo'lgan 1 krivoship ω=10rad/s burchak tezlik bilan aylanib, massasi 1kg bo'lgan 2 g'ildirakni harakatga keltiradi. Agar 2 g'ildirakni bir jinsli disk deb hisoblab, 3 silindrik sirt va 2 g'ildirak radiuslari orasidagi munosabat R=3r=0,6m bo'lsa, mexanizmning kinetik energiyasini aniqlang. (17)	
15.5.6. Uzunligi OA=0,4m bo'lgan 1 krivoship O o'qi atrofida ω_1=10rad/s burchak tezlik bilan tekis aylanib, 2 shatun va 3 krivoshiplarni harakatga keltiradi. Agar 2 shatunning massasi m_2=5kg va 1–3 krivoshiplarning inersiya momentlari 0,1kg·m^{2}dan bo'lsa, mexanizmning kinetik energiyasini hisoblang. (50)	
15.5.7. Massasi 2kg bo'lgan 1 polzun massasi 6kg, uzunligi AB=1m li sterjenga sharnir yordamida bog'langan. Agar polzun υ_A=1m/s tezlik bilan pastga tushsa, AB sterjenning uchi B gorizontal tekislikda sirpanadi deb, φ=60° holat uchun sistemaning kinetik energiyaisini aniqlang. (5)	
15.5.8. Massasi 40kg bo'lgan 1 jism υ_1=1m/s tezlik bilan to'g'ri chiziqli ilgarilanma harakat qiladi. Massasi 10kg bo'lgan 2 jism uning ustida υ_r=0,4m/s nisbiy tezlik bilan harakatlansa, sistemaning kinetik energiyasini hisoblang. (29,8)	
15.5.9. Massasi m_1=5kg bo'lgan 1 prizma υ_1=1m/s tezlik bilan gorizontal tekislikda harakat qiladi. Massasi 1kg bo'lgan 2 sterjen uchi bilan kichik g'ildirak yordamida prizma sirtiga tiralib, vertikal yo'naltiruvchi ichida yuqoriga ko'tarilsa, mexanizmning kinetik energiyasini aniqlang. (2,67)	
15.5.10. Massasi m_1=4kg bo'lgan 1 sterjen 60° burchak shaklida bo'lib, gorizontal yo'naltiruvchilar bo'ylab υ_1=1m/s tezlik bilan harakat qiladi. Massasi m_2=2kg li 2 sterjen 1 sterjenga vtulka orqali bog'langan bo'lib, o'z yo'naltiruvchisi bo'ylab harakatlansa, sistemaning kinetik energiyasini aniqlang. (2,75)	

15.6. Qattiq jism uchun kinetik energiyaning o'zgarishi haqidagi teorema

15.6.1. Radiusi 0,4m bo'lgan bir jinsli disk o'z tekisligiga perpendikular va disk gardishidan o'tgan o'q atrofida chorak marta aylanishi uchun unga qanday boshlang'ich burchak tezlik berish lozim? (5,72)

15.6.2. Uzunligi l=3m bo'lgan sterjen Oz o'qi atrofida yarim aylanishi uchun unga qanday boshlang'ich burchak tezlik ω_o berish kerak? (4,43)

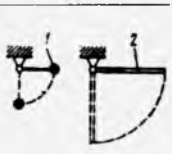
15.6.3. Vertikal o'q atrofida aylanuvchi jismga ω_0=2,24rad/s boshlang'ich burchak tezlik berilgan. Agar uning aylanish o'qiga nisbatan inersiya momenti J=8kg·m^2 bo'lsa, podshipniklarning ishqalanish qarshilik momentini o'zgarmas M=1N·m deb, jismning qancha burchakka aylanishini hisoblang. (20,1)

15.6.4. Massasi m=314kg, inersiya radiusi 1m bo'lgan rotorga ω_0=10rad/s boshlang'ich burchak tezlik berilganda, u 100 marta aylanib to'xtadi. Podshipniklarda hosil bo'ladigan ishqalanish qarshilik momentini aniqlang. Qarshilik momenti o'zgarmas deb olinsin. (25)

15.6.5. Aylanish o'qiga nisbatan inersiya momenti 3kg·m^2 bo'lgan rotorga o'zgarmas juft kuch momenti M=9N·m ta'sir etsa, uning burchak tezlanishini aniqlang. (3)

15.6.6. Massasi m=12kg, uzunligi l=2m bo'lgan bir jinsli sterjen AB valga mahkamlangan. Valga boshlang'ich ω_0=2rad/s burchak tezlik berilgan bo'lib, 20 marta aylanib to'xtadi. Podshipniklarda hosil bo'lgan ishqalanish momentini hisoblang (0,255)

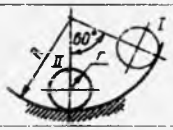
15.6.7. Massasi m, uzunligi ℓ bo'lgan 1 matematik mayatnikni va massasi m uzunligi 2ℓ bo'lgan bir jinsli 2 sterjenni bir vaqtda gorizontal holatdan boshlang'ich tezliksiz qo'yib yuborilsa, qaysi jismning massalar markazi tezligi quyi holatda katta bo'ladi. (1)



15.6.8. Massasi m radiusi R=0,5m bo'lgan yupqa devorli silindr gorizontal tekislik bo'ylab sirpanmasdan dumalaydi. Agar boshlang'ich paytda unga ω_o=4rad/s burchak tezlik berilgan bo'lsa, dumalab ishqalanish koeffitsiyentini δ=0,01m deb, silindr massa markazi C ning bosib o'tgan yo'lini aniqlang. (20,4)

15.6.9. Massasi m, radiusi R bo'lgan bir jinsli disk qiya tekislikdan sirpanmasdan yuqoriga dumalaydi. Agar boshlang'ich paytda diskning markazi υ_0=4m/s tezlikka ega bo'lsa, to'xtagunga qadar disk markazi C qancha yo'l bosadi? (2,45)

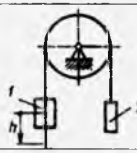
15.6.10. Radiusi r=0,1m bo'lgan halqa radiusi R=0,6m li silindrik sirtning ichki devori bo'ylab sirpanmasdan dumalanib, I tinch holatdan II holatga o'tsa, halqa massa markazining tezligini aniqlang. (1,57)



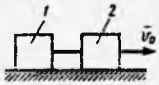
15.7. Mexanik sistema kinetik energiyasining o'zgarishi haqidagi teorema

15.7.1. Massalari 2kg va 4kg li ikkita yuk iplar yordamida qo'zg'almas blokka osilgan. Yuklarning tezlanishini aniqlang. (3,27)

15.7.2. Massalari m_1=2kg va m_2=1kg bo'lgan ikki yuk cho'zilmaydigan ip yordamida blokka osilgan bo'lib, 1 yuk tinch holatdan h=3m pastga tushgan paytda uning tezligini hisoblang. (4,43)

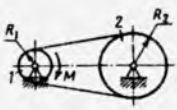


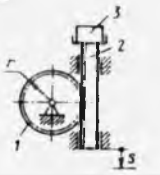
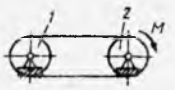
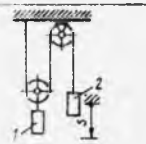
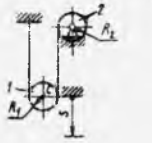
15.7.3. Bir xil m massali 1 va 2 yuklar ip vositasida bog'langan. 2 yuk υ_0=2m/s boshlang'ich tezlikka ega bo'lib, yuklar gorizontal yo'lda 4m masofa bosib, to'xtasa, ishqalanish koeffitsiyentini aniqlang. ($5{,}10\cdot10^{-2}$)



15.7.4. Bir xil, 2kg massali tishli g'ildiraklar 1 va 2 tinch holatdan o'zgarmas M=1N·m juft kuch momenti ta'sirida harakatga keltiriladi. Agar g'ildiraklarning inersiya radiuslari 0,2m dan bo'lsa, ikki marta aylangandan keyin ularning burchak tezligi qancha bo'ladi? (12,5)

15.7.5. Radiusi R_2=2R_1 bo'lgan ikki shkiv tasma yordamida bog'langan bo'lib, tinch holatdan o'zgarmas M=2,5N·m juft kuch momenti ta'sirida harakatga keladi. Agar shkivlarning aylanish o'qiga nisbatan inersiya momentlari J_2=2J_1=1kg·m^2 bo'lsa, 1 shkiv uch marotaba aylangandan so'ng burchak tezligi nechaga teng bo'ladi? (11,2)



15.7.6. Aylanish o'qiga nisbatan inersiya momenti 0,1kg·m^2 bo'lgan 1 tishli g'ildirak umumiy massasi 100kg bo'lgan 2 reyka va 3 yukka bog'langan. Agar sistema tinch holatdan harakatga kelib, reyka s=0,2m ga siljisa, 1 g'ildirak radiusini r=0,1m deb, 2 reykaning tezligini aniqlang. (1,89)	
15.7.7. Massalari m_1=m_2=20kg radiuslari R_1=R_2=0,2m bo'lgan bir jinsli g'ildiraklar bir-biriga bikir mahkamlangan bo'lib, tinch holatdan o'zgarmas M=2N·m juft kuchlar momenti ta'sirida 3m masofa bosib o'tishsa, ularning o'qlarining chiziqli tezligi nechaga teng? (1)	
15.7.8. Bir xil massali ikki shkiv o'zaro tasma vositasida bog'langan bo'lib, tinch holatdan o'zgarmas moment M=0,5N·m ta'sirida harakatga keladi. Agar uch marta aylanagandan so'ng shkivlar 2rad/s burchak tezlikka ega bo'lsa, ulardan birining aylanish o'qiga nisbatan inersiya momentini aniqlang. (2,36)	
15.7.9. Massalari m_1=2kg va m_2=4kg bo'lgan ikki yuk iplar vositasida bloklar orqali shiftga osilgan. Agar ular tinch holatdan harakatga kelib, 2 yuk s=4m masofa bosib o'tsa, uning tezligi qanchaga teng? (7,23)	
15.7.10. Massalari va radiuslari teng bo'lgan bir jinsli bloklar iplar vositasida shiftga bog'langan. Agar sistema tinch holatdan og'irlik kuchi ta'sirida harakatga kelib, 1 shkiv s=1m pastga tushsa, uning markazi C qanday tezlikka ega bo'ladi? (2,37)	

16.1. Qattiq jismning qo'zg'almas o'q atrofida aylanma harakat differensial tenglamalari

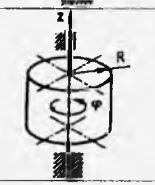
16.1.1. Agar plastinaning aylanma harakat tenglamasi $\varphi=5t^2-2$ bo'lib, o'qqa nisbatan inersiya momenti $J_z=0{,}125\text{kg}\cdot\text{m}^2$ bo'lsa, unga ta'sir etuvchi tashqi kuchlarning bosh momentini aniqlang. (1,25)

16.1.2. Vertikal o'qqa qiya qilib mahkamlangan sterjenning aylanma harakat qonuni $\varphi=2(t^2+1)$ va inersiya momenti $J_z=0{,}05\text{kg}\cdot\text{m}^2$ bo'lsa, unga ta'sir etuvchi tashqi kuchlarning bosh momentini hisoblang. (0,2)

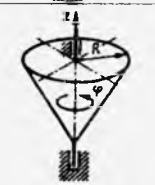
16.1.3. Diskning OZ o'qi atrofida aylanish tenglamasi $\varphi=t^3$ bo'lib, inersiya momenti $2\text{kg}\cdot\text{m}^2$ bo'lsa, $t=1$s paytdagi unga ta'sir etuvchi juft kuchlar momentining modulini hisoblang. (12)

16.1.4. Vertikal o'q atrofida aylanuvchi sterjen $\varphi=3t^2-t$ tenglama asosida aylansa, uning inersiya momentini $J_z=1/6\text{kg}\cdot\text{m}^2$ deb, sterjenga ta'sir etuvchi tashqi kuchlarning bosh momentini aniqlang. (1)

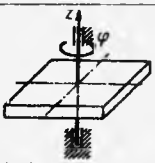
16.1.5. Massasi $m=60$kg, radiusi $R=1{,}41$m bo'lgan bir jinsli silindrning harakat tenglamasi $\varphi=t^3-5t^2$ bo'lsa, $t=2$s dagi jismga ta'sir etuvchi tashqi kuchlarning bosh momentini hisoblang. (119)



16.1.6. Massasi $m=10$kg, asoslarining radiusi $R=1$m bo'lgan konus simmetriya o'qi atrofida $\varphi=4\sin 2t$ qonun bilan aylansa, $t=\pi/4$s paytda unga ta'sir etuvchi tashqi kuchlarning aylanish o'qiga nisbatan bosh momentini aniqlang. Konusning inersiya momenti $J_z=0{,}3mR^2$ deb olinsin. (-48)



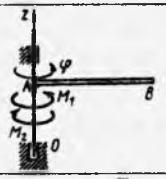
16.1.7. Inersiya momenti $J_z=10\text{kg}\cdot\text{m}^2$ bo'lgan to'g'ri to'rt burchak shaklidagi bir jinsli plastinaning harakat tenglamasi $\varphi=2\sin(\pi t/2)$ bo'lsa, $t=1$s dagi ta'sir etuvchi kuchlarning bosh momentini hisoblang. (-49,3)



16.1.8. Dvigatel vali $\omega=90e^{-20t}+85(1-e^{-20t})$ burchak tezlik bilan aylansa, uning inersiya momentini 1kg·m^2 deb, t=0,1 s dagi tashqi kuchlar bosh momentini aniqlang. (-13,5)

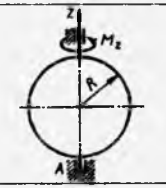
16.1.9. Inersiya momenti 6kg.m^2 bo'lgan disk juft kuch momenti M_1 va qarshilik momenti M_2=6N·m ta'sirida markaziy o'q atrofida ε=4rad/s^2 burchak tezlanish bilan aylansa, juft kuch momenti M_1 ni aniqlang. (30)

16.1.10. Massasi m=2kg, uzunligi AB=1m bo'lgan bir jinsli sterjen Oz o'qi atrofida juft kuch momenti M_1 va qarshilik momenti M_2=12N·m ta'sirida $\varphi=3t^2$ qonun bo'yicha aylansa, t=1s dagi juft kuch momenti M_1 ni hisoblang. (16)

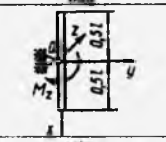


16.1.11. Massasi m=50kg, radiusi r=0,3m va inersiya radiusi 0,2m bo'lgan disk yetaklovchi va yetaklanuvchi tasmali uzatma taranglik kuchlari $T_1=2T_2$=100N vositasida aylansa, diskning burchak tezlanishini hisoblang. (7,5)

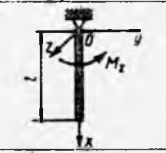
16.1.12. Massasi 4kg, radiusi R=0,6m bo'lgan bir jinsli yupqa disk Az vertikal o'q atrofida M_z=1,8N·m moment ta'sirida aylansa, diskning burchak tezlanishini aniqlang. (5)



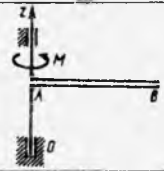
16.1.13. Massasi m=4kg, uzunligi ℓ=1m bo'lgan bir jinsli sterjen Oz o'qi atrofida burovchi moment M_z=3N·m ta'sirida aylansa, uning burchak tezlanishini aniqlang. (9)



16.1.14. Massasi m=3kg, uzunligi ℓ=1m bo'lgan bir jinsli sterjen Oz o'qi atrofida juft kuch momenti M_z=2N·m ta'sirida aylansa, uning burchak tezlanishi qanchaga teng? (2)



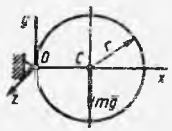
16.1.15. Massasi m=8kg, uzunligi AB=1,5m bo'lgan bir jinsli sterjen Oz o'qi atrofida juft kuch momenti $M_z=12\sin(3\pi/4)t$ ta'sirida aylanadi. t=2/3 s paytda uning burchak tezlanishini aniqlang. (2)



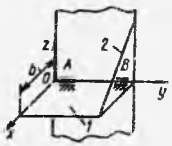
16.1.16. Dvigatel rotoriga $M=100(1-\omega/200)$ juft kuch momenti ta'sir etib, uni ishga tushirsa, rotorning inersiya momentini 2kg·m^2 hisoblab, rotor burchak tezlanishining maksimal qiymatini aniqlang. (50)

16.1.17. Dvigatel rotoriga $M=40(1-t/10)$ juft kuch momenti ta'sir etib, uni ishga tushirsa, rotor inersiya momentini 0,5 kg·m^2 hisoblab, rotor burchak tezlanishining maksimal qiymatini hisoblang. (80)

16.1.18. Radiusi $r=0,1$m bo'lgan bir jinsli disk og'irlik kuchi ta'sirida Oz gorizontal o'qi atrofida aylanadi. Agar u aylanishni radiusi OC gorizontal holatdaligida boshlagan bo'lsa, shu paytdagi burchak tezlanishni aniqlang. (65,4)

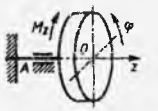


16.1.19. Massasi m, eni $b=1$m bo'lgan to'g'ri to'rt burchak shaklidagi bir jinsli plita A va B sharnirlar, hamda 2 sim arqon yordamida gorizontal holatda ushlab turilibdi. Agar 2 sim arqon uzilishi natijasida u aylanma harakatga kelsa, boshlang'ich paytdagi burchak tezlanishni aniqlang. (14,7)

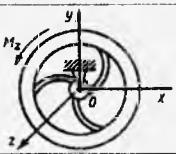


16.1.20. Massasi $m=4$kg bo'lgan kesik konus markaziy bo'lmagan Oz o'qi atrofida juft kuch momenti $M=24$N·m ta'sirida $\varepsilon=6$rad/s^2 burchak tezlanish bilan aylansa, aylanish o'qi va markaziy o'q orasidagi masofani $h=0,2$m deb, konusning markaziy o'qiga nisbatan inersiya momentini aniqlang. (3,84)

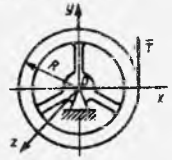
16.1.21. Devorga qistirib mahkamlangan OA konsol to'sinning uchiga rotor o'rnatilgan bo'lib, u tiklovchi moment $M_z=-\pi^2\varphi$ ta'sirida $\varphi=3\sin(\pi/4)t$ qonun bilan burilma tebranishda bo'lsa, rotorning Az o'qiga nisbatan inersiya momentini hisoblang. (16)



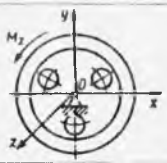
16.1.22. Massasi $m=5$kg, bo'lgan g'ildirak burovchi moment $M_z=180$N·m ta'sirida $\varphi=9t^2+2$ qonun bo'yicha aylansa, uning inersiya radiusini aniqlang. (1,41)



16.1.23. Massasi $m=50$kg, radiusi $R=0,5$m bo'lgan shkiv sim arqonning taranglik kuchi $T=18t$ ta'sirida $\varphi=t^3/3+3t$ qonun bo'yicha aylansa, uning inersiya radiusini hisoblang. (0,3)

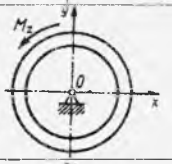


16.1.24. Massasi m=3kg bo'lgan g'ildirak burovchi moment M_z $9t$ ta'sirida Oz o'qi atrofida $\varphi = 2t^3$ qonun bilan aylansa, uning inersiya radiusini aniqlang. (0,5)

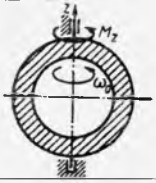


16.1.25. Massasi m=5kg, radiusi R=0,4m bo'lgan shkiv tasmalarning taranglik kuchlari $T_1=2T_2=10$N ta'sirida $\omega=10t$ burchak tezlik bilan aylansa, uning inersiya radiusini hisoblang. (0,2)

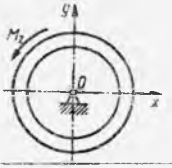
16.1.26. Massasi m=12kg, inersiya radiusi ρ=1,73m bo'lgan g'ildirak burovchi moment M_z=6N·m ta'sirida aylana boshlasa, $3s$ dan keyin uning burchak tezligi qancha bo'ladi? (0,501)



16.1.27. Inersiya momenti J_z=0,375kg·m^2 bo'lgan halqa ω_0=16rad/s boshlang'ich burchak tezlik bilan aylanayotgan paytda unga juft kuch momenti $M_z=3t^2$ ta'sir etsa, 1s dan keyin uning burchak tezligi qanchaga o'zgargan? (18,7)



16.1.28. Massasi m=1,5kg, inersiya radiusi ρ=0,1m bo'lgan g'ildirak tinch holatdan tashqi kuchlarning bosh momenti M_z=0,15N·m ta'sirida harakatga kelsa, 1s ichida qancha burchakka buriladi? (5)



16.1.29. Massasi m=2kg, uzunligi AB=1m bo'lgan bir jinsli sterjen tinch holatdan juft kuch momenti $M_z=4t$ ta'sirida aylana boshlasa, t=2s dan keyin necha radianga burilgan? (8)

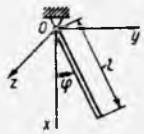
16.1.30. Massasi m=80kg, radiusi r=0,5m bo'lgan bir jinsli disk Oz gorizontal o'q atrofida juft kuch momenti $M=20t^2$ ta'sirida aylanadi. Agar uning boshlang'ich burchak tezligi ω_0=0 bo'lsa, t=6s dan keyin burchak tezligi qanchaga o'zgaradi? (144)

16.1.31. Inersiya momenti J_z=4kg.m^2 bo‘lgan bir jinsli shar M_z=1,2N·m burovchi moment ta’sirida ω_0=4,5 rad/s burchak tezlik bilan aylansa, necha sekunddan keyin uning burchak tezligi ikki barobariga ortadi? (15)

16.1.32. Keltirilgan inersiya momenti J_z=0,5kg·m^2 bo‘lgan yetaklovchi valga dvigateldan uzatiluvchi o‘zgarmas M_1=72N·m moment va yetaklanuvchi valning M_2=-0,02ω^2 momentlari ta’sir qilsa, yetaklovchi valning eng katta burchak tezligini aniqlang. (ω rad/s -yetaklovchi valning burchak tezligi). (60)

16.1.33. Boshlang‘ich burchak tezligi ω_0=12π rad/s bo‘lgan tishli g‘ildiraklar to‘plami M_z=8π(N·m) qarshilik momenti ta’sirida tekis sekinlanuvchan harakat qilib, 6s dan keyin to‘xtasa, uning inersiya momenti qancha bo‘ladi? (4)

16.1.34. Massasi m, uzunligi $\ell = 1m$ bo‘lgan bir jinsli sterjen gorizontal Oz o‘qi atrofida aylanishi mumkin. Agar uni muvozanat holatidan φ kichik burchakka og‘dirib, boshlang‘ich tezliksiz qo‘yib yuborilsa, kichik tebranishlarning chastotasini aniqlang. (3,84)

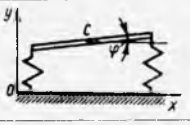


16.1.35. Massasi m=10kg, eni b=0,5m bo‘lgan to‘g‘ri to‘rtburchak shaklidagi plastina gorizontal AB o‘q atrofida aylanishi mumkin. Agar uni muvozanat holatidan φ kichik burchakka og‘dirib, boshlang‘ich tezliksiz qo‘yib yuborilsa, kichik tebranishlarning chastotasini hisoblang. (1,16)

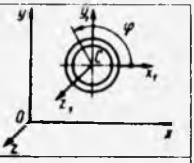
16.2. Qattiq jism tekis parallel harakatining differensial tenglamalari.

16.2.1. Massasi m=1kg bo‘lgan disk vertikal tekislikda x_S=0; y_S=14($1-e^{-0,98t}$)-10t; φ=3t tenglamalar bo‘yicha harakat qiladi. t=0,5s paytdagi tashqi kuchlarning bosh vektori miqdori nechaga teng? (8,25)

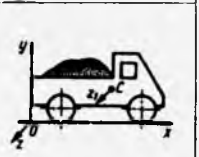
16.2.2. Massasi m=3kg bo‘lgan bir jinsli sterjenning harakat tenglamasi x_c=1,2m; y_c=0,001cos314t, φ=0,01cos314t bo‘lsa, t=0s paytdagi tashqi kuchlar bosh vektorining Oy o‘qidagi proyeksiyasini hisoblang. (-296)



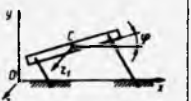
16.2.3. Markaziy o'qqa nisbatan inersiya momenti J_{cz1}=0,113kg·m^2 bo'lgan halqa vertikal tekislikda x_c=3m; y_c=4t-4,9t^2; φ=28(1-$e^{-0,1t}$) qonun bilan harakat qilsa, t=0,3 s paytda unga ta'sir qilayotgan tashqi kuchlar bosh momentining qiymatini aniqlang. (-3,07·10^{-2})



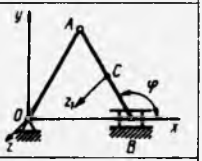
16.2.4. Markaziy o'qqa nisbatan inersiya momenti J_{Cz1}=7500kg·m^2 bo'lgan yuk mashinasi x_C=10t; y_C=1,5+0,1sin2πt; φ=0,1sin(2πt) qonun bo'yicha harakat qilsa, t=11,1 s dagi unga ta'sir qilayotgan tashqi kuchlar bosh momentining Cz_1 o'qiga nisbatan miqdorini hisoblang. (1,74·10^4)



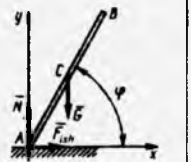
16.2.5. Suyuq betonni zichlashtiruvchi vibrolotok J_{Cz1}=0,83kg·m^2 inersiya momentiga ega bo'lib, vertikal tekislikda x_C=2+0,001cos157t; y_C=1+0,005 cos157t; φ=(35+cos157t)·10^{-3} qonun bilan tekislikka parallel bo'lgan, siltama tebranma harakat qilsa, tashqi kuchlarning bosh momentining maksimal qiymatini aniqlang. (20,5)



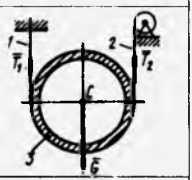
16.2.6. Inersiya momenti J_{CZ1}=0,15kg·m^2 bo'lgan AB shatunning harakat tenglamalari x_C=1,5cosπt; y_C=0,5sinπt; φ=π(1-t) bo'lsa, t=5s dagi unga ta'sir etuvchi tashqi kuchlarning momentlari yig'indisini Cz_1 o'qqa nisbatan hisoblang. (0)



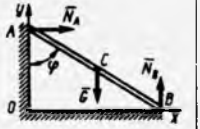
16.2.7. Massasi m=3kg bo'lgan bir jinsli sterjen tinch holatdan og'irlik kuchi ta'sirida bir uchi g'adir-budur gorizontal tekislikka sirpanib pastga tusha boshladi. Agar φ=60° bo'lgan holda yerning normal reaksiya kuchi N=18,17N bo'lsa, ishqalanish koeffitsiyentini f=0,1 deb, sterjen massa markazi tezlanishining Ax o'qiga proyeksiyasini aniqlang. (0,606)



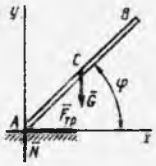
16.2.8. Massasi m=700kg bo'lgan 3 quvurni yuqoriga ko'tarish uchun 1 va 2 vertikal arqonlardan foydalaniladi. Agar arqonlardagi taranglik kuchlari mos ravishda T_1=3504N va T_2=4133N bo'lsa, quvur massa markazi C ning tezlanishini aniqlang. (1,1)



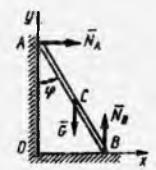
16.2.9. Massasi m=3kg bo'lgan sterjen silliq devor va silliq polga tiralib, pastga tusha boshlaydi. Agar φ=60° holatda massa markazi tezlanishi a_C=$\vec{i}$ -5,5$\vec{j}$ bo'lsa, A nuqtadagi devorning normal reaksiya kuchini aniqlang. (3)



