O’ZBEKISTON RESPUBLIKASI
OLIY VA O’RTA MAXSUS TA’LIM VAZIRLIGI
O’RTA MAXSUS KASB-HUNAR TA’LIMI MARKAZI
BUXORO VILOYAT O’RTA MAXSUS KASB-HUNAR TA’LIMI BOSHQARMASI
BUXORO DAVLAT TIBBIYOT INSTITUTI HUZURIDAGI
1-SON AKADEMIK LITSEY

M. N. NARZULLAYEV, V. Sh. FAYZIYEV

FORMULA PLYUS III

(Elementar fizikadan ma’lumotnoma)

Abiturientlar hamda fizika o’qituvchilari uchun uslubiy qo’llanma

Toshkent 2014

Mazkur kitobda elementar fizika kursining asosiy qonuniyatlarini aks ettiruvchi formulalar, 2003-2013 yillarda oliy o'quv yurtlariga kirish imtihonlarida berilgan ko'pgina murakkab masalalarni yechish uchun tayyor ishchi formulalar hamda grafiklar o'z aksini topgan. Ma'lumotnoma 6, 7, 8, 9-sinf fizika darsliklari hamda akademik litseylar uchun mo'ljallangan darsliklar asosida tuzilgan bo'lib, akademik litsey, kasb-hunar kollejlari, umumta'lim maktablari abiturientlari hamda fizika o'qituvchilari uchun mo'ljallangan.

Agar mazkur kitobdan xato topa olsangiz sizni quyidagi manzilda sovg'a kutmoqda:

Buxoro sh.
B. Naqshband 2^{A} uy
WWW.Kol.uz nnurbek@mail.ru
tel: +998 98 774 16 63; 998 65 226 16 03

Tuzuvchilar:
N. M. Narzullayev - magistr, Buxoro davlat tibbiyot instituti huzuridagi 1-son akademik litseyning oliy toifali fizika fani o'qituvchisi.
V. Sh. Fayziyev - magistr, Buxoro davlat tibbiyot instituti huzuridagi 1-son akademik litsey fizika fani o'qituvchisi.

Taqrizchilar:
Buxoro Davlat Universiteti fizika kafedrasi o'qituvchisi, texnika fanlari nomzodi: **K. A. Samiev**

Buxoro Davlat Universiteti fizika – matematika fakulteti umumtexnika fanlar kafedrasi mudiri pedagogika fanlari nomzodi, dotsent: **H. O. Jo'rayev**

Ma'lumotnoma Buxoro davlat tibbiyot instituti huzuridagi 1-son akademik litsey ilmiy-pedagogik kengashining 2014 yil 27 iyundagi 11-sonli yig'ilishi qarori bilan nashrga tavsiya qilingan.

So’zboshi

Ushbu ma’lumotnoma “Formula plyus” seriyasidagi 3-kitob bo’lib, oldingi nashrlardan ixchamligi, ko’pgina yangi ishchi formulalarni o’zida mujassam qilganligi, mavzularga ajratilganligi hamda mavjud xatolar tuzatilganligi bilan tubdan farq qiladi.

So’nggi yillarda oliy o’quv yurtlariga kirish imtihonlarida uchrayotgan test savollarining murakkablik darajasi keskin ortib borayotganligi hamda akademik litseylar uchun mo’ljallangan darsliklar asosida tuzilayotgani barchamizga sir emas.

Bu qo’llanmaning afzallik tomoni ham akademik litseylarning fizika chuqur o’rganiladigan yo’nalishlari uchun mo’ljallangan M. N. O’lmasova muallifligida hamda akademik litseylar va kasb-hunar kollejlari uchun mo’ljallangan A. G. G’aniyev, A. K. Avliyoqulov, G. A. Almardonova muallifligida yozilgan darsliklar asosida tuzilganligidir.

Akademik litseylarning 1, 2, 3 - bosqich talabalari uchun mo’ljallangan 3 tomlik darslikda keltirilgan murakkab masalalarning aksariyati hamda ko’pgina qo’shimcha adabiyotlarda keltirilgan 3-darajali testlarni yechishga mo’ljallangan ishchi formulalar mazkur kitobda o’z aksini topgan.

Ta’lim tizimiga qo’yilayotgan bugungi talab, talabalarning bilim darajasini kengaytirishni, ma`naviy va intellektual meroslarimizga to’g’ri munosabatda bo’lishni hamda ularning mustaqil ishlashini taqozo qiladi.

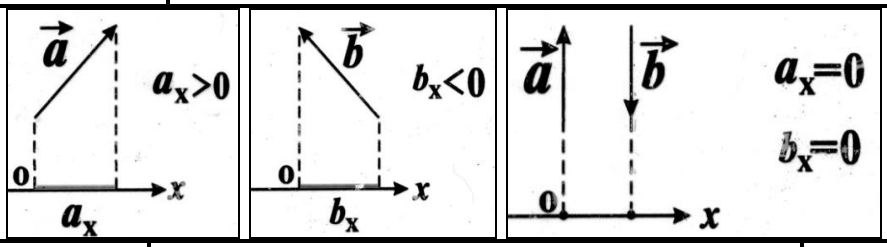
Mazkur qo’llanma bu borada olib borilayotgan ishlarni samaradorligini oshirishga katta xizmat qiladi. Noan’anaviy ta’limda talaba ta’lim ob’ekti va sub’yekti bo’ladi, mustaqil ishlash talabalarning o’quv imkoniyatlari, qobiliyatlari va ishlash sur’atlarini oshiradi, materialni sitqidildan o’zlashtirishga yordam beradi, har bir talaba o’zi uchun ishlaydi, kam vaqtni sarflab natijalarga ega bo’linadi hamda talabalar faolligi, ularning mustaqilligi, muloqat, hamkorlik ta’minlanadi. Bu imkoniyatlar ta’lim sifatini tubdan yangilash imkoniyatini beradi.

Ushbu qo’llanmadan fizika darslarida o’tilgan materialni mustahkamlashda, yangi mavzularda qiziqarli, muammoli masalalarni yechishda foydalanish mumkin.

Qo’llanmaga kiritilgan ma’lumotlar DTS talablariga to’liq javob beradi. Bu kabi ishlanmalar o’quvchilarni kelajakda mustaqil O’zbekistonimiz ravnaqi uchun xolis xizmat qiladigan yetuk ilmiy xodimlar bo’lib yetishishlarida muhim rol o’ynaydi.

Buxoro Davlat Universiteti fizika kafedrasi
o’qituvchisi, texnika fanlari nomzodi K. A. Samiev

MUNDARIJA

№	Formula nomi	Formula	Birligi
MEXANIKA **KINEMATIKA** **1-§. Kirish. Fizik kattaliklar. Vektorlar**			
1-1	Karrali va ulushli birlik-larning daraja ko'rsat-gichi old qo'shimchaga ham tegishli bo'ladi	$1km^2=1(km)^2=10^6m^2$	$1dm^2=10^{-2}m^2$
		$1sm^3=1(sm)^3=10^{-6}m^3$	$1mm^3=10^{-9}m^3$
		$1mm^2=10^{-6}m^2$	$1sm^3=10^{-6}m^3$
		$1sm^2=10^{-4}m^2$	$1dm^3=10^{-3}m^3=1l$
1-2	Vektorlarning son qiymati kosinuslar teoremmasidan topiladi	$\|c\|^2=\|a\|^2+\|b\|^2+2\|a\|\|b\|\cos a\wedge b$	
1-3	Vektorlar proeksiyasi		
1-4	Jism koordinatalari x_1; $y_1$bo'lgan nuqtadan x_2; y_2 nuqtaga ko'chsa, ko'chish vektori	$\|\vec{s}\|=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$	m
2-§. To`g`ri chiziqli tekis harakat			
2-1	Tekis harakatda tezlik	$\vartheta=\frac{\vec{s}}{t}$	m/s
2-2	Tezlik-yo'ldan vaqt bo'yicha olingan birinchi tartibli hosila	$\vartheta=x'=S'$	
2-3	Koordinata	$x=x_0+\vartheta_x t$	m
2-4	Ko'chish	$\vec{s}=\vec{\vartheta}t$	
2-5	Yo'l	$S=\|x-x_0\|$	
2-6	Natijaviy tezlik	$\vartheta^2=\vartheta^2{}_1+\vartheta^2{}_2+2\vartheta_1\vartheta_2\cos\alpha$	m/s

Nisbiy tezlikni topish:			
2-7	Agar jismlar qarama-qarshi yo'nalishda harakatlansa	$\vartheta_{nis} = \vartheta_1 + \vartheta_2$	m/s
2-8	Agar jismlar bir xil yo'nalishda harakatlansa	$\vartheta_{nis} = \vartheta_1 - \vartheta_2$	
2-9	Agar jismlar perpendikulyar(o'zaro tik) yo'nalishda harakatlansa	$\vartheta_{nis} = \sqrt{\vartheta_1^2 + \vartheta_2^2}$	
2-10	Agar jismlar o'zaro ixtiyoriy α burchak ostida harakatlansa	$\vartheta_{nis} = \sqrt{\vartheta_1^2 + \vartheta_2^2 - 2\vartheta_1\vartheta_2\cos\alpha}$	
2-11	Qarama-qarshi yo'nalishda harakatlanayotgan l_1 va l_2 uzunlikdagi ikki jismning bir-birining yonidan o'tish vaqti:	$t = \frac{l_1 + l_2}{\vartheta_1 + \vartheta_2}$	s
2-12	Bir xil yo'nalishda harakatlanayotgan l_1 va l_2 uzunlikdagi ikki jismning bir-birining yonidan o'tish vaqti	$t = \frac{l_1 + l_2}{\vartheta_1 - \vartheta_2}$	
2-13	l_1 uzunlikdagi poyezdning l_2 uzunlikdagi tunneldan o'tish vaqti	$t = \frac{l_1 + l_2}{\vartheta}$	
Kater daryoda S masofaga oqim yo'nalishida t_1 vaqtda borib, t_2 vaqtda qaytib kelgan bo'lsa:			
2-14	Oqim va katerning tezliklari	$\vartheta_0 = \frac{t_2 - t_1}{2t_1 \cdot t_2} \cdot S \qquad \vartheta_k = \frac{t_2 + t_1}{2t_1 \cdot t_2} \cdot S$	$\frac{m}{s}$
2-15	Kater va oqim tezliklari munosabati	$\vartheta_k = \frac{t_2 + t_1}{t_2 - t_1} \cdot \vartheta_0$	
2-16	Katerning borib-kelishdagi o'rtacha tezligi	$\vartheta_{o'r} = \frac{4t_1 \cdot t_2}{(t_1 + t_2)^2} \cdot \vartheta_k \qquad \vartheta_{o'r} = \frac{4t_1 \cdot t_2}{t_2^2 - t_1^2} \cdot \vartheta_0$	
2-17	O'rtacha tezlik	$\vartheta_{o'r} = \frac{S_1 + S_2 + \cdots + S_n}{t_1 + t_2 + \cdots + t_n};$	
2-18		$\vartheta_{o'r} = \frac{\vartheta_1 t_1 + \vartheta_2 t_2 + \cdots + \vartheta_n t_n}{t_1 + t_2 + \cdots + t_n};$	
2-19		$\vartheta_{o'r} = \frac{S_1 + S_2 + \cdots + S_n}{\frac{S_1}{\vartheta_1} + \frac{S_2}{\vartheta_2} + \cdots + \frac{S_n}{\vartheta_n}};$	

Xususiy hollarda o'rtacha tezlik:			
2-20	Vaqt teng ikkiga bo'linganda	$\vartheta_{o'r} = \frac{\vartheta_1 + \vartheta_2}{2}$	m/s
2-21	Yo'l teng ikkiga bo'linganda	$\vartheta_{o'r} = \frac{2\vartheta_1 \cdot \vartheta_2}{\vartheta_1 + \vartheta_2}$	
2-22	Agar jism yo'lning 1/3 qismini ϑ_1 tezlik bilan, qolgan 2/3 qismini ϑ_2 tezlik bilan o'tsa	$\vartheta_{o'r} = \frac{3\vartheta_1\vartheta_2}{2\vartheta_1 + \vartheta_2}$	
2-23	Yo'l teng 3 bo'lakka bo'lingan bo'lsa $s_1 = s_2 = s_3 = s/3$	$\vartheta_{o'r} = \frac{3\vartheta_1\vartheta_2\vartheta_3}{\vartheta_1\vartheta_2 + \vartheta_1\vartheta_3 + \vartheta_2\vartheta_3}$	
2-24	Agar jism t vaqtning 1/3 qismini ϑ_1 tezlik bilan, qolgan 2/3 qismini ϑ_2 tezlik bilan o'tsa	$\vartheta_{o'r} = \frac{\vartheta_1 + 2\vartheta_2}{3}$	
2-25	Agar qayiqning borib kelishdagi o'rtacha tezligi $\vartheta_{o'r}$, va kelish vaqti borish vaqtidan n marta katta bo'lsa, qayiqning turg'un suvdagi tezligi ϑ_q va suvning tezligi ϑ_S	$\vartheta_q = \frac{(n+1)^2}{4n}\vartheta_{o'r};$ $\vartheta_S = \frac{n^2-1}{4n}\vartheta_{o'r}$	
3-§. O'zgaruvchan harakat			
3-1	Oniy tezlik (Tekis tezlanuvchan harakat-da(+), tekis sekinlanuvchan harakatda(-)	$\vartheta_{oniy} = \lim_{\Delta t \to 0} \frac{\Delta s}{\Delta t} = \frac{ds}{dt}$ $\vec{\vartheta} = \vec{\vartheta}_0 \pm \vec{a}t$	$\frac{m}{s}$
3-2	**Tezlanish** Tezlanish tezlikdan vaqt bo'yicha olingan birinchi tartibli yoki yo'ldan vaqt bo'yicha olingan ikkinchi tartibli hosila	$\vec{a} = \frac{\vec{\vartheta} - \vec{\vartheta}_0}{t}$	$\frac{m}{s^2}$
3-3		$a = \frac{\vartheta^2 - \vartheta_0^2}{2S} \to \vartheta_0 = 0; \to a = \frac{\vartheta^2}{2S}$	
3-4		$a = \frac{2(S - \vartheta_0 t)}{t^2} \to \vartheta_0 = 0; \to a = \frac{2S}{t^2}$	
3-5		$a = \vartheta' = x'' = S''$	
3-6	Koordinata	$x = x_0 + \vartheta_x t \pm \frac{a_x t^2}{2}$	m

3-7	**Yo'l, ko'chish** (Tekis tezlanuvchan harakatda(+), tekis sekinlanuvchan harakatda(-)	$\vec{s} = \vec{\vartheta}_0 t \pm \frac{\vec{a}t^2}{2}$	
3-8		$\vec{s} = \frac{\vartheta^2 - \vartheta_0^2}{\pm 2a}$	
3-9	a tezlanish bilan harakat qilayotgan jismning ixtiyoriy n-sekundning o'zida o'tgan yo'li	$\vartheta_0 = 0 \Rightarrow S = \frac{a}{2}(2t-1);\quad S_n = \frac{a}{2}\left(t_n^2 - t_{n-1}^2\right)$	
		$\vartheta_0 \neq 0 \Rightarrow \qquad S_n = \vartheta_0 + \frac{a}{2}(2t_n - 1)$	
3-10	Oxirgi Δt vaqtda ΔS masofa bosib o'tganda harakatlanish vaqti	$t = \frac{\Delta S}{a \cdot \Delta t} + \frac{\Delta t}{2}$	s
3-11	Tekis o'zgaruvchan harakat qilayotgan jismning yo'l davomidagi o'rtacha tezligi	$\vartheta_{o'r} = \frac{\vartheta_0 + \vartheta}{2}$	
3-12	Tekis o'zgaruvchan harakat qilayotgan jismning tezligi S yo'l boshida ϑ_1, yo'l oxirida ϑ_2 bo'lsa, shu yo'lning o'rtasidagi tezlik ϑ	$\vartheta = \sqrt{\frac{\vartheta_1^2 + \vartheta_2^2}{2}}$	
3-14	Poyezdga kechikkan yo'lovchining oldidan oxirgidan oldingi vagon n_1 sekundda, oxirgi vagon n_2 sekundda o'tgan bo'lsa, kechikish vaqti	$t_k = \frac{n_1 \cdot n_2}{n_1 - n_2} - \frac{n_1 + n_2}{2}$	
3-15	Elektropoyezdning n-vagoni oldida turgan kuzatuvchi harakat boshlagan vagonning t_1 vaqtda o'tganligini, poyezdning oxiri o'tguncha esa t_2 vaqt o'tganligini aniqlagan bo'lsa, poyezdning vagonlari nechta? (Poyezd harakati tekis tezlanuvchan).	$n = \frac{t_2^2 + 2t_1^2}{t_1^2}$	
4-§. Vertikal harakat			
Jismning erkin tushish tenglamalari			
4-1	Erkin tushish tezlanishi	$g = \frac{\vec{\vartheta} - \vec{\vartheta}_0}{t}$	$\frac{m}{s^2}$

4-2	Sayyora sirtida erkin tushish tezlanishi	$g = G\frac{M}{R^2}$	
4-3	Sayyora sirtidan h balandlikda erkin tushish tezlanishi	$g = G\frac{M}{(R+h)^2}$	
4-4 4-5	Biror t vaqtdagi oniy tezlik:	$\vartheta_t = \vartheta_0 + gt$ $\vartheta_0 = 0 \Rightarrow \quad \vartheta = gt \quad \vartheta = \sqrt{2gh}$	$\frac{m}{s}$
4-6	Erkin tushish vaqti	$t = \sqrt{\frac{2h}{g}}$	s
4-7	Tushish balandligi	$h = \vartheta_0 t + \frac{gt^2}{2}$; $h = \frac{\vartheta_t^2 - \vartheta_0^2}{2g}$ $h = \vartheta_{o'r} t = \frac{\vartheta_0 + \vartheta}{2} t$	m
4-8	Biror h balandlikdan boshlang'ich tezlik bilan yuqoriga va pastga otilgan jismning yerga tushish vaqtlari t_y va t_p	$t_y = \frac{\sqrt{\vartheta_0^2 + 2gh} + \vartheta_0}{g}$; $t_p = \frac{\sqrt{\vartheta_0^2 + 2gh} - \vartheta_0}{g}$	s
4-9	Erkin tushayotgan jismning n-sekundda o'tgan yo'li	$\Delta h_n = \vartheta_0 + \frac{g}{2}(2n-1)$ $\vartheta_0 = 0 \rightarrow \Delta h_n = \frac{g}{2}(2n-1)$	m
Yuqoriga tik otilgan jismning harakati			
4-10	Butun yo'l davomida o'rtacha tezlik	$\vartheta_{o'r} = \frac{\vartheta_0}{2}$	m/s
4-11	Ko'tarilish balandligi	$h = \vartheta_0 t - \frac{gt^2}{2}$ $h = \frac{\vartheta^2{}_0}{2g} = \frac{\vartheta_0}{2} t$	m
4-12	Jism oxirgi h_1 yo'lni t_1 vaqtda o'tgan bo'lsa, Jismning tushish vaqti	$t = \frac{t_1}{2} + \frac{h_1}{gt_1}$	s