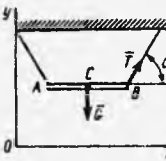
16.2.10. Massasi m=2kg bo‘lgan AB sterjen og‘irlik kuchi ta’sirida bir uchi bilan g‘adir-budur gorizontal tekislikka sirpanib, pastga tusha boshladi. Agar φ=45° holatda sterjen massa markazi tezlanishining Ay o‘qidagi proyeksiyasi $a_{Cy}=y''_C$=-5,64m/s^2 bo‘lsa, tekislikning sterjen uchiga ko‘rsatgan N normal bosimini aniqlang. (8,34)



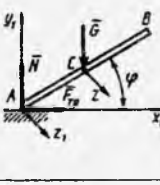
16.2.11. Massasi 2kg, uzunligi 1m bo‘lgan AB sterjen φ=30° holatda turgan bo‘lib, og‘irlik kuchi ta’sirida silliq devorga va polga tiralib sirpana boshladi. Agar harakat boshlanishi paytida uning massa markazi tezlanishining Oy o‘qiga proyeksiyasi y''_C=-1,84m/s^2 bo‘lsa, B uchida hosil bo‘lgan normal reaksiya kuchini aniqlang. (15,9)



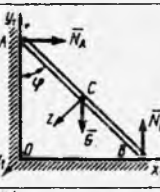
16.2.12. Massasi m=25kg, uzunligi AB=1,6 m bo‘lgan bir jinsli sterjen ikki arqon yordamida gorizontal holatida, muvozanatda ushlab turiladi. Agar chap tomondagi arqon qirqib yuborilsa, sterjen og‘irlik kuchi ta’sirida pastga harakat qiladi. O‘ng tomondagi arqonning tarangligini T=65N va $\varphi=60^0$ deb, sterjenning burchak tezligini aniqlang. (8,44)



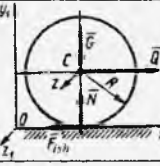
16.2.13. Uzunligi AB=0,5m inersiya momenti J_{Cz}=0,08kg·m^2 bo‘lgan sterjen Ax_1y_1 vertikal tekislikda φ=30° holatdan og‘irlik kuchi ta’sirida harakatga kelib, A uchi bilan yerga sirpanib, pastga tushadi. Agar yerning normal reaksiya kuchi N=12N, ishqalanish kuchi F_{ishq}=1,2N bo‘lsa, sterjen ε burchak tezlanishining qiymatini hisoblang. (30,6)



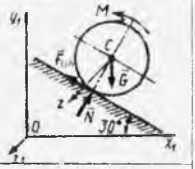
16.2.14. Massasi m=2kg, uzunligi AB=1m bo‘lgan bir jinsli sterjen φ=45° tinch holatdan harakatga kelib, uchlari bilan silliq devorga va silliq polga tiralib pastga sirpanadi. Agar A va B uchlaridagi normal reaksiyalari N_A=7,3N va N_B=12,2N bo‘lsa, sterjenning ε burchak tezlanishini aniqlang. (10,4)



16.2.15. Massasi m=20kg, radiusi R=0,3m va inersiya momenti J_{Cz}=0,9kg·m^2 bo‘lgan g‘ildirak gorizontal kuch Q=120 N ta’sirida harakat qilsa, ishqalanish kuchini F_{ishq}=40N deb, uning ε burchak tezlanishini hisoblang. (13,3)



16.2.16. Massasi m=300kg, radiusi R=0,15m va inersiya momenti J_{Cz}=3,4kg·m^2 bo'lgan silindr juft kuch momenti M=75N·m ta'sirida qiya tekislikdan yuqoriga ko'tarilsa, ishqalanish kuchini F_{ishq}=255N deb, uning burchak tezlanishini aniqlang. (10,9)



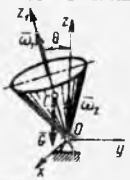
16.2.17. Massasi m=6kg, radiusi R=0,08m bo'lgan bir jinsli silindr shiftga bog'langan arqonga o'ralgan holda pastga tushadi. Agar arqondagi taranglik kuchi T=19,6N bo'lib, t =0 da burchak tezlik nolga teng bo'lsa, t=0,4s dagi ω burchak tezlikni hisoblang. (32,7)

16.3. Giroskopning elementar nazariyasi

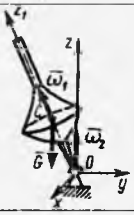
16.3.1. Simmetriya o'qiga nisbatan inersiya momenti 0,01kg·m^2 bo'lgan giroskopning aylanma burchak tezligi $\vec{\omega}_1=-2\vec{j}+120\vec{k}$, pretsessiya burchak tezligi $\vec{\omega}_2=3\vec{k}$ bo'lsa, og'irlik kuchining momentini aniqlang. (6,00·10^{-2})

16.3.2. Og'irligi G=10N, inersiya momenti J_{z1}=0,005kg·m^2 bo'lgan giroskopning aylanma burchak tezligi ω_1=150rad/s bo'lsa, OC=0,04m deb, uning pretsessiya burchak tezligini -ω_2 aniqlang. (0,533)

16.3.3. Inersiya momenti J_{z1}=0,001kg·m^2 bo'lgan pirildoq ω_1=100rad/s va ω_2=1,4 rad/s burchak tezliklar bilan muntazam pretsessiyada bo'lib, $\vec{\omega}_1$ va $\vec{\omega}_2$ larning orasidagi burchak θ=5° bo'lsa, uning og'irlik kuchi $\vec{G}$ ning O nuqtaga nisbatan momentini hisoblang. (1,22·10^{-2})



16.3.4. Og'irligi G=1N, inersiya momenti J_{z1}=0,002kg·m^2 bo'lgan pirildoq muntazam pretsessiyada bo'lib, pretsessiya burchak tezligi ω_2=0,1rad/s va OC=0,1m bo'lsa, aylanma burchak tezligi - $\omega_1$ni aniqlang. (500)

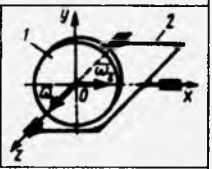


16.3.5. Og'irligi 5N va qo'zg'almas O nuqtadan og'irlik markazi C gacha bo'lgan masofa 0,1m bo'lgan pirildoq muntazam pretsessiyada bo'lib, aylanma va pretsessiya burchak tezliklari ω_1=200rad/s va ω_2=2rad/s bo'lsa, uning inersiya momenti J_{z1} ni toping. (1,25·10^3)

16.3.6. Massasi m=1kg, inersiya momenti J_{OC}=0,004kg·m^2 bo'lgan giroskop yer sirtida pretsessiyada bo'lib, burchak tezliklari $\vec{\omega}_1=-2\vec{i}+40\vec{k}$ va $\vec{\omega}_2=0{,}25\vec{k}$ bo'lsa, uning qo'zg'almas O nuqtasidan og'irlik markazigacha OC masofani toping. ($4{,}08\cdot10^{-3}$)

16.3.7. Massasi 0,1kg, inersiya momenti J_{z1}=0,001kg·m^2 bo'lgan giroskop biror sayyora sirtida pretsessiyada bo'lib, aylanma va pretsessiya burchak tezliklari ω_1=30rad/s va ω_2=0,054rad/s bo'lsa, uning qo'zg'almas O nuqtasidan og'irlik markazi C gacha bo'lgan masofani 0,01m deb, sayyoradagi erkin tushish tezlanishini aniqlang. (1,62)

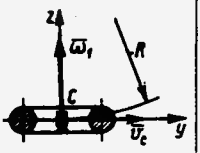
16.3.8. Inersiya momenti J_z=1,5kg·m^2 bo'lgan bir jinsli 1 disk Oz o'qi atrofida ω_1=100rad/s burchak tezliik bilan, 2 vosita yordamida esa Ox o'qi atrofida ω_2=0,5rad/s burchak tezlik bilan aylansa, uning giroskopik momentini aniqlang. (75)



16.3.9. Inersiya momenti J_z=10kg·m^2 bo'lgan val o'z o'qi atrofida $\vec{\omega}_1=250\vec{k}$ burchak tezlik bilan, podshipniklari va tagligi bilan esa $\vec{\omega}_2=5\vec{k}$ burchak tezlik bilan aylansa, uning giroskopik momentini aniqlang. (0)

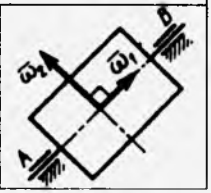
16.3.10. Inersiya momenti J_1=0,16kg·m^2 bo'lgan velosipedning oldingi g'ildiragi ω_1=20rad/s burchak tezlik bilan aylanadi. Bundan tashqari g'ildirak rul o'qi atrofida ham ω_2=2rad/s burchak tezlik bilan aylansa, hosil bo'lgan giroskopik momentni hisoblang. (6,4)

16.3.11. Radiusi R=50m bo'lgan aylanma yo'lda avtomobil $\vec{v}_c$=10m/s tezlik bilan harakatlanib, uning biror g'ildiragi J_1=1,8kg·m^2 inersiya momentga va o'z o'qi atrofida ω_1=33rad/s burchak tezlikka ega bo'lsa, g'ildirakda hosil bo'layotgan giroskopik momentni toping. (11,9)

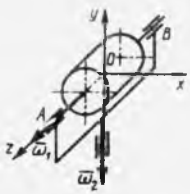


16.3.12. To'g'ri chiziqli harakatdan radiusi R=500m bo'lgan aylanma yo'lga o'tayotgan kema 10m/s tezlikka ega bo'lib, kemani harakatga keltiruvchi vinti esa 1200kg·m^2 inersiya momentga va o'z o'qi atrofida 70rad/s burchak tezlikka ega bo'lsa, kemaga ta'sir qiladigan giroskopik momentni hisoblang. ($1{,}68\cdot10^3$)

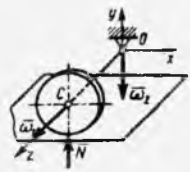
16.3.13. Inersiya momenti 4,5kg·m^2 bo'lgan bug'doy o'rish kombaynining AB o'rog'i o'z o'qi atrofida ω_1=90rad/s burchak tezlik bilan aylanadi. Dalaning notekisligi tufayli kombayn ham o'z vaqtida ω_2=0,8rad/s burchak tezlik bilan buralsa, hosil bo'lgan giroskopik momentning miqdorini aniqlang. (324)



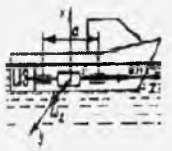
16.3.14. Inersiya momenti J_{oz}=0,4kg·m^2 bo'lgan val ω_1=120rad/s burchak tezlik bilan aylanadi. Bundan tashqari val podshipnikli g'ilofga mahkamlangan bo'lib, ular Oy o'qi atrofida ω_2=10rad/s burchak tezlik bilan aylanadi. Agar podshipniklar orasi AB=0,5m bo'lsa, podshipniklarda hosil bo'layotgan dinamik zo'riqishlarni aniqlang. (960)



16.3.15. Massasi m=100kg bo'lgan g'ildirak ω_1=30rad/s va ω_2=2,5rad/s burchak tezliklar bilan tekislik bo'ylab dumalab, O qo'zg'almas nuqta atrofida aylanadi. Agar g'ildirakning inersiya momenti J_{oz}=1,12kg·m^2 va OC masofa 1,1m bo'lsa, giroskopik moment ta'sirida hosil bo'lgan N tekislik normal reaksiyasini aniqlang. (76,4)



16.3.16. Inersiya momenti J_z=1,5kg·m^2, podshipniklar orasi a=0,8m bo'lgan qayiqning motori o'z o'qi atrofida ω_1=250rad/s, suv to'lqini natijasida ω_2=0,1sin$t$ burchak tezliklar bilan aylansa, podshipniklarga tushadigan giroskopik reaksiyaning eng katta qiymatini aniqlang. (46,9)



16.3.17. Inersiya momenti J_{oz}=0,5kg·m^2, podshipniklari orasi a=0,5m bo'lgan qayiqning motori o'z o'qi atrofida ω_1=151rad/s, ko'ndalang to'lqin ta'sirida esa ω_2=0,5rad/s burchak tezliklar bilan aylansa, podshipniklarga tushadigan giroskopik bosimni toping. Bu yerda $\overline{\omega}_1 \overline{\omega}_2$ ga perpendikular. (75,5)

17.1. Moddiy nuqta uchun kinetostatika usuli

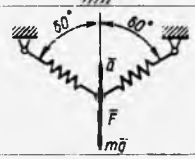
17.1.1. Massasi m=2kg bo'lgan moddiy nuqta g'adir-budur gorizontal tekislikda gorizontga nisbatan α=30° burchak ostida yo'nalgan F=10N kuch ta'siri ostida harakat qiladi. Agar tekislik va nuqta orasida ishqalanish koeffitsiyenti f=0,1 bo'lsa, nuqtaning tezlanishini aniqlang. (3,60)

17.1.2. Massasi m=60kg bo'lgan yuk ip yordamida g'altakka osilgan. Agar g'altakning radiusi r=0,4m bo'lib, $\varphi=0{,}6t^2$ qonun bo'yicha aylansa, ipning taranglik kuchini toping. (617)

17.1.3. Massasi m=0,6kg bo'lgan moddiy nuqta vertikal prujina uchida $x=25+3\sin 20t$, (x-sm larda), qonun bo'yicha tebransa, t=2s da prujinaning zo'riqishini aniqlang. (11,3)

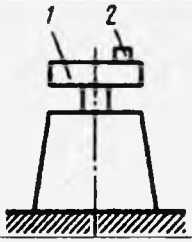
17.1.4. Massasi m=1kg bo'lgan moddiy nuqta vertikal bo'ylab so'nuvchi tebranma harakat qiladi. Agar tebranishlarni so'ndiruvchi dempferning qarshilik kuchi $\overline{R}=-0{,}1\overline{v}$ bo'lsa, nuqtaning tezligi va tezlanishi v=2m/s, a=14m/s^2 bo'lgan paytdagi prujinaning reaksiya kuchini toping. (23,6)

17.1.5. Massasi m=12kg bo'lgan moddiy nuqta bir xil ikkita prujinaga osilgan. Agar nuqtaga F=10N vertikal kuch ta'sir etib, uning tezlanishi a=3m/s^2 bo'lsa, prujinalarning har birida hosil bo'ladigan kuchlarning miqdorini aniqlang. (174)

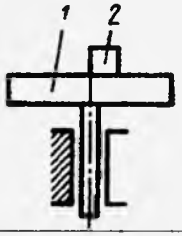


17.1.6. Massasi $m=8\cdot10^3$kg bo'lgan avtomobil ko'prik ustida harakatlanayotib tormoz yordamida a=6m/s^2 sekinlanish olsa, avtomobilni moddiy nuqta deb, ko'prikning O tayanchida hosil bo'ladigan gorizontal zo'riqishni toping (kN). (48)

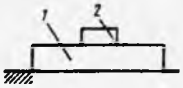
17.1.7. Taglikka o'rnatilgan 1 gorizontal platforma amplitudasi 8mm va chastotasi 8 *Hz* bo'lgan vertikal erkin tebranma harakat qiladi. Massasi 50g li 2 o'lchov asbobi platformaga mahkamlangan bo'lib, u bilan birga tebranadi. O'lchov asbobini uzib yuborishga harakat qilayotgan kuchning maksimal qiymatini hisoblang. (0,520)



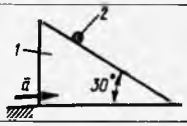
17.1.8. Vertikal o'qqa o'rnatilgan 1 gorizontal platforma amplitudasi 1mm bo'lgan vertikal erkin tebranma harakat qiladi. Tebranish amplitudasini saqlagan holda tebranish chastotasini o'zgartirish mumkin. Agar platformaning ustiga qo'yilgan jism u bilan birga tebransa, chastotaning qancha eng katta qiymatida jism platformadan uzilmay, birga tebranadi? (15,8)



17.1.9. Gorizontal yo'naltiruvchilar bo'ylab amplitudasi 0,981sm bo'lgan erkin tebranma harakat qilayotgan 1 vibrolotok ustida 2 jism turibdi. Ular orasidagi ishqalanish koeffitsiyenti f=0,1 bo'lsa, tebranish chastotaning qancha maksimal qiymatida jism sirpanmay o'z joyida qoladi? (10)

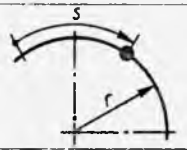


17.1.10. Gorizontal tekislikda harakat qiluvchi 1 pona ustidagi 2 moddiy nuqta tushib ketmasligi uchun pona qanday $\bar{a}$ tezlanish bilan harakatlanishi lozim. (5,66)

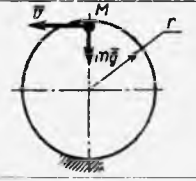


17.1.11. Massasi m=1kg li moddiy nuqta qiyaligi α=30° bo'lgan tekislikdan pastga tushadi. Agar qarshilik kuchlarining yig'indisi R=0,11v bo'lsa, nuqtaning erishishi mumkin bo'lgan eng katta tezligini toping. (44,6)

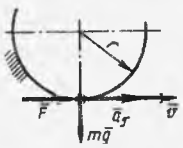
17.1.12. Massasi m=10kg bo'lgan moddiy nuqta s=4t^3 qonun bilan r=3m radiusli aylana bo'ylab harakat qilsa, t=1s dagi inersiya kuchlarining modulini hisoblang. (537)



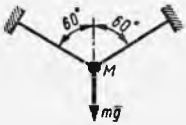
17.1.13. M moddiy nuqta radiusi r=9,81m bo'lgan silindr ichki sirti bo'ylab harakat qiladi. Ko'rsatilgan holatda nuqta silindr devorlaridan uzilmasligi uchun uning minimal tezligi qancha bo'lishi lozim? (9,81)



17.1.14. Massasi m=0,1kg bo'lgan moddiy nuqta radiusi r=0,4m li g'adir-budur silindr bo'yicha sirpanadi. Agar nuqta ko'rsatilgan past holatda υ=4m/s tezlikka va a_τ=7m/s^2 urinma tezlanishga ega bo'lsa, ishqalanish koeffitsiyentini f=0,1 deb, nuqtaga ta'sir qiluvchi $\overline{F}$ kuchining oniy qiymatini hisoblang. (1,20)

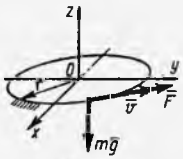


17.1.15. Massasi m=2kg bo'lgan moddiy nuqta ikki arqon vositasida shaklda ko'rsatilgandek muvozanatda ushlab turiladi. Agar arqonlarning biri qirqib yuborilsa, ikkinchisida hosil bo'ladigan taranglik kuchini aniqlang. (9,81)

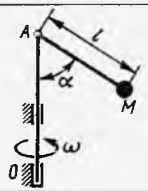


17.1.16. Yerning tabiiy yo'ldoshi bo'lgan Oy Yerning atrofida 163 m/s orbital tezlik bilan 384400 km uzoqlikda aylanadi. Agar Oyning massasi m=7,35·10^{22} kg bo'lsa, Oyni moddiy nuqta deb qarab, Yer Oyni qanday kuch bilan tortishini aniqlang. (5,08·10^{18})

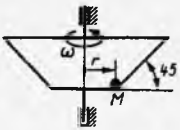
17.1.17. Massasi m=1,5kg bo'lgan moddiy nuqta gorizontal tekislikda joylashgan, radiusi r=0,5m li yo'naltiruvchilar bo'ylab o'zgarmas υ=2m/s tezlik bilan harakat qilsa, ishqalanish koeffitsiyentini f=0,15 deb olib, ta'sir etuvchi $\overline{F}$ kuchining modulini hisoblang. (2,85)



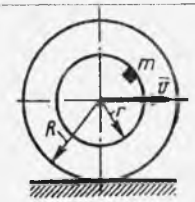
17.1.18. Uzunligi l=0,981m bo'lgan sterjen uchidagi M massali moddiy nuqta ω=4,47rad/s burchak tezlik bilan tekis aylanadi. Sterjenning massasini hisobga olmay, uning vertikal bilan hosil qilgan burchagini toping. (60)



17.1.19. Kesik konus shaklidagi idish vertikal o'q atrofida o'zgarmas ω burchak tezlik bilan aylanadi. Idish ichidagi M moddiy nuqta radiusi r=0,2m li kichik aylana ichida bo'lib, idish devori bo'ylab yuqoriga ko'tarilishi mumkin. Agar nuqta va idish devori orasidagi ishqalanish koeffitsiyenti f=0,1 bo'lsa, burchak tezlikning qanday maksimal qiymatida nuqta idish devoriga chiqmay o'z o'rnida qoladi? (7,74)

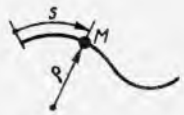


17.1.20. Avtomobil to‘g‘ri chiziqli yo‘lda υ=140km/soat tezlik bilan harakatlanadi. Uning g‘ildiragining ichiga r=0,2m masofada massasi m=80g li balansirlovchi yuk mahkamlangan bo‘lib, g‘ildirakning tebranishini hisobga olmay, yukning g‘ildirak devoriga bosim kuchini toping. Bunda R=35sm. (198)

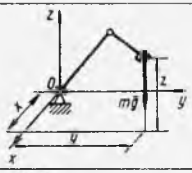


17.1.21. Massasi m=2kg bo‘lgan moddiy nuqta F=15N kuch ta’sirida g‘adir-budur gorizontal tekislikda υ tezlik bilan harakat qiladi. Agar ishqalanish koeffitsiyenti 0,3 bo‘lsa, nuqtaga ta’sir qiluvchi inersiya kuchining modulini aniqlang. (13,1)

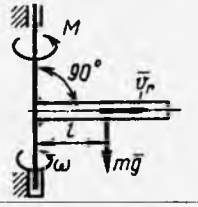
17.1.22. Massasi m=4kg bo‘lgan M moddiy nuqta egri chiziqli yo‘lda $s=0,5t^2+0,5\sin 4t$ qonun bo‘yicha harakat qiladi. Agar t=5s da egrilik radiusi ρ=4m bo‘lsa, nuqta inersiya kuchining modulini toping. (42,2)



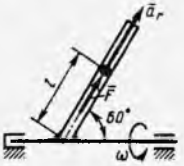
17.1.23. Massasi m=1kg bo‘lgan detalni manipulator «panjasi» fazoda $x=6t$; $y=5t^2$; $z=4t^2$ qonun bo‘yicha siljitadi. Detalni moddiy nuqta deb qarab, uning manipulator «panjasiga» ko‘rsatgan reaksiya kuchini aniqlang. (20,4)



17.1.24. Vertikal o‘q atrofida o‘zgarmas ω=1rad/s burchak tezlik bilan aylanuvchi gorizontal nay ichida massasi m=0,1kg li moddiy nuqta harakat qiladi. Agar nuqta aylanish o‘qidan l=0,2m masofada υ_r=2m/s nisbiy tezlikka erishsa, o‘qni harakatga keltiruvchi M juft kuch momentining qiymatini hisoblang. (0,08)

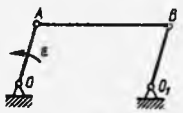
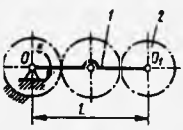
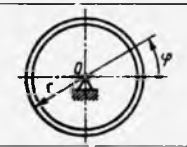
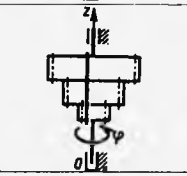
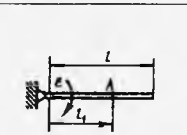


17.1.25. Gorizontal o‘qqa mahkamlangan naycha o‘zgarmas ω=2rad/s burchak tezlik bilan aylanadi. Naycha ichida massasi m=0,2kg bo‘lgan moddiy nuqta nisbiy a_r=4m/s^2 tezlanish bilan harakat qilsa, ℓ=0,2m holatda nay vertikal tekislikda turibdi deb, nuqtaga ta’sir qiluvchi $\bar{F}$ kuchining qiymatini hisoblang. (2,38)



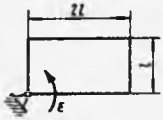
17.2. Inersiya kuchlarining bosh vektori va bosh momenti

17.2.1. Massasi 20kg bo‘lgan jism 20m/s^2 tezlanish bilan ilgarilanma harakatda bo‘lsa, inersiya kuchlarining bosh vektori modulini hisoblang. (400)

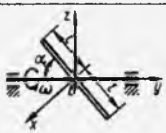
17.2.2. Shamirli parallelogramm $OABO_1$ ning OA=0,1m li krivoshipi tinch holatdan o'zgarmas burchak tezlanish ε=2rad/s^2 bilan aylana boshladi. Agar AB sterjenning massasi 2kg bo'lsa, t=1s dagi sterjenning inersiya kuchlari bosh vektorining modulini toping. (0,894)	
17.2.3. Planetar mexanizmning 1 yetaklovchi sterjeni o'zgarmas burchak tezlanish ε=10rad/s^2 bilan aylanadi. Og'irligi 2 kg bo'lgan 2 g'ildiragi esa ilgarilanma harakatda bo'ladi. Agar sterjenning uzunligi $\ell = 0{,}8m$ bo'lsa, ko'rsatilgan holat uchun 2 g'ildirakning O nuqtaga nisbatan inersiya bosh momentining qiymatini aniqlang. (12,8)	
17.2.4. Massasi 2kg, radiusi r=20sm halqa deb hisoblanuvchi g'ildirak $\varphi=2t^2$ qonun asosida harakat qilsa, massa markazi O ga nisbatan inersiya kuchlari bosh momentini hisoblang. (-032)	
17.2.5. Massasi 40kg bo'lgan bir jinsli silindr Oz o'qi atrofida $\omega=50t$ burchak tezlik bilan aylanadi. Agar silindr radiusi R=0,15m bo'lsa, aylanish o'qiga nisbatan silindr inersiya kuchlarining bosh momentini hisoblang. (22,5)	
17.2.6. Massasi 0,3kg, inersiya radiusi ρ=0,1m bo'lgan tishli g'ildiraklar (shesternyalar) to'plami Oz o'qi atrofida $\varphi=25t$ qonun asosida aylanadi. Oz o'qiga nisbatan inersiya kuchlarining bosh momentini aniqlang. (-0,15)	
17.2.7. Massasi m=1kg bo'lgan bir jinsli yupqa AB sterjen o'zgarmas burchak tezlik ω=5rad/s bilan o'ziga perpendikular o'q atrofida aylanadi. Uning o'lchamlarini l_1=0,2m, l_2=0,4m hisoblab, sterjenning inersiya kuchlari bosh vektorining qiymatini toping. (2,5)	
17.2.8. Uzunligi $\ell = 1{,}5m$ bo'lgan bir jinsli sterjen o'ziga perpendikular o'q atrofida ε burchak tezlanish bilan aylanadi. Sterjenda joylashgan, aylanish o'qidan ℓ_1 masofada inersiya kuchlarining keltirish markazi bo'lgan shunday A nuqtani topingki, inersiya kuchlarining bosh momenti shu nuqtaga nisbatan nol bo'lsin. (1)	

17.2.9. Massasi m=2kg, radiusi r=0,2m bo'lgan bir jinsli disk C markazdan ℓ=0,1m li ekssentrisitetdan o'tuvchi o'q atrofida ε=10rad/s^2 burchak tezlanish bilan tekis tezlanuvchan harakat qiladi. Inersiya kuchlarining bosh momentini aylanish o'qiga nisbatan hisoblang. (0,6)

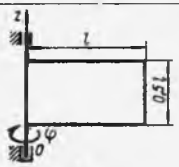
17.2.10. Massasi 1kg, o'lchamlari $\ell = 0{,}1m$ bo'lgan bir jinsli, to'rtburchak shaklidagi plastina o'ziga perpendikular o'q atrofida ε=30rad/s^2 burchak tezlanish bilan aylanadi. Aylanish o'qiga nisbatan inersiya kuchlarining bosh momentini aniqlang. (-0,5)



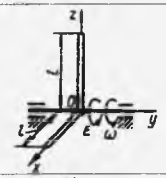
17.2.11. Massasi m=5kg, o'lchami $\ell = 0{,}25m$ bo'lgan bir jinsli sterjen gorizontal o'qqa nisbatan φ=45° burchak ostida mahkamlangan bo'lib, o'zgarmas ω=100rad/s burchak tezlik bilan aylanadi. Inersiya kuchlari bosh vektorining Ox o'qidagi proyeksiyasini toping. (-521)



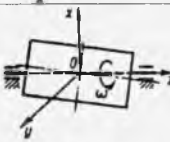
17.2.12. Massasi 3kg, o'lchamlari $\ell = 0{,}5m$ bo'lgan yupqa bir jinsli to'g'ri to'rtburchak plastina Oz vertikal o'q atrofida $\varphi = 3t^2$ qonun bilan aylanadi. Aylanish o'qiga nisbatan inersiya kuchlarining bosh momentini aniqlang. (1,5)



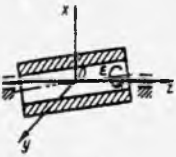
17.2.13. Har birining massasi 2kg, uzunligi $\ell = 0{,}4m$ bo'lgan ikkita bir jinsli sterjenlar gorizontal o'qqa mahkamlangan bo'lib, ω=10rad/s burchak tezlik va ε=100rad/s^2 burchak tezlanish bilan aylansa, inersiya kuchlari bosh vektorining qiymatini aniqlang. (80)



17.2.14. Markazdan qochma inersiya momenti J_{xz}=-2,5·10^{-3}kg·m^2, massa markazi aylanish o'qida joylashgan yupqa plastina o'zgarmas ω=200rad/s burchak tezlik bilan aylansa, Oy o'qiga nisbatan inersiya kuchlarining bosh momentini hisoblang. (100)

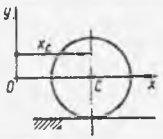


17.2.15. Markazdan qochma inersiya momentlari J_{xz}=1,6·10^{-3}kg·m^2, J_{yz}=0 bo'lgan quvur markaziy o'q Oz atrofida ε=180rad/s^2 burchak tezlanish bilan aylansa, Ox o'qiga nisbatan inersiya kuchlarining bosh momentini aniqlang. (0,288)

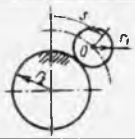


17.2.16. Massasi m=5kg, radiusi r=0,2m bo'lgan bir jinsli silindr tekislik bo'ylab, a=4m/s^2 tezlanish bilan dumalaydi. A nuqtaga nisbatan inersiya kuchlarining bosh momentini hisoblang. (6)

17.2.17. Massasi m=10kg bo'lgan bir jinsli silindr tekislik bo'ylab x_s=0,1sin0,25πt qonun bilan dumalasa, t=1s paytdagi inersiya kuchlari bosh vektorining miqdorini hisoblang. (0,436)



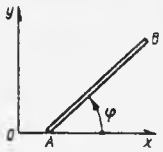
17.2.18. Massasi 10kg, radiusi r_1=12sm bo'lgan bir jinsli disk radiusi r_2=20sm li silindrik sirtning tashqi tomoni bo'ylab dumalaydi. Agar disk markazi O, s=50t^2 (sm) qonun bo'yicha harakat qilsa, t=1s paytdagi inersiya kuchlari bosh vektorining qiymatini toping. (32,8)



17.2.19. Massasi 20kg, radiusi r_1=0,24m bo'lgan bir jinsli silindr radiusi r_2 li doiraviy sirtda dumalaydi. Agar silindr markazi O ning tezlanishi a=60m/s^2 bo'lsa, silindr inersiya kuchlarining bosh momentini hisoblang. A nuqtani keltirish markazi deb olinsin. (-216)

17.2.20. Krivoship 1 ϖ = 4 rad /s o'zgarmas burchak tezlik bilan aylanib, massasi m=4kg va radiusi r=15sm bo'lgan bir jinsli 2 g'ildirakni harakatga keltiradi. Agar g'ildirak radiusi R=40sm li silindrning ichki devori bo'ylab dumalasa, g'ildirak inersiya kuchlari bosh vektorining modulini aniqlang. (16)

17.2.21. Massasi m=10kg, uzunligi AB=50sm bo'lgan bir jinsli sterjen Oxy tekislikda x_A=4t^2; y_A=0; φ=6t^2 qonun bo'yicha harakatlansa, massa markaziga nisbatan inersiya kuchlarining bosh momentini aniqlang. (-2,5)

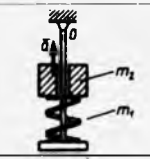


17.3. Qattiq jism va mexanik sistema uchun kinetostatika usuli

17.3.1. Massasi m=10kg bo'lgan jism gorizontal tekislikda ilgarilanma harakat qiladi. Jismning har bir nuqtasi radiusi 0,5m bo'lgan aylana bo'ylab o'zgarmas 1,5m/s tezlik bilan aylanadi. Jismga ta'sir qiluvchi tashqi kuchlar bosh vektorining gorizontal tashkil etuvchisining miqdorini toping. (45)

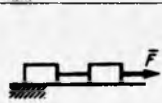
17.3.2. Massasi m=600kg bo'lgan qurilish ashyosi a=1,5m/s^2 tezlanish bilan yuqoriga ko'tarilsa, ko'tarish krani og'ma sim arqonlarida hosil bo'lgan zo'riqishlarni kN larda hisoblang. (3,92)

17.3.3. Massasi m_1=5kg bo'lgan vertikal sterjen bo'ylab massasi m_2=8kg li polzun prujina kuchi ta'sirida harakat qiladi. Polzunning tezlanishi a=50m/s^2 bo'lgan paytdagi O sharnir zo'riqishini toping. (5,28)

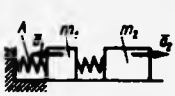


17.3.4. To'g'ri burchakli uchburchak shaklidagi 1 pona a=4m/s^2 tezlanish bilan harakat qilib, massasi m=2kg bo'lgan 2 richagni siljitadi. Richagning ponaga ko'rsatgan bosim kuchini hisoblang. (28,0)

17.3.5. Massalari 1kg dan bo'lgan ikki jism ip bilan bog'langan va gorizontal tekislikda F=40N kuch ta'sirida harakat qiladi. Agar ishqalanish koeffitsiyenti f=0,1 bo'lsa, jismlarni bog'lab turuvchi ipning taranglik kuchini toping. (20)

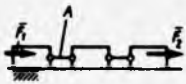


17.3.6. Massasi m_1=10kg va m_2=20kg bo'lgan ikki jism gorizontal tekislikda prujinalar yordamida tebranma harakat qiladi. Agar biror vaqtdan keyin jismlarning tezlanishi a_1=20m/s^2 va a_2=30m/s^2 bo'lsa, A prujinada hosil bo'lgan kuchning qiymatini aniqlang. (400)

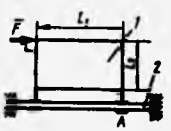


17.3.7. Yer sirtidan uchirilayotgan ikki bosqichli raketa R=90 kN kuch ta'sirida vertikal harakat qiladi. Agar raketa bosqichlarining massalari m_1=200kg va m_2=100kg bo'lsa, uchirish paytidagi ular orasida hosil bo'ladigan bosim kuchini kN larda hisoblang. (30)

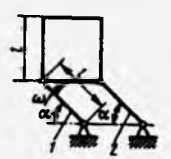
17.3.8. Bir xil massali uchta jism sterjenlar yordamida bog'langan va gorizontal tekislikda F_1=3kN va F_2=12kN kuchlar ta'sirida harakat qilsa, A sterjenda hosil bo'ladigan reaksiya kuchini aniqlang. (2·10^3)



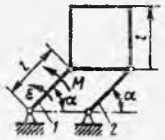
17.3.9. Massasi 6kg, o'lchamlari $\ell_1 = 250mm$ va $\ell_2 = 150mm$ bo'lgan bir jinsli to'rtburchak shaklidagi 1 plastina vertikal tekislikda joylashgan bo'lib, F=100N kuch ta'sirida 2 gorizontal yo'naltiriluvchilar bo'ylab ishqalanishsiz harakat qiladi. A sirpanish podshipnigida hosil bo'ladigan reaksiya kuchini toping. (59,4)



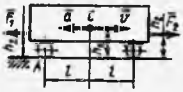
17.3.10. Gorizontal tekislikda joylashgan 1 sterjen o'zgarmas ω=10rad/s burchak tezlik bilan aylanib, massasi 5kg bo'lgan bir jinsli kvadrat plastinani harakatga keltiradi. Agar plastinaning o'lchami $\ell = 0,3m$ bo'lsa α=45° holat uchun 2 sterjenda hosil bo'ladigan reaksiya kuchini hisoblang. (150)



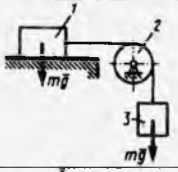
17.3.11. Gorizontal tekislikda joylashgan mexanizmning 1 sterjeni M juft kuch momenti ta'sirida ε=40rad/s^2 burchak tezlanish bilan aylanib, massasi 5kg bo'lgan kvadrat plastinani harakatga keltiradi. Agar plastinaning o'lchovi $\ell = 0{,}3m$ bo'lsa, α=45° holat uchun 2 sterjen reaksiya kuchining qiymatini aniqlang. (60)



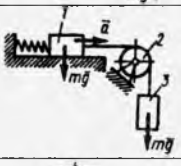
17.3.12. Massasi m=3·10^{4}kg, o'lchamlari l=5m, h_1=2,8m va h_2=1,6m bo'lgan vagonning massa markazi C poyezdning to'xtatish paytida a=5m/s^2 tezlanishga ega bo'lgan. Vagonning qo'shni vagonlar bilan bog'lanish joylarida F_1=10kN va F_2=30kN kuchlar hosil bo'lsa, A g'ildirakning temir yo'lga bosim kuchini kN larda hisoblang. Vagon tebranishlarini hisobga olmang. (102)



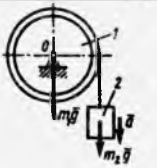
17.3.13. Massasi m=3kg dan bo'lgan 1 va 3 yuklar ip yordamida 2 blokka bog'langan. 1 yuk gorizontal silliq tekislikda harakat qilsa, 3 yuk og'irlik kuchi ta'sirida pastga tushadi. 2 blokning massasini hisobga olmay, ipning taranglik kuchini aniqlang. (14,7)



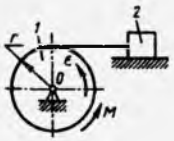
17.3.14. Massasi m=0,6kg dan bo'lgan 1 va 3 yuklar ip yordamida blok orqali bog'langan bo'lib a=3m/s^2 tezlanish bilan harakat qilsa, 2 blokning massasini hisobga olmay, blok sharnirida hosil bo'lgan reaksiya kuchini toping. (5,78)



17.3.15. Massasi m_2=5kg bo'lgan 2 yuk og'irlik kuchi ta'sirida a=3m/s^2 tezlanish bilan pastga tushib, massasi m_1=10kg li blokni aylantiradi. Agar aylanish o'qi blokning massa markazida bo'lsa, O sharnirda hosil bo'lgan reaksiya kuchining modulini aniqlang. (1,32)

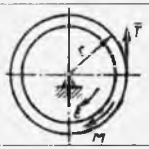


17.3.16. Radiusi r=20sm bo'lgan 1 baraban juft kuch momenti M ta'sirida o'zgarmas ε=2rad/s^2 burchak tezlanish bilan aylanib, massasi 4kg li 2 yukni tortadi. Agar 2 yukning tekislik bilan ishqalanish koeffitsiyenti f=0,1 bo'lsa, baraban massasini hisobga olmay, O sharnir reaksiya kuchining modulini hisoblang. (5,52)

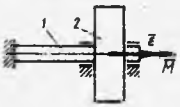


17.3.17. Vibrator ikki sinxron aylanuvchi pnevmoturbinalardan iborat bo'lib, ularning valiga r=10sm masofada m=0,5kg massalar o'rnatilgan. Agar trubinalar n=1000ayl/min chastotasi bilan aylansa, vibrator asosiga ko'rsatilayotgan eng katta dinamik zo'riqishni toping (kN). (1,10)

17.3.18. Radiusi r=0,2m, aylanish o'qiga nisbatan inersiya momenti 0,05 kg·m^2 bo'lgan g'ildirak juft kuch momenti M=1,5N·m va $\overline{T}$ kuch ta'sirida ε=20rad/s^2 burchak tezlanish bilan aylansa, T kuchning qiymatini aniqlang. (2,5)

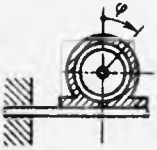


17.3.19. Aylanish o'qiga nisbatan inersiya momenti J=2kg·m^2 bo'lgan 2 g'ildirak 1 valga mahkamlangan bo'lib, juft kuch momenti M=400N·m ta'sirida ε=500rad/s^2 burchak tezlanish bilan aylansa, g'ildirakka valning ko'rsatgan juft kuch momentining miqdorini aniqlang. (600)



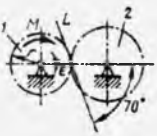
17.3.20. Tishli g'ildirak asos va gardishdan iborat bo'lib, ular o'zaro bir xil 4ta prujina orqali bog'langan. Gardishning massasi m=30kg, inersiya radiusi ρ=0,25m katta va kichik radiuslari r=0,15m, R=0,3m. Agar gardish o'qda ε=40rad/s^2 burchak tezlanish bilan aylanib, tishlashishdagi kuch R=800 N bo'lsa, har bir prujinada hosil bo'lgan $\overline{F}$ kuchini aniqlang. (251)

17.3.21. Inersiya momenti 6kg·m^2 bo'lgan elektrodvigatelning rotori tinch holatdan φ=200t^2 qonun bilan aylana boshladi. Agar elektrodvigatel qistirib mahkamlangan konsol to'sinda joylashgan bo'lsa, konsol va devor orasida hosil bo'lgan reaksiya momentini toping. (-2400)

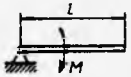
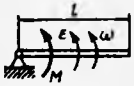
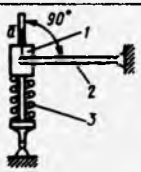
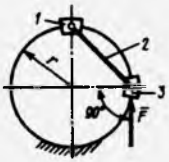
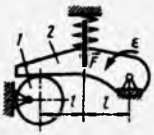
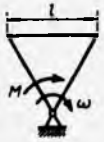
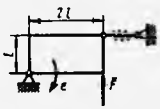


17.3.22. Elektrodvigatelni yoqishda uning rotoriga ε=30rad/s^2 burchak tezlanish berildi. Agar aylanish o'qiga nisbatan rotor va g'ilofning inersiya momentlari J_1=24kg·m^2 va J_2=20kg·m^2 bo'lsa, fundamentga prujina yordamida mahkamlangan elektrodvigatel g'ilofining burchak tezlanishini aniqlang. (36)

17.3.23. Massasi m=5kg, inersiya radiusi ρ=0,07m, radiusi r=0,1m bo'lgan tishli g'ildirak M=10N·m juft kuch momenti ta'sirida ε=200rad/s^2 burchak tezlik bilan aylansa, 2 tishli g'ildirakka L tishlashish chizig'ida ta'sir qiluvchi kuchning modulini toping. (54,3)



17.3.24. Uzunligi ℓ_1=1,5m bo'lgan bir jinsli sterjen gorizontal tekislikda tinch holatdan $\overline{F}$ kuch ta'sirida aylana boshladi. Boshlang'ich paytda, ℓ_2 masofaning qanday qiymatida O sharnir reaksiya kuchi nolga teng? (1)

17.3.25. Uzunligi ℓ=0,6m bo'lgan bir jinsli sterjen gorizontal tekislikda tinch holatdan M=40N·m juft kuch momenti ta'sirida aylansa, boshlang'ich paytda sharnirdagi reaksiya kuchining miqdorini aniqlang. (100)	
17.3.26. Massasi 4kg, uzunligi $\ell = 0{,}5m$ bo'lgan bir jinsli sterjen gorizontal tekislikda juft kuch momenti M ta'sirida aylanadi. Sterjenning burchak tezligi va tezlanishi ω=10rad/s va ε=100rad/s^2 bo'lgan paytda sharnir reaksiya kuchining modulini hisoblang. (141)	
17.3.27. Massasi 3kg bo'lgan 1 polzun siqilgan prujina 3 ta'sirida tinch holatdan a=10m/s^2 tezlanish bilan harakatni boshlaydi. Mexanizm gorizontal tekislikda joylashgan. Polzunga bog'langan sterjen 2 ning massasi 3kg bo'lsa, prujinada hosil bo'lgan kuchni toping. (40)	
17.3.28. Gorizontal tekislikda joylashgan, radiusi r bo'lgan ideal silliq halqa bo'ylab a_τ=4m/s^2 urinma tezlanish bilan harakat qilayotgan ikki polzun 1 va 3 massasi m=2kg li 2 sterjen yordamida bog'langan. Polzunlarning massasini hisobga olmay, harakatni vujudga keltirayotgan kuch $\overline{F}$ ni aniqlang. (5,33)	
17.3.29. Mexanizm gorizontal tekislikda joylashgan. Aylanish o'qiga nisbatan inersiya momenti J=6·10^{-4} kg·m^2, burchak tezlanishi ε=5000rad/s^2 bo'lgan 2 richagga prujinaning F=150N kuchi ta'sir etayotgan bo'lsa, $\ell = 0{,}04m$ deb richagning 1 g'ildirakka bosim kuchini aniqlang. (37,5)	
17.3.30. Massasi m=5kg, o'lchami $\ell = 0{,}3m$ bo'lgan teng tomonli bir jinsli plastina juft kuch momenti M ta'sirida o'zgarmas ω=10rad/s burchak tezlik bilan vertikal tekislikda aylansa, sharnirda hosil bo'ladigan maksimal reaksiya kuchini toping. (136)	
17.3.31. Aylanish o'qiga nisbatan inersiya momenti 0,02kg·m^2, o'lchami $\ell = 0{,}1m$ bo'lgan to'g'ri to'rtburchak plastina F=50N kuch ta'sirida gorizontal tekislikda aylanadi. Ko'rsatilgan holatda plastina ε=50rad/s^2 burchak tezlanishga ega bo'lsa, prujinaning reaksiya kuchini toping. (110)	

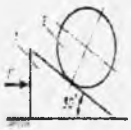
17.3.32. Uzunligi 0,6m bo'lgan OA krivoship juft kuch momenti M_z ta'sirida $\varepsilon=10 rad/s^2$ burchak tezlanish bilan aylanib, massasi 10kg li bir jinsli O_1A sterjenni harakatga keltirsa, juft kuch momenti M_z ni aniqlang. OA krivoshipning massasini hisobga olmang. (12)

17.3.33. Massasi 400 kg bo'lgan bir jinsli silindr $\overline{F}$ kuchi ta'sirida gorizontal tekislik bo'ylab dumalaydi. Uning C massa markazi $s=0,5t^2$ qonun asosida harakatlansa, $\overline{F}$ kuchining qiymatini hisoblang. (693)

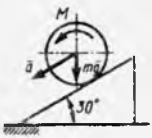
17.3.34. Massasi $m=40kg$, radiusi $r=0,2m$ bo'lgan bir jinsli silindr juft kuch momenti $M=10N\cdot m$ ta'sirida gorizontal tekislikda tinch holatdan sirpanib dumalashni boshladi. Agar sirpanib ishqalanish koeffitsiyenti $f=0,1$ bo'lsa, silindrning burchak tezlanishini toping. (2,69)

17.3.35. Yupqa devorli quvur og'irlik kuchi ta'sirida qiya tekislik bo'ylab sirpanmasdan dumalaydi. Quvur massa markazining tezlanishini aniqlang. (2,45)

17.3.36. Massasi $m_1=10kg$ li 1 prizma ishqalanish koeffitsiyenti $f=0,1$ bo'lgan gorizontal tekislikda sirpanishi mumkin. Prizmaning ustida turgan massasi $m_2=2kg$ bo'lgan bir jinsli silindr prizmaga nisbatan o'z o'rnida qolishi uchun prizmaga qanday $\overline{F}$ kuchi ta'sir etishi lozim? Boshlang'ich paytda ikkala jism ham tinch holatda bo'lgan. (79,7)

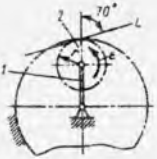


17.3.37. Massasi $m=10kg$ bo'lgan silindr qo'zg'almas prizma ustida og'irlik kuchi va juft kuch momenti M ta'sirida dumalaydi. Agar silindr massa markazining tezlanishi $a=6m/s^2$ bo'lsa, tekislikning prizmaga ko'rsatgan bosimining gorizontal tashkil etuvchisini toping. (52,0)



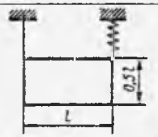
17.3.38. Massasi $m_1=1kg$, uzunligi $\ell=0,5m$ bo'lgan yetaklovchi richag 1 gorizontal tekislikda o'zgarmas burchak tezlik $\omega=10rad/s$ bilan aylanib, massasi $m_2=3kg$ bo'lgan 2 tishli g'ildirakni harakatga keltiradi. Yetaklovchi richagni bir jinsli sterjen deb hisoblab, O sharnir reaksiya kuchining miqdorini aniqlang. (175)

17.3.39. Yetaklovchi richag 1 gorizontal tekislikda ε=400rad/s^2 burchak tezlanish bilan aylanib, massasi 1kg, radiusi r=0,1m bo'lgan 2 tishli g'ildirakni harakatga keltiradi. Tishli g'ildirakni bir jinsli silindr deb, tishlashish chizig'i L da hosil bo'ladigan tishlashish kuchining miqdorini toping. (21,3)

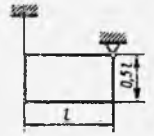


17.3.40. Uzunligi $\ell = 1m$ bo'lgan bir jinsli sterjen gorizontal holatda prujina va ip yordamida muvozanatda turibdi. Agar ip qirqib yuborilsa, sterjen qanday burchak tezlanish oladi? (-29,4)

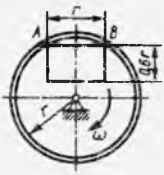
17.3.41. O'lchami $\ell = 1m$ bo'lgan to'rtburchak shaklidagi bir jinsli plastina gorizontal holatda prujina va ip yordamida muvozanatda turibdi. Agar ip qirqib yuborilsa, plastina qanday burchak tezlanish oladi? (23,5)



17.3.42. O'lchami $\ell = 1m$ bo'lgan to'rtburchak shaklidagi bir jinsli plastina gorizontal holatda ip va sharnir yordamida muvozanatda turibdi. Agar ip qirqib yuborilsa, plastina qanday burchak tezlanish oladi? (11,8)



17.3.43. Radiusi r=0,25m bo'lgan silindr shaklidagi idish vertikal o'q atrofida ω=10rad/s burchak tezlik bilan aylanadi. Idish ichida massasi 2kg bo'lgan to'rtburchak shaklidagi bir jinsli plastina gorizontal holatda A va B nuqtalarda idishga tiralib, idish bilan birga aylanadi. Shaklda ko'rsatilgan holat uchun A nuqtada hosil bo'layotgan reaksiya kuchini aniqlang. (16,3)



17.3.44. Gorizontal tekislikda joylashgan radiusi r=0,2m li disk tinch holatdan ε=400 rad/s^2 burchak tezlanish bilan aylana boshladi. Massasi 0,3kg bo'lgan bir jinsli sterjen bir uchi bilan A sharnir, ikkinchi B uchi bilan disk to'g'iniga tiralgan holda disk bilan birga aylansa, boshlang'ich paytda B nuqtada hosil bo'lgan reaksiya kuchini toping. (9,24)

17.3.45. Massasi m=5kg, uzunligi $\ell = 0,6m$ bo'lgan bir jinsli sterjen vertikal tekislikda tinch holatdan F=20N kuch ta'sirida harakatni boshlasa, boshlang'ich holatda uning burchak tezlanish qiymatini toping. (40)

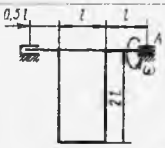
17.3.46. Massasi 8kg bo'lgan bir jinsli sterjen vertikal tekislikda tebranma harakat qiladi. Biror vaqtdan keyin uning A va B uchlari mos ravishda a_1=3m/s^2 va a_2=6m/s^2 tezlanishlarga ega bo'lsa, o'ng tomondagi prujinaning shu ondagi reaksiya kuchini toping. $\ell_1 = 1m, \ell_2 = 0,3m$ deb olinsin. (84,6)

17.3.47. Massasi 1000kg bo'lgan avtomobil kyzovi tebranish natijasida uning massalar C markazi a_c=2m/s^2 tezlanish va ε=1,6rad/s^2 burchak tezlanish olsa, avtomobil oldi o'qida hosil bo'ladigan reaksiya kuchini kN larda hisoblang. Avtomobil kuzovining o'lchamlari $\ell = 1{,}5m$ va inersiya momentini J_{cx}=1300kg·m^2 deb oling. (3,21)

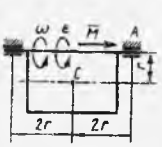
17.4. Podshipniklardagi dinamik reaksiyalarini aniqlash

17.4.1. Jism bosh markaziy inersiya o'qi Oz atrofida ω burchak tezlik va ε burchak tezlanish bilan aylanadi. Jismning markazdan qochma inersiya momenti J_{xu} nolga teng bo'lmasa, podshipniklardagi dinamik reaksiya kuchi nolga teng bo'lishi mumkinmi? (Ha)

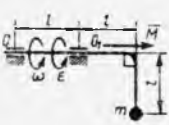
17.4.2. Massasi 0,4kg, o'lchami l=10sm bo'lgan bir jinsli to'rtburchak shaklidagi plastina o'zgarmas ω=60rad/s burchak tezlik bilan aylansa, A podshipnikdagi dinamik reaksiya kuchining miqdorini toping. (57,6)



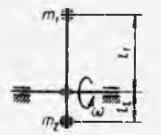
17.4.3. Massasi m=10kg bo'lgan bir jinsli silindrsimon jism juft kuch momenti M ta'sirida aylanadi. Agar jismning massalar markazi C aylanish o'qidan r=0,2m masofada bo'lsa, jismning burchak tezlik ω=5rad/s va burchak tezlanishi ε=50rad/s^2 bo'lgan paytda A podshipnikdagi dinamik reaksiya kuchining modulini aniqlang. (55,9)



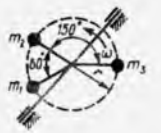
17.4.4. Massasi m=0,5kg bo'lgan moddiy nuqta juft kuch momenti $\overline{M}$ ta'sirida OO_1 o'q atrofida aylanadi. Agar o'lchamlarda $\ell = 0{,}15m$ bo'lsa, nuqtaning burchak tezligi ω=5rad/s bo'lgan paytda O_1 podshipnikdagi dinamik reaksiyaning modulini toping. (7,08)



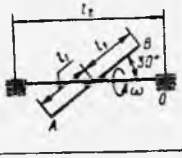
17.4.5. Massasi m_1=2kg va m_2 bo'lgan yuklar uzunliklari l_1=0,5m va l_2=0,2m bo'lgan sterjenlar yordamida o'qqa mahkamlanib, o'zgarmas ε burchak tezlanish bilan aylanadi. Podshipniklardagi dinamik reaksiya nolga teng bo'lishi uchun m_2 qanchaga teng bo'lishi lozim? Yuklarni moddiy nuqta deb oling. (5)



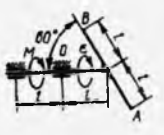
17.4.6. O'zgarmas burchak tezlik ω bilan aylanayotgan o'qqa bir xil masofada va o'qqa perpendikular tekislikda uchta yuk mahkamlangan. Agar yuklarning massasi m_1=m_2=2kg bo'lsa, podshipniklardagi reaksiya kuchi nolga teng bo'lishi uchun m_3 nechaga teng bo'lishi kerak? Yuklarni moddiy nuqta deb oling. (3,46)



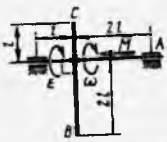
17.4.7. Massasi 1kg, o'lchamlari l_1=0,3m bo'lgan bir jinsli AB sterjen gorizontal o'q atrofida o'zgarmas burchak tezlik ω=10rad/s bilan aylanadi. Agar podshipniklar orasidagi masofa l_2=0,8m bo'lsa, O podshipnikdagi dinamik reaksiyaning modulini aniqlang. (1,62)