4-13	Jism oxirgi h_1 yo'lni t_1 vatqda o'tgan bo'lsa, jismning tushish balandligi h	$h=\frac{g}{2}\left(\frac{t_1}{2}+\frac{h_1}{gt_1}\right)^2;$	m
4-14	h balandlikdan tashlangan jism-ning oxirgi t_1 vatqda o'tgan yo'li	$h_1=h-\frac{g}{2}\left(\sqrt{\frac{2h}{g}}-t_1\right)^2$	
4-15	Turli balandlikdan yerga tashlangan jismlar balandliklari orasidagi farq	$\Delta h=\frac{g}{t}(t_2^2-t_1^2)$	m
4-16	Jism boshlang'ich tezlik bilan yuqoriga yoki pastga otilishidan qatiy nazar yerga bir xil quyidagi tezlik bilan tushadi	$\vartheta_t=\sqrt{\vartheta_0^2+2gh}$	
4-17	Jismning ixtiyoriy h balandlikdagi tezligi	$\vartheta=\pm\sqrt{\vartheta_0^2-2gh}$	
4-18	Agar bir xil boshlang'ich tezlik bilan yuqoriga Δt vaqt oralatib otilgan ikki jism h balandlikda uchrashsa, jismlarning boshlang'ich tezligi	$\vartheta_0=\sqrt{\left(\frac{g\cdot\Delta t}{2}\right)^2+2gh}$	
4-19	Agar bir xil boshlang'ich tezlik bilan yuqoriga Δt vaqt oralatib otilgan ikki jism h balandlikda uchrashsa, jismlarning uchrashish vaqti (t_1- 1-jism otilgandan uchrashguncha o'tgan vaqt, t_2- 2-jism otilgandan uchrashguncha o'tgan vaqt)	$t_1=\frac{\vartheta_0}{g}+\frac{\Delta t}{2}$ $t_2=\frac{\vartheta_0}{g}-\frac{\Delta t}{2}$	s
4-20	Agar ikki jism biror balandlikdan bir vaqtda yuqoriga va pastga ϑ_0 boshlang'ich tezlik bilan otilsa, t vaqtdan so'ng ular orasidagi masofa	$\vartheta_1=\vartheta_0+gt$ $\vartheta_2=\vartheta_0-gt$ $S=2\vartheta_0 t$	$\frac{m}{s}$
4-21	h balandlikdan suvga otilgan jism h_1 chuqurlikkacha cho'ksa, suvda bo'lgan vaqti	$t=\frac{2h_1}{\sqrt{2gh}}$	s

4-22	h balandlikdan suvga otilgan jism h_1 chuqurlikkacha cho'ksa, suvdagi tezlanishi	$a = -g\frac{h}{h_1}$	m/s^2
5-§. Jismning murakkab harakati			
h balandlikdan gorizontal otilgan jismning harakati			
5-1	Gorizontal yo'nalishda tezlik	$\vartheta_x = \vartheta_0$	$\frac{m}{s}$
5-2	Uchish(tushish) vaqti	$t = \sqrt{\frac{2h}{g}} = \frac{2h}{\vartheta_0} = \frac{\vartheta_0}{g} tg\alpha$	s
5-3	Ko'chish koordinatalari	$X = \vartheta_0 t \qquad Y = \frac{gt^2}{2}$	m
5-4	Tushish balandligi	$h = \frac{\vartheta_0^2}{2g} tg^2\alpha; \quad h = \frac{\vartheta^2{}_0}{2g} = \frac{\vartheta_0 t}{2}$	m
5-5	Uchish uzoqligi (Gorizontal yo'nalish-da o'tilgan yo'l)	$S_x = \vartheta_0 t = \vartheta_0\sqrt{\frac{2h}{g}}$	
5-6	Maksimal uchish uzoqligi	$s_{\max} = \frac{\vartheta_0^2}{g}$	m
5-7	O'rtacha tezlik	$\vartheta_{o'r} = \frac{\vartheta_0}{2} \qquad \vartheta = \vartheta_0\sqrt{1+tg\alpha}$	$\frac{m}{s}$
5-8	Qiyalik burchagi	$tg\alpha = \frac{gt}{\vartheta_0} = \frac{\sqrt{2gh}}{\vartheta_0}$	rad
5-9	Yerga tushish nuqtasidagi tezlik	$\vartheta = \sqrt{\vartheta_x^2 + \vartheta_y^2} = \sqrt{\vartheta_0^2 + g^2t^2} = \sqrt{\vartheta_0^2 + 2gh}$	$\frac{m}{s}$
5-10	Tangensial tezlanishi	$a_t = \frac{g^2 t}{\sqrt{\vartheta_0^2 + g^2t^2}}$	$\frac{m}{s^2}$

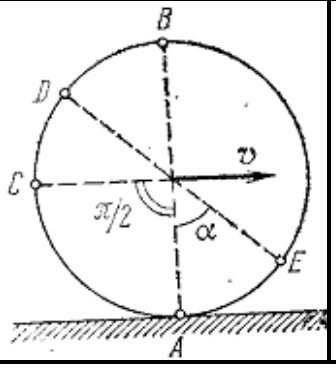
5-11	Normal tezlanishi	$a_n = \frac{\vartheta_0 g}{\sqrt{\vartheta_0^2 + g^2 t^2}}$	
5-12	Egrilik radiusi	$R = \frac{\sqrt{\left(\vartheta_0^2 + g^2 t^2\right)^3}}{\vartheta_0 g}$	m
Gorizontga nisbatan burchak ostida otilgan jismning harakati			
5-13	Gorizontal yo'nalishda jism tezligi	$\vartheta_x = \vartheta_0 \cos\alpha;$	$\frac{m}{s}$
5-14	Vertikal yo'nalishda jism tezligi	$\vartheta_y = \vartheta_0 \sin\alpha;$	
5-15	t vaqt o'tgandan so'ng jism tezligining tashkil etuvchilari	$\vartheta_x = \vartheta_0 \cos\alpha;$ $\vartheta_y = \vartheta_0 \sin\alpha - gt$	
5-16	Egrilik radiusi	$R = \frac{\sqrt{\left(\vartheta_x^2 + \vartheta_y^2\right)^3}}{\vartheta_x g}$	m
5-17		$R = \frac{\sqrt{\left(\vartheta_0^2 \cdot cos^2\alpha + \left(\vartheta_0 \cdot \sin\alpha - g \cdot t\right)^2\right)^3}}{\vartheta_0 \cdot \cos\alpha \cdot g}$	
5-18	Maksimal balandlikda egrilik radiusi	$R = 2 \cdot h \cdot ctg^2\alpha$	
5-19	Maksimal ko'tarilish balandligi	$h = \frac{\vartheta_0^2 \sin^2\alpha}{2g}$ $\quad h = \frac{gt^2}{8}$	m
5-20	Jismning ko'tarilish yoki tushish vaqti	$t_1 = \frac{\vartheta_0 \sin\alpha}{g}$	s
5-21	Jismning to'la uchish vaqti	$t = t_1 + t_2 = 2t_1 = \frac{2\vartheta_0 \sin\alpha}{g}$ $\quad t = \frac{2\sqrt{\vartheta_0^2 - \vartheta_{\min}^2}}{g}$	
5-22	Uchish uzoqligi	$s = \vartheta_x t = \frac{\vartheta_0^2 \sin 2\alpha}{g};$ $\quad S = \frac{2\sqrt{\vartheta_0^2 - \vartheta_{\min}^2}}{g}\vartheta_{\min}$	m
5-23		$s = 4h_{\max} \cdot ctg\,\alpha$	

5-24	t vaqtdan keyingi ko'tarilish-dagi qiyalik burchagi φ	$tg\varphi = \frac{\vartheta_0 \sin\alpha - gt}{\vartheta_0 \cos\alpha}$	rad
5-25	Ko'tarilishdagi qiyalik burchagi φ bo'ladigan vaqt	$t = \frac{\vartheta_0}{g}\left(\sin\alpha - tg\varphi\cos\alpha\right)$	s
5-26	t vaqtdan keyingi tushish-dagi qiyalik burchagi φ	$tg\varphi = \frac{gt - \vartheta_0 \sin\alpha}{\vartheta_0 \cos\alpha}$	rad
5-27	Tushishdagi qiyalik burchagi φ bo'ladigan vaqt	$t = \frac{\vartheta_0}{g}\left(\sin\alpha + tg\varphi\cos\alpha\right)$	s
5-28	Jismning otilish burchagi	$ctg\,\alpha = \frac{2S}{gt^2}$	rad
5-29	Jismning otilish tezligi	$\vartheta_0 = \frac{1}{2}\sqrt{(gt)^2 + \left(\frac{2S}{t}\right)^2}$	$\frac{m}{s}$
5-30	Burchak ostida otilgan jismning istalgan vaqtdagi balandligi	$h = h_0 + \vartheta_0 t\sin\alpha - \frac{gt^2}{2}$	
5-31	Tangensial tezlanishi	$a_\tau = \frac{g^2 t}{\sqrt{\upsilon_x^2 + g^2 t^2}}$	$\frac{m}{s^2}$
5-32	Normal tezlanishi	$a_n = \frac{g\upsilon_x}{\sqrt{\upsilon_x^2 + g^2 t^2}}$	
Biror balandlikdan gorizontga nisbatan burchak ostida otilgan jismning harakati			
5-33	h_0 balandlikdan α burchak ostida yuqoriga otilgan jismning maksimal ko'tarilish balandligi	$h_{\max} = h_0 + \frac{\vartheta_0^2 \sin^2\alpha}{2g}$	m
5-34	h_0 balandlikdan α bur-chak ostida ϑ_0 tezlik bilan yuqoriga qiyalatib otilgan jismning tushish vaqti	$t = \frac{\sqrt{\vartheta_0^2 \sin^2\alpha + 2gh_0} + \vartheta_0 \sin\alpha}{g}$	

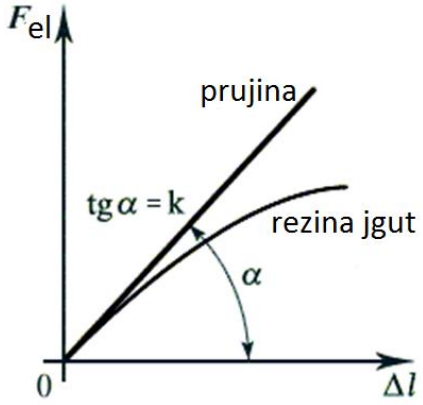
5-35	h_0 balandlikdan α bur-chak ostida ϑ_0 tezlik bilan pastga qiyalatib otilgan jismning tushish vaqti	$t=\frac{\sqrt{\vartheta_0^2\sin^2\alpha+2gh}-\vartheta_0\sin\alpha}{g}$
5-36	h_0 balandlikdan α bur-chak ostida ϑ_0 tezlik bilan yuqoriga qiyalatib otilgan jismning uchish uzoqligi	$S=\vartheta_0\cos\alpha\cdot t$
5-37	Y_0 (h) balandlikdan α burchak ostida ϑ_0 tezlik bilan yuqoriga qiyalatib otilgan jismning tushish tezligi	$\vartheta=\sqrt{\vartheta_0^2+2gh};$
5-38	h_0 balandlikdan α burchak ostida ϑ_0 tezlik bilan yuqoriga qiyalatib otilgan jismning tushish burchagi	$tg\varphi=\frac{\vartheta_y}{\vartheta_x}=\frac{\sqrt{(\vartheta_0\sin\alpha)^2+2gh}}{\vartheta_0\cos\alpha}$

6-§. Aylanma harakat

6-1	Tekis aylanma harakatning davri	$T=\frac{t}{n}=\frac{2\pi R}{\vartheta}=\frac{1}{\nu}$	$T=2\pi\sqrt{\frac{R}{a}}$	s
6-2	Tekis aylanma harakatning chastotasi	$\nu=\frac{n}{t}=\frac{1}{\mathrm{T}}$	$\nu=\frac{1}{2\pi}\sqrt{\frac{a}{R}}$	$\frac{1}{s}$
6-3	Aylana bo'ylab tekis harakatning chiziqli tezligi	$\vartheta=2\pi R\nu=\frac{2\pi R}{T}$	$\vartheta=\omega R$ $\vartheta=\sqrt{aR}$	
6-4	Sayyoraning ma'lum kengligida chiziqli tezlik	$\vartheta=\frac{2\pi R}{T}\cos\alpha$		$\frac{m}{s}$
6-5	To'la tezlanish	$a=\sqrt{a_t^2+a_n^2}$		$\frac{m}{s^2}$
6-6	Markazga intilma(normal) tezlanish	$a_n=\frac{\vartheta^2}{R};\ a_n=\omega^2R;$ $a_n=\omega\vartheta$		
6-7		$a_n=\frac{4\pi^2R}{T^2};\quad a_n=4\pi^2\nu^2R$		

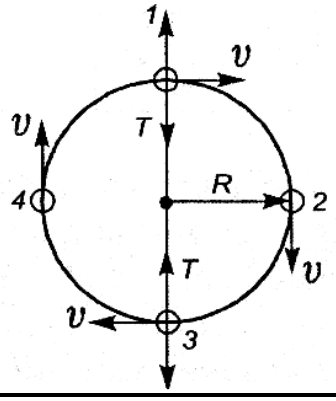
6-8	Tangensial tezlanish	$a_t = \Delta\vartheta / t; \quad a_t = R\varepsilon$	
6-9	Burchakli tezlik $\omega = \omega_0 + \varepsilon t$	$\omega = \frac{\varphi}{t} = 2\pi\nu = \frac{2\pi}{T} = \sqrt{\frac{a}{R}}$	$\frac{rad}{s}$
6-10	ε-burchak tezlanish	$\varepsilon = \frac{\Delta\omega}{\Delta t} = \frac{\omega - \omega_0}{t} \qquad \varepsilon = \frac{a_t}{R}$	rad/s^2
6-11	Burchak	$\varphi = 2\pi N = \frac{2\pi t}{T} = \omega \cdot t$	rad
6-12		$\varphi = 2\pi\vartheta t; \quad \varphi = \sqrt{\frac{a}{R}} \cdot t: \quad \varphi = \frac{\vartheta \cdot t}{R}$	
6-13		$\varphi = \omega_0 t + \frac{\varepsilon t^2}{2} \qquad \varphi = \frac{\omega^2 - \omega_0^2}{2\varepsilon}$	
6-14		$\upsilon_A = 0; \qquad \upsilon_B = 2\vartheta; \qquad \upsilon_C = \sqrt{2}\upsilon;$ $\upsilon_D = 2\upsilon\cos\frac{\alpha}{2}; \qquad \upsilon_E = 2\upsilon\sin\frac{\alpha}{2}$	m/s
6-15	Agar yetakchi g'ildirak diametri d_1 (tishli uzatmada tishlar soni N_1) va yetaklanuvchi g'ildirak diametri d_2 (tishli uzatmada tishlar soni N_2)bo'lsa, uzatish soni u	**Uzatmalar** Agar shkiflar bitta o'qqa o'rnatilgan bo'lsa: $\omega_1 = \omega_2$ bo'ladi. $u = \frac{d_2}{d_1} = \frac{R_2}{R_1} = \frac{N_2}{N_1}; \ \vartheta_1 = \vartheta_2$ $\left[\frac{R_1}{R_2} = \frac{\nu_2}{\nu_1} = \frac{\omega_2}{\omega_1} = \frac{T_1}{T_2}\right]$	
6-16	Disk ikki nuqtasida ΔR radiuslar farqi	$R = \frac{\vartheta_1 \cdot \Delta R}{\vartheta_1 - \vartheta_2}; \quad \vartheta = \frac{\Delta\vartheta}{2\pi\Delta R}; \quad \omega = \frac{\Delta\vartheta}{\Delta R}$	

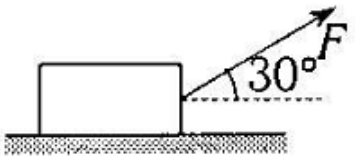
	tezliklar farqi $\Delta\vartheta = \vartheta_1 - \vartheta_2$ ga teng bo'lsa:		
II bob. Dinamika **7-§. Nyuton qonunlari**			
7-1	Zichlik	$\rho = \frac{m}{V}$	$\frac{kg}{m^3}$
7-2	Suvda tushayotgan jismning zichligi	$\rho = \rho_S \frac{g}{g-a}$	$\frac{kg}{m^3}$
7-3	Suyuqlikda qalqib chiqayotgan jismning tezlanishi	$a = \frac{\rho_s - \rho}{\rho} g$	$\frac{m}{s^2}$
7-4	Zichliklari ρ_1 va ρ_2 bo'lgan moddalar aralashmasining zichligi ρ bo'lsa, qotishma-ning x % ni ρ_1 zichlikli modda tashkil qiladi	$x = \frac{\rho_2(\rho_1 - \rho)}{\rho(\rho_1 - \rho_2)}$	%
7-5	Massa	$m = \rho \cdot V$	kg
7-6	**Nyutonning 1-qonuni** (inersiya qonuni)	$\vec{F} = 0 \Rightarrow \vartheta = 0; \vartheta = const$	
7-7	**Nyutonning 2-qonuni** (Ilgarilanma harakat dinamikasining asosiy qonuni)	$\vec{F} = m\vec{a}$	N
7-8	**Nyutonning 3-qonuni**	$\vec{F}_1 = -\vec{F}_2$	
7-9	Jismlarning o'zaro ta'sirdan olgan tezlanishlari jismlarning massalariga teskari proporsional bo'lib, qarama-qarshi yo'nalgan	$m_1 a_1 = -m_2 a_2$ $\frac{m_1}{m_2} = \frac{a_2}{a_1}$	
8-§. Elastiklik kuchi			
8-1	Elastiklik kuchi	$F_{el} = -\kappa \Delta l$	N
8-2	Absolyut uzayish	$\Delta l = l - l_0$	m
8-3	Bikrlik	$k = \frac{ES}{l_o}; \quad k = \frac{F_x}{\lvert\Delta l\rvert}; \quad k = \frac{F_{el}^2}{2W_p}; \quad k = \frac{2W_p}{\Delta x^2}$	$\frac{N}{m}$