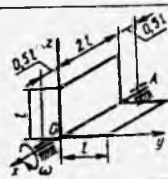
17.4.8. Massasi 4kg, o'lchamlari $\ell = 0{,}4m$ bo'lgan bir jinsli AB sterjen juft kuch momenti M ta'sirida gorizontal o'q atrofida tinch holatdan ε=120rad/s^2 burchak tezlanish bilan aylana boshladi. Boshlang'ich paytda O podshipnikda hosil bo'ladigan dinamik reaksiya kuchining qiymatini toping. (27,7)



17.4.9. Massasi 3kg, o'lchamlari $\ell = 0{,}3m$ bo'lgan bir jinsli BC sterjen juft kuch momenti $\overline{M}$ ta'sirida aylanadi. Burchak tezlik ω=10rad/s va burchak tezlanish ε=100rad/s^2 bo'lgan paytda A podshipnikdagi dinamik reaksiya kuchining modulini aniqlang. (21,2)

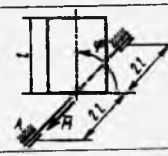


17.4.10. Massasi 4kg, o'lchamlari l=0,2m bo'lgan bir jinsli, ikki yoqli burchak ko'rinishdagi yupqa jism Ax o'qi atrofida ω=20rad/s o'zgarmas burchak tezlik bilan aylansa, A podshipnik dinamik reaksiya kuchining miqdorini toping. (56,6)

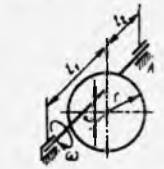


17.4.11. Massasi 1kg, o'lchamlari $\ell = 0{,}2m$ bo'lgan ikkita bir xil sterjenlar Oy o'qi atrofida o'zgarmas ω=8rad/s burchak tezlik bilan aylansa, A podshipnikda hosil bo'luvchi dinamik reaksiyani toping. (20,2)

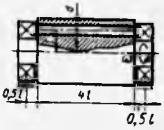
17.4.12. Massasi 6kg, o'lchamlari l=0.2m bo'lgan to'rtburchak shaklidagi bir jinsli plastina juft kuch momenti M ta'sirida simmetriya o'qiga perpendikulyar o'q atrofida $\varphi=5t^3$ qonun bo'yicha aylansa, t=1s paytdagi A podshipnikning dinamik reaksiyasini hisoblang. (68,1)



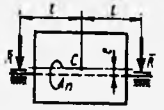
17.4.13. Massasi m=8kg, radiusi r=20sm bo'lgan bir jinsli disk perpendikulyar o'q atrofida ω=10rad/s burchak tezlik bilan tekis aylanadi. Agar o'qning joylashishi ℓ_1=80sm, ℓ_2=40sm va ekssentrisiteti e=10sm bo'lsa, A podshipnikda hosil bo'layotgan dinamik zo'riqishni aniqlang. (53,3)



17.4.14. Zichligi ρ=7,8 g/sm^3, uzunligi 4ℓ ($\ell = 5sm$) bo'lgan valning ichida uning o'qi bo'ylab diametri d=1sm li teshik ochilgan va u ω=200rad/s burchak tezlik bilan aylansa, har bir podshipnikda hosil bo'luvchi dinamik reaksiyasini toping. (123)



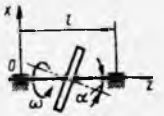
17.4.15. Massasi 400kg bo'lgan elektrodvigatel rotori o'z o'qi atrofida 3000 ayl/min chastota bilan aylansa, podshipniklardagi dinamik reaksiya kuchlari R=400N dan ortib ketmasligi uchun aylanish o'qidan rotor massa markazi C da joylashgan markaziy o'qni qancha e (mm) masofaga siljitish mumkin? (0,0203)



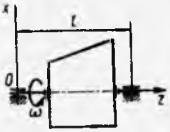
17.4.16. Radiusi r=0,3m bo'lgan ventilatorning yupqa ishchi g'ildiragi ω=120rad/s burchak tezlik bilan aylanadi. Podshipniklardagi dinamik reaksiya kuchi R=300N bo'lsa, g'ildirakning dinamik balansirovka (ortiqcha dinamik kuchini yo'qotish) qilish uchun uning to'g'riga massasi qanday m qiymatga ega bo'lgan yuk o'rnatish lozim? (0,139)

17.4.17. Massasi 6kg, o'lchami $\ell = 0,2m$ bo'lgan bir jinsli to'rtburchak plastina simmetrik o'qiga nisbatan α=30° qiya bo'lgan o'q atrofida o'zgarmas ω=24rad/s burchak tezlik bilan aylansa, A podshipnikda hosil bo'ladigan dinamik reaksiya modulini aniqlang. (41,6)

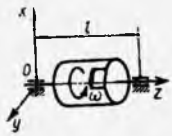
17.4.18. Bir jinsli diskning simmetriya o'qi Oxz tekisligida joylashgan bo'lib, aylanish o'qiga nisbatan α shunday burchak tashkil qiladiki, uning markazdan qochma inersiya momenti J_{xz}=4·10^{-4}kg·m^2 ga teng. Agar podshipniklar $\ell = 0,15m$ masofada joylashgan bo'lib, disk ω=90rad/s burchak tezlik bilan aylansa, O podshipnikda hosil bo'layotgan dinamik reaksiya kuchini hisoblang. (21,6)



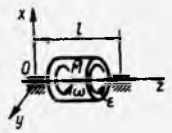
17.4.19. Yupqa plastina o'zgarmas ω=60rad/s burchak tezlik bilan aylanadi. Uning massa markazi aylanish o'qida joylashgan bo'lib, markazdan qochma inersiya momenti plastina tekisligidagi koordinata o'qlarga nisbatan J_{xz}=2·10^{-3} kg·m^2 ga teng. Agar podshipniklar $\ell = 0,2m$ masofada bo'lsa O podshipnikdagi dinamik reaksiya kuchini toping. (36)



17.4.20. Jism o‘zgarmas ω=100rad/s burchak tezlik bilan aylanadi. Uning massa markazi aylanish o‘qida joylashgan bo‘lib, markazdan qochma inersiya momentlari $J_{xz}=J_{yz}$=0,003kg·m^2 bo‘lsa, podshipniklar orasini $\ell = 0{,}3m$ deb, O podshipnikdagi dinamik reaksiya kuchini toping. (141)



17.4.21. Rotor juft kuch momenti $\overline{M}$ ta’sirida ω=10rad/s burchak tezlik va ε=60rad/s^2 burchak tezlanish bilan Oz o‘qi atrofida aylanadi. Agar rotorning markazdan qochma inersiya momentlari J_{xz}=0, $J_{yz}=5\cdot10^{-3}$ kg.m^2 bo‘lib, podshipniklar $\ell = 0{,}25m$ masofada bo‘lsa, O podshipnikdagi dinamik reaksiya kuchini aniqlang. (2,33)



XVIII BOB. MUMKIN BO‘LGAN KO‘CHISHLAR PRINSIPI

18.1. Bog‘lanishlar va ularning tenglamalari. Sistemaning erkinlik darajasi

18.1.1. Bir nuqtasi bilan mahkamlangan qattiq jism harakatda bo‘lsa, uning erkinlik darajasi nechaga teng? (3)

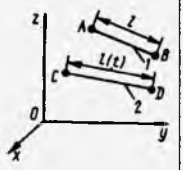
18.1.2. Ikkita moddiy nuqta 1 va 2 fazoda harakat qiladi. Birinchi nuqtaga tenglamasi $x^2+y^2+z^2-25=0$ bog‘lanish, ikkinchisiga esa $x^2+y^2+z^2-25t^2\le0$ bog‘lanish qo‘yilgan. Qaysi moddiy nuqtaga bo‘shatilmaydigan golonom bog‘lanish qo‘yilgan? (2)

18.1.3. Fazodagi A,B,C va D moddiy nuqtalar o‘zaro uzunligi o‘zgarmas ℓ=const va o‘zgaruvchan $\ell(t)$ sterjenlar yordamida bog‘langan. Ularning bog‘lanishlari quyidagi tenglamalar bilan berilgan:

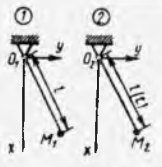
$(x_B-x_A)^2+(y_B-y_A)^2+(z_B-z_A)^2-l^2=0$

$(x_D-x_C)^2+(y_D-y_C)^2+(z_D-z_C)^2-[l(t)]^2=0$

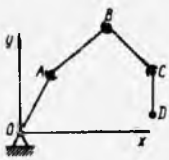
qaysi sterjenga golonom statsionar bog‘lanish qo‘yilgan? (1)



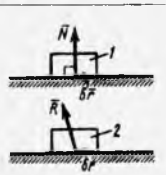
18.1.4. M_1 va M_2 moddiy nuqtalar matematik mayatnik sifatida osilgan bo'lib, uzunliklari o'zgarmas $\ell = const$ va o'zgaruvchan $\ell(t)$ hisoblanadi. Agar ularning bog'lanish tenglamalari mos ravishda $x^2+y^2-\ell^2 \le 0$ va $x^2+y^2-[\ell(t)]^2 \le 0$ bo'lsa, qaysi shaklda nostatsionar golonom bog'lanishga ega? (2)



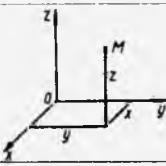
18.1.5. Moddiy nuqtalar O, *A*, *B*, *C* va *D* o'zaro o'zgarmas uzunlikdagi vaznsiz sterjenlar orqali bog'langan. *O* nuqta qo'zg'almas bo'lib, *A*, *B*, *C* va *D* nuqtalar *Oxy* tekisligida harakat qiladi. Sterjenlar orqali qo'yilgan statsionar golonom bog'lanishlar sonini aniqlang. (4)



18.1.6. 1 va 2 jismlar qo'zg'almas gorizontal tekislik bo'ylab sirpanadi. Bog'lanish reaksiyalarining elementar ishlari birinchi jism uchun $\delta A = \overline{N} \cdot \delta \overline{r}$, $(\overline{N} \cdot \delta \overline{r} = 0)$ ikkinchisi uchun $\delta A = \overline{R} \cdot \delta \overline{r} \neq 0$, bo'lsa, qaysi jismga ideal bog'lanish qo'yilgan? (1)

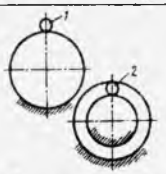


18.1.7. Moddiy nuqta *M* fazoda erkin harakat qilsa, uning erkinlik darajasi nechaga teng? (3)

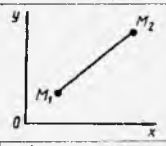


18.1.8. Moddiy *M* nuqta *Oxy* tekislikda joylashgan naycha ichida harakatlansa, uning erkinlik darajasi nechaga teng? (1)

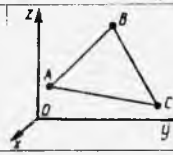
18.1.9. 1 sharcha silliq silindr ustida, 2 sharcha esa ikkita silindrlar orasida harakat qiladi. Qaysi sharchaga bo'shatmaydigan bog'lanish qo'yilgan? (2)



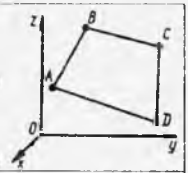
18.1.10. Moddiy nuqtalar M_1 va M_2 vaznsiz bikir sterjen bilan bog'langan bo'lib, *Oxy* tekisligida harakatlansa, sistemaning erkinlik darajasi nechaga teng? (3)



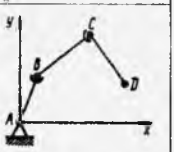
18.1.11. Moddiy nuqtalar *A*, *B* va *C* o'zaro vaznsiz bikir sterjenlar yordamida bog'langan bo'lib, fazoda harakatlansa, sistemaning erkinlik darajasi nechaga teng? (6)



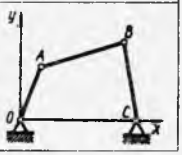
18.1.12. Moddiy nuqtalar *A, B, C* va *D* o'zaro uzunliklari o'zgarmas vaznsiz bikir sterjenlar yordamida bog'langan bo'lib, fazoda harakatlansa, sistemaning erkinlik darajasi nechaga teng? (6)



18.1.13. Moddiy nuqtalar *A, B, C* va *D* o'zaro uzunliklari o'zgarmas, vaznsiz bikir sterjenlar orqali bog'langan bo'lib, *A* qo'zg'almas nuqta atrofida *Axy* tekislikda harakat qilsa, sistemaning erkinlik darajasini aniqlang. (3)



18.1.14. Uzunliklari $OA=l_1$, $AB=l_2$ va $BC=l_3$ bo'lgan sharnirli to'rt zvenoli mexanizmning erkinlik darajasini aniqlang. (1)

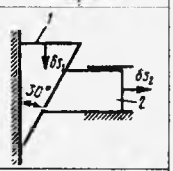


18.2. Sistemaning mumkin bo'lgan ko'chishlari

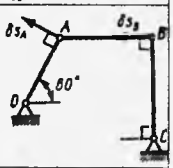
18.2.1. *AB* to'g'ri chiziqli sterjenning *A* va *B* nuqtalari unga nisbatan 30° va 60° burchaklar hosil qiluvchi mumkin bo'lgan ko'chishlarining nisbati nechaga teng? (0,577)

18.2.2. Agar 1 va 2 tishli g'ildiraklarning tishlari soni $z_1=30$ va $z_2=90$ bo'lsa, ularning mumkin bo'lgan ko'chishlari $\delta\varphi_1$ va $\delta\varphi_2$ larning nisbatini aniqlang. (3)

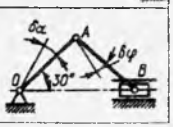
18.2.3. 1 va 2 ponalarning mumkin bo'lgan ko'chishlari δs_1 va δs_2 larning nisbatini hisoblang.



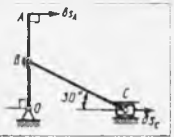
18.2.4. To'rt zvenoli mexanizm *AB* shatunining nuqtalari *A* va *B* larning mumkin bo'lgan ko'chishlari δs_A va δs_B larning nisbatini aniqlang. (1,73)



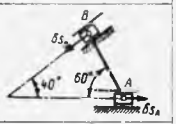
18.2.5. Agar krivoship va shatunning uzunliklari teng $OA=AB$ bo'lsa, shatun *AB* va krivoship *OA* larning mumkin bo'lgan burchak ko'chishlari $\delta\varphi$ va $\delta\alpha$ larining nisbatini aniqlang. (1)



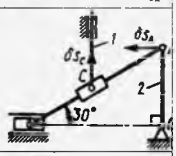
18.2.6. Agar krivoship-polzunli mexanizmda $OB=AB$ bo'lsa, krivoshipning A va polzunning C nuqtalarining mumkin bo'lgan ko'chishlari δs_A va δs_C larning nisbatini aniqlang. (2)



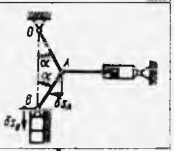
18.2.7. Elipsograf AB shatuni A va B nuqtalarining mumkin bo'lgan ko'chishlari δs_1 va δs_B lar nisbatini hisoblang. (0,344)



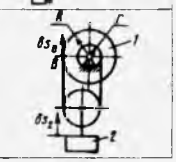
18.2.8. Krivoship 2 ning A va richag 1 ning C nuqtalarining mumkin bo'lgan ko'chishlarining nisbatini aniqlang. (1,73)



18.2.9. Press mexanizmi shatunining A va B nuqtalari mumkin bo'lgan ko'chishlari δs_A va δs_B ning nisbatini aniqlang. Bunda $OA=AB$ va $\alpha=30°$ deb olinsin. (1,73)



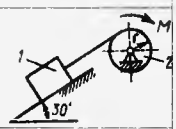
18.2.10. Differensial chig'iriqning 1 barabanidagi B nuqtasi va 2 yukning mumkin bo'lgan ko'chishlarining, δs_B va δs_2 larning nisbatini aniqlang. Bunda $R=2r=20$sm. (4)



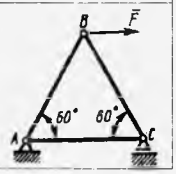
18.3. Mumkin bo'lgan ko'chishlar prinsipi

18.3.1. Tishli uzatmaning tishlari soni $z_2=2z_1$ bo'lgan ikkita g'ildiraklardan iborat. 1 g'ildirakka momenti $M_1=10$N·m bo'lgan juft kuch ta'sir etadi. Tishli uzatmani muvozanatda (tinch holatda) ushlab turish uchun 2 g'ildirakka momenti nechaga teng bo'lgan juft kuch qo'yish lozim? (20)

18.3.2. Og'irligi 200 N bo'lgan 1 yukni bir tekisda yuqoriga tortish uchun radiusi $r=20$sm li 2 barabanga momenti nechaga teng bo'lgan juft kuch qo'yish lozim? (20)



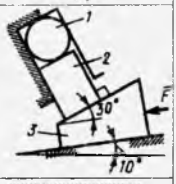
18.3.3. Agar tekis fermaning B tuguniga $F=6000$N kuch ta'sir etsa, AC sterjenida qanday zo'riqish hosil bo'ladi? ($3\cdot10^3$)



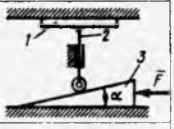
18.3.4. Tishlar soni $z_2=2z_1$ bo'lgan tishli 1 va 2 g'ildiraklardan iborat mexanizm momenti M bo'lgan juft kuch ta'sirida aylanib, 3 baraban yordamida og'irligi $4\cdot10^3$N li 4 yukni bir tekisda tortadi. Agar 3 baraban radiusi r=10sm va sirpanib ishqalanish koeffitsiyenti f=0,2 bo'lsa, juft kuch momenti M ning qiymatini aniqlang. (40)

18.3.5. Tishli g'ildirak 1 ga momenti M_1=40N·m bo'lgan juft kuch ta'sir etadi. Agar g'ildiraklarning radiusi $r_1=r_2$ bo'lsa, mexanizm tinch holatda turishi uchun OA krivoshipga qanday qiymatga ega bo'lgan M momentli juft kuch qo'yish lozim? (80)

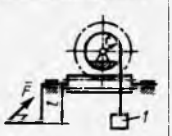
18.3.6. Qiyaligi 10° bo'lgan tekislikda harakatlanishi mumkin bo'lgan 3 jismga harakat tekisligiga parallel kuch F=460N ta'sir etib, 1 va 2 jismlarni bosadi. 2 jismning 1 jismga bosimini aniqlang. (920)



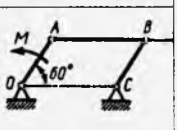
18.3.7. 3 ponaga F=100N kuch ta'sir etib, 2 richag yordamida 1 jismni qisadi. Agar α=11° bo'lsa, 2 richagning 1 jismga bosim kuchini aniqlang. (514)



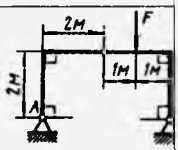
18.3.8. Chiziqlari chervyakli uzatmasining uzatishlar soni 50 ga teng. Agar barabanning radiusi r=0,12m, dastakning uzunligi l=0,2m bo'lsa, og'irligi $4\cdot10^3$N bo'lgan l yukni bir tekisda yuqoriga tortish uchun dastakka qo'yilgan kuchning $\overline{F}$ miqdori qancha bo'lishi lozim? (48)



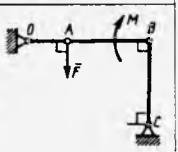
18.3.9. Sharnirli parallelogramm $OABC$ ning AB shatuniga gorizontal F=50N kuch ta'sir etadi. Agar krivoshipning uzunligi OA=10sm bo'lsa, mexanizmni muvozanatda ushlab turish uchun krivoshipga qanday juft kuch momenti M ta'sir etishi lozim? (4,33)



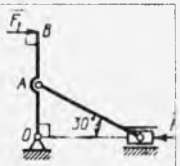
18.3.10. Uch sharnirli arkning birinchi qismiga $F=8\cdot10^3$ N vertikal kuch ta'sir etadi. A sharnirda hosil bo'ladigan reaksiya kuchining vertikal tashkil etuvchisini aniqlang. ($2\cdot10^3$)



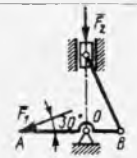
18.3.11. To'rtta zvenodan iborat sharnirli mexanizmning OA krivoshipining A nuqtasiga $\overline{F}$ kuchi, uzunligi AB=0,4m bo'lgan shatunga esa momenti M=40N·m ga teng bo'lgan juft kuch ta'sir etib, mexanizm muvozanat holatida qolishi uchun $\overline{F}$ kuchining miqdori qancha bo'lishi kerak? (100)



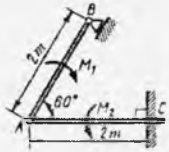
18.3.12. Krivoship-polzunli mexanizm muvozanat holatida qolishi uchun F_1=100N va OA=AB bo'lsa, polzunga qanday kattalikdagi F_2 kuch ta'sir etishi lozim? (200)



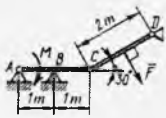
18.3.13. Krivoship-polzunli mexanizm muvozanat holatida qolishi uchun F_2=100N va OA=2OB bo'lsa, AB krivoshipga qanday kattalikdagi $\overline{F}_1$ kuch ta'sir etishi lozim? (100)



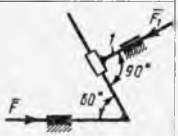
18.3.14. Gorizontal to'sin AC bir uchi bilan devorga bikir mahkamlangan bo'lib, unga momenti M_2=600N·m li juft kuch ta'sir qiladi. AC to'sinning A uchiga sharnir yordamida biriktirilgan AB to'singa momenti M_1=400N·m li juft kuch ta'sir etsa, C nuqtada hosil bo'ladigan reaksiya momentini aniqlang. (400)



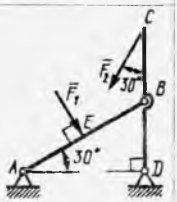
18.3.15. AC va CD to'sinlar C nuqtada sharnir vositasida bog'langan bo'lib, gorizontal joylashgan AC to'sin B nuqtada prizma uchiga tayanadi va unga momenti M=2·10^{3}N·m li juft kuch ta'sir etadi. CD to'sinning o'rtasiga F=4·10^{3}N kuch ta'sir etsa, B nuqtadagi reaksiya kuchining miqdorini aniqlang. (5,46·10^3)



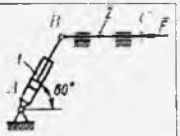
18.3.16. Sterjenli mexanizmning 1 sterjeniga F_1=400N kuch ta'sir etib, mexanizmni muvozanatda ushlab turishi uchun qanday miqdordagi F kuch ta'sir etishi mumkin? (346)



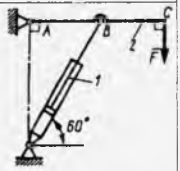
18.3.17. Mexanizmning AB va CD sterjenlari o'zaro sharnir yordamida bog'langan bo'lib, F_1=200 N va F_2=600 N kuchlar ta'sirida bo'lsa, A sharnirda hosil bo'layotgan reaksiya kuchining gorizontal tashkil etuvchisini aniqlang. Sterjenlarning o'lchamlari AE=BE=BC=BD=1m. (500)



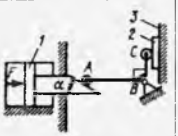
18.3.18. Gidrosilindr 1 yordamida 2 richag muvozanatda ushlab turiladi. Agar richagga F=400 N kuch ta'sir etsa, o'lchamlarni AB=BC deb, gidrosilindr porshenida hosil bo'ladigan bosim kuchini aniqlang. (0,924)



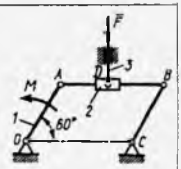
18.3.19. Mexanizmning 2 sterjeniga gorizontal F=3kN kuch ta'sir etadi. Muvozanatda turgan mexanizm gidrosilindirining porshenida hosil bo'ladigan bosim kuchini aniqlang. Bunda AB=BC. (6)



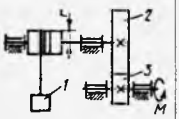
18.3.20. Porshen 1 ga F=250N kuch ta'sir etadi. ABC richag 2 detalni 3 asosga bosib, muvozanatda ushlab turishi uchun richagning detalga bosim kuchi qanday kattalikda bo'lishi lozim? Shakldagi o'lchamlar quyidagicha: α=30°, AB=0,8m; BC=0,4m. (866)



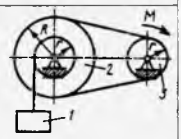
18.3.21. $OABC$ to'rt zvenoli sharnirli parallelogrammning AB shatuniga 2 halqasimon vtulka kiygizilgan bo'lib, 3 vertikal sterjen yo'naltiruvchi yordamida ushlab turiladi. Agar sterjenga F=400N kuch qo'yilgan bo'lsa, mexanizm muvozanat holatida bo'lishi uchun uzunligi OA=0,2m li krivoshipga qanday kattalikda juft kuch momenti M qo'yilishi kerak? (40)



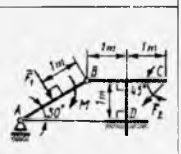
18.3.22. Radiusi r=0,2m bo'lgan baraban tishlari soni z_2=2z_3 nisbatli g'ildiraklarga ulangan. Baraban yordamida 900 N og'irlikdagi 1 yukni bir tekisda yuqoriga tortish uchun tishli g'ildirakli uzatmaga momenti qanday kattalikdagi juft kuch qo'yish lozim? (90)



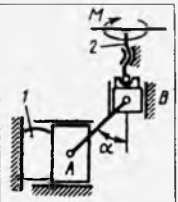
18.3.23. Tasma yordamida bog'langan g'ildiraklarning radiuslari R=2r=40sm bo'lib, og'irligi 900 N bo'lgan 1 yukni bir tekisda yuqoriga ko'tarish uchun 3 g'ildirakka momenti qancha kattalikdagi juft kuch qo'yish kerak bo'ladi? (90)



18.3.24. AB sterjenga F_1=800N li kuch va qiymati M=70N·m ga teng bo'lgan momentli juft kuch ta'sir etadi. BCD sterjenning C nuqtasiga F_2=280N li kuch qo'yilgan bo'lsa, D tayanchdagi reaksiya kuchining gorizontal tashkil etuvchisini aniqlang? (202)



18.3.25. Vint qadami h=1sm bo'lgan press mexanizmiga momenti M=1N·m li juft kuch ta'sir etadi. $\alpha=45^0$ muvozanat holat uchun pressning 1 jismga bosim kuchini toping. (628)



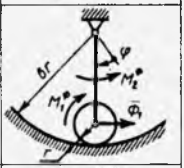
XIX BOB. DINAMIKANING UMUMIY TENGLAMASI

19.1. Erkinlik darajasi 1 va 2 ga teng bo'lgan mexanik sistemalardagi umumlashgan inersiya kuchlarini aniqlash

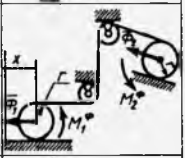
19.1.1. Erkinlik darajasi 1 ga teng bo'lgan mexanik sistemaning umumiy tenglamasidagi inersiya kuchlarining elementar ishlari turli ishorali bo'lishlari mumkinmi? (Yo'q)

19.1.2. Agar inersiya kuchi Φ_1=0,5 N, inersiya kuchlarining momentlari M_1^{Φ}=0,2N·m, M_2^{Φ}=0,1N·m, radiusi r=0,2 m bo'lgan sistemaning umumlashgan koordinatasi φ ga bog'liq bo'lgan umumlashgan inersiya kuchlarini hisoblang? (-0,2)

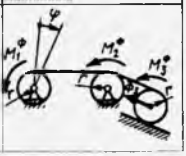
19.1.3. Agar inersiya kuchi Φ_1=0,5 N, inersiya kuchlarining momentlari M_1^{Φ}=0,05N·m, M_2^{Φ}=0,5N·m radiusi r=0,1 m bo'lgan sistemaning umumlashgan koordinatasi φ ga bog'liq bo'lgan umumlashgan inersiya kuchlarini hisoblang. (-1)



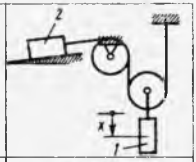
19.1.4. Agar inersiya kuchlari $\Phi_1=\Phi_2$=10N, inersiya kuchlarining momentlari $M_1^{\Phi}=M_2^{\Phi}$=1N·m, radiusi r=0,1 m bo'lgan sistemaning umumlashgan koordinatasi φ ga bog'liq bo'lgan umumlashgan inersiya kuchini hisoblang. (-40)



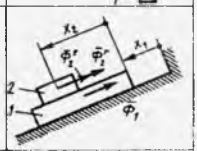
19.1.5. Radiuslari r=0,1m dan bo'lgan g'ildiraklardan tuzilgan sistemaga inersiya kuchi Φ_3=10N, inersiya momentlari $M_1^{\Phi}=M_2^{\Phi}=M_3^{\Phi}$=1N·m ta'sir etsa, umumlashgan koordinata φ uchun umumlashgan inersiya kuchini aniqlang. (-3)



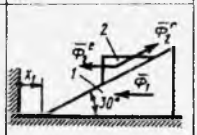
19.1.6. Massalari $m_1=m_2=1$kg, tezlanishi $a=x''=1$m/s^2 va vaznsiz bloklardan iborat sistemada umumlashgan koordinata sifatida x olingan bo'lsa, umumlashgan inersiya kuchini hisoblang. (-5)



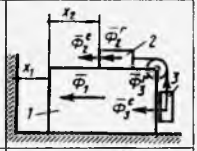
19.1.7. Ikkita jismdan iborat sistemaning 1 jismiga inersiya kuchi $\Phi_1=10$N, 2 jismga esa nisbiy va ko'chirma inersiya kuchlari $\Phi_2^e=\Phi_2^r=5$N ta'sir etsa, umumlashgan koordinata x_1 uchun umumlashgan inersiya kuchini aniqlang. (-20)



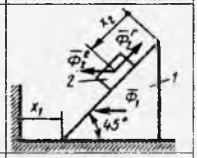
19.1.8. Ikkita jismdan iborat sistemaning 1 jismiga inersiya kuchi $\Phi_1=10$N. 2 jismiga esa nisbiy va ko'chirma inersiya kuchlari $\Phi_2^e=5$N, $\Phi_2^r=10$N ta'sir etsa, umumlashgan koordinata x_1 uchun umumlashgan inersiya kuchini aniqlang. (-6,34)



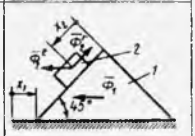
19.1.9. Uchta jismdan iborat sistemaning 1 jismiga $\Phi_1=4$N, 2 va 3 jismlarga nisbiy va ko'chirma inersiya kuchlari $\Phi_2^e=2$N, $\Phi_2^r=1$N, va $\Phi_3^e=2$N, $\Phi_3^r=1$N ta'sir etsa, x_2 umumlashgan koordinata uchun umumlashgan inersiya kuchini toping. (-4)



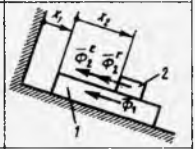
19.1.10. Ikki jismdan iborat sistemaning 1 jismiga inersiya kuchi $\Phi_1=5$N, 2 jismga nisbiy va ko'chirma inersiya kuchlari $\Phi_2^e=1$N, $\Phi_2^r=8$N ta'sir etsa, x_2 umumlashgan koordinata uchun umumlashgan inersiya kuchini hisoblang. (-7,29)



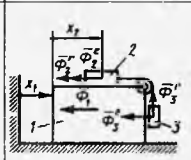
19.1.11. Ikki jismdan iborat sistemaning 1 jismiga inersiya kuchi $\Phi_1=5$N, 2 jismga nisbiy va ko'chirma inersiya kuchlari $\Phi_2^e=1$N, $\Phi_2^r=8$N ta'sir etsa, x_1 umumlashgan koordinata uchun umumlashgan inersiya kuchini toping. (-0,344)



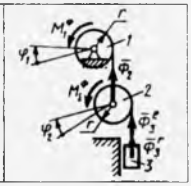
19.1.12. Ikki jismdan iborat sistemaning 1 jismiga inersiya kuchi $\Phi_1=8$N, 2 jismiga esa nisbiy va ko'chirma inersiya kuchlari $\Phi_2^e=5$N, $\Phi_2^r=5$N ta'sir etsa, x_2 umumlashgan koordinata uchun umumlashgan inersiya kuchini aniqlang. (-10)



19.1.13. Uchta jismdan iborat sistemaning 1 jismiga inersiya kuchi $\Phi_1=4$N, 2 va 3 jismiga nisbiy va ko'chirma inersiya kuchlari $\Phi_2^e=2$N, $\Phi_2^r=1$N va $\Phi_3^e=2$N, $\Phi_3^r=1$N ta'sir etsa, x_1 umumlashgan koordinata uchun umumlashgan inersiya kuchini hisoblang. (-9)



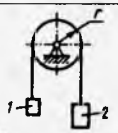
19.1.14. Radiuslari r=0,2m bo'lgan ikkita 1 2 g'ildirak va 3 yukdan iborat sistemaning jismlariga mos ravishda Φ_2=0,4N, Φ_3'=0,2N, Φ_3'=0,1N, M_1^Φ=0,4N·m, M_2^Φ=0,1N·m; inersiya kuchlari va momentlari ta'sir etsa, x_1 umumlashgan koordinata uchun umumlashgan inersiya kuchini aniqlang. (-0,54)



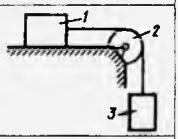
19.2. Sistema jismlari harakatiga dinamikaning umumiy tenglamasini qo'llash

19.2.1. Ideal bog'lanishli sistema uchun dinamikaning umumiy tenglamasida reaksiya kuchlari qatnashadimi? (Yo'q)

19.2.2. Massalari m_2=2m_1 bo'lgan 1 va 2 yuklar sim arqon yordamida radiusi r blokga osib qo'yilgan. Blokning massasini hisobga olmay, yuklarning tezlanishini toping. (3,27)

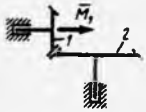


19.2.3. Massalari m_1=m_3=2kg li yuklar ip vositasida vaznsiz 2 blok orqali bog'langan. Agar 1 yukning tekislikdagi sirpanish ishqalanish koeffitsiyenti f=0,1 bo'lsa, yuklarning tezlanishini aniqlang. (4,41)



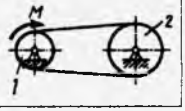
19.2.4. Massasi m=2,5kg bo'lgan 2 reyka o'zgaruvchi F=9t^2 kuch ta'sirida harakatga kelib, radiusi r=0,4m va aylanish o'qiga nisbatan inersiya momenti J_1=2kg·m^2 bo'lgan 1 g'ildirakni aylantiradi. t=1s vaqtdagi 1 g'ildirakning burchak tezlanishini hisoblang. (1,5)

19.2.5. Radiuslari r_1=0,15m va r_2=0,3m, aylanish o'qiga nisbatan inersiya momentlari J_1=0,02kg·m^2 va J_2=0,04kg·m^2 bo'lgan tishli g'ildirakli mexanizmga momenti M_1=0,15N·m ga teng bo'lgan juft kuch ta'sir etsa, 1 g'ildirakning burchak tezlanishini toping. (5)



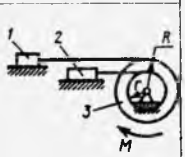
19.2.6. Radiusi r=0,1m, aylanish o'qiga nisbatan inersiya momenti J_1=0,01kg·m^2 bo'lgan 1 shesternya momenti M=1,4N·m li juft kuch ta'sirida aylanib, massasi m_2=1kg li 2 reykani siljitadi. 1 shesternyaning burchak tezlanishini toping. (21)

19.2.7. Radiuslari r_1=0,05m va r_2=0,1m; aylanish o'qlariga nisbatan inersiya momentlari J_1=0,01kg·m^2 va J_2=0,02kg·m^2 bo'lgan shkivlar momenti M=0,15N·m li juft kuch ta'sirida harakatga kelsa, 1 shkivning burchak tezlanishini aniqlang. (10)

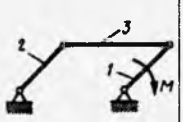


19.2.8. Radiuslari r_1=0,1m va r_2=0,2m; aylanish o'qlariga nisbatan inersiya momentlari J_1=0,02kg·m^2 va J_2=0,04kg·m^2 bo'lgan tishli g'ildiraklar momenti M=0,3N·m li juft kuch ta'sirida aylansa, 1 g'ildirakning burchak tezlanishini hisoblang. (10)

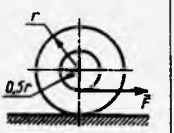
19.2.9. Massalari teng m_1=m_2=10kg li ikki yuk radiuslari R=0,2m va r=0,1m, aylanish o'qiga nisbatan inersiya momenti J_3=0,1kg·m^2 bo'lgan baraban yordamida momenti M=0,6N·m juft kuch ta'sirida tortilsa, 3 barabanning burchak tezlanishini aniqlang. (1)



19.2.10. Gorizontal tekislikda joylashgan mexanizm krivoshiplari uzunligi l=0,2m, massalari m_1=m_2=1kg li bir jinsli sterjenlardan iborat bo'lib, momenti M=0,8 N·m li juft kuch ta'sirida harakatga keladi. Agar 3 sterjenning massasi m_3=2kg bo'lsa, 1 krivoshipning burchak tezlanishini aniqlang. (7,5)

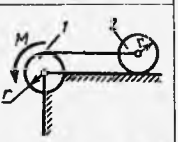


19.2.11. Massasi 2kg, inersiya radiusi ρ=6sm bo'lgan g'altakka ip o'ralgan bo'lib, uning uchidan F=0,5N li kuch bilan tortiladi. Agar g'altakning radiusi r=8sm bo'lsa, sirpanmasdan dumalayotgan g'altakning burchak tezlanishini aniqlang. (1)

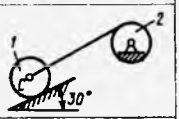


19.2.12. Massalari teng m_1=m_2=m_3, radiuslari bir xil 1 va 2 bir jinsli disklarga 3 yuk osilgan bo'lsa, yukning tushish tezlanishini toping. (4,36)

19.2.13. Radiuslari teng r=0,2m, massalari bir xil m_1=m_2=1kg, markaziy o'qqa nisbatan inersiya momentlari J_1=J_2=0,02kg·m^2 bo'lgan g'ildiraklar o'zgarmas momentli M=0,2N·m juft kuch ta'sirida harakat qilsa, 1 g'ildirakning burchak tezlanishini aniqlang. (2,5)



19.2.14. Radiuslari va massalari bir xil bo'lgan bir jinsli silindrlardan iborat bo'lgan 1 va 2 g'ildiraklar harakatida 1 g'ildirak markazi C ning tezlanishini aniqlang. (2,45)

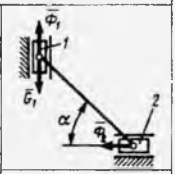


19.2.15. Gorizontal yo'lda turgan, massasi m_2=425kg li platforma ustida massasi m_1=75kg bo'lgan odam a_r=2m/s^2 nisbiy tezlanish bilan yugursa, platformaning tezlanishi qancha bo'ladi? (0,3)

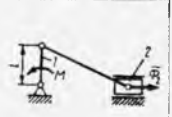
19.3. Mexanik sistema tashqi ta'sirlarini va parametrlarini aniqlashda dinamikaning umumiy tenglamasini qo'llash

19.3.1. Mexanik sistema harakatining differensial tenglamalari dinamikaning umumiy tenglamalari yordamida tuzilsa, tenglamalar soni sistemaning erkinlik darajasiga bog'liq bo'ladimi? (Ha)

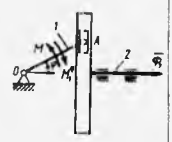
19.3.2. Bir-biriga bog'langan ikki polzunning harakatida $\Phi_1=\Phi_2=10$N inersiya kuchlari ta'sir etsa, $\alpha=45°$ holat uchun 1 polzunning G_1 og'irligini aniqlang. (20)



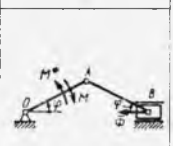
19.3.3. Uzunligi l=0,1m li 1 krivoship momenti M bo'lgan juft kuch ta'sirida aylanadi. 2 polzunning inersiya kuchi $\Phi_2=10$N ga teng. Krivoshipning 2 polzun yo'naltiruvchilariga perpendikular holatida 1 krivoshipga ta'sir etayotgan juft kuch M momenti miqdorini hisoblang. (1)



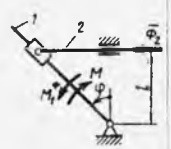
19.3.4. Uzunligi OA=0,2m bo'lgan 1 krivoship momenti M juft kuch ta'sirida aylanib, 2 kulisani harakatga keltiradi. Agar $\varphi=30°$ holatda krivoshipga inersiya kuchlari bosh momenti M_1^{Φ}=0,2N·m, kulisaga inersiya kuchlari bosh vektori Φ_2=1N ta'sir etsa, mexanizmni gorizontal tekislikda joylashgan deb, juft kuch momenti M ning qiymatini toping. (0,3)



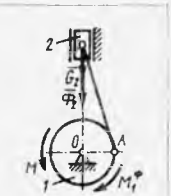
19.3.5. Uzunliklari o'zaro teng $OA=AB$=0,1m krivoship-polzunli mexanizm gorizontal tekislikda joylashgan bo'lib, momenti M juft kuch ta'sirida harakatga keladi. Agar $\varphi=30°$ holatida krivoshipga inersiya kuchlarining bosh momenti M^{Φ}=0,2N·m, polzunga inersiya kuchlari bosh vektori F=1N ta'sir etsa, M momentning qiymatini hisoblang. (0,3)



19.3.6. Gorizontal tekislikda joylashgan kulisali mexanizmning 1 krivoshipi momenti M juft kuch ta'sirida harakatga keladi. Agar $\varphi=45°$ holatida krivoshipga inersiya kuchlarining bosh momenti M_1^{Φ}=0,1N·m, 2 kulisaga esa inersiya kuchlarining bosh vektori Φ_2=1N ta'sir etsa, ℓ masofani 0,1m deb olib, M momentning miqdorini aniqlang. (0,3)

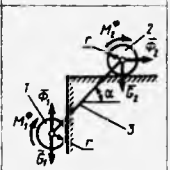


19.3.7. Radiusi OA=0,1m bo'lgan 1 disk momenti M juft kuch ta'sirida aylanib, 2 polzunni harakatga keltiradi. Agar polzunga inersiya kuchlarining momenti M_1^{Φ}=0,1N·m va inersiya kuchi Φ_2=1N ta'sir etsa. OA radius polzun yo'naltiruvchilariga perpendikular bo'lgan holda juft kuch momenti M ning qiymatini toping. Polzunning vazni G_2=1N. (0,3)



19.3.8. Radiuslari $2r$ va r=0,1m bo'lgan ikki g'ildirak o'zaro bog'langan bo'lib, $\overline{F}$ kuchi ta'sirida harakat qiladi. Agar g'ildiraklarga inersiya kuchlarining bosh vektorlari Φ_1=4N va Φ_2=1N, inersiya kuchlarining bosh momentlari M_1^{Φ}=0,8N·m va M_2^{Φ}=0,1N·m ta'sir etsa, $\overline{F}$ kuchining miqdorini aniqlang. (9)

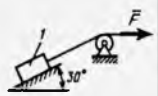
19.3.9. Radiuslari bir xil r=0,1m bo'lgan ikki g'ildirak vaznsiz 3 sterjen bilan bog'langan bo'lib, og'irlik kuchlari ta'sirida harakatga keladi. Agar α=45° holatida g'ildiraklarga inersiya kuchlarining bosh vektorlari $\Phi_1=\Phi_2$=10N va bosh momentlari $M_1^{\Phi}=M_2^{\Phi}$=0,5N·m ta'sir etsa, 1 g'ildirakning G_1 og'irlik kuchini aniqlang. (30)



19.3.10. Reduktorli mexanizm juft kuch momenti M ta'sirida harakatga kelib, tishlar soni Z_1=50; Z_2=100 bo'lgan shesternyalarni aylantiradi. Agar shesternyalarga inersiya kuchlarining bosh momentlari M_1^{Φ}=0,1N·m, M_2^{Φ}=1N·m ta'sir qilsa, tasmali uzatmaning uzatish nisbati i=0,5 deb, aylantiruvchi moment M ning qiymatini toping. (0,3)

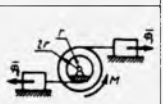
19.3.11. Massasi m_1=10kg bo'lgan 1 jism $\overline{F}$ kuchi ta'sirida a=1m/s^2 tezlanish bilan yuqoriga tortilsa, $\overline{F}$ kuchining qiymatini toping. (108)

19.3.12. Massasi m=1kg li 1 jism $\overline{F}$ kuchi ta'sirida ishqalanish koeffitsiyenti f=0,1 bo'lgan qiya tekislikda a=1m/s^2 tezlanish bilan harakat qilsa, $\overline{F}$ kuchining qiymatini aniqlang. (6,75)

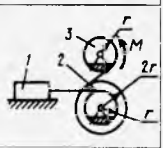


19.3.13. Massasi m_1=200kg bo'lgan 1 to'sin $\overline{F}$ kuchi ta'sirida a=1m/s^2 tezlanish bilan harakat qilib, radiuslari teng r=0,1m, aylanish o'qiga nisbatan inersiya momentlari $J_1=J_2$=0,1kg·m^2 ga teng bo'lgan g'ildiraklarni aylantirsa, $\overline{F}$ kuchining qiymatini hisoblang. (220)

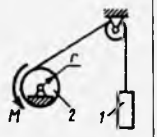
19.3.14. Sistema yuklariga inersiya kuchlarining bosh vektorlari Φ_1=2N va Φ_2=1N ta'sir qiladi. Yuklar radiusi r=0,1m bo'lgan barabanga tortilishi uchun qanday miqdordagi momenti M juft kuch ta'sir qilishi lozim? (0,5)



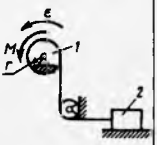
19.3.15. Radiuslari r=0,1m, aylanish o'qiga nisbatan inersiya momentlari J_2=0,04kg·m^2 va J_3=0,02kg.m^2 bo'lgan g'ildiraklar juft kuch momenti M ta'sirida aylanib, massasi m_1=10kg li 1 yukni 1m/s^2 tezlanish bilan tortsa, M momentning qiymatini aniqlang. (1,1)



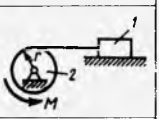
19.3.16. Massalari teng $m_1=m_2=2$kg bo'lgan 1 yuk va 2 baraban momenti M bo'lgan juft kuch ta'sirida harakatga keladi. Agar yukning yuqoriga tortilish tezlanishi $1 m/s^2$ bo'lsa, barabanni radiusi $r=0,2$m li bir jinsli silindr deb, M momentning miqdorini toping. (4,52)



19.3.17. Massalari teng $m_1=m_2=1$kg bo'lgan 1 baraban va 2 yuk momenti M bo'lgan juft kuch ta'sirida harakatga keladi. Agar barabanning burchak tezlanishi $\varepsilon=1 rad/s^2$ bo'lsa, barabanning radiusi $r=0,2$m li bir jinsli silindr deb, M momentining qiymatini toping. (0,06)

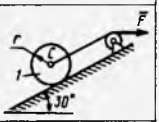


19.3.18. Radiusi $r=0,1$m, aylanish o'qiga nisbatan inersiya momenti $J_2=0,1$kg·m^2 2 baraban momenti M juft kuch ta'sirida aylanib, massasi 1kg bo'lgan 1 jismni $1 m/s^2$ tezlanish bilan tortsa, M momentning qiymatini aniqlang. (1,1)

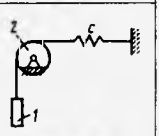


19.3.19. Massalari va radiuslari bir xil $m_1=m_2=2$kg, $r=0,2$m bo'lgan ikki g'ildiraklar momenti M juft kuch ta'sirida harakatga keladi. Agar g'ildiraklarni bir jinsli silindr deb hisoblansa, 1 g'ildirak $\varepsilon=1 rad/s^2$ burchak tezlanishga erishishi uchun M ning qiymati qanday bo'lishi lozim? (0,07)

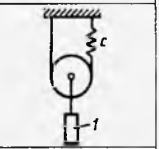
19.3.20. Massasi $m_1=20$kg, radiusi $r=0,4$m bo'lgan bir jinsli g'ildirakning C markazi $a_c=1 m/s^2$ tezlanishga erishishi uchun $\overline{F}$ kuchining qiymati qanchaga teng bo'lishi kerak? (128)



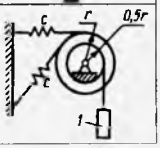
19.3.21. Massasi $m_1=0,5$kg bo'lgan 1 jism massasi $m_2=1$kg li blok vositasida bikirligi $c=100$N/m ga teng prujinaga osilgan holda tebransa, 1 jismning erkin vertikal tebranishlarining chastotasini hisoblang. Blokni bir jinsli disk deb oling. (10)

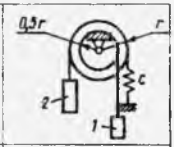
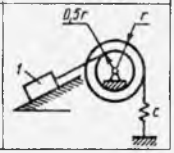


19.3.22. Massasi $m=1$kg li 1 jism blok vositasida bikirligi $c=100$N/m bo'lgan prujinali ipga osilgan holda tebransa, erkin vertikal tebranishlarning chastotasini aniqlang. (20)



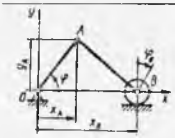
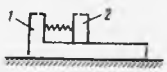
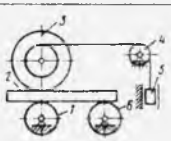
19.3.23. Massasi $m=4$kg li 1 yuk radiusi $r=0,2$m bo'lgan shkiv vositasida bikirligi bir xil $c=100$N/m ikki prujinaga bog'langan holda tebransa, erkin vertikal tebranishlarning davrini toping. (0,446)



19.3.24. Massalari m_1=1kg va m_2=2kg bo'lgan ikki jism shkiv vositasida bikirligi c=100N/m li prujinaga osilgan holda tebransa, 1 jismning erkin vertikal tebranishlarining chastotasini aniqlang. (6,67)	
19.3.25. Massasi m=1kg bo'lgan 1 jism shkiv yordamida bikirligi c=1N/sm li prujinaga bog'langan holda tebransa, 1 jism erkin tebranishlarining chastotasini hisoblang. (20)	

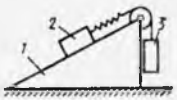
XX BOB. LAGRANJNING IKKI XIL TENGLAMALARI

20.1. Umumlashgan koordinatalar

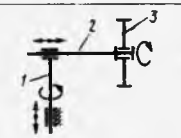
20.1.1. Futbol to'pi erkin uchayotgan holatda bo'lsa, uning umumlashgan koordinatalari soni nechta? (6)	
20.1.2. Krivoship - shatunli mexanizm vositasida harakat qilayotgan g'ildirakli sistemada x_A, y_A, x_B, φ, φ_B koordinatalardan bir vaqtda nechtasi umumlashgan koordinatalar bo'la oladi? (1)	
20.1.3. Dumaloq jism qiya tekislikda joylashgan idish ichida sirpanib dumalasa, uning umumlashgan koordinatalar sonini aniqlang. (2)	
20.1.4. Gorizontal tekislikda erkin harakat qilayotgan 1 jism ustida joylashgan 2 jism prujinaga bog'langan holda siljisa, sistemaning harakati chizma tekisligida deb faraz qilib, umumlashgan koordinatalar sonini toping. (2)	
20.1.5. Mexanik sistema 1 va 6 g'ildiraklardan, 2 brusdan, 4 blokdan, 3 katokdan va 5 yukdan iborat bo'lsa, sistemaning umumlashgan koordinatalari sonini hisoblang. (2)	

20.1.6. Uchta sterjen sharnir yordamida bog'langan bo'lib, bir vertikal tekislikda harakat qilsa, sistemaning umumlashgan koordinatalari sonini aniqlang. (3)

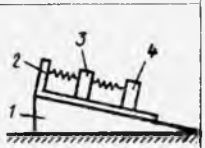
20.1.7. Uchburchakli I prizma gorizontal tekislikda erkin harakat qilishi mumkin. 2 va 3 jismlar o'zaro prujina vositasida bog'langan bo'lib, prizmaga nisbatan harakat qiladi. Sistemaning harakati chizma tekisligida amalga oshadi deb, uning umumlashgan koordinatalari sonini aniqlang. (3)



20.1.8. Mexanizm 1 vertikal o'qdan, 2 gorizontal sterjendan va 3 g'ildirakdan iborat bo'lsa, 3 g'ildirakning umumlashgan koordinatalar sonini aniqlang. (4)



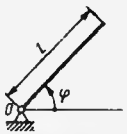
20.1.9. Uchburchakli I prizma gorizontal tekislikda erkin harakat qilishi mumkin. 2 jism prizmaning ustida siljiydi. 3 va 4 jismlar prujinalar vositasida o'zaro va 2 jismga nisbatan harakat qiladi. Sistemaning harakati vertikal tekislikda sodir bo'lyapti deb faraz qilib, sistemaning umumlashgan koordinatalar sonini toping. (4)



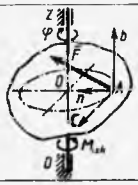
20.2. Erkinlik darajasi birga teng bo'lgan sistemalarning umumlashgan kuchlari

20.2.1. Mexanik sistemaning potensial energiyasi $\Pi=15\varphi^2$ bo'lib, bu yerda φ – radianlarda. $\varphi=90^\circ$ holat uchun sistemaning umumlashgan koordinatasi φ ga mos bo'lgan umumlashgan kuchni aniqlang. (-47,1)

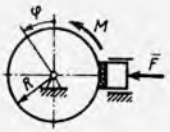
20.2.2. Massasi m=30kg, uzunligi l=3m bo'lgan bir jinsli sterjen vertikal tekislikda aylansa, umumlashgan koordinata φ ning $\varphi=45^\circ$ holati uchun unga mos bo'lgan umumlashgan kuchni aniqlang. (-312)



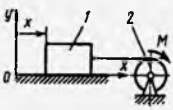
20.2.3. Jism $\overline{F}=30\overline{\tau}+25\overline{n}+40\overline{b}$ kuch ta'sirida vertikal Oz o'qi atrofida aylanadi. Podshipniklarning qarshilik kuchlarining momenti M=0,8N·m ga teng. Agar $\overline{F}$ kuch qo'yilgan nuqtadan aylanish o'qigacha bo'lgan masofa OA=0,2m bo'lsa, jismning burilish burchagi φ ga bog'liq bo'lgan umumlashgan kuchning qiymatini aniqlang. (5,2)



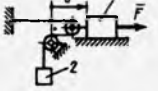
20.2.4. Silindr shaklidagi jism momenti M=20N·m bo'lgan juft kuch ta'sirida aylanadi. Harakatni to'xtatish qurilmasi, tormoz kolodkasi, jismga F=100N kuch bilan bosadi. Agar jism va kolodka orasidagi ishqalanish koeffitsiyenti f=0,4 bo'lsa, silindr radiusini R=0,4m deb, umumlashgan koordinata φ uchun mos keladigan umumlashgan kuchning qiymatini hisoblang. (4)



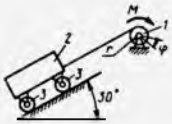
20.2.5. Radiusi R=0,25m bo'lgan silindr momenti M=25 N·m juft kuch ta'sirida aylanib, massasi m=30kg li 1 jismni cho'zilmaydigan ip yordamida tortadi. Agar 1 jism va gorizontal tekislik orasidagi ishqalanish koeffitsiyenti f=0,2 bo'lsa, x umumlashgan koordinataga tegishli bo'lgan umumlashgan kuchni aniqlang. (41,1)



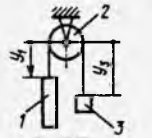
20.2.6. Massalari o'zaro teng m_1=m_2=15kg bo'lgan ikki yuk 1 va 2 ip vositasida o'zaro bog'langan bo'lib, F=350N kuch ta'sirida harakatga keladi. Umumlashgan koordinata sifatida s ni qabul qilib, unga tegishli umumlashgan kuchning qiymatini aniqlang. (55,7)



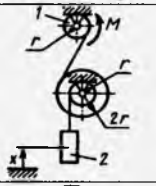
20.2.7. Radiusi r=0,1m bo'lgan 1 baraban momenti M=50 N·m li juft kuch ta'sirida aylanib, aravachani yuqoriga tortadi. Agar aravachaning to'rtta g'ildiragi m_3=1 kg dan, yuqori qismi esa m_2=40kg bo'lsa, barabanning burilish burchagi φ uchun umumlashgan kuchni hisoblang. (28,4)