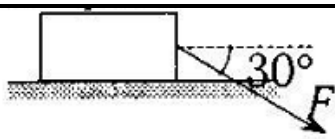
8-4	m massali yuk osilgan prujinaning bikrligi		$k = \frac{mg}{\Delta l}$	
8-5	Ketma-ket ulanganda umumiy bikrlik		$\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2}$	
8-6	Parallel ulanganda umumiy bikrlik		$k = k_1 + k_2$	
8-7	Mexanik kuchlanish	$\sigma = \frac{F}{S}$	$\sigma = E\varepsilon$	$\frac{N}{m^2}$
8-8	Mustahkamlik chegarasi σ bo'lgan, bir uchidan osilgan ip(tros)ning maksimal uzunligi	Havoda: $l_{\max} = \frac{\sigma}{\rho \cdot g}$		
		Suyuqlikda: $l_{\max} = \frac{\sigma}{(\rho_{jism} - \rho_{suyuq}) \cdot g}$		
8-9	Mustahkamlik chegarasi σ , zichligi ρ bo'lgan devorning maksimal balandligi		$h_{\max} = \frac{\sigma}{\rho \cdot g}$	
8-10	Nisbiy uzayish	$\varepsilon = \frac{\lvert\Delta l\rvert}{l} = \frac{\sigma}{\mathrm{E}}$		
8-11	Yung moduli	$E = \frac{\sigma}{\varepsilon}$		$\frac{N}{m^2}$
8-12	Guk qonuni	$F = \frac{ES}{l_0}\lvert\Delta l\rvert$		N
8-13		$tg\alpha = \frac{F_x}{\lvert\Delta l\rvert} = k$		$\frac{N}{m}$
9-§. Tortishish kuchlari				
9-1	Ikki jism orasidagi o'zaro tortishish kuchi	$F = G\frac{m_1 m_2}{R^2}$		N

9-2	H balandlikda tortishish kuchi	$F = G\frac{m_1 m_2}{(R+h)^2}$	
9-3	Og'irlik kuchi	$F_{og'} = mg$	
9-4	Yer sirtidan h balandlik-dagi og'irlik kuchi	$F_{og'}^{h} = F_{og'}^{yersirt} \cdot \left(\frac{R}{R+h}\right)^2$	
9-5	h balandlikda sayyo-raning tortish kuchi n marta kamaysa	$h = R\left(\sqrt{n}-1\right)$	m
9-6	Erkin tushish tezlanishi ρ -sayyoraning o'rtacha zichligi; R- sayyoraning radiusi.	$g = G\frac{M}{R^2}$	m/s^2
9-7		$g = G\rho\frac{4}{3}\pi R$	
9-8	h balandlikda erkin tushish tezlanishi	$g_h = g_0\left(\frac{R}{R+h}\right)^2; \quad g_h = G\frac{M}{(R+h)^2}$	
9-9	Biror bir planetadagi erkin tushish tezlanishini Yerdagi erkin tushish tezlanishiga nisbati	$\frac{g_{plan}}{g_{yer}} = \left(\frac{M_{plan}}{M_{yer}}\right)\cdot\left(\frac{R_{yer}}{R_{plan}}\right)^2;$ $\frac{g_{plan}}{g_{yer}} = \frac{\rho_{plan}\cdot R_{plan}}{\rho_{yer}\cdot R_{yer}}$	
9-10	1-kosmik tezlik	$\vartheta_1 = \sqrt{gR} = \sqrt{G\frac{M}{R}} = 7{,}9\frac{km}{s}$	m/s
9-11	2-kosmik tezlik	$\vartheta_2 = \sqrt{2}\vartheta_1 = 11{,}2\frac{km}{s}$	
9-12	3-kosmik tezlik	$\vartheta_3 = 16{,}7\frac{km}{s}$	
9-13	Sayyora sirtidan h balandlikda doiraviy orbita bo'ylab aylanayotgan yo'ldoshning tezligi	$\vartheta_h = \sqrt{G\frac{M}{R+h}} = \sqrt{g_h(R+h)} =$ $= R\sqrt{\frac{g}{R+h}} = \vartheta_1\sqrt{\frac{R}{R+h}}$	

9-14	Sayyora qora tuynukka aylanishi uchun uning radiusi quyidagicha bo'lishi kerak (c=3·10^{8}m/s) $\vartheta_2 = c \Rightarrow$	$c = \sqrt{\frac{2GM}{R}} \Rightarrow$	$R = G\frac{2M}{c^2}$
9-15	Yer atrofida aylanma trayektoriya bo'ylab harakatlanayotgan jism bir trayektoriyadan ikkinchi trayektoriyaga o'tganida tezlikning o'zgarishi	$\frac{\vartheta_2}{\vartheta_1} = \sqrt{\frac{R_1}{R_2}}$	$\frac{\vartheta_2}{\vartheta_1} = \sqrt{\frac{T_1}{T_2}}$
9-16	Suniy yo`ldoshning aylanish davri	$T = \frac{2\pi\sqrt{R^3}}{\sqrt{GM}}; \quad T = \sqrt{\frac{3\pi}{G\rho}}$	s
9-17	Yo`ldosh h balandlikda aylansa davri	$T = \frac{2\pi\sqrt{(R+h)^3}}{\sqrt{GM}};$	
9-18	Sayyora sirtidan h balandlikda doiraviy orbita bo'ylab aylana-yotgan yo'ldoshning tezlanishi	$a_h = \frac{\vartheta_h}{R+h};$	m/s^2
9-19	Jismni Yer sirtidan cheksizlikka otish uchun bajariladigan ish	$A = G\frac{mM}{R}; \quad A = \frac{m\vartheta^2}{2}$	J
9-20	a tezlanish bilan yuqoriga tezlashayot-gan yoki pastga sekinlashayotgan holda jismning vazni ma ga ortadi	$P = m(g+a)$	N
9-21	Jism a tezlanish bilan yuqoriga sekin-lashayotgan yoki pastga tezlashayot-gan holda vazni ma ga kamayadi	$P = m(g-a)$	
9-22	a=o bo'lganda	$P = mg$	
9-23	Jism erkin tushganda	$a = g; \quad P = 0$	
9-24	Jism vertikal tekislikda aylana bo'ylab harakat-langanda jismning yuqori nuqtadagi og'irligi P_Y va quyi nuqtadagi og'irligi P_Q	$P_Q = mg + ma; \; P_Q = mg + \frac{m\vartheta^2}{R}$	
9-25		$P_Y = mg - ma; \; P_Y = mg - \frac{m\vartheta^2}{R}$	
9-26		Yoki qavariq (-) va botiq(+) ko'prikdan o'tayotgan jism og'irligi yoki ko'prikka bosim kuchi	

	Qavariq ko'prik (-) va botiq ko'prik (+)	$P = m(g \pm 4\pi^2 v^2 R); \quad P = m(g \pm \frac{4\pi^2 R}{T^2})$
9-27	$P = m(g \pm a); \quad P = m(g \pm \frac{\vartheta^2}{R}); \quad P = m(g \pm \omega^2 R); \quad P = m(g \pm \omega\vartheta)$	
9-28	Qavariq ko'prikning yuqori nuqtasida jismni vaznsiz holatga keltiruvchi tezlik (R - ko'prik radiusi)	$\vartheta = \sqrt{gR}$
9-29	Botiq sirtning pastki nuqtasida jism og'irligi k marta ortadigan tezlik	$\vartheta = \sqrt{(k-1)gR}$
9-30	yuklanish –n	$n = \frac{P}{mg} = \frac{m(g+a)}{mg} = 1 + \frac{a}{g} = 1 + \frac{\vartheta^2}{gR}$
9-31	m massali yukni ko'tara oladigan ip yordamida m_x massali yukni a tezlanish bilan ko'tarish mumkin	$m_x = \frac{g}{g+a} \cdot m$
9-32	Jismning solishtirma og'irligi - uning hajm (v) birligidagi ogirligi	$d = \frac{P}{V} = \frac{mg}{V} = \rho g$ **N/m³**
9-33	Pastga tushayotgan lift tezlanuvchan harakatlansa, lift ichidagi matematik mayatnikning tebranish davri	$T = 2\pi\sqrt{\frac{l}{g-a}}$ s
9-34	Pastga tushayotgan lift sekinlanuvchan harakatlansa, lift ichidagi matematik mayatnikning tebranish davri	$T = 2\pi\sqrt{\frac{l}{g+a}}$ s
9-35 9-36 9-37	Arqonga bog'lab aylantirilgan jism  	$T_1 = \frac{m\vartheta^2}{R} - mg$ $T_2 = T_4 = \frac{m\vartheta^2}{R}$ $T_3 = \frac{m\vartheta^2}{R} + mg$ s
9-38	Aylanayotgan diskdagi jismning muvozanat sharti	$\frac{m\vartheta^2}{R} = \mu \cdot mg; \qquad \vartheta = \sqrt{\mu g R}$ $\omega = \sqrt{\frac{\mu g}{R}}; \qquad R = \frac{\mu g}{4\pi^2 v^2}$

9-39	l Ipga osilgan gorizontal tekislikda aylanma harakat qilayotgan jism uchun	$T\sin\alpha=\frac{m\vartheta^2}{l\sin\alpha};\quad T\cos\alpha=mg$	
		$tg\alpha=\frac{\vartheta^2}{gl\sin\alpha};\quad \nu=\frac{1}{2\pi}\sqrt{\frac{g}{l\cos\alpha}}$	
9-40	**Kepler qonuni-** Yer atrofida aylana bo'ylab harakatlanayotgan yo'ldosh uchun: R_1 va R_2 - aylana radiuslari, T_1 va T_2 - shu trayektoriyalar bo'yicha aylanish davrlari)	$\left(\frac{R_2}{R_1}\right)^3=\left(\frac{T_2}{T_1}\right)^2$	
9-41	Qayrilishdagi velosipedchining muvozanati	$F=mgctg\alpha$	N
	Aylanayotgan konusdagi shar	$mgctg\alpha=\frac{m\vartheta^2}{R}$	
9-42	Qayrilayotgan velosipedchi, motosiklchi yoki konkichi uchun (R – aylana radiusi) $\mu=tg\alpha$	$\frac{m\vartheta^2}{R}\cdot tg\alpha=mg;\qquad tg\alpha=\frac{gR}{\vartheta^2}$	
9-43	Markazga intilma kuch	$F=m\omega^2R;\quad F=m\omega\vartheta;\quad F=\frac{m\vartheta^2}{R}$ $F=4\pi^2\nu^2mR;\quad F=\frac{4\pi^2Rm}{T^2};\quad F=m\varepsilon R$	
10-§. Ishqalanish kuchi			
10-1	Ishqalanish kuchi	$F_{ishq}=\mu F_N$	N
10-2	Gorizontal tekislikda Ishqalanish kuchi	$F_{ishq}=\mu mg$	
10-3	Gorizontal tekis sirtdagi jismni a tezlanish bilan tortish uchun kerak bo'lgan kuch	$F_T=\mu mg+ma$	
10-4	Gorizontal sirtdagi m massali jismni gorizontga nisbatan α burchak	 $\mu=\frac{F\cos\alpha}{mg-F\sin\alpha}$	
		$a\neq0\Rightarrow ma=F\cos\alpha-\mu(mg-F\sin\alpha)$	

10-5	ostida ta’sir qiluvchi F kuch bilan tekis harakatga keltirilayotgan bo’lsa, sirtning ishqalanish koeffisienti	 $\mu = \frac{F\cos\alpha}{mg + F\sin\alpha}$	
		$a \neq 0 \Rightarrow ma = F\cos\alpha - \mu(mg + F\sin\alpha)$	
10-6	Ishqalanish koeffisienti μ va radiusi R bo’lgan yo’lda harakatlanayotgan avtomobilning sirpanmay burilishining chegaraviy tezligi	$\vartheta \le \sqrt{\mu Rg}$	
10-7	Gorizontal tekislikda ϑ tezlik bilan harakatlanayotgan ipga osilgan sharning vertikaldan ochilish burchagi	$tg\alpha = \frac{\vartheta^2}{Rg}$	
10-8	Gorizontal tekislikda ϑ tezlik bilan harakatla-nayotgan ipga osilgan sharning aylanish davri	$T = 2\pi\sqrt{\frac{l}{g}\cos\alpha}$	
10-9	Stol ustida turgan l uzunlikdagi zanjirning osilib turgan qismi uzunligi quyidagicha bo’lganda sirpanib tusha boshlaydi	$l_{os} = \frac{\mu}{1+\mu}l$	
10-10	Aylanayotgan diskda turgan jismning muvozanat sharti	$\frac{m\vartheta^2}{R} = \mu \cdot mg;$ $\vartheta = \sqrt{\mu gR}$ $\omega = \sqrt{\frac{\mu g}{R}};$ $R = \frac{\mu g}{4\pi^2\nu^2}$	
10-11	Tormozlanish vaqti	$t = \frac{m\vartheta_0}{F_{ishq}};$ $t = \frac{\vartheta_0}{\mu \cdot g}$	s
10-12	Tormozlanish yo`li	$S = \frac{\vartheta_0 t}{2};$ $S = \frac{m\vartheta_0^2}{2F_{ishq}};$ $S = \frac{\vartheta_0^2}{2\mu \cdot g}$	m
10-13	Tormozlanishda jism tezlanishi	$a = \mu \cdot g$	m/s^2
10-14	Dumalash ishqalanishi kuchi	$F_{dish} = \frac{\mu F_N}{R}$	N
10-15	Mutloq silliq ustida turgan M massali taxta ustidagi m massali taxtacha F kuch bilan tortilsa(taxta va taxtacha	$F_{ish} < F \Rightarrow Ma = \mu mg;$ $F_{ish} > F \Rightarrow (M+m)a = F$	

	orasidagi ishqalanish koeffisiyenti μ)		
Qiya tekislikda turgan jismning harakati			
10-16	Sirpantiruvchi kuch	$F_1 = mg\sin\alpha$	N
10-17	Tekislikka ta'sir etuvchi normal kuch	$F_2 = mg\cos\alpha$	
10-18	Ishqalanish kuchi	$F_{ishq} = \mu F_2 = \mu mg\cos\alpha$	
Jismning qiya tekislikda muvozanatda turish sharti			
10-19	$F_1 \le F_3 = F_{ishq}$	$mg\sin\alpha \le \mu F_2 = \mu mg\cos\alpha$; $\mu \ge tg\alpha$	
10-20	Agar $\mu < tg\alpha$ bo'lsa:	$a = g(\sin\alpha - \mu\cos\alpha)$	
10-21	Jismning qiya tekislik bo'ylab yuqoriga tekis tortib chiqarish uchun kerak bo'lgan kuch	$F_T = mg(\sin\alpha + \mu\cdot\cos\alpha)$	
10-22	Jismning qiya tekislik bo'y-lab yuqoriga a tezlanish bilan tortib chiqarish uchun kerak bo'lgan kuch	$F_T = m(g\cdot\sin\alpha + \mu\cdot g\cdot\cos\alpha + a)$	
10-23	Jismning qiya tekislikdan tekis tortib tushirish uchun kerak bo'lgan kuch	$F_T = mg(\mu\cdot\cos\alpha - \sin\alpha)$	
10-24	Jismning qiya tekislikdan a tezlanish bilan tortib tushirish uchun kerak bo'lgan kuch:	$F_T = m(\mu\cdot g\cdot\cos\alpha - g\cdot\sin\alpha + a)$	
10-25	Jismning qiya tekislikdan tushib ketmasligi uchun ustidan qiya sirtga tik holda bosish uchun kerak bo'lgan kuch	$F_B = mg(\sin\alpha - \mu\cdot\cos\alpha)/\mu$	
10-26	Qiya tekislikning foydali ish koeffisienti	$\eta = \frac{\sin\alpha}{\sin\alpha + \mu\cos\alpha} = \frac{1}{1 + \mu ctg\alpha}$	%
11-§. Impuls			
11-1	Jism impulsi	$P = m\vartheta$	$\frac{kg\cdot m}{s}$

		$P=\frac{2W_k}{\vartheta};\qquad P=\sqrt{2W_k\cdot m}$	
11-2	Kuch impulsi	$\Delta P=F\cdot t$	$N\cdot s$
11-3	m massali jism tekislikka ϑ tezlik bilan tik yo'nalish-da noelastik urilganda jism impulsining o'zgarishi	$\Delta P=m\cdot\vartheta$	
11-4	m massali jism tekislikka α burchak ostida ϑ tezlik bilan noelastik urilganda impulsning o'zgarishi	$\Delta P=m\cdot\vartheta\cos\alpha$	
11-5	m massali tekislikka ϑ tezlik bilan elastik urilgandagi impulsning o'zgarishi	$\Delta P=2m\vartheta$	
11-6	m massali jism tekislikka α burchak ostida ϑ tezlik bilan elastik urilganda impulsning o'zgarishi	$\Delta P=2m\vartheta\cos\alpha$	
11-7	Jismlar bir xil yo'nalishda harakatlansa jismlar sistemasining impulsi	$P=m_1\vartheta_1+m_2\vartheta_2$	
11-8	Jismlar qarama-qarshi tomonga harakat-lansa jismlar sistemasining impulsi	$P=m_1\vartheta_1-m_2\vartheta_2$	
11-9	Jismlar perpendikulyar yo'nalishda harakatlansa jismlar sistemasining impulsi	$P=\sqrt{(m_1\vartheta_1)^2+(m_2\vartheta_2)^2}$	
11-10	Jismlar α burchak ostida harakat qilsa jismlar sistemasining impulsi $P=\sqrt{(m_1\vartheta_1)^2+(m_2\vartheta_2)^2+2(m_1\vartheta_1)\cdot(m_2\vartheta_2)\cos\alpha}$		
11-11	Impulsning saqlanish qonuni	$m_1\vec{\vartheta}_1+m_2\vec{\vartheta}_2=m_1\vec{\vartheta}_1'+m_2\vec{\vartheta}_2'$	$\frac{kg\cdot m}{s}$
Agar tenglamani skalyar ko'rinishda yozsak to'qnashuvchi jismlar har tomonga harakat qilayotgan bo'lsa(-) ishora bilan olinadi.			
11-12	$m_1\vartheta_1\pm m_2\vartheta_2=m_1\vartheta_1'+m_2\vartheta_2'$		
11-13	Jism impulsining o'zgarishi	$m\vec{\vartheta}-m\vartheta_0=\vec{F}t$	
11-14	Noelastik to'qnashuv	$m_1\vartheta_1\pm m_2\vartheta_2=\vartheta(m_1+m_2)$	