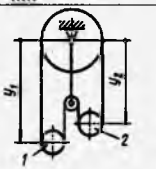
20.2.8. Massalari m_1=30kg va m_3=10kg yuklar cho'zilmaydigan sim arqon yordamida 2 blok orqali bog'langan. 1 yukning siljishi y_1 ni umumlashgan koordinata deb olib, umumlashgan kuchni hisoblang. (196)

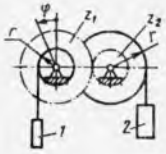
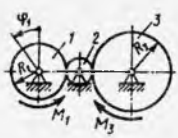
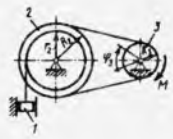
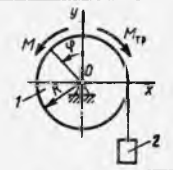
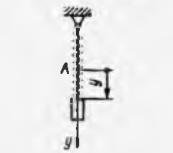
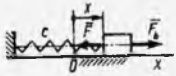


20.2.9. Radiusi r=0,1m bo'lgan 1 baraban momenti M=50 N·m juft kuch ta'sirida aylanib, 2 yukni yuqoriga tortadi. Agar yukning massasi m=100 kg bo'lsa, uning siljishi x ni umumlashgan koordinata deb, umumlashgan kuchni toping. (19)

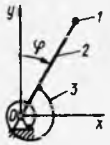


20.2.10. Massalari m_1=24kg va m_2=16kg li silindrlar sim arqon yordamida osilgan. 2 silindr markazining siljishi y_2 ni umumlashgan koordinata deb, unga mos umumlashgan kuchni aniqlang. (-78,5)

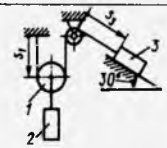


20.2.11. Tishlar soni z_1=60 va z_2=40 bo'lgan tishli g'ildiraklar orqali bog'langan barabanlarga massalari m_1=1kg va m_2=2kg li yuklar osilgan. Agar barabanlar radiuslari r va $2r$ bo'lib, r=0,1m bo'lsa, 1 barabanning burilish burchagini umumlashgan koordinata deb, unga mos umumlashgan kuchini toping. (6,87)	
20.2.12. Radiuslari R_1=0,3m, R_3=0,5m bo'lgan uchta g'ildirak friksion uzatmani hosil qilib, ularga momentlari M_1=15N·m va M_3=5N·m li juft kuchlar ta'sir etadi. Umumlashgan koordinata sifatida 1 g'ildirakning burilish burchagi φ_1 ni olib, unga mos umumlashgan kuchni aniqlang. (12)	
20.2.13. Radiuslari R_2=0,5m, r_2=0,4m va R_3=0,2m bo'lgan shkivlar tasma yordamida bog'lanib, momenti M=25 N·m bo'lgan juft kuch ta'sirida harakatga keladi. Agar 2 shkiv massasi 10kg bo'lgan 1 yukni yuqoriga tortsa, 3 g'ildirak aylanish burchagi φ_3 ni umumlashgan koordinata sifatida tanlab olib, unga mos umumlashgan kuchni hisoblang. (9,30)	
20.2.14. Radiusi R=0,3m bo'lgan 1 silindrga momenti M=120 N·m li juft kuchi va ishqalanish kuchi momenti M_{ishq}=10N·m ta'sir etib, massasi m_2=40kg li 2 yukni yuqoriga tortadi. Silindrning aylanish burchagi φ ni umumlashgan koordinata sifatida qabul qilib, unga mos umumlashgan kuchni toping. (-7,72)	
20.2.15. Massasi m=6kg bo'lgan yuk prujinaga osilgan holda tebranadi, yukka F=-300 y qiymatli qaytaruvchi kuch ta'sir etadi. Yukning siljishi y ni umumlashgan koordinata sifatida qabul qilib, unga mos umumlashgan kuchni aniqlang. (19,6)	
20.2.16. Gorizontal prujinaga mahkamlangan yukka bikirligi c=300 N/m bo'lgan prujinaning elastiklik kuchi va o'zgaruvchi F_B=40cos3t kuchlar ta'sir etadi. Yukning gorizontal ko'chishi x ni umumlashgan koordinata deb olib, unga mos umumlashgan kuchni t=2s da x=0,1m holat uchun aniqlang. (8,41)	

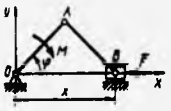
20.2.17. Uzunligi l=0,5 m bo'lgan 2 sterjenning uchiga massasi m_1=20kg li 1 moddiy nuqta o'rnatilgan bo'lib, sterjenga 3 spiralsimon prujina burovchi momenti M=-80φ ta'sir etadi. Sterjen buralish burchagi φ ni umumlashgan koordinata deb olib, $\varphi=\frac{\pi}{6}$ holat uchun unga mos umumlashgan kuchni aniqlang. (7,16)



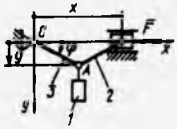
20.2.18. Massalari teng m_1=m_2=m_3=5kg bo'lgan 1, 2, 3 jismlar cho'zilmaydigan ip yordamida bog'langan. 1 jismning siljishi s_1 ni umumlashgan koordinata deb olib, unga mos umumlashgan kuchni hisoblang. (49,1)



20.2.19. Krivoship-polzunli mexanizmga momenti M=1,5 N·m juft kuch va o'zgarmas F=20N kuch ta'sir etadi. Agar OA=AB=0,2m bo'lsa, krivoshipning burilish burchagi φ ni umumlashgan koordinata deb tanlab, unga mos umumlashgan kuchni φ=45° holat uchun hisoblang. (4,16)



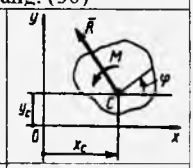
20.2.20. Uzunliklari teng l=0,5m li ikki sterjen A sharnir orqali bog'langan bo'lib, unga massasi 5kg bo'lgan yuk osilgan. Agar 2 sterjen uchidagi polzunga F=100N kuch ta'sir qilsa, 3 sterjenning burilish burchagi φ ni umumlashgan koordinata deb, unga mos umumlashgan kuchni φ=25° holat uchun hisoblang. (-20,0)



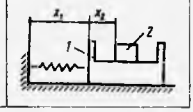
20.3. Erkinlik darajasi bir nechta bo'lgan sistemaning umumlashgan kuchlari

20.3.1. Mexanik sistemaga ta'sir etuvchi kuchlarning elementar ishlarining yig'indisi δA=20δq_1+30δq_2+60δq_3 ga teng. Umumlashgan koordinata q_1, q_2, q_3 lardan q_2 ga mos kelgan umumlashgan kuchning qiymatini aniqlang. (30)

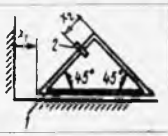
20.3.2. Jismga ta'sir qiluvchi tekislikda joylashgan barcha kuchlar bosh vektori $\overline{R}$=-6$\bar{i}$+9$\bar{j}$ va bosh momenti M=14N·m ga keltirilgan bo'lsa, φ ni umumlashgan koordinata deb, unga mos kelgan umumlashgan kuchni hisoblang. (14)



20.3.3. Massalari m_1=10kg va m_2=5kg bo'lgan jismlardan iborat sistemaning x_2 umumlashgan koordinatasiga qanday umumlashgan kuch to'g'ri keladi? (0)



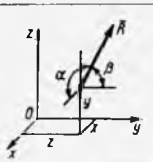
20.3.4. Massalari m_1=1kg va m_2=0,1kg bo'lgan jismlardan iborat sistemaning x_2 umumlashgan koordinatasi uchun mos bo'lgan umumlashgan kuchni aniqlang. (0)



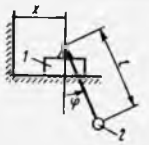
20.3.5. Konservativ sistemaga ta'sir qiluvchi $\Pi=3x_1^2+2x_2$ potensial energiyaga mos x_2 umumlashgan koordinata uchun umumlashgan kuchni hisoblang. (-2)

20.3.6. Konservativ sistemaga ta'sir qiluvchi $\Pi=(18+24s)\cos\varphi$ potensial energiya berilgan, bu yerda s va φ umumlashgan koordinatalar. s koordinata uchun mos bo'lgan umumlashgan kuchning qiymatini s=0,5m va φ=2rad holat uchun hisoblang. (9,99)

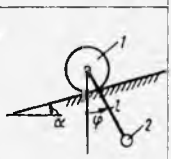
20.3.7. Moddiy nuqtaga ta'sir qiluvchi kuchlarning teng ta'sir etuvchisining qiymati $|R|$=50N va koordinata o'qlari bilan α=60°, β=70° burchaklar tashkil qilsa, y umumlashgan koordinataga mos keluvchi umumlashgan kuchni aniqlang. (17,1)



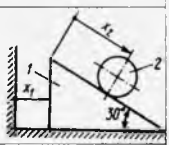
20.3.8. Mayatnikli sistema ikki jismdan iborat bo'lib, ularning massalari m_1=10kg va m_2=1kg, uzunligi l=0,5m ga teng. Umumlashgan koordinata sifatida φ mayatnikning og'ish burchagini tanlab, unga mos umumlashgan kuchni φ=30° holat uchun hisoblang. (-2,45)



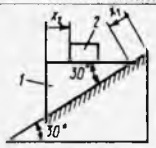
20.3.9. Mayatnikli sistema ikki jismdan iborat bo'lib, ularnig massalari m_1=10kg va m_2=1kg ga, uzunligi l=1m ga teng. Mayatnikning og'ish burchagi φ ni umumlashgan koordinata sifatida qabul qilib, unga mos umumlashgan kuchni φ=30° va α=15° holat uchun hisoblang. (-4,91)



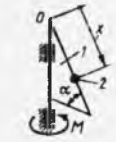
20.3.10. Massalari m_1=4kg va m_2=2kg bo'lgan, ikki jismdan iborat sistemada x_2 koordinatani umumlashgan koordinata deb, unga mos umumlashgan kuchni aniqlang. (9,81)



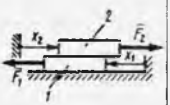
20.3.11. Massalari m_1=8kg va m_2=2kg bo'lgan, ikki jismdan iborat sistemada x_1 koordinatani umumlashgan koordinata deb, unga mos umumlashgan kuchni toping. (49,1)



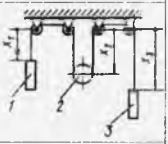
20.3.12. Uchburchak shaklidagi plastina momenti M=1N·m bo'lgan juft kuch ta'sirida vertikal o'q atrofida aylanadi. Uchburchakning gipotenuzasi bo'ylab sirpanuvchi moddiy nuqtaning massasi m=0,1kg bo'lib, α=60° ga teng. Moddiy nuqtaning siljishi x ni umumlashgan koordinata deb, unga mos keluvchi umumlashgan kuchning qiymatini hisoblang. (0,850)



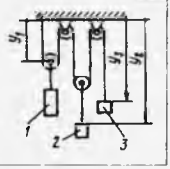
20.3.13. Massalari teng m_1=m_2=10kg li plastinalarga F_1=50N va F_2=30N kuchlar ta'sir etadi. Agar barcha sirtlardagi ishqalanish koeffitsiyenti f=0,15 bo'lsa, x_1 ni umumlashgan koordinata qilib olib, unga mos umumlashgan kuchni aniqlang. (5,86)



20.3.14. Massalari m_1=100kg, m_2=220kg va m_3=150kg bo'lgan 1;3 yuklar va 2 silindr vertikal tekislikda harakat qiladi. Yuklarning ko'chishlari x_1 va x_3 ni umumlashgan koordinatalar deb, x_3 ga mos keluvchi umumlashgan kuchni toping. (3,92)



20.3.15. Massalari m_1=12kg, m_2=6kg va m_3=4kg bo'lgan yuklar vertikal tekislikda harakatlanadi. 1 va 2 yuklarning siljishini umumlashgan koordinatalar deb tanlab, y_1 ga mos keluvchi umumlashgan kuchni hisoblang. (39,2)



20.4. Kinetik potensial

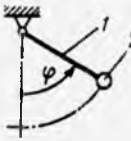
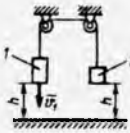
20.4.1. Mexanik sistemaning kinetik potensiali $f(x,\dot{x})=12\dot{x}+2x^2$ ko'rinishdagi funksiya orqali aniqlanishi mumkinmi? (Yo'q)

20.4.2. Konservativ sistemaning kinetik potensiali $f(x,\dot{x})=4\dot{x}^2-4x^2$ ko'rinishda berilishi mumkinmi? (Ha)

20.4.3. Mexanik sistemaning kinetik potensiali $f(x,\dot{x})=4\dot{x}^3+2x^2$ funksiya ko'rinishda bo'lishi mumkinmi? (Yo'q)

20.4.4. Mexanik sistemaning kinetik energiyasi $T=10\dot{\varphi}^2$ ga, potensial energiyasi esa $\Pi=2\varphi^2$ ga teng bo'lsa, sistema kinetik potensialining miqdori qancha bo'ladi? Bunda umumlashgan koordinataning miqdori φ=3rad, umumlashgan tezlikni esa $\dot{\varphi}$=2rad/s deb oling. (22)

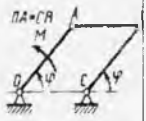
20.4.5. Massasi m=20kg bo'lgan jism silliq qiya tekislik bo'ylab pastga tushadi. Jism s=2m yo'l bosganda tezligi υ=3m/s bo'lsa, uning kinetik potensiali qancha bo'ladi?

Boshlang'ich paytda, s=0 da, jismning potensial energiyasini Π_0=0 deb oling. (-75,8)	
20.4.6. Massasi m=1kg bo'lgan moddiy nuqta vertikal yuqoriga ko'tarilmoqda. Agar u h=6m ga ko'tarilganda kinetik potensiali nolga teng bo'lsa, uning tezligi υ nechaga teng bo'ladi? Boshlang'ich paytda, h=0 da, potensial energiyani Π_0=0 deb oling. (10,8)	
20.4.7. Massasi 60 kg bo'lgan 1 jism υ=1m/s tezlik bilan harakat qiladi. Radiusi r=0,2m li 2 silindrning aylanish o'qiga nisbatan inersiya momenti J_A=2 kg m^2 ga teng. 1 jism y=1m masofada turganda sistemaning kinetik potensialini hisoblang. Boshlang'ich paytda, y=0 da, sistemaning potensial energiyasi nolga teng. (-534)	
20.4.8. Massasi m=1kg bo'lgan jismga ta'sir etuvchi prujinaning elastiklik kuchi F=-100x ga teng. Jismning koordinatasi x=0,1m va tezligi υ=1m/s bo'lsa, uning kinetik potensialini aniqlang. x=0 da Π_0=0. (0)	
20.4.9. 1 sterjenga mahkamlangan 2 yuk vertikal tekislikda harakat qiladi. Agar mayatnikning kinetik energiyasi T=0,8$\dot{\varphi}^2$ va potensial energiyasi Π=9,81(1-cosφ)ga teng bo'lsa, og'ish burchagi φ=60° va burchak tezligi ω=1rad/s bo'lgan paytdagi kinetik potensialni hisoblang. (-4.11)	
20.4.10. Massalari m_1=10kg va m_2=5kg bo'lgan ikki yuk vertikal tekislikda harakat qiladi. Agar 1 jismning tezligi υ_1=3m/s bo'lganda ikkala jismlar gorizontal tekislikdan teng h=2m balandlikda bo'lganda, sistemaning kinetik potensialini aniqlang. Bu holatda sistemaning potensial energiyasini Π_0=0 deb oling. (-227)	

20.5. Erkinlik darajasi birga teng bo'lgan sistema uchun Lagranjning ikkinchi xil tenglamasi

20.5.1. Mexanik sistemaning kinetik energiyasi T=8$\dot{\varphi}^2$ ga, umumlashgan kuchi Q=16-φ ga teng. Bunda φ umumlashgan koordinata (rad). φ=8rad bo'lgan paytdagi φ burchak tezlanishni φ'' ni toping. (0,5)

20.5.2. Mexanizm vertikal tekislikda harakatlanadi. Uning OA krivoshipiga momenti M bo'lgan juft kuch ta'sir qiladi. Umumlashgan koordinataga nisbatan sistemaning kinetik energiyasi $T=2\dot{\varphi}^2$, umumlashgan kuchi $Q=M-8\cos\varphi$ bo'lsa, $\varphi=0{,}25\pi$ va $\varphi''=2\text{rad/s}^2$ holatda burovchi moment M ning qiymatini toping. (13,7)



20.5.3. Mexanik sistemaning kinetik energiyasi $T=5\dot{\varphi}^2+30\sin\varphi\cdot\dot{\varphi}$, umumlashgan kuchi $Q_\omega=-20\sin\varphi$ ga teng. Bunda umumlashgan kuch Q N·m da, umumlashgan koordinata φ- rad da o'lchanadi. Mexanik sistemaning umumlashgan koordinatasi $\varphi=3$rad bo'lgan paytdagi burchak φ'' tezlanishni aniqlang. (0,282)

20.5.4. Mexanik sistemaning kinetik potensiali umumlashgan koordinata y va umumlashgan tezlik $\dot{y}$ orqali $L=\dot{y}^2+2y$, ifodalangan bo'lsa, tezlanish $\ddot{y}$ ni aniqlang. (1)

20.5.5. Mexanik sistemaning kinetik potensiali umumlashgan koordinata φ va umumlashgan tezlik $\dot{\varphi}$ orqali $L=2\dot{\varphi}^2+4\varphi+1$, ifodalangan bo'lsa, burchak tezlanish φ'' ni toping. (1)

20.5.6. Mexanik sistemaning kinetik potensiali umumlashgan koordinata φ orqali $L=14\dot{\varphi}^2+2\varphi$, ifodalangan bo'lsa, harakat boshlangandan 2s dan keyin umumlashgan tezlik $\dot{\varphi}$ ni aniqlang. Boshlang'ich paytda $t=0$ da $\dot{\varphi}_0=2\text{rad/s}$. (2,14)

20.5.7. Mexanik sistemaning kinetik potensiali $L=16\dot{x}^2+20x$ ga teng. Agar boshlang'ich payt $t=0$ da, $x_0=0$, $\dot{x}_0=2\text{m/s}$ bo'lsa, $t=3$s paytda umumlashgan koordinata x ning qiymatini toping. (8,81)

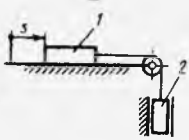
20.5.8. Mexanik sistemaning kinetik energiyasi $T=2\dot{x}^2$ va potensial energiyasi $\Pi=4x$ bo'lsa, sistemaning umumlashgan tezligi $\dot{x}$ ni $t=3$s da aniqlang. Boshlang'ich paytda, $t=0$ da, $\dot{x}_0=13\text{m/s}$ deb hisoblang. (10)

20.5.9. Mexanik sistemaning kinetik energiyasi $T=12\dot{x}^2$ va potensial energiyasi $\Pi=-2gx$ bo'lsa, umumlashgan koordinata x metrlarda deb, tezlanish $\ddot{x}$ ni toping. (0,818)

20.5.10. Mexanik sistemaning kinetik energiyasi $T=1{,}5\dot{s}^2$, potensial energiyasi $\Pi=150s^2$ bo'lsa, $s=0{,}01$m paytdagi tezlanish $\ddot{s}$ ni hisoblang. (-1)

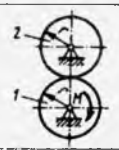
20.5.11. Vertikal o'q atrofida aylanuvchi disk momenti M=6 N·m bo'lgan juft kuch ta'sirida aylanib, $T=12\dot{\varphi}^2$ kinetik energiyaga ega bo'lsa, diskning burchak tezlanishi ε ni aniqlang. (0,25)

20.5.12. Massalari $m_1=m_2$=6kg bo'lgan jismlardan iborat sistema $T=6\dot{s}^2$ kinetik energiyaga ega bo'lsa, 1 jism va gorizontal tekislik orasidagi ishqalanish koeffitsiyentini f=0,2 deb, 1 jismning tezlanishi a_1 ni aniqlang. (3,92)

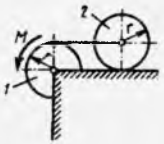


20.5.13. Mexanik sistema massasi m=20kg bo'lgan 1 jism va aylanish o'qiga nisbatan inersiya momenti J_0=2kg·m^2 ga teng 2 silindrdan iborat. Agar silindrning radiusi r=0,2m bo'lib, momenti M=20N·m li juft kuch ta'sirida aylansa va sistemaning kinetik energiyasi $T=35\dot{s}^2$ ga ega bo'lsa, 1 jismning tezlanishi a_1 ni aniqlang. (0,470)

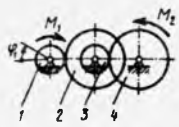
20.5.14. Massalari teng $m_1=m_2$=10kg, radiuslari bir xil r=0,2m bo'lgan bir jinsli disklardan iborat sistemaga M=0,4 N·m li juft kuch ta'sir etsa, 1 diskning burchak tezlanishini aniqlang. (1)



20.5.15. Radiuslari o'zaro teng r=0,5m, massalari $m_1=m_2$=4kg bo'lgan 1 blok va 2 g'ildirak mexanik sistemani tashkil qilib, momenti M=0,6N·m li juft kuch ta'sirida harakatga keladi. Agar 2 g'ildirak gorizontal tekislik bo'ylab sirpanmasdan dumalasa, uni bir jinsli silindr deb, burchak tezlanishini aniqlang. (0,4)



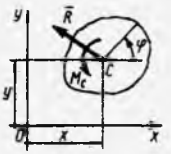
20.5.16. Radiuslari $r_1=r_3$=10sm va $r_2=r_4$=15sm bo'lgan g'ildiraklar momenlari M_1=5N·m va M_2=9N·m li juft kuchlari ta'sirida harakatga kelib, $T=2\dot{\varphi}_1^2$ kinetik energiyaga ega bo'lsa, 1 g'ildirakning burchak tezlanishi $\ddot{\varphi}$ ni aniqlang. (0,25)



20.6. Erkinlik darajasi bir necha bo'lgan sistema uchun Lagranjning ikkinchi xil tenglamalari

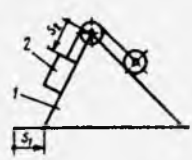
20.6.1. Mexanik sistemaning kinetik energiyasi $T=0{,}25\dot{x}_1^2+0{,}25(\dot{x}_1^2+\dot{x}_1\dot{x}_2+\dot{x}_2^2)$ ko'rinishda berilgan. Agar biror vaqtdan keyin tezlanishi $\ddot{x}_1=5\text{m/s}^2$ va umumlashgan kuchi $Q_{x2}=2{,}5\text{N}$ bo'lsa, x_2 umumlashgan koordinataga tegishli sistema harakati differensial tenglamasidan $\ddot{x}_2$ tezlanishni aniqlang. (2,5)

20.6.2. Tekis parallel harakat qilayotgan jismga bosh vektori $\bar{R}=-6\bar{i}+4\bar{j}$ va bosh momenti $M_C=4\text{N}\cdot\text{m}$ bo'lgan kuchlar sistemasi ta'sir qiladi. Agar jismning kinetik energiyasi $T=4\dot{x}^2+4\dot{y}^2+0{,}5\dot{\varphi}$ bo'lsa, massa markazi C nuqtaning tezlanishi $\ddot{y}$ ni toping. (0,5)



20.6.3. Mexanik sistemaning kinetik energiyasi $\dot{s}_1$ va $\dot{s}_2$ umumlashgan tezliklar orqali berilgan: $T=0{,}5\dot{s}_1^2+\dot{s}_2^2+\dot{s}_1\dot{s}_2$. Umumlashgan kuchlar mos ravishda $Q_{s1}=-3\text{N}$ va $Q_{s2}=2\text{N}$ bo'lsa, $\ddot{s}_2$ tezlanishni hisoblang. (5)

20.6.4. Mexanik sistemaning kinetik energiyasi s_1 va s_2 umumlashgan tezliklar orqali berilgan: $T=200\dot{s}_1^2+167\dot{s}_2^2-45{,}2\dot{s}_1\dot{s}_2$. Agar s_2 umumlashgan koordinataga mos umumlashgan kuch $Q_2=265\text{N}$ ma'lum bo'lsa, $\ddot{s}_1=0{,}1\text{m/s}^2$ holat uchun $\ddot{s}_2$ tezlanishni toping. (0,807)



20.6.5. Mexanik sistemaning kinetik energiyasi umumlashgan tezliklar $\dot{x}$ va $\dot{y}$ orqali berilgan: $T=0{,}5\dot{x}^2+2\dot{y}^2$. Agar umumlashgan kuchlar $Q_x=3\text{N}$ va $Q_y=4\text{N}$ bo'lsa, tezlanishlar nisbatini $\ddot{x}/\ddot{y}$ ni aniqlang. (3)

20.6.6. Mexanik sistemaning kinetik energiyasi $T=10\dot{x}_1^2+4\dot{x}_2^2$ va potensial energiyasi $\Pi=5x_1^2+8x_2^2$ berilgan bo'lsa, sistemaning harakat differensial tenglamalari bir-biriga bog'liq bo'ladimi? (Ha)

20.6.7. Mexanik sistemaning kinetik energiyasi $T=2\dot{x}^2+10\dot{x}\cdot\dot{\varphi}+2\dot{\varphi}^2$ va potensial energiyasi $\Pi=12(x+5\varphi)^2$ berilgan bo'lsa, sistemaning harakat differensial tenglamalari bir-biriga bog'liq bo'ladimi? (Yo'q)

20.6.8. Mexanik sistemaning kinetik energiyasi φ va s umumlashgan koordinatalar orqali berilgan: $T=0{,}02\dot{\varphi}^2+5\dot{s}^2$, potensial energiyasi esa $\Pi=-50s$ bo'lsa, $\ddot{s}$ tezlanishni aniqlang. (5)

20.6.9. Massasi m bo'lgan moddiy nuqtaning kinetik energiyasi $T=0{,}5m(\dot{x}^2+\dot{y}^2+\dot{z}^2)$ va potensial energiyasi $\Pi=-9{,}8mz$ umumlashgan koordinata z va umumlashgan tezliklar $\dot{x},\dot{y},\dot{z}$ bo'lsa, $\ddot{z}$ tezlanishni toping. (9,8)

20.6.10. Mexanik sistemaning kinetik energiyasi $T=6\dot{x}^2+8\dot{y}^2+10\dot{z}^2$ va potensial energiyasi $\Pi=-(6x+8y+10z)$ umumlashgan koordinatalar x, y, z va umumlashgan tezliklar $\dot{x},\dot{y},\dot{z}$ orqali berilgan bo'lsa, $\ddot{z}$ tezlanishni hisoblang. (0,5)

20.6.11. Konservativ sistemaning kinetik energiyasi $T=\dot{x}_1^2+0{,}75\dot{x}_2^2-\dot{x}_1\dot{x}_2$ va potensial energiyasi $\Pi=-x_1-x_2$ berilgan. Sistema harakati differensial tenglamasidan x_1 umumlashgan koordinataga mos tezlanish $\ddot{x}_1$ ning qiymatini $x_2=0{,}5$ m holat uchun aniqlang. (0,25)

20.6.12. Konservativ sistemaning kinetik energiyasi $T=\dot{x}_1^2+\dot{x}_2^2+2\dot{x}_1\dot{x}_2$ va potensial energiyasi $\Pi=0{,}5x_1^2+x_2$ berilgan. Sistema harakati differensial tenglamasidan x_2 umumlashgan koordinataga mos tezlanish $\ddot{x}_2$ ni $x_1=0{,}25$m holat uchun aniqlang. (-0,25)

20.6.13. Mexanik sistemaning kinetik energiyasi $T=8\dot{x}_1^2+2\dot{x}_2^2$ va potensial energiyasi $\Pi=2(x_1-x_2)^2$, x_1,x_2 umumlashgan koordinatalar orqali berilgan bo'lsa, sistema harakati differensial tenglamalari bir-biriga bog'liq bo'ladimi? (Yo'q)

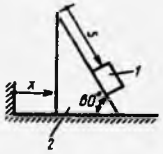
20.6.14. Mexanik sistemaning kinetik energiyasi $T=0{,}7\dot{\varphi}^2+0{,}5(\dot{s}^2+(s\dot{\varphi}^2))$ va potensial energiyasi $\Pi=-10\cos\varphi\cdot(1+s)$, s(m), φ(rad) umumlashgan koordinatalar orqali berilgan bo'lsa, $\ddot{s}$ tezlanishning qiymatini $\varphi=0$ va $\dot{\varphi}=0$ boshlang'ich holat uchun aniqlang. (10)

20.6.15. Mexanik sistemaning kinetik potensiali $L=1{,}5\dot{x}_1^2+9\dot{x}_2^2+6\dot{x}_1\dot{x}_2-6x_1^2$ berilgan bo'lsa, sistemaning harakat differensial tenglamasidan x_1 umumlashgan koordinataga tegishli $x_1=0{,}1$m va $\ddot{x}_1=1\text{m/s}^2$ holat uchun $\ddot{x}_2$ tezlanishni hisoblang. (-0,7)

20.6.16. Mexanik sistemaning kinetik potensiali $L=\dot{\varphi}_1^2+4\dot{\varphi}_2^2+4\dot{\varphi}_1\dot{\varphi}_2-\varphi_1-4\varphi_2$ berilgan bo'lsa, sistemaning harakat differensial tenglamasidan φ_1 umumlashgan koordinataga mos $\ddot{\varphi}_2=-0{,}5\text{m/s}^2$ holat uchun $\ddot{\varphi}_1$ burchak tezlanishni aniqlang. (0,5)

20.6.17. Mexanik sistemaning kinetik potensiali $L=4\dot{x}^2-x^4-6x^2$ x umumlashgan koordinat a orqali berilgan bo'lsa, $x=2$m paytdagi $\ddot{x}$ umumlashgan tezlanishning qiymatini hisoblang. (-7)

20.6.18. Gorizontal tekislikda harakat qiluvchi ikki jismdan iborat sistemaning kinetik energiyasi $T=m(\dot{x}^2+0,5\dot{s}^2+0,5\dot{x}\,\dot{s})$ lar umumlashgan tezlik $\dot{x},\dot{s}$ lar orqali berilgan bo'lsa, $\ddot{x}/\ddot{s}$ tezlanishlar nisbatini aniqlang. (-0,25)



20.6.19. Massalari m_1=5kg va m_2=8kg bo'lgan jismlar $\overline{F}_1$ va $\overline{F}_2$ kuchlar ta'sirida harakat qilsa, umumlashgan koordinatalarni s_1 va s_2, umumlashgan kuchlarini Q_{s1}=3N Q_{s2}=5N deb, 2 jismning tezlanishi $\ddot{s}_2$ ni aniqlang. (0,625)

XXI BOB. MEXANIK SISTEMANING KICHIK TEBRANISHLARI

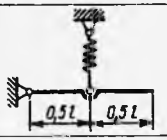
21.1. Erkinlik darajasi bitta bo'lgan sistemaning tebranishlari

21.1.1. Mexanik sistemaning kichik tebranishlarining differensial tenglamasi $\ddot{q}+(4\pi)^2q=0$ berilgan. Boshlang'ich paytda umumlashgan koordinata q_0=0,02m va umumlashgan tezlik $\dot{q}_0$=2m/s bo'lsa, tebranish amplitudasini aniqlang. (0,160)

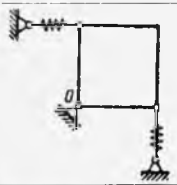
21.1.2. Mexanik sistemaning kichik tebranma harakati $56\ddot{q}+825q=0$ differensial tenglama bilan berilgan bo'lsa, erkin tebranishlar davrini toping. (1,64)

21.1.3. Massasi 40kg bo'lgan 1tishli gardish radiusi r=0,2 m bo'lgan 2 markazga nisbatan aylanib, prujinalarni siqadi. Muvozanat holatida prujinalar erkin holatda deb hisoblansin. Agar gardishning inersiya radiusi 0,24 m va har bir prujinaning bikirligi $5\cdot10^5$ N/m dan bo'lsa, gardish tebranishining chastotasini aniqlang. (29,7)

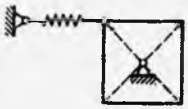
21.1.4. Massasi 3kg, uzunligi l bo'lgan sterjen bikirligi 400 N/m li prujina yordamida gorizontal tekislikda tebranadi. Sterjen tebranishining chastotasini rad/s larda toping. (10)



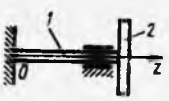
21.1.5. Massasi 10kg bo'lgan bir jinsli deformatsiyalanmaydigan plastina bikirligi bir xil 1kN/m li prujinalar vositasida gorizontal tekislikda O sharnir atrofida tebranma harakat qiladi. Tebranma harakat chastotasini hisoblang. (2,76)



21.1.6. Massasi 10kg bo'lgan bir jinsli deformatsiyalanmaydigan kvadrat plastina bikirligi 1kN/m li prujina yordamida tebranma harakat qilsa, tebranishning chastotasini aniqlang. (1,95)

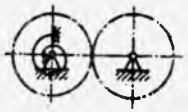


21.1.7. Oz o'qiga nisbatan inersiya momenti J_z=25kg·m^2 bo'lgan disk buralma bikirlik koeffitsiyenti C_φ=40.000 N·m/rad li 1 o'qning uchiga mahkamlangan holda Oz o'qi atrofida buralma tebranma harakat qilsa, tebranishlarning chastotasini aniqlang. (40)

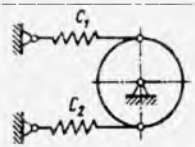


21.1.8. Aylanish o'qiga nisbatan inersiya momentlari 0,04kg·m^2 dan bo'lgan uchta bir xil tishli g'ildiraklar buralma bikirlik koeffitsiyenti c=10N·m/rad li spiralsimon prujina yordamida tebransa, erkin tebranishlarning davrini aniqlang. (0,688)

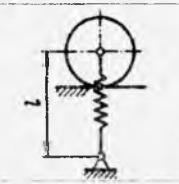
21.1.9. Massalari 5kg dan, inersiya radiuslari 6sm dan bo'lgan ikkita tishli g'ildiraklar buralma bikirlik koeffitsiyenti c=1N·m/rad li spiralsimon prujina yordamida tebranma harakat qilsa, erkin tebranishlar davrini aniqlang. (1,19)



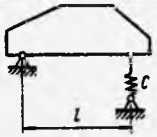
21.1.10. Massasi m=2kg bo'lgan bir jinsli deformatsiyalanmaydigan disk bikirliklari c_1=900 N/m va c_2=700 N/m li prujinalar yordamida buralma tebranma harakat qilsa, kichik tebranishlarning chastotasini toping. (40)



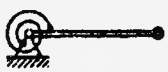
21.1.11. Massasi 2kg bo'lgan bir jinsli silindr gorizontal tekislikda dumalashi mumkin. Silindrga mahkamlangan prujinaning elastiklik kuchi statik muvozanat holatida 150N bo'lsa, uning uzunligini ℓ=0,5m deb olib, kichik tebranishlarning chastotasini hisoblang. (10)



21.1.12. Og'ir jism prujina yordamida qo'zg'almas sharnir atrofida buralma tebranma harakat qiladi. Agar prujinaning bikirligi c=80kN/m, tebranma harakat chastotasi 4 *Gs* bo'lsa, jismning aylanish o'qiga nisbatan inersiya momentini aniqlang. Bunda ℓ=2m. (507)



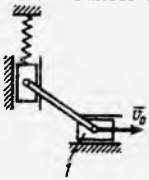
21.1.13. Massasi 1,2kg, uzunligi 0,4m bo'lgan bir jinsli sterjenning uchiga massasi 0,8kg li moddiy nuqta mahkamlangan bo'lib, spiralsimon prujina yordamida tebranma harakat qiladi. Agar tebranishlarning chastotasi 20 *Hz* bo'lsa, spiralsimon prujinaning bikirligini aniqlang. ($3{,}03\cdot10^3$)



21.1.14. Konservativ mexanik sistemaning kinetik energiyasi $T=60\dot{q}^2$ ga teng bo'lib, bunda q umumlashgan koordinata (rad). Agar sistema burilma tebranma harakatining chastotasi ω=10rad/s bo'lsa, spiralsimon prujinaning burilma bikirlik koeffitsiyentini aniqlang. ($1{,}2\cdot10^4$)

21.1.15. Bikir sterjenning erkin tebranishlari chiziqli bo'lmagan $\ddot{q}+300\sin q-230\sin q/\sqrt{5-4\cos q}=0$ differensial tenglamalar orqali berilgan. Bunda q umumlashgan koordinata. Agar tebranishlarni kichik tebranishlar deb olsak, uning chastotasini hisoblang. (1,33)

21.1.16. Konservativ mexanik sisitemaning kichik erkin tebranishlari chastotasi 2 *Hz* ga teng. Agar boshlang'ich paytda 1 polzun statik muvozanat holatida va uning tezligi υ_0=0,2m/s bo'lsa, polzunning tebranish amplitudasini hisoblang. (0,0159)

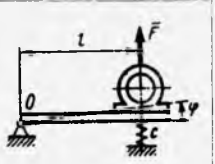


21.1.17. Mexanik sistemaning tebranishlari $9\ddot{q}+4q=2\sin 2t$ differensial tenglamalar orqali ifodalanadi. Bunda, q umumlashgan koordinata. Agar uyg'otuvchi kuchning fazasi majburiy tebranma harakat fazasi bilan ustma-ust tushsa sistema tebranishlari majburiy tebranish bo'la oladimi? (Yo'q)

21.1.18. Konservativ mexanik sistema rezonansli tebranma harakatda bo'lib, uning umumlashgan koordinatasi q ning o'zgarish qonuni shaklida ko'rsatilgan. Agar uyg'otuvchi kuchning amplitudasi ikki barobar orttirilsa, yo'naltiruvchi N chiziqning ordinatalari necha marotaba ortadi? (2)

21.1.19. Mexanik sistemaning tebranishlari $2\ddot{q}+3q=2\sin 5t$ tenglama bilan ifodalanadi. Bunda, q umumlashgan koordinata, metrlarda o'lchanadi. Majburiy tebranma harakat umumlashgan koordinata amplitudasini millimetr o'lchovida toping. (42,6)

21.1.20. Jism kichik tebranishlarining differensial tenglamasi $J\ddot{\varphi}+cl^2\varphi=lF$ ko'rinishda ifodalanadi. Agar jismning aylanish o'qiga nisbatan inersiya momenti J=6kg·m^2, o'lchovi l=0,5m, prujinaning bikirligi c=3kN/m, uyg'otuvchi kuch F=10sin6πt bo'lsa, majburiy tebranma harakat amplitudasini radian o'lchovida aniqlang. ($3{,}62\cdot10^{-3}$)



21.1.21. Agar mexanik sistemaning tebranma harakati differensial tenglamasi $8\ddot{q}+16\dot{q}+800q=0$ orqali ifodalansa, tebranishdagi so'nish dekrementini aniqlang. Bunda, q umumlashgan koordinata. (1,88)

21.1.22. Agar mexanik sistemaning tebranma harakati differensial tenglamasi $15\ddot{q}+30\dot{q}+900q=0$ ko'rinishda bo'lsa, tebranishning logarifmik dekrementini aniqlang. Bunda, q umumlashgan koordinata. (0,818)

21.1.23. Chiziqli bo'lmagan mexanik sistemaning tebranma harakati $\ddot{q}+3\sin\dot{q}+4q=0$ differensial tenglama orqali berilsin. Bunda, q umumlashgan koordinata. Sistema kichik tebranishlarining logarifmik dekrementini aniqlang. (7,12)

21.1.24. Mexanik sistemaning tebranma harakati $20\ddot{q}+120\dot{q}+720q=0$ differensial tenglama bilan ifodalanadi. Bunda, q umumlashgan koordinata. Sistemaning tebranishlari davriy bo'lmagan (aperiodik) bo'la oladimi? (Yo'q)

21.1.25. Mexanik sistemaning tebranma harakati $3\ddot{q}+6\dot{q}+2q=0$ differensial tenglama bilan berilgan bo'lib, bunda q umumlashgan koordinata hisoblanadi. Bunday harakat davriy bo'lmagan harakat (aperiodik) bo'la oladimi? (Ha)

21.1.26. Mexanik sistemaning so'nuvchi tebranma harakati $2\ddot{q}+\dot{q}+8q=0$ differensial tenglama bilan berilgan. Bunda, q umumlashgan koordinata. Ikki tebranish davri oralig'ida tebranish amplitudasi necha marta kamayadi? (4,87)

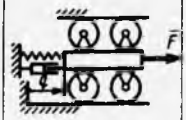
21.1.27. Mexanik sistemaning so'nuvchi tebranma harakati $12\ddot{q}+48\dot{q}+432q=0$ differensial tenglamasi orqali ifodalanadi. Bunda, q umumlashgan koordinata. Erkin so'nuvchi tebranish davrini aniqlang. (1,11)

21.1.28. Mexanik sistemaning erkin so'nuvchi tebranishlari $2\ddot{q}+3\dot{q}+5q=0$ differensial tenglama bilan ifodalanadi. Bunda, q umumlashgan koordinata, m. Boshlang'ich paytdagi umumlashgan koordinata miqdori $q_0=0$ va uning hosilasi $\dot{q}_0 = 1m/s$ bo'lsa, $t=1$s da q ning miqdori qancha bo'ladi. (0,334)

21.1.29. Mexanik sistemaning tebranma harakati $5\ddot{q}+10\dot{q}+125q=12\sin 5t$ differensial tenglama bilan ifodalanadi. Bunda, q – umumlashgan koordinata. Turg'un majburiy tebranma harakat faza burchagini (siljishi) aniqlang. (1,57)

21.1.30. Mexanik sistemaning harakati differensial tenglamasi $\ddot{q}+4\dot{q}+9q=10\sin 3t$ ko'rinishda berilgan. Agar qarshilik koeffitsiyenti ikki marotaba oshirilsa, turg'un majburiy tebranma harakat amplitudasi necha marotaba kamayadi? (2)

21.1.31. Mexanik sistema tebranma harakatining differensial tenglamasi $64\ddot{q}+170\dot{q}+3000q=F$ ko'rinishda ifodalanadi. Bunda, q – umumlashgan koordinata; $F=150\sin 8t$(N) uyg'otuvchi kuch. Turg'un majburiy tebranish amplitudasini aniqlang. ($8{,}59\cdot10^{-2}$)

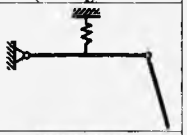


21.1.32. Agar garmonik bo'lgan umumlashgan uyg'otuvchi kuch amplitudasi uch marta kamaytirilsa, konservativ bo'lmagan, erkinlik darajasi birga teng mexanik sistemaning turg'un majburiy tebranishlar amplitudasi necha marotaba kamayadi? (3)

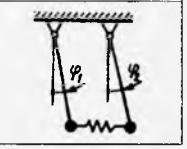
21.2.Erkinlik darajasi ikkiga teng bo'lgan sistemaning tebranishlari

21.2.1. Mexanik sistemaning kinetik energiyasi $T=14\dot{q}_1^2+2\dot{q}_2^2$ ga teng. Umumlashgan koordinatalar q_1 va q_2 ga mos keluvchi umumlashgan kuchlar $Q_1=3q_1$ va $Q_2=5q_2$ bo'lsa, sistema tebranma harakatda bo'la oladimi? (Yo'q)

21.2.2. Bir-biriga bog'langan ikki bikir sterjenlar vertikal tekislikda kichik tebranishlar sodir etadi. Sistemaning tebranishida nechta xususiy chastotalari mavjud bo'ladi? (2)



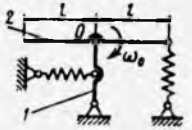
21.2.3. Prujina yordamida bog'langan ikki matematik mayatnik vertikal tekislikda kichik tebranishlar sodir etadi. Mayatniklarning vertikaldan og'ish burchaklari φ_1 va φ_2 asosiy (bosh) koordinatalar bo'la oladimi? (Yo'q)



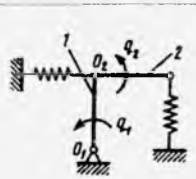
21.2.4. Sharnir vositasida bog'langan ikki bikir sterjenlar vertikal tekislikda kichik tebranishlar sodir etadi. Umumlashgan koordinatalar sifatida q_1 va q_2 sterjenlarning vertikaldan og'ish burchaklarini olsak, bu koordinatalar asosiy (bosh) koordinatalar bo'la oladimi? (Yo'q)

21.2.5. Konservativ mexanik sistema tebranma harakatining kinetik potensiali $L=c_1\dot{q}_1^2+c_2q_2^2-c_3q_1^2-c_4q_2^2$ ko'rinishga ega. Bunda, q_1, q_2 – umumlashgan koordinatalar, c_1, c_2, c_3, c_4 lar esa o'zgarmas qiymatlar. Umumlashgan koordinatalar q_1, q_2 lar mexanik sistema uchun bir vaqtda bosh koordinatalar ham bo'la oladimi? (Ha)

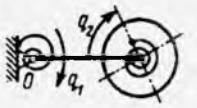
21.2.6. Mexanik sistema gorizontal tekislikda joylashgan bo'lib, statik muvozanatda turibdi. Agar 2 sterjenga 0 sharnir atrofida boshlang'ich ω_0 burchak tezlik berilsa, 1 sterjen kichik burchak tebranma harakat qiladimi? (Yo'q)



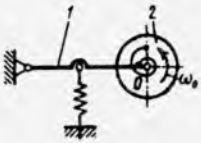
21.2.7. Ikkita 1 va 2 sterjenlardan tuzilgan mexanik sistema gorizontal tekislikda joylashgan bo'lib, bunda q_1 – 1 sterjen O_1 sharnirning atrofida burilish burchagi; q_2 – 2 sterjenning O_2 sharnir atrofida burilish burchagi. Ularni umumlashgan koordinatalar deb hisoblasak, q_1 va q_2 sistema kichik tebranishlari uchun bosh koordinatalar bo'la oladimi? (Ha)



21.2.8. Bir jinsli bo'lgan sterjen va diskdan tuzilgan mexanik sistema gorizontal tekislikda harakat qilishi mumkin. Umumlashgan koordinatalar deb olingan q_1 va q_2 lar bir vaqtning o'zida sistema tebranishlari uchun bosh koordinatalar bo'la oladimi? (Yo'q)



21.2.9. Bir jinsli sterjen 1 va disk 2 dan tuzilgan mexanik sistema gorizontal tekislikda statik muvozanat holatda turibdi. Agar 2 diskga O sharnir atrofida boshlang'ich burchak tezlik ω_0 berilsa, 1 sterjen kichik burchak tebranishlar hosil qiladimi? (Ha)



21.2.10. Bir jinsli bukilmaydigan, uzunligi $2l(l=1\text{m})$ bo'lgan sterjen bir xil ikkita prujina yordamida chastotalari teng kichik tebranishlarda ishtirok etishi uchun prujinalar qanday l_1 masofalarda joylashishi lozim? (0,577)

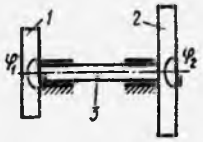
21.2.11. Mexanik sistemaning kinetik energiyasi $T=\dot{q}_1^2+2\dot{q}_2^2$ ga, potensial energiyasi $\Pi=16q_1^2+80q_2^2$ ga teng bo'lsa, sistema tebranma harakatining chastotasini eng kichik qiymatini toping. (4)

21.2.12. Mexanik sistema 3 o'qqa mahkamlangan 1 va 2 disklardan iborat bo'lib, ularning buralma tebranma harakatlari

$3\ddot{\varphi}_1+110(\varphi_1-\varphi_2)=0$

$7\ddot{\varphi}_2+110(\varphi_2-\varphi_1)=0$

differensial tenglamalar orqali ifodalanadi. Sistema tebranma harakati chastotasining eng kichik quyi qiymatini aniqlang. (0)



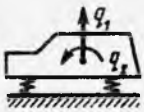
21.2.13. Gorizontal to'g'ri chiziq bo'ylab harakat qiluvchi ikki jismdan iborat mexanik sistemaning kinetik energiyasi $T=3\dot{q}_1^2+8\dot{q}_2^2$, potensial energiyasi $\Pi=12(q_1-q_2)^2$ bo'lsa, sistema tebranma harakati chastotasining eng quyi qiymatini hisoblang. (0)

21.2.14. Avtomobil kichik tebranishlarining differensial tenglamalari:

$1000\ddot{q}_1+2\cdot10^5q_1-10^4q_2=0$

$3{,}24\cdot10^3\ddot{q}_2+4{,}5\cdot10^5q_2-10^4q_1=0$

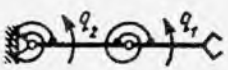
ko'rinishda bo'lsa, tebranishlar chastotasining yuqori qiymatini aniqlang. Bunda q_1 va q_2 umumlashgan koordinatalar. (2,25)



21.2.15. Manipulator kichik tebranishlari:

$0{,}114\ddot{q}_1+0{,}135\ddot{q}_2+3000q_1-3000q_2=0$

$0.237\ddot{q}_2+0{,}135\ddot{q}_1+8000q_2-3000q_1=0$ differensial tenglamalar orqali ifodalansa, tebranishlar chastotasining quyi qiymatini aniqlang. Bunda q_1 va q_2 umumlashgan koordinatalar. (12,6)



21.2.16. Agar konservativ bo'lmagan mexanik sistemaning kichik tebranishlarida unga normal uyg'otuvchi kuch $F=F_0\sin2\pi nt$, n chastota (xususiy chastotalar n_1 va n_2 dan farq qiladi) bilan ta'sir qilayotgan bo'lsa. sistemaning tebranishlari bir chastotali bo'la oladimi? (Ha)

21.2.17. Konservativ mexanik sistema kichik tebranishlarining xususiy chastotalari n_1=6Hz va n_2=12Hz ga teng. Uyg'otuvchi garmonik F kuchning chastotasi n_3=15Hz ga teng. Agar uyg'otuvchi kuch F ning amplitudasini o'zgartirmay, uning chastotasini 3Hz

ga oshirilsa, sistemaning turg'un majburiy tebranma harakatini amplitudasi ortadimi? (Yo'q)	

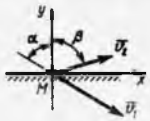
XXII BOB. ZARBA NAZARIYASI

22.1. Zarbali kuchning moddiy nuqtaga ta'siri

22.1.1. Massasi m=0,2kg bo'lgan moddiy nuqta $\vec{\upsilon}_1=10\vec{i}-2\vec{j}$ tezlik bilan harakatlanayotgan paytda unga zarbali kuch ta'sir etib, nuqtaning tezligi $\vec{\upsilon}_2=-6\cdot\vec{i}+8\vec{j}$ ga o'zgardi. Zarbali impulsning miqdorini aniqlang. (3,77)

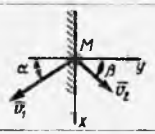
22.1.2. Massasi m=0,1kg bo'lgan M moddiy nuqta qo'zg'almas asosga urilib, yuqoriga sapchiydi. Agar urilishgacha uning tezligi υ_1=7m/s bo'lib, urinma Mx bilan γ_1=64° tashkil qilsa, zarbadan keyin υ_2=3,4m/s tezlik bilan γ_2=69° burchakni tashkil qiladi. Zarbali impulsning Mx o'qiga proyeksiyasini aniqlang. (-0,185)

22.1.3. Massasi m=1kg bo'lgan M moddiy nuqta υ_1=10m/s tezlik bilan harakatlanib, tekislikka uriladi. Zarbadan keyingi tezlik υ_2=8m/s bo'lib, urilish va sapchish burchaklari α=60°va β=75° bo'lsa, zarbali impulsning My o'qqa proyeksiyasini aniqlang. (7,07)



22.1.4. Massasi m=0,4kg bo'lgan M moddiy nuqta $\vec{\upsilon}_1=-3\vec{i}-4\vec{j}$ tezlik bilan harakatlanadi. Unga $\vec{S}=1,8\vec{i}+2,4\vec{j}$ zarbali impuls ta'sir etgandan keyingi υ_2 tezligini aniqlang. (2,5)

22.1.5. Moddiy nuqta M vertikal silliq devorga urilib, sakraydi. Agar urilish burchagi α=30°, sapchish burchagi β=36° bo'lib, υ_2=5,1m/s tezlikka ega bo'lsa, urilishgacha nuqtaning tezligi υ_1 nechaga teng bo'lgan? (6,00)

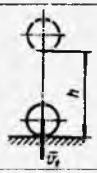


22.1.6. Moddiy nuqtaga $\vec{S}=10\vec{k}$ zarbali impuls ta'sir etadi. Zarbagacha nuqtaning tezligi $\upsilon_1=-10\vec{k}$, zarbadan keyingi tezligi $\vec{\upsilon}_2=5\vec{k}$ bo'lsa, moddiy nuqtaning massasini aniqlang. (0,667)

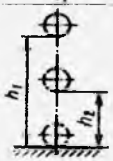
22.1.7. Moddiy nuqta to‘g‘ri chiziqli zarba ta’sirida qo‘zg‘almas to‘siqqa υ_1=6m/s tezlik bilan urilib, sapchiydi. Agar tiklash koeffitsiyenti k=0,5 bo‘lsa, zarbadan keyingi tezligini aniqlang. (3)

22.1.8. Moddiy nuqta to‘g‘ri chiziqli zarba ta’sirida qo‘zg‘almas to‘siqqa υ_1=8m/s tezlik bilan urilib, υ_2=6m/s tezlik bilan sapchiydi. To‘siqning tiklash koeffitsiyentini aniqlang. (0,75)

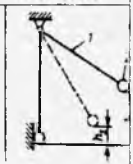
22.1.9. Gorizontal asosning tiklash koeffitsiyenti k=0,8 bo‘lsa, vertikal pastga otilgan koptok h=3m yuqoriga ko‘tarilishi uchun qanday υ_1 tezlik bilan asosga urilishi zarur. (9,59)



22.1.10. Sharcha h_1=1,5m balandlikdan boshlang‘ich tezliksiz tushib, gorizontal asosga uriladi. Agar sharcha zarbdan keyin h_2=0,8m balandlikka sapchisa, tiklash koeffitsiyentini hisoblang. (0,730)



22.1.11. Ingichka ip 1 yordamida osilgan 2 sharcha h_1=0,6m balandlikdan boshlang‘ich tezliksiz tushadi. Agar sharcha vertikal devorga urilib, k=0,55 tiklash koeffitsiyenti bilan sapchisa, sharcha zarbadan keyin qancha h_2 balandlikka ko‘tariladi? (0,182)



22.1.12. Moddiy nuqta 12m/s tezlik bilan qo‘zg‘almas to‘siqqa uriladi. Agar zarbali kuch miqdori nuqta og‘irligidan besh marotaba katta bo‘lsa, zarba vaqtini hisoblang. Zarbani markaziy va absolut elastik bo‘lmagan deb oling. (0,245)

22.1.13. Massasi m=0,5kg bo‘lgan bolg‘a absolut elastik bo‘lmagan zarba bilan sandonga uriladi. Agar zarbada bolg‘aning tezligi υ=10m/s va zarba vaqti 0,0002s bo‘lsa, bolg‘aning sandonga urilishidagi zarbali kuchini KN da aniqlang. (25)

22.1.14. Massasi m=1kg bo‘lgan moddiy nuqta υ_1=2m/s tezlik bilan qo‘zg‘almas to‘siqqa uriladi. Agar tiklash koeffitsiyenti k=0,6 bo‘lsa, zarba paytidagi kinetik energiyaning qanchaga kamayishini hisoblang. (1,28)

22.2. Ikki jismning markaziy to‘g‘ri zarbasi

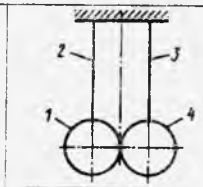
22.2.1. Massasi m_1=4kg bo‘lgan jism υ=10m/s tezlik bilan kelib, massasi m_2=100kg qo‘zg‘almas jismga urilsa, zarbaning birinchi fazasida zarbali impulsning miqdorini toping. (28,6)