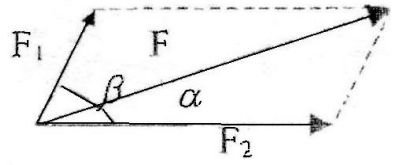
		jismlar bir tomonga harakatlansa(+), har tomonga harakatlansa (-)	
11-15	Ko'lda turgan uzunligi l, massasi m_1 bo'lgan qayiqning quyrug'idan m_2 massali kishi qayiq uchiga o'tsa, qayiqning siljishi x va odamning siljishi y	$x=\frac{m_1}{m_1+m_2}l$ $y=\frac{m_2}{m_1+m_2}l$	m
11-16	Elastik to'qnashuvdan keying tezliklar(Agar to'qnashuvchi jismlar har tomonga harakat qilayotgan bo'lsa(-) ishora bilan olinadi)	$\vartheta_1^{'}=\frac{(m_1-m_2)\vartheta_1\pm 2m_2\vartheta_2}{m_1+m_2};$	$\frac{m}{s}$
11-17		$\vartheta_2^{'}=\frac{2m_1\vartheta_1\pm(m_2-m_1)\vartheta_2}{m_1+m_2}$	
11-18	Agar m_1 massali shar m_2 massali shardan itarilib, ϑ_1 tezlik olsa, 2-shar tezligi	$\vartheta_2=\frac{m_1}{m_2}\vartheta_1$	
12-§ Mexanik ish va quvvat			
12-1	Mexanik ish	$A=FS\cos\alpha$	J
12-2	Og'irlik kuchining ishi	$A=mg(h_1-h_2)$	
12-3	Qiya tekislikda tortish kuchining ishi	**A=L(mgsinα +μmgcosα +ma)**	
12-4	Qiya tekislik bo'ylab jismni yuqoriga chiqa-rishda ichki energiyani oshirishga sarflangan ish	**A_s=Lμmgcosα**	
12-5	Mexanik ishni kinetik energiyaga bog'liqligi	$A=\frac{m(\vartheta_2^2-\vartheta_1^2)}{2}$	
12-6	Qiya tekislik bo'ylab jismni yuqoriga chiqarishda ishning ichki energiyani oshirishga sarflangan qismi	$1-\eta=\frac{\mu}{(\mathrm{tg}\alpha+\mu)};$ $1-\eta=\frac{\mu\cos\alpha}{(\sin\alpha+\mu\cos\alpha)}$	
12-7	Elastiklik kuchining ishi	$A=\frac{k\cdot x^2}{2};\quad A=\frac{F_{el}\cdot x}{2};\quad A=\frac{F_{el}^2}{2k}$	J
12-8	Gorizontal sirtda ishqalanish kuchining bajargan ishi	$A=F_{ishq}l=\mu mgl$	

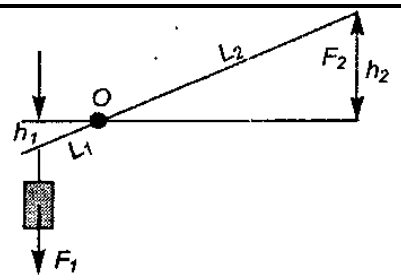
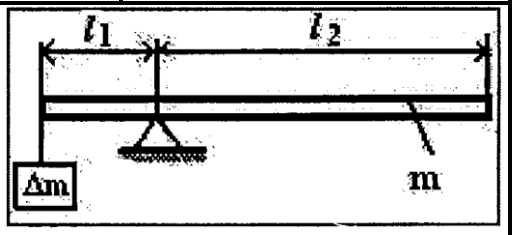
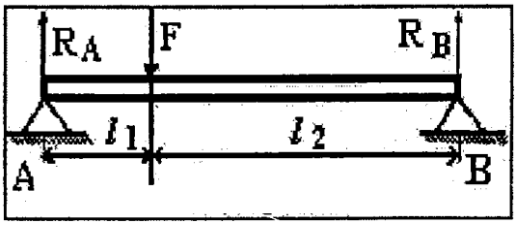
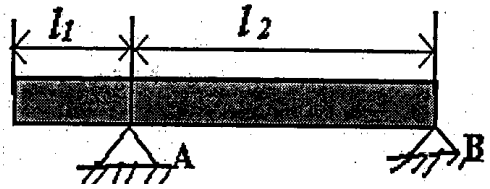
12-9	Qiya tekislikda ishqalanish kuchining bajargan ishi	$A = \mu mgl \cdot \cos\alpha$	
12-10	Yerda yotgan l uzunlikdagi sterjinni tik qilib qo'yishda bajarilgan ish	$A = mgl/2$	
12-11	Sterjinni gorizontga nisbatan α burchakka og'dirishda bajarilgan ish	$A = mg\frac{1}{2} \cdot \sin\alpha$	
12-12	Mexanik quvvat	$N = \frac{A}{t} = \frac{Fs}{t} = F\vartheta\cos\alpha$ $N = \frac{mgh}{\eta t};\quad N = \frac{m\vartheta^2}{2t}$	W
12-13	O'zgarmas tezlik bilan ketayotgan avtomobilning tortish kuchi F_{tor} bo'lib, S masofada yoqqan yoqilg'I massasi	$m_{yoq} = \frac{SF_{tor}}{\eta q}$	kg
12-14	Quvvat N ga teng bo'lgan dvigatel m massali yukni h balandlikka t vaqtda olib chiqqanidagi FIK	$\eta = \frac{mgh}{N \cdot t} \cdot 100\%$	%
12-15	Dvigatelining quvvati N_{dv} ga teng bo'lgan mashina o'zgarmas ϑ tezlikda ketayotgan bo'lsa	$\eta_{dv} = \frac{F_{tor} \cdot \vartheta}{N_{dv}} \cdot 100\%$	%
12-16	Foydali ish kooeffisiyenti	$\eta = \frac{A_f}{A_u} = \frac{N_f}{N_u} = \frac{W_f}{W_u}$	
13-§. Mexanik energiya			
13-1	Kinetik energiya	$W_{kin} = \frac{m\vartheta^2}{2}$	J
13-2	Qiya tekislikdan sirpanishsiz dumalab tushayotgan silindrning kinetik energiyasi	$W_k = \frac{3}{4}m\vartheta_0^2$	
13-3	Qiya tekislikdan sirpanib dumalab tushayotgan silindrning kinetik energiyasi	$W_k = \frac{5m\vartheta_0^2}{4} + \frac{J_0\omega^2}{2}$	
13-4	Potensial energiya	$W_p = mgh$	

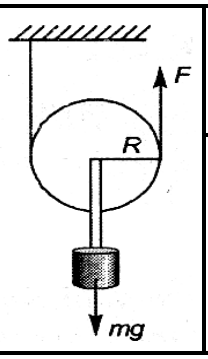
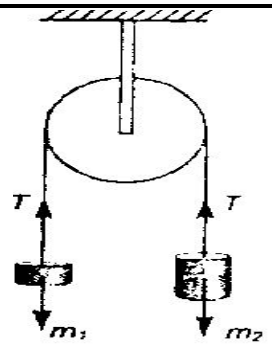
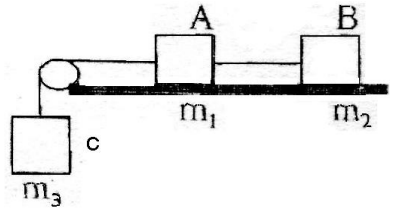
13-5	Elastik deformasiya potensial energiyasi	$W_p = \frac{k\Delta l^2}{2} = \frac{F_{el}\Delta l}{2}$	
13-6	To'liq energiya	$W_T = W_к + W_p$	
13-7	Mexanik energiyaning saqlanish qonuni	$mgh + \frac{m\vartheta^2}{2} = const$	
13-8	Jismning h_{max} balandlikdan tushishida energiyaning saqlanish qonuni	$mgh_m = \frac{m\upsilon^2}{2} + mgh$	
13-9	υ_0 tezlik bilan yuqoriga itilgan jismning ko'ta-rilishida energiyaning saqlanish qonuni	$\frac{m\upsilon_0^2}{2} = \frac{m\upsilon^2}{2} + mgh$	

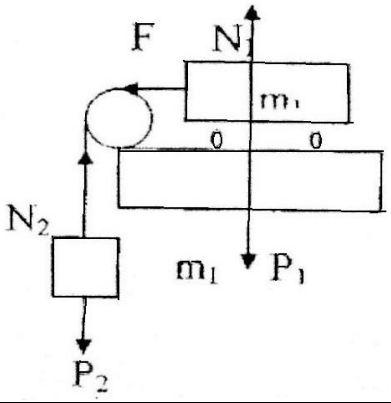
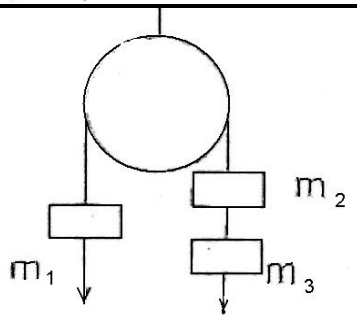
III bob. Statika

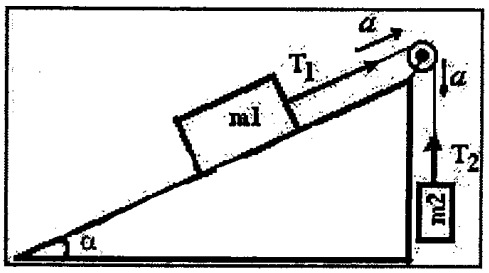
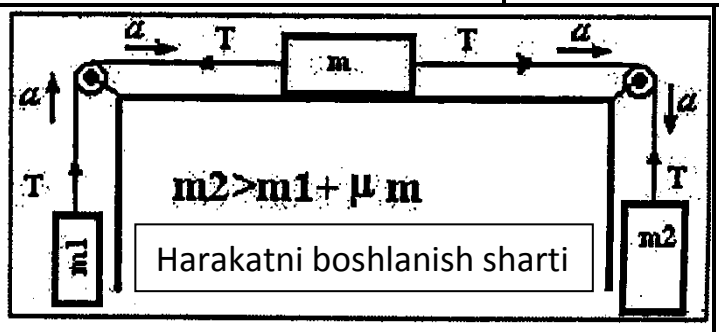
14-§ Jismlarning muvozanat shartlari. Kuch momenti

14-1	Jismlar sistemasining massa markazi	$x_m = \frac{m_1 \cdot x_1 + m_2 \cdot x_2}{m_1 + m_2}$	m
14-2	Natijalovchi kuch	$F^2 = F_1^2 + 2F_1F_2\cos\alpha + F_2^2$	N
14-3	 Kuchlarni ajratish	$F_1 = F\frac{\sin\alpha}{\sin(\alpha+\beta)};\ \ F_2 = F\frac{\sin\beta}{\sin(\alpha+\beta)}$ Kuchni ikkita tashkil etuvchilarga ajratish	
14-4	Kuchni ikkita parallel tashkil etuvchilarga ajratish	$F_1 = \frac{F}{\frac{l_1}{l_2}+1};\ \ F_2 = \frac{F}{\frac{l_2}{l_1}+1};$	
14-5	Kuch momenti	$\mathrm{M} = \mathrm{F}\cdot\mathrm{l}$	Nm
14-6	Aylanish o'qiga ega bo'lgan jismning muvozanat sharti	$\vec{M}_1 + \vec{M}_2 + ... + \vec{M}_n = 0$	
14-7	Richakning muvozanat sharti	$F_1l_1 = F_2l_2$	
14-8	Richakda ish bajarish	$\frac{h_2}{h_1} = \frac{l_2}{l_1} = \frac{F_1}{F_2}$	

		$A_1 = F_1 h_1; \quad A_2 = F_2 h_2$
14-9	Yerda yotgan massasi m, uzunligi L bo'lgan sterjenni bir uchidan yerga tiralgan holda ko'tarish uchun kerak bo'lgan eng katta kuch	$F = \frac{1}{2} mg$
14-10	Yerda yotgan massasi m, uzunligi L bo'lgan sterjenni bir uchidan yerga tiralgan holda ko'tarish uchun bajariladigan ish	$A = \frac{1}{2} mgL$
14-11	Yerda yotgan massasi m, uzunligi L bo'lgan sterjenni ikkinchi uchidan gorizontga nisbatan α burchakka ko'tarishda bajarilgan ish	$A = \frac{1}{2} mgL \sin\alpha$
14-12	Agar m massali yuk bir jinsli sterjen uchlaridan aylanish o'qigacha l_1 va l_2 masofagacha qilib o'rnatilgan bo'lsa ($l_1 > l_2$), sterjen muvozanatda bo'lishi uchun l_1 yelkaga qo'shimcha osilgan yukning massasi	 $\Delta m = \frac{l_2 - l_1}{2l_1} m;$
14-13	Agar 2 ta tayanchda gorizontal yotgan vaznsiz balkaning uchlaridan L_1 va L_2 masofadagi nuqtasiga F kuch qo'yilsa, tayanchlarga quyidagicha taqsimlanadi	 $R_B = \frac{L_1}{L_1 + L_2} F; \quad R_A = \frac{L_2}{L_1 + L_2} F$
14-14	Agar yuqoridagi rasmda balka massasi m ni hisobga olsak	$R_A = \frac{L_2}{L_1 + L_2} F + \frac{mg}{2} \qquad R_B = \frac{L_1}{L_1 + L_2} F + \frac{mg}{2}$
14-15	m massali bir jinsli balka og'irligidan tushadigan A va B tayanchlardagi reak-siya kuchlari R_A va R_B	 $R_A = \frac{l_1 + l_2}{2l_2} mg; \quad R_B = \frac{l_2 - l_1}{2l_2} mg$

14-16	Vazinsiz richakning yelkalariga F_1 va F_2 kuchlar qo'yilgan bo'lsa ($l=l_1+l_2$)	$l_1 = \frac{F_2}{F_1+F_2} l;\quad l_2 = \frac{F_1}{F_1+F_2} l$
14-17	Massasi m va uzunligi l bo'lgan richagning yelkalariga F_1 va F_2 kuchlar qo'yilganda muvozanat sharti ($l=l_1+l_2$)	$mg = \frac{2(F_1 l_1 - F_2 l_2)}{l_2 - l_1}$
14-18	Agar bitta tayanch ustida turgan sterjenning chap tomoni zichligi ρ_1 bo'lgan materialdan yasalgan bo'lib, uzunligi l_1 bo'lsa, zichligi ρ_2 bo'lgan materialdan yasalgan o'ng tomoni uzunligi l_2 quyidagicha	$l_2 = \sqrt{\frac{\rho_1}{\rho_2}} l_1$
14-19	Bir xil R radiusli ikkita ρ_1 va ρ_2 ziklikli sharlar bir-biriga tegib turgan nuqtasida biriktirib qo'yilsa, sistemaning og'irlik markazi 2-shardan X masofada	$X = \frac{\rho_1 - \rho_2}{\rho_1 + \rho_2} R$ m
	Blokka osilgan yuklar harakati	
14-20		Ko'char blok kuchdan 2 marta yutuq beradi: $F = \frac{mg}{2}$
	n ta ko'char bloklar ketma-ket ulangan bo'lsa	$F = \frac{mg}{2^n} \quad \vartheta = \frac{\vartheta_F}{2^n}$
14-21	Ko'char blokning foydali ish koeffitsiyenti η ga teng bo'lsa	$F = \frac{mg}{2\eta}$
14-22	 $m_2>m_1$	$T = \frac{2m_1m_2}{m_1+m_2} g; \qquad a = \frac{m_2-m_1}{m_2+m_1} g$ $T = m_2(g-a) = m_1(g+a)$ (Ko'chmas blok kuchdan yutuq bermaydi, faqat kuchning yo'nalishini o'zgartirib beradi)
14-23		$a = \frac{m_3 g}{m_1+m_2+m_3}; \; F = \frac{(m_1+m_2)m_3 g}{m_1+m_2+m_3}$

14-24		$a = \dfrac{m_2 g}{m_1 + m_2}$
14-25		$a = \dfrac{m_3 g}{2m + m_3}; \qquad m = m_1 = m_2$

14-26		$a = \frac{m_2 - m_1(\sin\alpha + \mu\cos\alpha)}{m_2 + m_1} g;$ $T = \frac{m_1 m_2 g}{m_1 + m_2}(1 + \sin\alpha + \mu\cos\alpha);$
14-27		$a = \frac{m_2 - (m_1 + \mu m)}{m_1 + m + m_2} g$ $T_1 = \frac{2m_2 + m(1-\mu)}{m_1 + m + m_2} m_1 g$ $T_2 = \frac{2m_1 + m(1+\mu)}{m_1 + m + m_2} m_2 g$
14-28	t vaqtdan keyin jismning ko'chmas blokdagi tezligi va blokning aylanish chastotasi	$\vartheta = \frac{\lvert m_1 - m_2 \rvert}{m_1 + m_2} \cdot gt;$ $\nu = \frac{\vartheta}{2\pi R}$

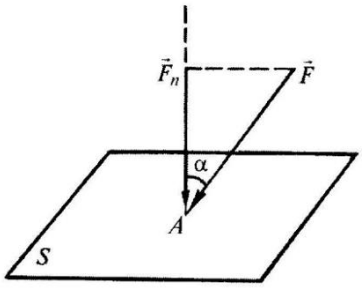
15- Inersiya momenti. Impuls momenti

15-1	Inersiya momenti	**I = mr²**	Kg·m²
15-2	**Aylanma harakat dinamikasining asosiy tenglamasi** (I- Inersiya momenti, ε – burchak tezlanish.	Kuch momenti: $M = I \cdot \varepsilon$	N·m
15-3	**Impuls momenti**	$L = I\omega$	Kg·m²/s
15-4	Kuch momentining impulsi	$M\Delta t$	N·m·s
15-5	Impuls momentining o'zgarish qonuni	$M\Delta t = I\omega - I\omega_0$	
15-6	Aylanma harakat kinetik energiyasi	$W_k = \frac{J\omega^2}{2}$	J
15-7	Agar jism dumalayotgan bo'lsa, uning to'la kinetik energiyasi	$W_k = \frac{m\vartheta^2}{2} + \frac{J\omega^2}{2}$	

IV bob. Suyuqlik va gazlar mexanikasi

16-§. Suyuqlik va gazlarda bosim

16-1	Bosim	$\mathrm{P} = \frac{F}{S}$	Pa

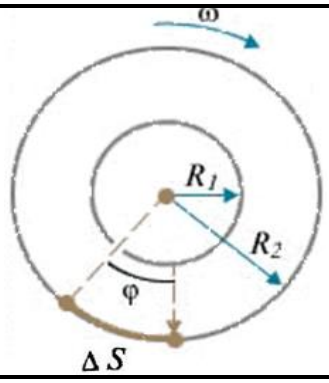
16-2		$\mathrm{P} = \frac{F}{S}\cos\alpha$	
16-3	**Gidrostatik yoki aerostatik bosim** (suyuq-likning idish tubiga beradigan bosimi)	$P = \rho_s gh$	
16-4	Suyuqlikning idishning yon devoriga beradigan bosimi	$P_y = \rho g \frac{h}{2}$	
16-5	Agar suyuqlikka p_0 tashqi bosim (masalan, havoning bosimi) ta'sir qilayotgan bo'lsa, u holda suyuqlikning ichida h chuqurlikdagi bosim	$P = P_0 + \rho_s gh$	
16-6	Ko'l tubidan chiqib kelayotgan pufak-cha hajmi yuqoriga chiqquncha n mar-ta oshsa, ko'lning chuqurligi($g=10 m/s^2$ bo'lganda)	$T_1 = T_2 \Rightarrow h = 10(n-1);$	
16-7		$T_1 \neq T_2 \Rightarrow h = 10(\frac{T_2}{T_1}n - 1);$	
16-8		$n = \frac{V_2}{V_1} = \left(\frac{R_2}{R_1}\right)^3$	
16-9	Suyuqlik sathidan h chuqirlikda joylashgan teshikdan otilib chiqayotgan suvning tezligi	$\vartheta = \sqrt{2gh}$	
16-10	Agar yuzasi S bo'lgan teshikdan zichligi ρ bo'lgan suyuqlik	$m = \rho \cdot S \cdot \vartheta \cdot t$	Kg
16-11	ϑ tezlik bilan otilib chiqayotgan bo'lsa, t vaqt ichida otilib chiqqan suyuqlik massasi va suyuqlik oqimining quvvati	$N = \frac{\rho \cdot S \cdot \vartheta^3}{2}$	W
16-12-14	Tutash idishlar	$\frac{h_1}{h_2} = \frac{\rho_2}{\rho_1};$ $P_T = \frac{2\rho_1\rho_2 h_0}{\rho_1 + \rho_2};$ $\Delta h = h_1 \frac{\rho_1 - \rho_2}{\rho_1 - \rho_2}$	
16-15-16	Gidravlik press	$\frac{F_1}{F_2} = \frac{S_1}{S_2}$ $\eta = \frac{F_{2f}}{F_2} \cdot 100\%$	

16-17	Ixtiyoriy balandlikdagi Atmosfera bosimi	$P = \mathrm{P}_0 \cdot e^{-\frac{\mu g h}{RT}}$	Pa
17-§ Bernulli tenglamasi. Harakatlanayotgan suyuqlik va gazlarda bosim			
17-1	Oqimning uzluksizlik tenglamasi	$S\vartheta = const \quad S_1\vartheta_1 = S_2\vartheta_2$	
17-2	Trubadan m massali suyuqlik ϑ tezlik bilan t vaqtda oqib o'tsa, trubaning ko'ndalang kesim yuzasi	$S = \frac{m}{\vartheta t \rho_s}$	
17-3-4	Suyuqlik oqimining quvvati	$N = \frac{\pi d^2 \rho \vartheta^3}{8}; \quad N = \frac{S\rho\vartheta^3}{2}$	
17-5	Bernulli tenglamasi	$\frac{\rho \upsilon_1^{\,2}}{2} + \rho g h_1 + P_1 = \frac{\rho \upsilon_2^{\,2}}{2} + \rho g h_2 + P_2$	Pa
17-6		$\frac{\rho \upsilon^2}{2} + \rho g h + P = const$	
17-7	Puazeyl qonuni r-trubaning radiusi.	$\upsilon = -\frac{\Delta P}{\Delta l}\frac{r^2}{8\eta}$; $\frac{\Delta P}{\Delta l}$-bosim gradiyenti; η-suyuqlikning qovushqoqlik (yoki yopishqoqlik, yoxud ichki ishqalanish) koeffitsiyenti; υ-oqimning o'rtacha tezligi;	m/s
17-8	Puazeyl formulasi(vaqtning biror Δt oralig'ida trubadan oqib o'tgan suyuqlikning Δ V hajmi)	$\Delta V = -\frac{\pi r^4}{8\eta}\frac{\Delta P}{\Delta l}\Delta t$	m^3
17-9	Stoks formulasi(Qovushqoq suyuqlik ichida harakatlanayotgan shar uchun qarshilik kuchi)	$F = 6\pi\eta r\upsilon$	
17-10	Aerostat tezlanishi	$a = g\left(\frac{\rho_2 g V}{\rho_1 g V_1 + P_2} - 1\right)$	m/s^2
17-11-12	Samolyot qanotining minimal ko'tarish kuchi	$F_T = \frac{\eta N}{\upsilon}; \quad F = ma + \mu p = m\frac{\vartheta^2}{2S} + \mu m g$	
18-§ Arximed kuchi. Suzish shartlari			
18-1	Arximed kuchi	$F_A = \rho_s g V_j; \quad F = \rho g (h_2 - h_1)s$	N

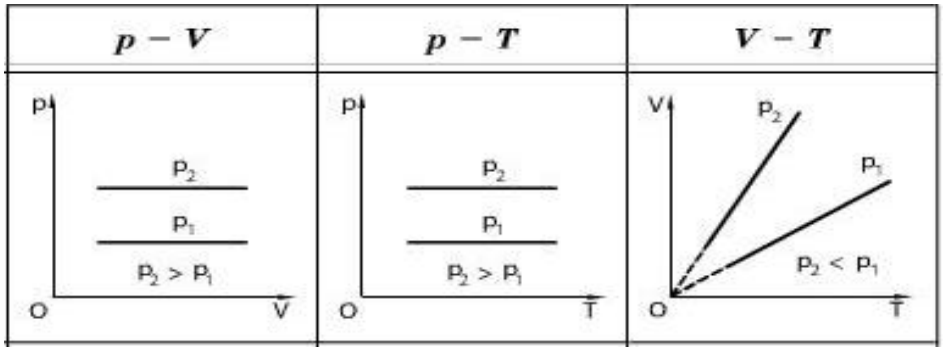
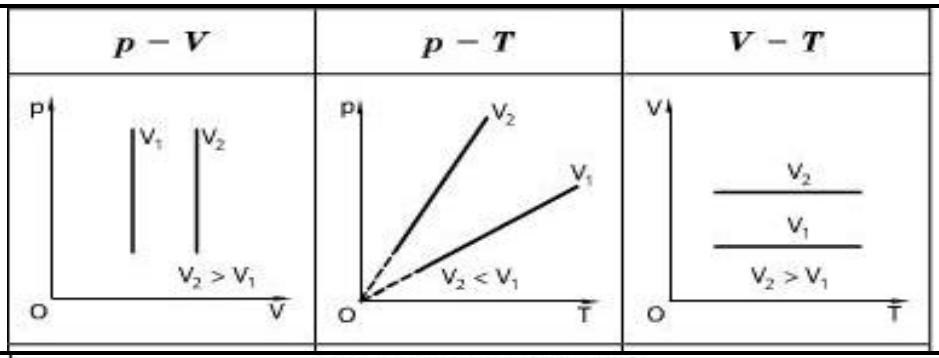
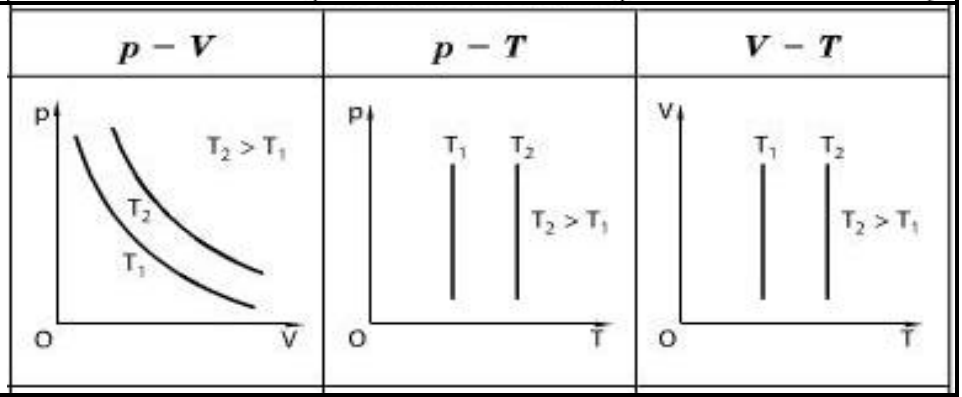
18-2	Jismning suyuqlikdagi og'irligi	$P_1 = F_{og'} - F_A;$	N
18-3	Suvdan ko'tarilayotgan jismning n qismi suvdan chiqqanda taranglik kuchi N marta ortsa, jismning zichligi	$\rho = \rho_S \frac{N-1+n}{N-1}$	
18-4	Suyuqlikka botirilgan havodagi og'irligi P, suyuqlikdagi og'irligi P_1 bo'lgan jismning zichligi	$\rho = \rho_S \frac{P}{P-P_1}$	
18-5	Suluqlikda jism og'irligi n marta kamaygan bo'lsa, jism zichligi	$\rho_j = \frac{n}{n-1} \cdot \rho;$ $n = \frac{mg}{mg - F_{og'}}$	
18-6-7	Jismning ρ_1 zichlikli suyuqlikdagi og'irligi P_1, ρ_2 zichlikli suyuqlikdagi og'irligi P_2 bo'lsa, jismning zichligi va hajmi	$\rho = \frac{P_2\rho_1 - P_1\rho_2}{P_2 - P_1}$ $V = \frac{P_1 - P_2}{g(\rho_2 - \rho_1)}$	Kg/m^3 m^3
18-8	ρ zichlikli metal shar ichidagi bo'shliq havo hajmi V_B bo'lib, bu shar suyuqlik ichida muallaq turgan bo'lsa, sharning massasi va hajmi	$m = \frac{\rho \cdot \rho_s}{\rho - \rho_s} V$ $V = \frac{\rho_s}{\rho_j - \rho_s} V_B$	kg
18-9	ρ zichlikli($\rho_2 < \rho < \rho_1$), V hajmli jism zichliklari ρ_1, ρ_2 bo'lgan suyuqliklar ichida to'la botgan holda turibdi. Jism hajmining pastdagi 1-suyuqlikda turgan qismining hajmi V_1 va yuqoridagi 2- suyuqlikda turgan qismining hajmi V_2	$V_1 = \frac{\rho - \rho_2}{\rho_1 - \rho_2} V$ $V_2 = \frac{\rho_1 - \rho}{\rho_1 - \rho_2} V$	
18-10	Agar jism hajmining yarmi ρ_1 zichlikli suyuqlikda, qolgan yarmi ρ_2 zichlikli suyuqlikda turgan bo'lsa, jismning ρ zichligi($\rho_2 < \rho < \rho_1$)	$\rho = \frac{\rho_1 + \rho_2}{2}$	
18-11-12	ρ_S zichlikli suyuqlikda ρ_T zichlikli tuz eriganda, umumiy hajmi V_E, zichligi ρ_E bo'lgan eritma hosil bo'lsa, suyuqlik hajmi V_S va tuz hajmi V_T quyidagich	$V_S = \frac{\rho_T - \rho_E}{\rho_T - \rho_S} V_E$ $V_T = \frac{\rho_E - \rho_S}{\rho_T - \rho_S} V_E$	

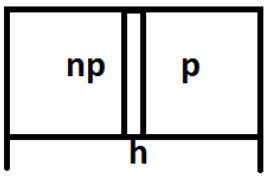
18-13-14	ρ_S zichlikli suyuqlikda ρ_T zichlikli tuz eriganda, umumiy massasi m_E, zichligi ρ_E bo'lgan eritma hosil bo'lsa, suyuqlik massasi m_S va tuz massasi m_T quyidagich	$m_S = \frac{\rho_S}{\rho_E}\frac{\rho_T-\rho_E}{\rho_T-\rho_S}m_E$ $m_T = \frac{\rho_T}{\rho_E}\frac{\rho_E-\rho_S}{\rho_T-\rho_S}m_E$	
18-15-16	Jism V_j hajmining V_b qismi suyuqlikka botgan bo'lsa, suyuqlik ustidagi hamda botgan qismlarining hajmlari	$V_u = \frac{\rho_s-\rho}{\rho_s}V_j \qquad V_b = \frac{\rho}{\rho_s}V_j$	
18-17	To'la botirilgach qo'yib yuborilgan cho'kmaydigan jism oladigan dastlabki tezlanish(suyuqlik qarshilik kuchi hisobga olinmaganda)	$a = \frac{\rho_s-\rho_j}{\rho_j}g$	
18-18	Cho'kayotgan jism oladigan dastlabki tezlanish (suyuqlik qarshilik kuchi hisobga olinmaganda)	$a = \frac{\rho_j-\rho_s}{\rho_j}g$	
18-19	h balandlikdan suyuqlikka tashlangan jismning cho'kish chuqurligi	$l = \frac{\rho}{\rho_s-\rho}h$	m
18-20	Asosining yuzi S, balandligi h, zichligi ρ bo'lgan, suyuqlikda turgan va cho'kmaydigan prizmatik jismni suyuqlikka to'la botirish uchun bajariladigan ish A_B va chiqarib olish uchun bajariladigan ish A_{CH}	$A_B = \frac{Sh^2g}{2\rho_s}(\rho_s-\rho)^2$	
18-21		$A_{CH} = \frac{Sh^2g}{2\rho_s}\rho^2$	
18-22	Brusok suvdan olib moyga botirilganda cho'kish balandligi Δh ga ortgan bo'lsa, brusok massasi	$m = S_0\Delta h\cdot\frac{\rho_s\cdot\rho_{moy}}{\rho_s-\rho_{moy}}$	
MOLEKULAR FIZIKA VA TERMODINAMIKA **V bob. Molekular fizika** **19-§. Molekular-kinetik nazariya**			
19-1	Molekulalar(yoki atomlar) markazlari orasidagi masofa	$D = \sqrt[3]{\frac{V_\mu}{N_A}} = \sqrt[3]{\frac{\mu}{\rho N_A}} = \sqrt[3]{\frac{kT}{P}};$	m
19-2	Moddaning nisbiy molekulyar yoki atom massasi	$\boldsymbol{M_N} = \frac{\boldsymbol{m_o}}{\boldsymbol{m_{oC}/12}} \qquad \boldsymbol{A}_{\text{relativ}} = \frac{\boldsymbol{m_o}}{\boldsymbol{m_{oC}/12}}$	

19-3	Modda miqdori	$\nu = \frac{N}{N_A} = \frac{m}{\mu} = \frac{\rho V}{\mu} = \frac{nV}{N_A} = \frac{PV}{RT}$	mol
19-4	Avagadro soni	$N_A = \frac{N}{\nu} = \frac{\mu}{m_0} = 6.02 \cdot 10^{23}$	
19-5	Loshmidt soni	$N_L = 2.69 \cdot 10^{25} m^{-3}$	
19-6	Molyar massa	$\mu = m_0 N_A = \frac{m}{\nu} = \frac{\rho RT}{P}$	kg /mol
19-7	Aralashmaning molyar massasi	$\mu = \frac{m_1 + m_2 + m_3 ... + m_n}{\frac{m_1}{\mu_1} + \frac{m_2}{\mu_2} + \frac{m_3}{\mu_3} + ... \frac{m_n}{\mu_n}}$ $\mu = \frac{\nu_1\mu_1 + \nu_2\mu_2 + \nu_3\mu_3 ... + \nu_n\mu_n}{\nu_1 + \nu_2 + \nu_3 ... + \nu_n}$	
19-8	Modda massasi	$m = \nu\mu = m_0 N$	kg
19-9	Molekulalari soni	$N = \nu N_A = \frac{m}{m_0}$	
19-10	Molekula massasi	$m_0 = \frac{\mu}{N_A} = \frac{m}{N}$	
19-11	Zarrachalar konsentrasiyasi	$n = \frac{N}{V} = \frac{3}{2}\frac{P}{E} = \frac{N_A \rho}{\mu}$	m^{-3}
20-§. Ideal gaz			
20-1	Molekulyar-kinetik nazariyaning asosiy tenglamasi	$P = \frac{1}{3} n m_0 \overline{\vartheta}^2 = \frac{1}{3}\rho\overline{\vartheta}^2 = \frac{2}{3} n\overline{E}$	Pa
20-2	Molekulalar ilgari-lanma harakatining o'rtacha kitnetik energiyasi	$\overline{E}_k = \frac{3}{2}kT; \quad \overline{\mathrm{E}} = \frac{m\overline{\vartheta}^2}{2}; \quad E_k = \frac{3P}{2n}$	J
20-	Dalton qonuni	**$P = P_1 + P_2 + P_3 + ...$**	Pa

3			
20-4	Apsolyut harorat T(Kelvin shkalasi) va Selsiy shkalasi bo'yicha o'lchangan harorat t orasidagi bog'lanish	$T \approx t + 273$ $t \approx T - 273$	K^0 C^0
20-5	Apsolyut harorat	$T = \frac{2}{3}\frac{E}{k} = \frac{\vartheta^2 \mu}{3R}; \quad \left(R = 8.3144\left[\frac{J}{mol \cdot K}\right]\right)$	K^0
21-§. Gaz mo'lekulalarining tezligi. Klapeyron—Mendeleyev tenglamasi			
21-1	Molekulalar sonining tezliklar bo'yicha Maksvell taqsimot funksiyasi	$\frac{\Delta N}{\Delta v} = N\frac{4}{\sqrt{\pi}}\left(\frac{\mu}{2RT}\right)^{\frac{3}{2}} \cdot e^{-\frac{\mu v^2}{2RT}} \cdot v^2$	
21-2	O'rtacha kvadratik tezlik	$\vartheta_{kv} = \sqrt{\frac{3RT}{\mu}} = \sqrt{\frac{3kT}{m_0}} = \sqrt{\frac{3P}{m_0 n}} = \sqrt{\frac{3P}{\rho}} = \sqrt{\frac{3VP}{m}}$	
21-3	O'rtacha arifmetik tezlik	$\vartheta_{ar} = \sqrt{\frac{8RT}{\pi\mu}} = \sqrt{\frac{8kT}{\pi m_0}} = \sqrt{\frac{3kT}{\mu}} = 1.60\sqrt{\frac{RT}{\mu}}$	
21-4	Eng katta ehtimolli tezlik	$\vartheta_{eh} = \sqrt{\frac{2RT}{\mu}} \quad \left\lvert k = \frac{R}{N_A} = 1.3807 \cdot 10^{-23}\left[\frac{J}{K}\right]\right.$	
21-5	Agar Shtern tajribasida asbobning aylanish chastotasi ν, kumush molekulalarining burchak siljishi φ bo'lsa, kumush bug'i molekulasining tezligi (R_2-R_1 -Ichki va tashqi slindrlar orasidagi masofa)	$\overline{\vartheta} = \frac{R_2 - R_1}{\varphi} 2\pi\nu$	
21-6		Shtern tajribasida turli tezlikli molekulalarning ΔS yoy bo'ylab yoyilishi $\overline{\vartheta} = 2\pi\nu R_2 \frac{R_2 - R_1}{\Delta S}$	
21-7	Molekulaning o'rtacha yugurish yo'li	$\bar{l} = \frac{1}{\sqrt{2}} n\pi d^2$	m
21-8-11	Ideal gaz bosimi	$P = nkT = \frac{N}{V}kT \qquad P = \frac{m}{\mu V}RT = \frac{\nu RT}{V} = \frac{\rho RT}{\mu}$	
21-12-	Ideal gaz holat tenglamasi	Mendeleev-Klapeyron tenglamasi	