22.2.2. Massasi m_1=0,01kg bo‘lgan sharcha vertikal pastga tushib, massasi m_2=10kg bo‘lgan qo‘zg‘almas gorizontal to‘siqqa υ=6m/s tezlik bilan uriladi. Agar tiklash koeffitsiyenti k=0,6 bo‘lsa, zarbaning ikkinchi fazasida zarba impulsining miqdori qancha bo‘ladi? ($3{,}60\cdot10^{-2}$)

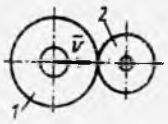
22.2.3. Massalari teng $m_1=m_2$=1000kg bo‘lgan ikki jism miqdorlari bir xil $|\upsilon_1|=|\upsilon_2|$=0,5m/s, yo‘nalishlari qarama-qarshi tezliklar bilan bir-biriga uriladi. Agar tiklash koeffitsiyenti k=0 bo‘lsa, zarbali impulsning qiymatini aniqlang. (500)

22.2.4. Massasi m_1=100kg bo‘lgan qo‘zg‘almas jismga massasi m_2=1kg li ikkinchi jism υ_2=1m/s tezlik bilan kelib uriladi. Agar tiklash koeffitsiyenti k=0,5 bo‘lsa, zarbali impulsning qiymatini aniqlang. (1,49)

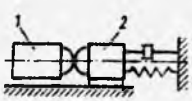
22.2.5. Massalari teng bo‘lgan 1 va 4 ikki sharlar, 2 va 3 ip yordamida osib qo‘yilgan. Agar 1 shar υ=0,5m/s tezlik bilan qo‘zg‘almas holatda turgan 4 sharga urilsa, tiklash koeffitsiyentini k=0,8 deb, zarbadan keyingi 4 sharning tezligini toping. (0,45)



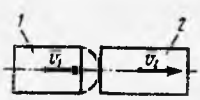
22.2.6. Massasi m_1 bo‘lgan shayba (yupqa g‘ildirak) υ=1m/s tezlik bilan massasi m_2 qo‘zg‘almas shaybaga uriladi. Agar zarbni to‘g‘ri va markaziy deb, tiklash koeffitsiyentini k=0,5, massalar miqdori $m_1=3m_2$ bo‘lsa, 2 shaybaning zarbadan keyingi tezligini aniqlang. (1,13)



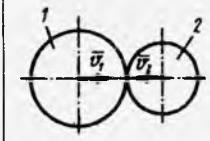
22.2.7. Massasi m_1=5kg bo‘lgan 1 jism massasi m_2 1 amortizator (zarbni qaytargich) ga kelib uriladi. Tiklash koeffitsiyenti k=0,7 bo‘lib, zarbdan keyin 1 jismning tezligi nolga teng bo‘lishi uchun 2 jism qancha massaga ega bo‘lishi lozim? (7,14)



22.2.8. υ_1=10m/s tezlik bilan harakatlanayotgan 1 jism shu yo‘nalishda υ_2=5m/s tezlik bilan ketayotgan 2 jismga uriladi. Agar jismlar massalari teng $m_1=m_2$ bo‘lsa, jismlarning absolut elastik bo‘lmagan zarbadan keyingi birgalikda qilgan harakat tezligini toping. (7,5)



22.2.9. Massalari m_1=2kg va m_2=1kg bo'lgan ikki jism bir xil tezliklar $|\upsilon_1|=|\upsilon_2|$=6m/s bilan qarama-qarshi yo'nalishda to'qnashadi. Agar tiklash koeffitsiyenti k=0,5 bo'lsa, zarbadan keyin 2 jismning tezligi qancha bo'ladi? (6)



22.2.10. Massalari m_1=3kg va m_2=1kg, tezliklari υ_{10}=5m/s va v_{20}=0 bo'lgan jismlar to'g'ri markaziy zarbadan keyin bir xil $\upsilon_1=\upsilon_2$=3,75m/s tezlikka erishsa, kinetik energiyaning sarfini hisoblang. (9,38)

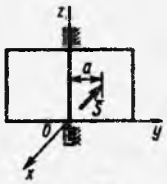
22.2.11. Massalari teng $m_1=m_2$=1000kg, tezligining miqdorlari bir xil $|\vec{\upsilon}_{10}|=|\vec{\upsilon}_{20}|=5m/s$ bo'lgan ikki jism qarama-qarshi yo'nalishda to'qnashadi. Agar zarbadan keyin $|\vec{\upsilon}_1|=|\vec{\upsilon}_2|=1m/s$ bo'lsa, kinetik energiyaning sarfini toping. ($2{,}4\cdot10^4$)

22.2.12. Massasi m_1=1kg bo'lgan jism υ_{10}=2m/s tezlik bilan kelib, massasi m_2=3kg li qo'zg'almas jismga uriladi. Zarbani absolut noelastik deb hisoblab, kinetik energiyaning sarfini toping. (1,5)

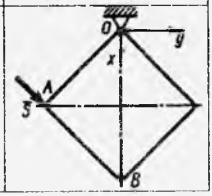
22.3. Qo'zg'almas o'qqa nisbatan aylanma harakat qilayotgan jismga zarbali kuchning ta'siri

22.3.1. Qo'zg'almas Oz o'qi atrofida ω_0=150rad/s burchak tezlik bilan aylanayotgan jismga momenti $M_z(S)$=0,1N·m·s zarbali impuls ta'sir etib, zarbadan so'ng ω=146rad/s burchak tezlik olgan bo'lsa, jismning inersiya momentini hisoblang. (0,025)

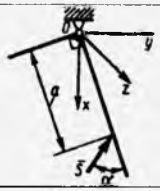
22.3.2. Inersiya momenti J_{oz}=0,002kg·m^2 bo'lgan yupqa plastina o'zining simmetrik Oz o'qi atrofida aylanishi mumkin. Agar uning aylanish o'qidan a=0,1m masofada turgan nuqtasiga qiymati 0,5 N·s zarbali impuls ta'sir qilsa, plastinaning zarbadan keyingi aylanish burchak tezligini aniqlang. (25)



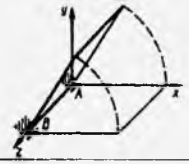
22.3.3. Inersiya momenti J_{oz}=0,1kg·m^2 bo'lgan kvadrat shaklidagi plastina O sharnir yordamida osib qo'yilgan. Agar tinch holatda turgan plastinaning AB tomoni bo'ylab S=2N·s zarbali impuls berilsa, plastina tomonini 0,3 m deb, uning burchak tezligini aniqlang. (6)



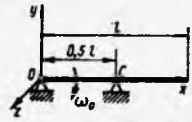
22.3.4. To‘g‘ri burchakli dastak O nuqtada sharnir yordamida bog‘langan bo‘lib, Oxy tekislikda harakatlanishi mumkin. Agar dastakning a=0,8m uzoqdagi nuqtasiga α=50° burchak ostida S=10N·s zarbali impuls ta’sir etsa, uning zarbadan keyingi burchak tezligini aniqlang. Inersiya momenti J_{Oz}=1,6kg·m^2 deb olinsin. (3,83)



22.3.5. Inersiya momenti J_{Az}=10kg·m^2 bo‘lgan qopqoq ω_0=3rad/s burchak tezlik bilan yopiladi. Zarbani absolut elastik emas deb, aylanish o‘qiga nisbatan zarbali impulsning momentini aniqlang. (30)

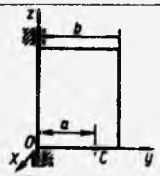


22.3.6. Massasi m=2kg bo‘lgan bir jinsli sterjen Oz o‘qi atrofida ω_0=1,2rad/s burchak tezlik bilan aylanadi. Sterjen C to‘siqqa kelib uriladi va orqaga qaytadi. Agar sterjenning uzunligi l=0,5m bo‘lsa, zarbaning birinchi fazasida zarbali impulsning miqdorini aniqlang. (0,8)

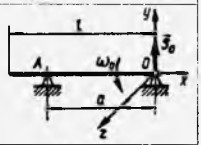


22.3.7. Uzunligi AB=0,6m, inersiya momenti J_{Az}=0,24kg·m^2 bo‘lgan sterjen Az o‘qi atrofida aylanib, a=0,4m uzoqlikda joylashgan to‘siqqa uriladi. Agar burchak tezligi zarbagacha ω_0=4rad/s, zarbadan keyin esa ω=3rad/s bo‘lsa, sterjenning to‘siqqa urilishdagi tiklash koeffitsiyentini aniqlang. (0,75)

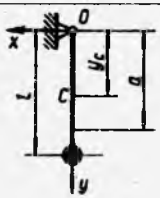
22.3.8. Massasi m=50kg bo‘lgan bir jinsli eshik ω_0=1rad/s burchak tezlik bilan aylanib, C nuqtada joylashgan to‘siqqa uriladi. Agar zarbadan keyin eshikning burchak tezligi ω=0,3rad/s bo‘lsa, masofalarni a=0,6m va b=0,8m deb, zarbali impulsning modulini aniqlang. (23,1)



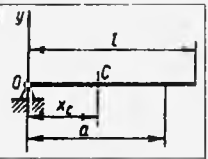
22.3.9. Uzunligi l=0,9m bo‘lgan bir jinsli sterjen Oz o‘qi atrofida ω_0=2rad/s burchak tezlik bilan aylanib, A nuqtadagi to‘siqqa uriladi. O nuqtadagi zarbali impuls S_0 nolga teng bo‘lishi uchun a masofa qancha bo‘lishi lozim. (0,667)



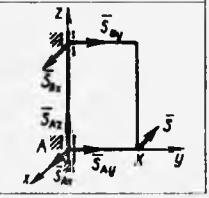
22.3.10. Massasi 0,2 kg bo‘lgan moddiy nuqta uzunligi l=0,6m; massasi 0,8kg li sterjenga osilgan bo‘lib, Oz o‘qi atrofida aylanadi. Agar sistemaning inersiya momenti J_0=0,168kg·m^2 va massa markazi C aylanish o‘qidan y_c=0,36m masofada bo‘lsa, zarba markazidan to aylanish o‘qigacha bo‘lgan a masofani toping. (0,467)



22.3.11. Uzunligi l=0,8m; massasi m=2,4kg, massa markazi x_c=0,37m bo'lgan bir jinsli bo'lmagan sterjenning zarba markazi a=0,5m masofada bo'lsa, sterjenning aylanish o'qiga nisbatan inersiya momentini aniqlang. (0,444)



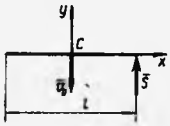
22.3.12. Az o'qi atrofida $\vec{\omega}=-5\vec{k}$ burchak tezlik bilan aylanayotgan to'g'ri to'rtburchak eshikning $K(0;1;0)$ nuqtasiga $\vec{S}=-20\vec{i}+2\vec{j}$ zarbali impuls ta'sir qilsa, A tovondagi (podpyatnikdagi) hosil bo'layotgan zarbali impulsning S_{Az} tashkil etuvchisini aniqlang. (0)



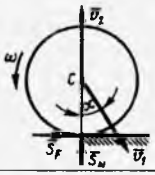
22.4. Tekis parallel harakat qilayotgan qattiq jismga zarbali kuchning ta'siri

22.4.1. Massasi 20 kg bo'lgan jismning zarbagacha tezligi $\vec{v}=3\vec{i}$ va burchak tezligi $\vec{\omega}=4\vec{k}$ bo'lib, unga $\vec{S}=-20\vec{i}$ zarbali impuls ta'sir qilsa, zarbadan keyingi tezligini toping. (2)

22.4.2. Uzunligi l=1,2m,massasi m=5kg bo'lgan bir jinsli sterjen aylanishsiz υ_0=2m/s tezlik bilan vertikal pastga tushadi. Agar sterjenning bir uchiga S=12N·s zarbali impuls ta'sir etsa, zarbadan keyin massa markazi C ning tezligini toping. (0,4)

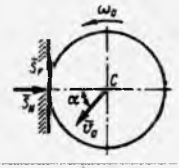


22.4.3. Qattiq burab tepilgan to'pning massa markazi zarbadan keyin υ_1=4m/s tezlikka ega bo'lib, vertikalga $\alpha=30^\circ$ burchak ostida yerga tushadi va yuqoriga υ_2=2,5m/s tezlik bilan sakraydi. Agar to'pning massasi m=0,05kg bo'lsa, zarbali impulsning normal tashkil etuvchisini S_N toping. (0,298)



22.4.4. Gimnastik halqa burab otilgan bo'lib, yerga tushishdan avval uning massa markazi υ_1=3m/s tezlikka ega bo'ldi. Zarbadan keyin halqa υ_2=1,8m/s tezlik bilan yuqoriga sakraydi. Agar tushish va sakrash burchaklari $\alpha=45^\circ$, $\beta=32^\circ$ bo'lsa, normal impulps S_N ning tiklash koeffitsiyentini toping. (0,720)

22.4.5. Massasi m=0,6kg bo'lgan disk ω_0=2rad/s burchak tezlik bilan aylanib, massa markazi υ_O=1,8m/s tezlikka ega holda vertikal devorga α=45° burchak ostida uriladi. Agar normal impulsning tiklash koeffitsiyenti k=0,55 bo'lsa, normal impuls S_N ning qiymatini hisoblang. (1,18)

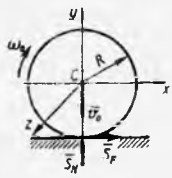


22.4.6. Massasi m=0,2kg bo'lgan shar aylanma harakatsiz υ_0=2m/s tezlik bilan α=45^0 burchak ostida qo'zg'almas gorizontal tekislikka uriladi va β=60^0 burchak ostida υ=1,5m/s tezlik bilan yuqoriga sapchiydi. Urinma impuls $\overline{S}_F$ ning modulini aniqlang. (2,30·10^{-2})

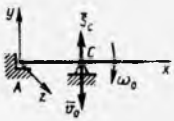
22.4.7. Massasi m=0,4kg bo'lgan shar aylanma harakatsiz υ_0=3m/s tezlik bilan α=75° burchak ostida qo'zg'almas tekislikka uriladi. Normal impuls S_N ning tiklash koeffitsiyenti k=0,5 ga teng. Agar zarba paytidagi ishqalanish hisobga olinib, ishqalanish koeffitsiyentini f=0,1 bo'lsa, to'la ishqalanish holatida urinma impuls S_F=fS_N ning qiymatini aniqlang. (4,66·10^{-2})

22.4.8. Inersiya momenti J_C=0,04kg·m^2 bo'lgan AB sterjen aylanma harakatsiz gorizontal holatda υ_0=2m/s tezlik bilan pastga tushib, massa markazidan a=0,1m masofadagi D to'siqqa uriladi. Agar zarbali impuls S_D=2N·s bo'lsa, zarbadan keyin sterjenning burchak tezligi ω ni aniqlang. (5)

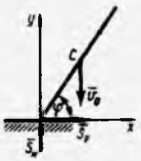
22.4.9. Inersiya momenti J_{Cz}=0,003kg.m^2, R=0,1m radiusli to'p burab tepilgan bo'lib, ω_0=6rad/s burchak tezlik bilan aylanma harakat qiladi va massa markazining υ_0=0,8m/s tezligi bilan yerga vertikal uriladi. Agar zarba paytida zarbali impulsning tashkil etuvchilari S_N=0,85N·s; S_F=0,085N·s ga teng bo'lsa, to'pning zarbadan keyingi burchak tezligi ω ni aniqlang. (3,17)



22.4.10. Bir jinsli sterjen Az o'qi atrofida ω_0=4rad/s burchak tezlik bilan aylanib, C qo'zg'almas to'siqqa o'rtasi bilan uriladi. Zarba paytida aylanish o'qi Az dan sapchish (uzilish) zarbali impulssiz ro'y beradi. Zarbadan so'ng sterjenning burchak tezligini toping. (4)



22.4.11. Massasi m=2kg, uzunligi l=0,6m bo'lgan bir jinsli sterjen aylanmasdan υ_0=2m/s tezlik bilan qo'zg'almas tekislikka uriladi. Zarba paytida zarbali impulsning tashkil etuvchilari S_N=2,5N·s, S_τ=0,5N·s ga, burchagi φ=55°ga teng bo'lsa, zarbadan keyin sterjenning burchak tezligini aniqlang. (5,12)



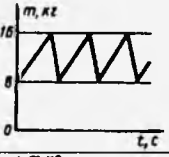
XXIII BOB. MASSASI O'ZGARUVCHAN NUQTA DINAMIKASI

23.1. Meshcherskiy tenglamasi

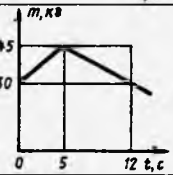
23.1.1. Massasi o'zgaruvchan jism qiymati 160N bo'lgan kuch ta'sirida harakat qiladi. Agar jismning massasi $m=24e^{4t}$ qonun bo'yicha o'zgarsa, birikayotgan zarralarning nisbiy tezligini nol deb olib, jismning t=0s vaqtdagi tezlanishini hisoblang. (6,67)

23.1.2. Moddiy nuqtaning massasi $m=24(1+01,t)$ qonun bo'yicha o'zgaradi. Agar nuqta proyeksiyalari F_x=80N, F_y=150N bo'lgan o'zgarmas kuch F ta'sirida harakat qilsa, t=4 s.da uning tezlanishi qancha bo'ladi? Birikayotgan zarralarning nisbiy tezligini nolga teng deb oling. (5,06)

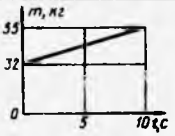
23.1.3. Agar massasining o'zgarishi shakldagi grafik ko'rinishda berilgan nuqta o'zgarmas 260N li kuch ta'sirida harakat qilsa, uning tezlanishini aniqlang. Qo'shiluvchi va ajraluvchi zarralarning nisbiy tezligi nolga teng. (32,5)



23.1.4. Agar jismning massasi shaklda ko'rsatilgan grafik bo'yicha o'zgarsa, t=10s paytdagi reaktiv kuchning miqdorini aniqlang. Ajralayotgan zarralarining nisbiy tezligi 3,5m/s ga teng. (7,50)



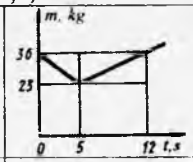
23.1.5. Idish suv nasosi yordamida suyuqlik bilan to'ldirilmoqda. Uning massasi o'zgarishi shakldagidek bo'lsa, reaktiv kuchning modulini aniqlang. Suyuqlik zarralarining qo'shilishdagi nisbiy tezligi 2,8m/s ga teng. (6,44)



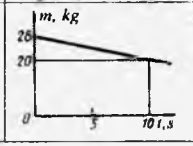
23.1.6. Nuqtaning massasi $m=1+\cos 3t$ qonun bo'yicha o'zgaradi. Agar qo'shilayotgan va ajralayotgan zarralarning nisbiy tezligi 2,1m/s bo'lsa, reaktiv kuchning minimal qiymatini hisoblang. (0)

23.1.7. Reaktiv avtomobil nusxasi (modeli) ning massasi $m=6e^{-0,5t}$ qonun bo'yicha o'zgarsa, boshlang'ich, $t=0$ paytdagi, reaktiv kuchning miqdorini aniqlang. Ajraluvchi zarralarning nisbiy tezligi 4m/s ga teng. (12,0)

23.1.8. Reaktiv kuch ta'sirida harakatlanuvchi nuqtaning massasi shakldagi grafik bo'yicha o'zgarsa, uning $t=10$s dagi tezlanishini aniqlang. Qo'shiluvchi zarralarning nisbiy tezligi 27m/s ga teng. (1,55)



23.1.9. Reaktiv avtomobil nusxasi (modeli) ning massasi shakldagi grafik ko'rinishda o'zgaradi. Agar avtomobil reaktiv kuch ta'sirida harakatlanib, ajralib chiquvchi zarralarning nisbiy tezligi 2,8m/s bo'lsa, $t=10$s paytdagi avtomobilning tezlanishini aniqlang. (0,112)



23.1.10. Agar moddiy nuqtaning massasi $m=54(1-0,4t)$ qonun bo'yicha o'zgarib, ajraluvchi zarralarning nisbiy tezligi 21m/s bo'lsa, $t=1,5$ s paytda nuqtaning tezlanishi qancha bo'ladi? (21,0)

23.1.11. Jism faqat reaktiv kuch ta'sirida harakatlanib, massasi $m=415(1+\alpha t)$ qonun bo'yicha o'zgaradi. Agar $t=0$ da jismning tezlanishi 32m/s^2 bo'lib, qo'shiluvchi zarralarning nisbiy tezligi 380m/s bo'lsa koeffitsiyent α ning qiymatini aniqlang. $(8,42\cdot10^{-2})$

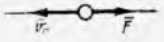
23.1.12. Jismning massasi $m=310(1+0,03t)$ qonun bilan o'zgarib, faqat reaktiv kuch ta'sirida harakat qiladi. Agar $t=0$ da jismning tezlanishi 27m/s^2 ga teng bo'lsa, qo'shiluvchi zarralarning nisbiy tezligini toping. (900)

23.1.13. Raketa faqat reaktiv kuch ta'sirida 75m/s^2 tezlanish bilan harakatlanib, massasi $m=500e^{-\alpha t}$ qonun bo'yicha o'zgaradi. Agar ajraluvchi zarralarning nisbiy tezligi 1200m/s bo'lsa, koeffitsiyent α ning qiymati qancha bo'ladi? $(6,25\cdot10^{-2})$

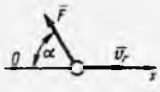
23.1.14. Raketa faqat reaktiv kuch ta'sirida harakatlanib, massasi $m=500e^{-0,06t}$ qonun bilan o'zgaradi. Agar raketaning tezlanishi 60 m/s^2 bo'lsa, ajralib chiquvchi zarralarning nisbiy tezligini aniqlang. (10^3)

23.1.15. Raketa faqat reaktiv kuch ta'sirida harakatlanib, massasi $m=410(1-\alpha t)$ qonun bilan o'zgaradi. Agar $t=0$ da raketa tezlanishi 39 m/s^2 bo'lib, ajraluvchi zarralarning nisbiy tezligi 750m/s bo'lsa, koeffitsiyent α ning qiymatini toping. $(5,2\cdot10^{-2})$

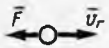
23.1.16. Massasi o'zgaruvchan jism o'zgarmas kuch $F=86$N va reaktiv kuch ta'sirida harakat qiladi. Boshlang'ich paytda, $t=0$ da, ajraluvchi zarralarning nisbiy tezligi $v_r=12$m/s bo'lsa, jismning tezlanishini aniqlang. Jismning massasi $m=240e^{-0,2t}$ qonun bo'yicha o'zgaradi. (2,76)



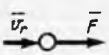
23.1.17. Massasi $m=46(1+3t)$ qonun bo'yicha o'zgaruvchi jism o'zgarmas kuch $F=2$kN va reaktiv kuch ta'sirida harakat qiladi. Agar $t=3$s paytda qo'shiluvchi zarralarning nisbiy tezligi $\upsilon_r=31$m/s va o'zgarmas kuchning ta'siri yo'nalishi $\alpha=60°$ bo'lsa, jismning tezlanishining Ox o'qiga nisbatan proyeksiyasini aniqlang. (7,13)



23.1.18. Massasi $m=82(1+4t)$ qonun bo'yicha o'zgaruvchi jism o'zgarmas $F=500$N kuch va reaktiv kuch ta'sirida to'g'ri chiziqli tekis harakat qiladi. Qo'shiluvchi zarralarning nisbiy tezligini toping. (1,52)



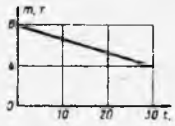
23.1.19. Massasi $m=15+160t$ qonun bo'yicha o'zgaruvchi jism o'zgarmas $F=250$N kuch va reaktiv kuch ta'sirida harakat qiladi. Agar biror vaqt o'tgandan keyin jismning tezlanishi 10m/s^2 va qo'shiluvchi zarralarning nisbiy tezligi $\upsilon_r=5$m/s bo'lsa, o'tgan vaqtni aniqlang. (0,563)



23.2. Siolkovskiy formulasi

23.2.1. Raketaning boshlang'ich paytdagi massasi 5tonna va tezligi $\upsilon_0=0$ bo'lib. uchgandan bir qancha vaqt keyin uning massasi 2 tonnaga, ajraluvchi zarralarning nisbiy tezligi $\upsilon_r=1,5$km/s bo'lsa, yerning tortishish kuchlari va muhit qarshiligi kuchlarini hisobga olmay raketaning tezligini km/s da toping. (1,37)

23.2.2. Raketaning massasi shaklda ko'rsatilgan grafik bo'yicha o'zgaradi. Tortishish kuchlarini va muhit qarshilik kuchlarini hisobga olmay, ajraluvchi zarralarning nisbiy tezligini aniqlang. Bu tezlik harakat davomida o'zgarmas deb qarang $t=30$s dagi tezligi 700m/s, boshlang'ich tezligini esa $\upsilon_0=0$ deb oling. (1,01)

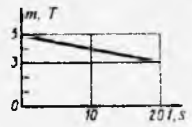


23.2.3. Massasi $m=7-0,02t$ qonun bo'yicha o'zgaruvchi jism faqat reaktiv kuch ta'sirida harakat qilib, $t=120$s paytda 720 m/s tezlikka erishadi. Jism massasi tonnalarda hisoblangan. Agar boshlang'ich paytda jism tezligi $\upsilon_0=0$ bo'lsa, ajraluvchi zarralarning nisbiy tezligini km/s da aniqlang. (1,72)

23.2.4. Massasi $m=4-0,01t$, qonun bo'yicha o'zgaruvchi raketa faqat reaktiv kuch ta'sirida ilgarilanma harakat qiladi. Agar uchirilgandan 2 minut o'tgandan keyin ajraluvchi zarralarning nisbiy tezligi $\upsilon_r=2$km/s bo'lsa, raketaning tezligi qancha bo'ladi? (713)

23.2.5. Biror vaqt oralig'ida ilgarilanma harakatdagi raketaning massasi 3 marta kamaysa, tortishish kuchlari va muhit qarshiligi kuchlarini hisobga olmay, shu vaqt mobaynida uning tezligining orttirmasini toping. Ajraluvchi zarralarning nisbiy tezligi υ_r 800m/s ga teng. (879)

23.2.6. Raketa ilgarilanma harakatda bo'lib, uning massasi grafikda ko'rsatilgandek o'zgaradi. Agar boshlang'ich paytda raketaning tezligi nolga teng bo'lsa, t=20s paytda ajraluvchi zarralarning tezligini υ_r=1,8km/s deb, uning tezligini toping. Tortishish kuchlari va muhit qarshiligi kuchlari hisobga olinmasin. (919)



23.2.7. Boshlang'ich massasi 5 tonna bo'lgan raketa tortishish kuchlari va muhit qarshiligi kuchlari hisobga olinmagan holda to'g'ri chiziqli harakat qiladi. Biror vaqtdan keyin raketaning massasi 3tonna bo'lib, uning tezligi 600m/s bo'lsa, ajraluvchi qismining nisbiy tezligini km/s da aniqlang. Raketaning boshlang'ich tezligi υ_0=0. (1,18)

23.2.8. Uchayotgan raketaning massasi 800kg, tezligi 1200m/s paytida uning dvigateli o'chirib qo'yilsa, raketaning boshlang'ich massasini tonnalarda hisoblang. Raketaning boshlang'ich tezligi υ_0=0. Tortishish va muhit qarshiligi kuchlari hisobga olinmasin. Ajralayotgan moddiy zarralarning nisbiy tezligi υ_r=900m/s. (3,04)

23.2.9. Raketa faqat reaktiv kuch ta'sirida ilgarilanma harakat qiladi. Agar biror paytdan keyin uning tezligi 4200m/s, ajraluvchi qismining nisbiy tezligi υ_r=1500m/s bo'lsa, shu paytdagi raketaning massasini toping. Uning boshlang'ich massasi m=12 10^3kg, tezligi esa υ_0=0. (730)

23.2.10. Raketa faqat reaktiv kuch ta'sirida ilgarilanma harakat qiladi. Agar biror vaqtdan keyin uning tezligi 2300m/s, ajraluvchi zarralarning nisbiy tezligi υ_r=1800m/s bo'lsa, raketa massasi necha martaga kamaygan. Boshlang'ich paytda υ_0=0. (3,59)

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