15		$PV = \frac{m}{\mu}RT = \nu RT = \frac{\mathbf{N}}{\mathbf{N_A}}RT;\quad P = \frac{\rho}{M}RT$	
21-16	Gazning massasi	$m = \frac{PV\mu}{RT}$	kg
21-17-20	Gazning zichligi	$\rho = \frac{P\mu}{RT}\quad \rho = \frac{n\mu}{N_A}\quad \rho = \frac{\nu \cdot \mu}{V}\quad \rho = \frac{3P}{\vartheta^2}$	Kg/m^3
21-21	Klapeyron tenglamasi	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} = \frac{PV}{T} = const$	
21-22	Agar hajm, bosim, harorat-dan tashqari idishdagi gaz massasi ham o'zgarsa	$\frac{P_1V_1}{T_1m_1} = \frac{P_2V_2}{T_2m_2} = ... = \frac{P_nV_n}{T_nm_n} = const$	
21-23	Gaz massasining yarmi chiqarib yuborilganda	$\frac{P_1V}{T_1} = 2\frac{P_2V}{T_2}$	
21-24	Gaz massasining n qismi chiqarib yuborilganda	$\frac{P_1}{P_2} = \frac{T_1}{(1-n)T_2}\qquad P_2 = \frac{(1-n)P_1T_2}{T_1}$	
21-25	Idishlar tutashtirilganda umumiy bosim, modda miqdori teng bo'lganda	$P = \frac{2P_1 \cdot P_2}{P_1 + P_2}$	
21-26	Idishlar tutashtirilganda umumiy bosim, hajmlari teng bo'lganda	$P = \frac{P_1 + P_2}{2}$	
21-27	Idishlar tutashtirilganda umumiy bosim, bir xil gaz bo'lsa	$P = \frac{(m_1 + m_2) \cdot P_1 \cdot P_2}{P_1 \cdot m_2 + P_2 \cdot m_1}$	
21-28	Idishlar tutashtirilganda umumiy bosim, massalari bir xil bo'lsa	$P = \frac{(\mu_1 + \mu_2) \cdot P_1 \cdot P_2}{P_1 \cdot \mu_1 + P_2 \cdot \mu_2}$	
22-§. Gaz qonunlari			
22-1	Izobara (Gey-Lyussak qonuni)	$P = const,\quad \frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{V}{T} = const\quad \beta = \frac{P - P_0}{P_0T}$	

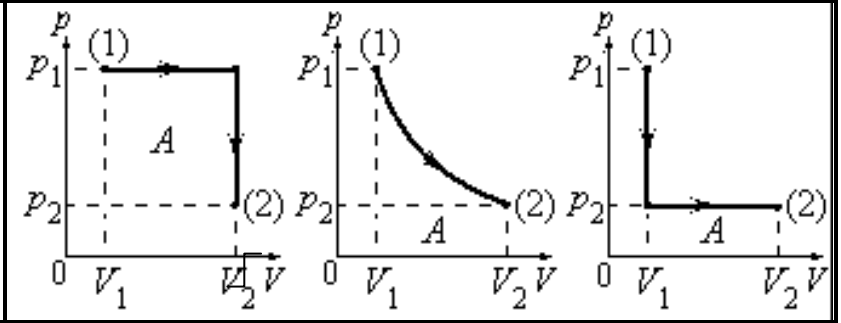
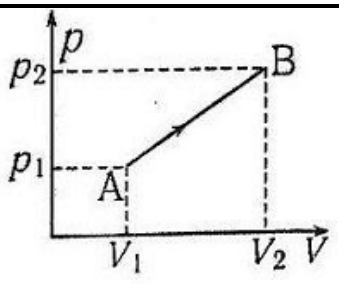
22-2	Izoxora (Sharl qonuni)	$V = \text{const}, \quad \frac{P_1}{T_1} = \frac{P_2}{T_2} = \frac{P}{T} = \text{const} \quad \alpha = \frac{V - V_0}{V_0 T}$
22-3	Izoterma (Boyl-Mariott qonuni)	$T = \text{const}, \quad P_1 V_1 = P_2 V_2 = PV = \text{const}$ $\frac{P_1}{P_2} = \frac{V_2}{V_1} = \frac{\rho_1}{\rho_2}$
22-4	Agar P_1 bosimdagi V_1 hajmli idish, P_2 bosimdagi V_2 hajmli idish, P_3 bosimdagi V_3 hajmli idishlar tutashtirilsa, natijav bosim	$P = \frac{P_1 V_1 + P_2 V_2 + P_3 V_3}{V_1 + V_2 + V_3}$
22-5	Izobarik jarayonda holat parametrlarining o'zgarish grafiklari	
22-6	Izoxorik jarayonda holat parametrlarining o'zgarish grafiklari	
22-7	Izotermik jarayonda holat parametrlarining o'zgarish grafiklari	
22-8	Hajmi V_0 bo'lgan havo so'rib olayotgan nasos silindrining ishchi hajmi V_1 bo'lsa, N ta sikldan so'ng idishdagi bosim n marta kamayadi	$p_n = \frac{p_0}{(V_0 + V_1)^N}$

22-9	 Uzunligi h bo'lgan yopiq silindrik idishni erkin siljiydigan porshen teng ikkiga ajratib turibdi. Porshen mahkamlab qo'yilganda bir tomondagi bosim ikkinchisidan n marta farq qilsa, porshen bo'shatilganda qanday masofaga siljishi. T=const	$\Delta h = \frac{n-1}{2(n+1)} h$
Xususiy gaz qununlari		
22-10	$PV^k = const \Rightarrow$	$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{k-1}$
22-11	$P^n V = const \Rightarrow$	$\frac{T_2}{T_1} = \left(\frac{P_1}{P_2}\right)^{n-1}$
22-12	$P^n V^k = const \Rightarrow$	$\frac{T_2}{T_1} = \left(\frac{P_1}{P_2}\right)^{n-1} \left(\frac{V_1}{V_2}\right)^{k-1}$
22-13	$\frac{V^n}{T} = const \Rightarrow$	$\frac{P_2}{P_1} = \left(\frac{V_2}{V_1}\right)^{n-1}$
22-14	$\frac{V}{T^k} = const \Rightarrow$	$\frac{P_2}{P_1} = \left(\frac{T_1}{T_2}\right)^{k-1}$
22-15	$\frac{V^n}{T^k} = const \Rightarrow$	$\frac{P_2}{P_1} = \left(\frac{V_2}{V_1}\right)^{n-1} \left(\frac{T_1}{T_2}\right)^{k-1}$
22-16	$\frac{P^n}{T} = const \Rightarrow$	$\frac{V_2}{V_1} = \left(\frac{P_2}{P_1}\right)^{n-1}$
22-17	$\frac{P}{T^k} = const \Rightarrow$	$\frac{V_2}{V_1} = \left(\frac{T_1}{T_2}\right)^{k-1}$

22-18	$\frac{P^n}{T^k} = const \Rightarrow$	$\frac{V_2}{V_1} = \left(\frac{P_2}{P_1}\right)^{n-1}\left(\frac{T_1}{T_2}\right)^{k-1}$

VI bob.Termodinamika

23-§. Termodinamika elementlari

23-1	Ideal gaz-ning ichki energiyasi	$U = \frac{i}{2}\nu RT = \frac{i}{2}\frac{m}{\mu}RT = \frac{i}{2}PV = \frac{i}{2}kTN$	J
23-2	1-atomli Ideal gazning ichki energiyasi i=3	$U = \frac{3}{2}\nu RT = \frac{3}{2}\frac{m}{\mu}RT = \frac{3}{2}PV = \frac{3}{2}\frac{N}{N_A}RT$	
23-3	2-atomli Ideal gazning ichki energiyasi i=5	$U = \frac{5}{2}\nu RT = \frac{5}{2}\frac{m}{\mu}RT = \frac{5}{2}PV = \frac{5}{2}\frac{N}{N_A}RT$	
23-4	3 va undan ko'p atomli Ideal gazning ichki energiyasi i=6	$U = \frac{6}{2}\nu RT = \frac{6}{2}\frac{m}{\mu}RT = \frac{6}{2}PV = \frac{6}{2}\frac{N}{N_A}RT$	
23-5	Termodinamik ish (gaz hajmi-ning o'zgarishi-da bajarilgan ish)	$A = P(V_2 - V_1) = P\Delta V = \nu R\Delta T = \frac{m}{\mu}R\Delta T;$	
23-6	Gaz hajmi V_1 dan V_2 gacha o'zgarganda bajarilgan ish	$A = \int_{V_1}^{V_2} P(V)dV$	
23-7	Bosim grafigining absissa o'qi bilan hosil qilgan yuzi son jihatidan termodina-mik ishga teng.		
23-8		$\Delta A = P_1(V_2 - V_1) + \frac{(P_2 - P_1)(V_2 - V_1)}{2}$	

24-§. Termodinamika qonunlari

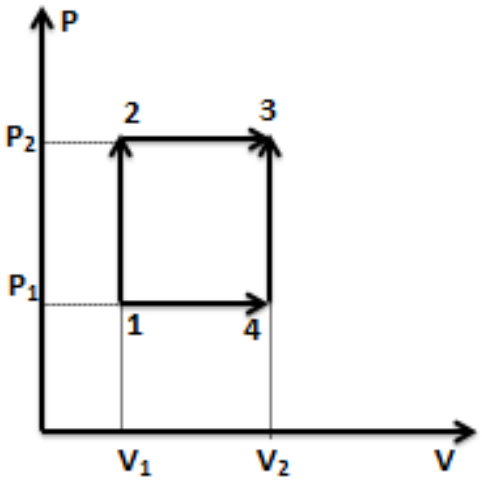
24-1	Termodinamikaning 1 –qonuni	$Q = \Delta U + A; \quad Q = \Delta U - A';$ $Q = \Delta U + P\Delta V$ A-sistemaning tashqi kuchlarga qarshi bajargan ishi; A'-tashqi kuchlarning sistema ustida bajargan ishi; Q-sistemaga berilgan issiqlik miqdori; ΔU -sistema ichki energiyasining o'zgarishi.

Termodinamika birinchi qonunining izojarayonlarga tadbiqi

24-2	Izobara	$P = const \Rightarrow \Delta A \neq 0 \quad \Delta U \neq 0 \qquad Q = \Delta U + A$
24-3	1-atomli gaz	$A_1 = 0.4Q; \qquad \Delta U_1 = 0.6Q$
24-4	2-atomli gaz	$A_2 = \frac{2}{7}Q \qquad \Delta U_2 = \frac{5}{7}Q$
24-5	3 va undan ko'p atomli gaz	$A_3 = 0.25Q; \qquad \Delta U_3 = 0.75Q$
24-6	Izobarik jarayonda ish	$A = P(V_2 - V_1) = P\Delta V = \nu R\Delta T = \frac{m}{\mu} R\Delta T;$
24-7	Izoxora	$V = const \Rightarrow \Delta V = 0 \qquad A = 0; \qquad Q = \Delta U$
24-8		Gaz isitilsa: $Q > 0; \Delta U > 0$ Gaz sovitilsa: $Q < 0; \Delta U < 0$
24-9	Izoterma	$T = const \Rightarrow \Delta T = 0 \qquad \Delta U = 0 \qquad Q = A$
24-10		$Q = A' = \frac{m}{\mu} RT \ln \frac{V_2}{V_1} = \frac{m}{\mu} RT \ln \frac{P_1}{P_2}$
24-11		Gaz isitilsa: $Q > 0; A > 0$ Gaz sovitilsa: $Q < 0; A < 0$
24-12	Adiabata	$\Delta U = -A; \qquad A = \frac{3}{2}\frac{m}{\mu} R(T_1 - T_2) = \frac{3}{2}(P_1V_1 - P_2V_2)$

Issiqlik mashinalari

24-13	Karno sikli davomida gazning bajargan ishi	$A = Q_1 - Q_2$	J

24-14	Real issiqlik mashinasining FIK	$\eta = \frac{Q_1 - Q_2}{Q_1} 100\%$	%
24-15	Ideal issiqlik mashinasining FIK	$\eta = \frac{T_1 - T_2}{T_1} 100\%$	
24-16		$\eta = \frac{Q_{1,2} + Q_{2,3} - \lvert Q_{3,4} \rvert - \lvert Q_{4,1} \rvert}{Q_{1,2} + Q_{2,3}} 100\%$	

25-§. Moddalarning issiqlik sig'imlari. Modda agregat holatining o'zgarishi

25-1	Solishtirma issiqlik sig'imi	$c = \frac{Q}{m(T_2 - T_1)}$	J/kgK
25-2	Jismning issiqlik sig'imi	$C = mc \qquad C = \frac{Q}{(T_2 - T_1)}$	J/K
25-3	Jismga berilgan issiqlik miqdori	$Q = cm(T_2 - T_1) \qquad Q = C\Delta T$	J
25-4	Issiqlik balansi tenglamasi	$\sum Q_{ber} = \sum Q_{ol} \qquad Q_1 + Q_2 + Q_3 + \ldots = 0$	J
25-5-6	Sovuq va issiq suv aralashmasining oxirgi harorati. Rixman tenglamasi	$t = \frac{m_1 t_1 + m_2 t_2}{m_1 + m_2}; \quad t = \frac{V_1 t_1 + V_2 t_2}{V_1 + V_2}$	C^0
25-7	m_1 massali sovuq suyuqlikni Δt_1 haroratga qizdirish uchun m_2 massali suyuqlik Δt_2 haroratga sovishi kerak	$\Delta t_2 = \frac{m_1}{m_2} \Delta t_1$	
25-8	Molyar issiqlik sig'imi	$C_\mu = \frac{Q}{\mu \Delta T} = \mu \cdot c$	$\frac{J}{mol \cdot K}$

O'zgarmas P bosim, V hajm, T haroratda solishtirma issiqlik sig'imi

25-9	Bir atomli ideal gaz uchun	$C_P=\frac{5R}{2\mu};\quad C_V=\frac{3R}{2\mu};\quad C_T=\frac{1}{0};$	$\frac{J}{kg\cdot K}$
25-10	Ikki atomli ideal gaz uchun	$C_P=\frac{7R}{2\mu};\quad C_V=\frac{5R}{2\mu};\quad C_T=\frac{1}{0};$	
25-11	Uch va undan ko'p atomli ideal gaz uchun	$C_P=4\frac{R}{\mu};\quad C_V=3\frac{R}{\mu};\quad C_T=\frac{1}{0};$	
25-12	1,2,3 va ko'p atomli ideal gazlar uchun Puasson koeffisiyenti	$\left(\gamma=\frac{C_P}{C_V}\right)\quad \gamma_1=\frac{5}{3};\quad \gamma_2=\frac{7}{5};\quad \gamma_3=\frac{4}{3};$	
25-13	Mayer formulasi	$C_p=C_V+R;\ C_p=\frac{i}{2}R+R;\ C_V=\frac{i}{2}R;$	$\frac{J}{kg\cdot K}$
25-14	Solishtirma bug'lanish	$Q=rm$	J
26-§. Havoning namligi. Suyuqlikning sirt tarangligi. Kapillarlik hodisasi			
26-1-2	Havoning nisbiy namligi	$\varphi=\frac{P}{P_0}\cdot 100\%=\frac{\rho}{\rho_0}\cdot 100\%$	%
26-3	Agar t_1 haroratda to'yingan bug' bosimi P_{T1}, nisbiy namlik φ_1 bo'lsa, t_2 ($t_2 > t_1$) haroratda to'yingan bug' bosimi P_{T2}, nisbiy namlik φ_2	$\varphi_2=\frac{T_2}{T_1}\frac{P_{T1}}{P_{T2}}\varphi_1$	
26-4	Hajmlari $V_1, V_2, V_3,\ldots V_n$ bo'lgan balonlardagi nisbiy namliklar mos holda $\varphi_1,\varphi_2,\varphi_3\ldots\varphi_n$ bo'lsa, ularni ingichka nay bilan tutashtirganda hosil bo'ladigan natijaviy nisbiy namlik	$\varphi=\frac{\varphi_1V_1+\varphi_2V_2+\varphi_3V_3\ldots\varphi_nV_n}{V_1+V_2+V_3\ldots V_n}$	
Suyuqlik sirt tarangligi va kapilyarlik hodisalari			
26-5	Suyuqlikning sirt energiyasi	$W_p=\sigma S$	J
26-6	Har birining erkin sirt potensial energiyasi W_0 bo'lgan n ta tomchi qushilishidan hosil bo'lgan tomchining potensial energiyasi W va ichki energiyasining ortishi ΔU	$\Delta U=\left(n-\sqrt[3]{n^2}\right)\cdot W_0$ $W=\sqrt[3]{n^2}\cdot W_0$	

26-7	Sirt taranglik kuchi	$F = \sigma l$	N
26-8	Sirt taranglik koeffisienti	$\sigma = \frac{mg}{2\pi r} = \frac{k\Delta l}{2\pi r}$	N/m
26-9	Laplas formulasi (Agar suyuqlik sirti yassi bo'lmasa, u qisqarib, yassi sirtga intiladi va ichki bosimdan tashqari Δp qo'shimcha bosim hosil bo'ladi).	$p = \frac{2\sigma}{R}$	Pa
26-10	Havodagi sferik sovun pufagi ichidagi qo'shimcha bosim (sovun pufagining sirti 2 ta uchun)	$p = \frac{4\sigma}{R}$	
26-11	**Jyuren formulasi**: Kapillyar nayda yoki orasidagi masofa r bo'lgan ikkita parallel plastinkada suyuqlikning ko'tarilish balandligi	$h = \frac{2\sigma\cos\alpha}{r\rho_s g}$	m
26-12	Agar naycha kesimi tomoni a bo'lgan kvadrat bo'lsa suyuqlikning ko'tarilish balandligi	$h = \frac{4\sigma}{a\rho_s g}$	
26-13	Agar naycha kesimi tomonlari a va b bo'lgan to'g'ri to'rtburchak bo'lsa ko'tarilish balandligi	$h = \frac{2\sigma}{\rho_s g}\left(\frac{1}{a}+\frac{1}{b}\right)$	
26-14	Diametri d bo'lgan tomizg'ichdan tomayotgan suyuqlik tomchilari soni (V-suyuqlik hajmi)	$N = \frac{\rho V g}{\sigma\pi d}$	
26-15	Sovun pufagining radiusini R_1 dan R_2 gacha oshirishda tashqi kuch bajargan ish	$A = 8\pi\sigma\left(R_2^2 - R_1^2\right)$	

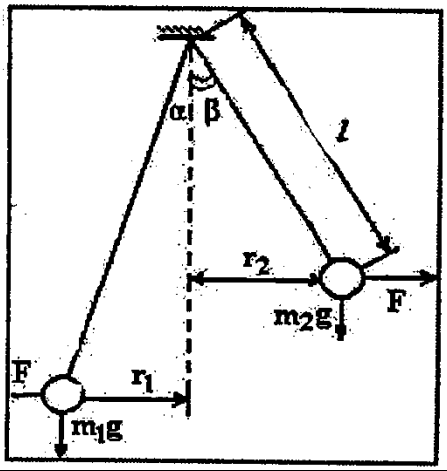
Real gazlar. Van-der-vaals tenglamasi

26-16	Ixtiyoriy m massali gaz uchun Van-der-vaals tenglamasi	$\left(p + \frac{m^2}{\mu^2}\frac{a}{V^2}\right)\left(V - \frac{m}{\mu}b\right) = \frac{m}{\mu}RT$

μ — gazning molyar massasi, V**μ** — gazning molyar hajmi,
V— gazning m massasining hajmi, a va b lar Van-der-Valls doimiylari;

26-17	1 mol gaz uchun Van-der-Vaals tenglamasi	$\left(p + \frac{a}{V_\mu^2}\right)\left(V_\mu - b\right) = RT$

27-§. Kristall va amorf jismlarning xossalari			
27-1	Moddaning solishtirma erish issiqligi	$\lambda = \frac{Q}{m}$	J/kg
27-2	Erish issiqligi	$Q = \lambda m$	J
27-3	Suyuqlikka tushurilgan jismning solishtirma erish issiqligi	$\lambda = \frac{(m_1c_1 + m_2c_2)(T - T_1) - m_3c_3(T_2 - T)}{m_3}.$	
m_1 , m_2 , m_3 –mos ravishda suyuqlikning, kalorimetrning hamda jismning massalari, c_1 , c_2 , c_3 –mos ravishda suyuqlikning, kalorimetrning hamda jismning solishtirma issiqlik sig'imlari, T_1-Kalorimetr va suvning boshlang'ich haroratlari, T_2-suyuqlikka tushurilgan jismning erish harorati, T-ma'lum vaqt o'tgandan keyingi sistemaning umumiy harorati.			
27-4	Yoqilg'ining solishtirma yonish issiqligi	$q = \frac{Q}{m}$	J/kg
27-5	Yonish issiqligi	$Q = qm$	J
27-6	Qurilmaning FIK	$\eta = \frac{Q_f}{Q_y}100\%$	%
ELEKTRODINAMIKA **VII bob. Elektrostatika** **28-§. Eektr zaryadlari. Kulon qonuni**			
28-1	Elektr zaryadining saqlanish qonuni	$q_1 + q_2 + q_3 + ... + q_N = const$	C
28-2	Ortiqcha elektronlar soni	$n = \frac{q}{e}$	
28-3-4	Kulon qonuni	$F = \kappa\frac{q_1q_2}{\varepsilon r^2}$ $\quad F = \frac{q_1q_2}{4\pi\varepsilon_0\varepsilon r^2}$	N
28-5	Proporsionallik koeffisienti	$\kappa = \frac{1}{4\pi\varepsilon_0} \approx 9\cdot10^9$	$\frac{Nm^2}{C^2}$
28-6	Elektr doimiysi	$\varepsilon_0 = 8{,}8542\cdot10^{-12}$	$\frac{C^2}{Nm^2}$

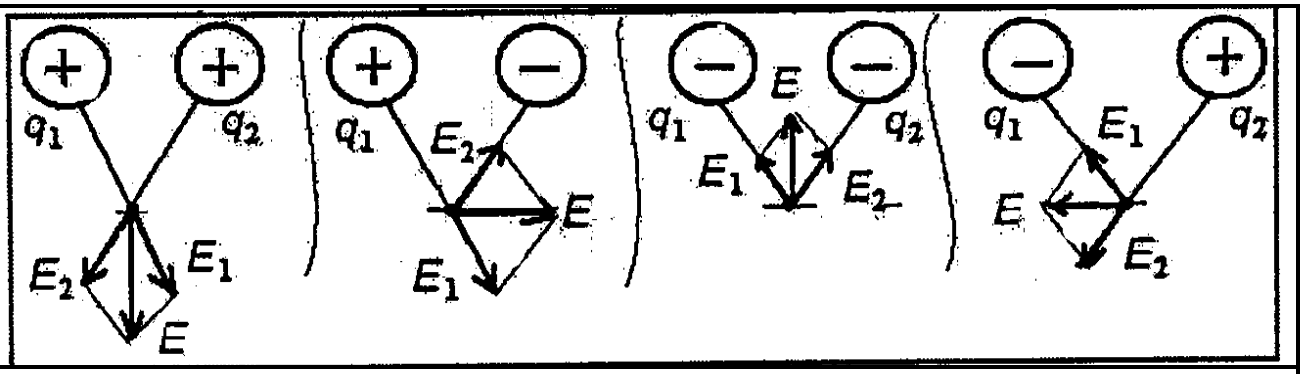
28-7	q_1, q_2 zaryadlar orasiga q_1 zaryaddan x masofaga q zaryad joylashtirilsa, q_1, q hamda q_2, q zaryadlar orasidagi Kulon kuchi	$F_1 = \kappa \frac{q_1 q}{x^2} \qquad F_2 = \kappa \frac{q_2 q}{(r-x)^2}$
28-8	Bir nuqtaga uzunligi l bo'lgan ipga osilgan m_1 va m_2 massali, zaryadlari q_1 va q_2 bo'lgan sharchalarning vertikaldan og'ish masofasi, og'ish burchaklari, Kulon kuchi va zaryadlari 	$r_1 = l \sin\alpha; \quad r_2 = l \sin\beta$
28-9		$tg\alpha = \frac{F}{m_1 g}; \quad tg\beta = \frac{F}{m_2 g}$
28-10		$F = \kappa \frac{q_1 q_2}{(r_1 + r_2)^2}$
28-11		$q = r \cdot \sqrt{\frac{2mg \cdot tg\alpha}{k}}$
28-12		$q = \frac{\varepsilon_0 mg \cdot tg\alpha}{\sigma}$
28-13	Ikkita zaryadlangan sharlar bir-biriga tekkizib va avvalgi holatiga qaytarilganda ta'sir kuchlarining o'zgarishi	$\frac{F_1}{F_2} = \frac{(q_1 + q_2)^2}{4q_1 \cdot q_2}$
28-14	Bir xil o'lchamli sharlar bir-biriga tekkizib yana oldingi joyiga keltirilganda potensial energiyasining necha marta o'zgarishi	$\frac{W_2}{W_1} = \frac{(q_1 + q_2)^2}{4q_1 \cdot q_2}$

29-§. Elektr maydon kuchlanganligi. Ostrogradskiy—Gauss teoremasi

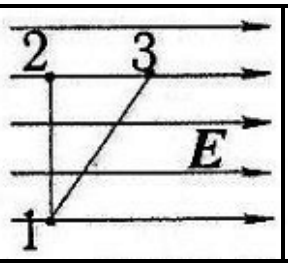
29-1	Elektr maydon kuchlanganligi	$\vec{E} = \frac{\vec{F}}{q} = k\frac{\lvert q\rvert}{\varepsilon r^2} \qquad \vec{E} = \frac{q}{4\pi\varepsilon_0 \varepsilon r^2}$	$\frac{N}{C}$
29-2	Elektr maydonning superpozisiya prinsipi	$\vec{E} = \vec{E}_1 + \vec{E}_2 + \ldots + \vec{E}_N$	
29-3	Ikkita zaryad uchun ($\alpha - \vec{E}_1, \vec{E}_2$ vektorlar orasidagi burchak)	$E = \sqrt{E_1^2 + E_2^2 + 2E_1 E_2 \cos\alpha}$	

29-4	E gorizontal yo'nalishdagi elektr maydonida elektronning tezlanishi	$a=\frac{eE}{m_e};$	$a=\frac{eU}{m_e\cdot d}$
29-5	Agar sirt kuch chiziqlariga perpendikular va maydon bir jinsli bo'lib, uning kuchlanganligi E bo'lsa, u holda kuchlanganlik oqimi	$N=ES$	
29-6	Ostrogradskiy—Gauss teoremasi: zaryadlarni o'z ichiga oluvchi har qanday berk sirt orqali o'tuvchi kuchlanganlik oqimi o'ralib olingan zaryadlarning algebraik yig'indisining elektr doimiysiga nisbatiga teng bo'ladi.	$N=\frac{\sum_{i=1}^{n} q_i}{\varepsilon_0}$	
29-7	Zaryadning sirt zichligi	$\sigma=\frac{q}{S}=\frac{4\pi\varepsilon\varepsilon_0\varphi R}{S}$	C/m^2
29-8	Sfera sirtida zaryadning sirt zichligi	$\sigma=\frac{\varepsilon\varepsilon_0\varphi}{R}$ $\left[\varepsilon=\frac{F_V}{F_M}\right]$	
29-9	Tekis zaryadlangan cheksiz tekislikning maydon kuchlanganligi	$E=\frac{\sigma}{2\varepsilon_0}$	V/m
29-10	Qarama-qarshi ishorali tekis zaryadlangan ikkita cheksiz parallel tekisliklarning maydon kuchlanganligi	$E=\frac{\sigma_1}{\varepsilon_0}+\frac{\sigma_2}{\varepsilon_0};$	
29-11	$\sigma_1=\sigma_1=\sigma\Rightarrow$	$E=E_+ + E_-\Rightarrow$ $E=\frac{\sigma}{\varepsilon_0}$	
29-12	Bir tekis zaryadlangan sferaning maydon kuchlanganligi	$E=k\frac{q}{R^2}=\frac{\sigma}{\varepsilon\varepsilon_0}$	
Sharning ichida maydon kuchlanganligi faqat sharning markazida nolga teng bo'ladi, markazdan uzoqlashgan sari maydon kuchlanganligi masofaga proporsional ravishda ortib boradi.			
29-13	Zaryadlangan shar sirtidagi elektr maydonining kuchlanganligi(r=R)	$E=k\frac{q}{R^2}=\frac{\sigma}{\varepsilon\varepsilon_0}$	V/m
29-14	Zaryadlangan shar tashqarisidagi elektr maydonining kuchlanganligi(r>R)	$E=k\frac{q}{r^2}=\frac{\sigma}{\varepsilon\varepsilon_0}$	

29-15	R-radiusli disk markazidan d uzoqlikda yotgan nuqtada elektr maydon kuchlanganligi	$E=\frac{\sigma}{\varepsilon\varepsilon_0}\left(1-\frac{d}{\sqrt{R^2+d^2}}\right)$	
29-16	R-radiusli halqa markazidan d uzoqlikda yotgan nuqtada elektr maydon kuchlanganligi	$E=kq\frac{d}{\left(R^2+d^2\right)^3}$	
29-17	Zaryadlangan cheksiz uzun ipdan d uzoqlikda yotgan nuqtada elektr maydon kuchlanganligi τ -zaryadning chiziqli zichligi.	$E=\frac{\tau}{2\pi\varepsilon\varepsilon_0 d}$	
29-18	Maydonning elektrostatik induksiyasi	$D=\varepsilon\varepsilon_0 E$	$\frac{V}{m}=\frac{N}{C}$
29-19 29-20	Agar q_1 va q_2 zaryadlar bir xil ishorali bo'lsa, bu zaryadlarni tutashtiruvchi chiziqda va zaryadlar orasida shunday nuqta mavjudki (bu nuqta moduli katta zaryaddan uzoqda moduli kichik zaryadga yaqin joylashgan), shu nuqtadagi natijaviy maydon kuchlanganligi nolga teng. Ushbu nuqtaning 1-zaryaddan uzoqligi X_1 va 2-zaryaddan uzoqligi X_2: r-zaryadlararo masofa.	$X_1=\frac{\sqrt{\lvert q_1\rvert}}{\sqrt{\lvert q_1\rvert}+\sqrt{\lvert q_2\rvert}}r$ $X_2=\frac{\sqrt{\lvert q_2\rvert}}{\sqrt{\lvert q_1\rvert}+\sqrt{\lvert q_2\rvert}}r$	
29-21 29-22	Agar q_1 va q_2 zaryadlar har xil ishorali bo'lsa, bu zaryadlarni tutashtiruvchi chiziqda va zaryadlardan tashqarida shunday nuqta mavjudki (bu nuqta moduli katta zaryaddan uzoqda moduli kichik zaryadga yaqin joylashgan), shu nuqtadagi natijaviy maydon kuchlanganligi nolga teng. Ushbu nuqtaning 1-zaryaddan uzoqligi X_1 va 2-zaryaddan uzoqligi X_2 (r-zaryadlararo masofa)	$X_1=\frac{\sqrt{\lvert q_1\rvert}}{\sqrt{\lvert q_1\rvert}-\sqrt{\lvert q_2\rvert}}r$ $X_2=\frac{\sqrt{\lvert q_2\rvert}}{\sqrt{\lvert q_1\rvert}-\sqrt{\lvert q_2\rvert}}r$	
29-23	**Musbat bilan musbat, musbat bilan manfiy, manfiy bilan manfiy zaryadlar hosil qilgan natijaviy maydonning kuchlanganligi yo'nalishlari**		



30-§. Zaryadni ko`chirilishda bajarilgan ish. Potensial

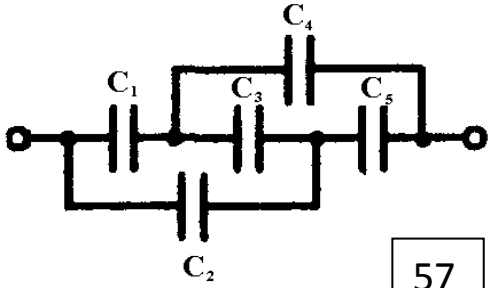
30-1	Zaryadni bir jinsli elektr maydonda ko'chirishda bajarilgan ish	$A = q\Delta\varphi \quad A = \kappa\frac{qq_0}{\varepsilon r}$	J
30-2	Zaryadlarning o'zaro ta'sir potensial energiyasi	$W_p = q\Delta\varphi \qquad W_p = \kappa\frac{q_1q_2}{\varepsilon r}$	
30-3		$A_{123} = A_{12} + A_{23} \quad A_{12} = 0 \quad A_{123} = A_{23}$ $A = q(\varphi_3 - \varphi_2)$	
30-4	Elektr maydonning energiya zichligi	$\varpi = \frac{\varepsilon\varepsilon_0 E^2}{2}$	J/m^3
30-5	Elektr maydonda harakatlanayot-gan zarrachaning tezligi	$\vartheta = \sqrt{\frac{2Eq\Delta l}{m}}$	m/s
30-6	Elektr maydonda harakatlanayotgan zarrachaning bosib o'tgan yo'li	$\Delta l = \frac{\vartheta^2 m}{2Eq}$	m
30-7	Elektr maydonda harakatlanayotgan zarrachaning to'xtashi uchun ketgan vaqt	$t = \frac{\vartheta m}{Eq}$	s
30-8	Elektr maydonda harakatlanayotgan zarrachaning elektr maydon kuchlanganligi	$E = \frac{\vartheta m}{tq}$	V/m
30-9	Elektr maydon potensiali	$\varphi = \frac{W_p}{q} = k\frac{q}{\varepsilon r}$	V

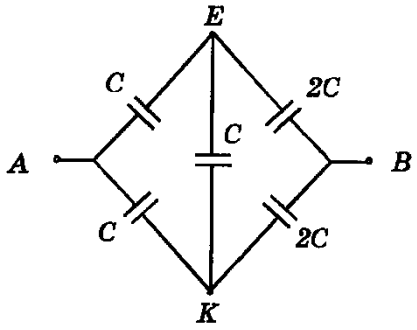
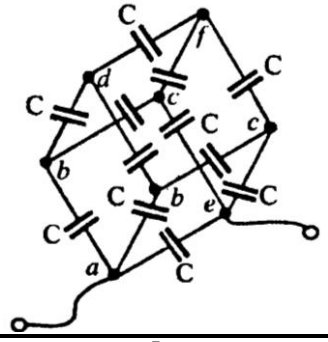
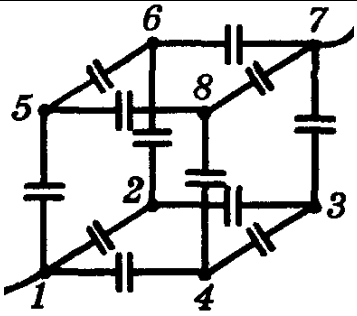
30-10	q_1, q_2 nuqtaviy zaryadlar bir-biridan r masofada joylashgan, 1- zaryaddan r_1 va 2- zaryaddan r_2 masofada turgan nuqtadagi maydon potensiali(zaryadlar turli ishorali bo'lsa (-) ishora olinadi).	$\varphi = k\left(\frac{q_1}{R_1} \pm \frac{q_2}{R_2}\right)$	
30-11	Elektr maydon kuchlanganligi va potensiallar farqi orasidagi bog'lanish	$E = \frac{\varphi_1 - \varphi_2}{l}$	V/m
30-12	Radiusi va zaryadlari R_1,q_1 va R_2,q_2 hamda 1-sharning potensiali katta($q_1/R_1 > q_2/R_2$) bo'lsa, 2-sharga o'tgan zaryad miqdori Δq, natijaviy potensial φ' va har bir sharchada qolgan zaryadlar q_1' , q_2'	$\Delta q = \frac{q_1 R_2 - q_2 R_1}{R_1 + R_2};$	
30-13		$\varphi' = k\frac{q_1 + q_2}{R_1 + R_2};$	
30-13		$q_1' = \frac{(q_1 + q_2)R_1}{R_1 + R_2};$	
30-14		$q_2' = \frac{(q_1 + q_2)R_2}{R_1 + R_2};$	
30-15	Agar R_1 radiusli sharning potensiali φ_1 R_2 radiusli sharning potensiali φ_2 $(\varphi_1 > \varphi_2)$ bo'lsa, bu sharlar tekkizilganda 1-shardan 2-sharga o'tgan zaryad miqdori Δq, har bir sharchada hosil bo'ladigan zaryadlar q_1' , q_2' va natijaviy potensial φ'	$\Delta q = \frac{R_2 R_1(\varphi_1 - \varphi_2)}{k(R_1 + R_2)};$	
30-16		$\varphi' = \frac{\varphi_1 R_1 + \varphi_2 R_2}{R_1 + R_2};$	
30-17		$q_1' = \frac{(\varphi_1 R_1 + \varphi_2 R_2)R_1}{k(R_1 + R_2)};$	
30-18		$q_2' = \frac{(\varphi_1 R_1 + \varphi_2 R_2)R_2}{k(R_1 + R_2)};$	
30-19	φ_1 va φ_2 potensiallarga ega radiuslari teng bo'lgan 2 ta shar tekkizilsa natijaviy potensial	$\varphi' = \frac{\varphi_1 + \varphi_2}{2}$	V
30-20	φ_1 va φ_2 potensiallarga ega zaryadlari teng bo'lgan 2 ta shar tekkizilsa natijaviy potensial	$\varphi' = \frac{2\varphi_1\varphi_2}{\varphi_1 + \varphi_2};$	

30-21	Har biri φ_0 potensialga ega bo'lgan N ta tomchi qo'shilgandagi potensial:	$\varphi = \varphi_0 \frac{N}{\sqrt[3]{N}}$	
30-22	**Agar zaryadlar turli ishorali bo'lsa, bu zaryadlarni tutashtiruvchi chziqda shunday 2 ta nuqta mavjudki, bu nuqtalarda zaryadlar hosil qilgan natijaviy potensial nolga teng.** Bu nuqtalarning har bir zayaddan uzoqliklari. r-zaryadlar orasidagi masofa; $X_{1,1}$ va $X_{1,2}$- natijaviy potensial nolga teng bo'ladigan nuqtalardan 1-zaryadgacha bo'lgan masofa; $X_{2,1}$ va $X_{2,2}$- natijaviy potensial nolga teng bo'ladigan nuqtalardan 2-zaryadgacha bo'lgan masofa.	$X_{1,1} = \frac{\lvert q_1 \rvert}{\lvert q_1 \rvert + \lvert q_2 \rvert} r;$ $X_{1,2} = \frac{\lvert q_1 \rvert}{\lvert q_1 \rvert - \lvert q_2 \rvert} r;$ $X_{2,1} = \frac{\lvert q_2 \rvert}{\lvert q_1 \rvert + \lvert q_2 \rvert} r;$ $X_{2,2} = \frac{\lvert q_2 \rvert}{\lvert q_1 \rvert - \lvert q_2 \rvert} r;$	
30-23	**Agar zaryadlar turli ishorali bo'lsa, bu zaryadlarni tutashtiruvchi chziqda shunday 2 ta nuqta mavjudki, bu nuqtalarda zaryadlar hosil qilgan natijaviy potensial nolga teng. Bu nuqtalarning har bir zayaddan uzoqliklari.** r-zaryadlar orasidagi masofa; $X_{1,1}$ va $X_{1,2}$- natijaviy potensial nolga teng bo'ladigan nuqtalardan 1-zaryadgacha bo'lgan masofa; $X_{2,1}$ va $X_{2,2}$- natijaviy potensial nolga teng bo'ladigan nuqta-lardan 2-zaryadgacha bo'lgan masofa.	$X_{1,1} = \frac{\lvert q_1 \rvert}{\lvert q_1 \rvert + \lvert q_2 \rvert} r;$ $X_{1,2} = \frac{\lvert q_1 \rvert}{\lvert q_1 \rvert - \lvert q_2 \rvert} r;$ $X_{2,1} = \frac{\lvert q_2 \rvert}{\lvert q_1 \rvert + \lvert q_2 \rvert} r;$ $X_{2,2} = \frac{\lvert q_2 \rvert}{\lvert q_1 \rvert - \lvert q_2 \rvert} r;$	
30-24	Potensiallar farqi	$U = \varphi_1 - \varphi_2 = \frac{m\left(\vartheta_1^2 - \vartheta_2^2\right)}{2q}$	V
31-§. Elektr sig`imi. Kondensatorlar			
31-1	Yakkalangan o'tkazgichning elektr sig'imi	$C = \frac{q}{U};$ $C = \frac{q}{\varphi}$	F
31-2	Yassi kondensator sig'imi	$C = \frac{\varepsilon_0 \varepsilon S}{d}$	

31-3	Sferik kondensator Sig'imi	$C = 4\pi\varepsilon_0\varepsilon\dfrac{R_1R_2}{R_2-R_1}$	
31-4	Silindrik kondensator Sig'imi	$C = \dfrac{2\pi\varepsilon_0\varepsilon l}{\ln\dfrac{R_2}{R_1}}$	
30-29	Izolyatsiyalangan shar elektr sig'imi	$C = 4\pi\varepsilon_0 R;\qquad C = \dfrac{q}{\varphi-\varphi_0};\qquad C = \dfrac{R}{k}$	
31-5	Yakkalangan muhitdagi sharning elektr sig'imi	$C = 4\pi\varepsilon\varepsilon_0 R;\qquad C = \dfrac{\varepsilon R}{k}$	
31-6	Sirt zichligi σ bo'lgan, zaryadlangan shar sirtidan l masofada maydon potensiali φ bo'lsa, sharning elektr sig'imi	$C = \dfrac{2\pi\varepsilon_0^2\varphi}{\sigma}\left(1+\sqrt{1+\dfrac{4\sigma l}{\varepsilon_0\varphi}}\right)$	
31-7	Kondensatorning zaryadi, kuchlanishi va sig'imi orasidagi bog'lanish	$C = \dfrac{q}{U};\qquad U = \dfrac{q}{C};\qquad q = CU;$	
31-8	Yassi kondensator zaryadi	$q = \dfrac{\varepsilon\varepsilon_0 SU}{d}$	
Kondensatorlarni parallel ulash			
31-9	Sig'im	$C = C_1 + C_2 + \ldots + C_n$	F
31-10	Kuchlanish	$U_{um} = U_1 = U_2 = U_3 \ldots = U_n$	V
31-11	Zaryad	$q_{um} = q_1 + q_2 + q_3 \ldots + q_n$	C
31-12	U_1 va U_2 kuchlanishgacha zaryadlangan, C_1 va C_2 sig'imli kondensatorlarni bir xil ishorali qoplamalari bilan o'zaro ulanganda issiqlikka aylangan elekt energiyasi	$\Delta W = \dfrac{C_1U_1^2}{2} + \dfrac{C_2U_2^2}{2} - \dfrac{(q_1+q_2)^2}{2(C_1+C_2)}$	
Kondensatorlarni ketma-ket ulash			
31-13	Sig'im	$\dfrac{1}{C} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \ldots \dfrac{1}{C_n}$	F

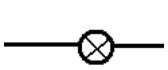
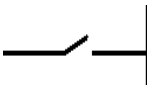
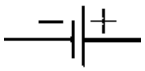
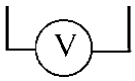
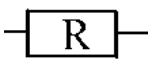
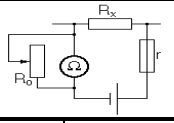
31-14	Kuchlanish	$U_{um} = U_1 + U_2 + U_3 .... + U_n$	V
31-15	Zaryad	$q_{um} = q_1 = q_2 = q_3 .... = q_n$	C
31-16-18	Yassi kondensator plastinkalarining tortishish kuchi	$F = \frac{\varepsilon\varepsilon_0 E^2 S}{2} = \frac{\varepsilon\varepsilon_0 U^2 S}{2d^2} = \frac{\sigma^2 S}{2\varepsilon\varepsilon_0}$	N
31-19	Zaryadlangan (manbadan uzilgan) kondensatorning energiyasi	$W = \frac{q^2}{2C}$	J
31-20-23	Manbaga ulangan kondensatorning energiyasi	$W = \frac{qU}{2} = \frac{CU^2}{2}; \quad W = \frac{q\Delta\varphi}{2} = \frac{C\Delta\varphi^2}{2}$	
31-24-26	Yassi kondensator energiyasi	$W = \frac{\varepsilon\varepsilon_0 E^2 Sd}{2} = \frac{\varepsilon\varepsilon_0 U^2 S}{2d} = \frac{\sigma^2 Sd}{2\varepsilon\varepsilon_0}$	
31-27-30	Zaryadlan-gan shar energiyasi	$W_{shar} = \frac{q\varphi}{2}; \quad W_{shar} = \frac{kq^2}{2R}$ $W_{shar} = \frac{\varphi^2 R}{2k}; \quad W_{shar} = 2\pi\varepsilon_0 R\varphi^2$	
31-31-33	Elektr maydonning energiya zichligi	$\omega = \frac{W}{V} \quad \omega = \frac{\varepsilon\varepsilon_0 E^2}{2} \quad \omega = \frac{\varepsilon\varepsilon_0 U^2}{2d^2}$	J/m^3
31-34-35	C_1 va C_2 sig'imli kondensatorlarni U kuchlanish manbaiga ketma-ket ulaganda har bir kondensatorda hosil bo'ladigan kuchlanishlar	$U_1 = \frac{C_2}{C_1 + C_2} U$ $U_2 = \frac{C_1}{C_1 + C_2} U$	
31-36-37	C_1 va C_2 sig'imli kondensatorlarni U kuchlanish manbaiga parallel ulaganda har bir kondensatorda hosil bo'ladigan zaryadlar	$q_1 = C_1 U$ $q_2 = C_2 U$	
31-38-39	q zaryadgacha zaryadlangan C_1 sig'imli kondensatorni manbadan uzib, zaryadsiz C_2 sig'imli kondensatorga parallel ulaganda har bir kondensatorda hosil bo'ladigan zaryadlar	$q_1 = \frac{C_1}{C_1 + C_2} q;$	

		$q_2 = \frac{C_2}{C_1 + C_2} q$
31-40	φ potensiallar farqi hosil qilinib, C_1 kondensatorni manbadan uzib, C_2 kondensatorga parallel ulaganda hosil bo'ladigan potensiallar farqi φ' va kamaygan kuchlanish	$\varphi' = \frac{C_1}{C_1 + C_2} \varphi$
31-41 31-42 31-43	Agar manbadan uzilgan C_1 va C_2 sig'imli kondensatorlarning qoplamalari orasidagi kuchlanishlar mos holda U_1 va U_2, qoplamadagi zaryad miqdorlari esa q_1 va q_2 bo'lsa, bu kondensatorlar parallel ulaganda hosil bo'ladigan kuchlanish va har bir kondensatorda hosil bo'ladigan zaryadlar	$q_1 = \frac{C_1}{C_1 + C_2}(q_1 + q_2);$ $q_2 = \frac{C_2}{C_1 + C_2}(q_1 + q_2);$ $U = \frac{q_1 + q_2}{C_1 + C_2} = \frac{C_1 U_1 + C_2 U_2}{C_1 + C_2}$
31-44	C sig'imli yassi kondensatorlarning qoplamalari orasidagi masofaning yarmi ε_1 dielektrik bilan, 2 chi yarmi ε_2 dielektrik bilan to'ldirilsa, hosil bo'lgan sig'im	$C' = \frac{2\varepsilon_1 \varepsilon_2}{\varepsilon_1 + \varepsilon_2} C$
31-45	C sig'imli yassi kondensatorlarning qoplamalari yuzasining yarmi ε_1 dielektrik bilan, 2 chi yarmi ε_2 dielektrik bilan to'ldirilsa, hosil bo'lgan sig'im	$C' = \frac{\varepsilon_1 + \varepsilon_2}{2} C$
31-46	Plastinkalarining yuzasi S, orasidagi masofa d bo'lgan yassi havo kondensatori EYK $\mathcal{E}$ bo'lgan tok manbaiga ulangan. Kondensator ichiga plastinkalarga parallel ravishda h (h<d) qalinlikdagi metall plastinka kiritilsa tok manbayi bajaradigan ish	$A = \frac{\varepsilon_0 \varepsilon^2 Sh}{2d(d-h)}$
31-47		$C_1 = C_2 = C_3 = C_4 = C_5 = C$ $\frac{C_1}{C_4} = \frac{C_2}{C_5}$ Nisbat teng bo'lgan hollarda C_3 sig'imdan tok o'tmaydi. Shuning uchun bu sig'imni sxemadan olib tashlaymiz. $C_{Um} = C$

31-48		K va E nuqtalarda potensiallari teng, potensiallar farqi 0 ga tengligi uchun KE yo'nalishda tok oqmaydi bu kondensator zaryadlanmaydi. $C_{Um}=\frac{4C}{3}$
31-49		$\frac{1}{C_{abce}}=\frac{1}{C_{ab}}+\frac{1}{C_{bc}}+\frac{1}{C_{ce}}=\frac{1}{2C}+\frac{2}{5C}+\frac{1}{2C};$ $C_{abce}=\frac{10C}{14}=\frac{5C}{7}:$ $C_{ae}=C_{abce}+C=\frac{5C}{7}+C=\frac{12C}{7}$
31-50		$\frac{1}{C_{Um}}=\frac{1}{3C}+\frac{1}{6C}+\frac{1}{3C}=\frac{5}{6C};$ $C_{Um}=\frac{6}{5}C=1{,}2C.$

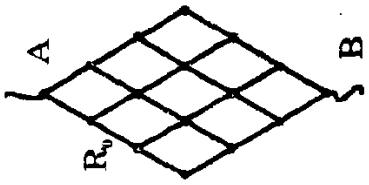
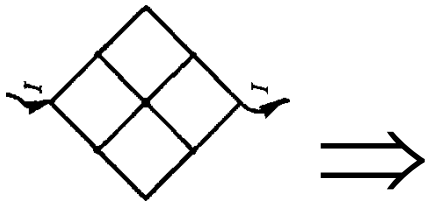
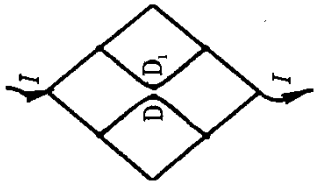
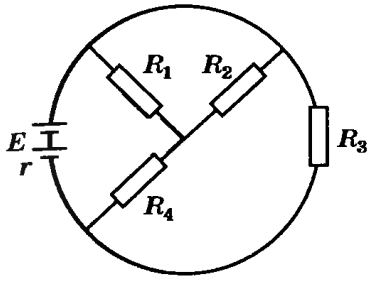
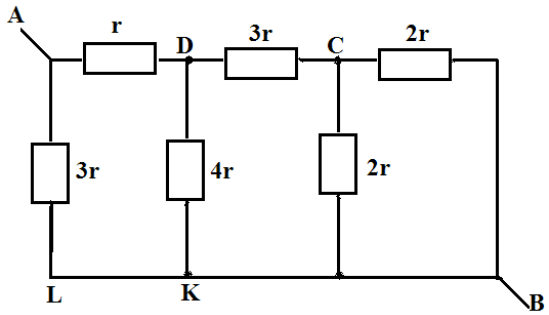
VIII bob. O'zgarmas tok qonunlari

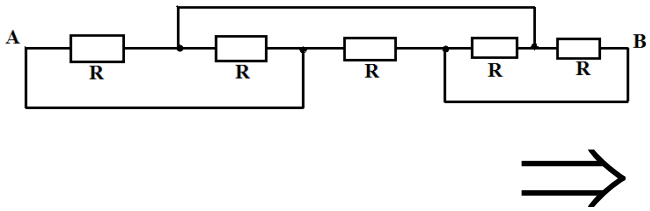
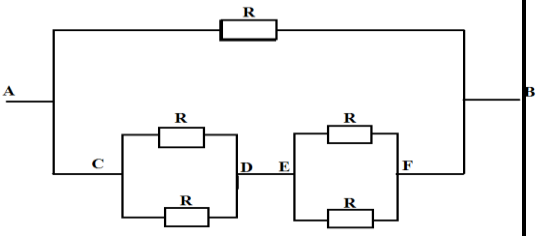
32-§. Elektr toki va tok zichligi. Zanjirning bir qismi uchun Om qonuni

32-1	Elektr lampa		Kalit	
32-2	O'zgarmas tok manbayi		Ampermetr	
32-3	Voltimetr		Generator	
32-4	Rezistor		Reostat	
32-5	Tok kuchi	$I=\frac{q}{t}$ $I=q_0n\vartheta S$		A
32-6	Zaryadning tartibli harakat tezligi	$\vartheta=\frac{j}{qn};$ $\vartheta=\frac{I}{qnS};$ $\vartheta=\frac{U}{en\rho l}$		
32-7	Tok kuchining zichligi	$\vec{j}=\frac{I}{S};$ $\vec{j}=q_0n\vartheta;$ $j=\frac{U}{\rho\cdot l};$ $j=\frac{E}{\rho}$		$\frac{A}{m^2}$

32-7	Elektr yurutuvchi kuch(EYK)	$\varepsilon = \frac{A}{q_0}$	V
32-8	Manbaning EYK zanjir ochiq bo'lganda uning qutblaridagi potensiallar ayirmasiga teng	$\varepsilon = \varphi_2 - \varphi_1;$ $\varepsilon = 0 \Rightarrow U = \varphi_2 - \varphi_1$	V
32-9	Kuchlanish	$U = \frac{A}{q_0}$	V
32-10	Zanjirning bir qismi uchun Om qonuni	$I = \frac{U}{R};$ $\mathrm{R = const \Rightarrow I \sim U}$ $\mathrm{U = const \Rightarrow I \sim 1/R}$	
32-11	Elektr qarshilik	$R = \rho \frac{RS}{l}$	Ω
32-12	Solishtirma qarshilik	$\rho = \frac{RS}{l}$	$\Omega \cdot m$
32-13	Bir jinsli silindrsimon yoki prizma shaklidagi o'tkazgichning elektr qarshiligi (o'zgamas temperatura sharoitida) ρ_{zich} -zichlik; ρ_{sq} -solishtirma qarshilik	$R = \rho_{sq} \cdot \rho_{zich} \frac{l^2}{m}$ $R = \frac{\rho_{sq}}{\rho_{zich}} \cdot \frac{m}{S^2}$	
32-14	Elektr maydon kuchlanganligi	$E = \frac{IR}{l} = \frac{\rho I}{S} = \rho j$	V/m
33-§. O'tkazgichlarni ketma-ket va parallel ulash			
33-1	Metallar qarshiligining temperaturaga bog'liqligi	$R = R_0(1+\alpha t)$	Ω
33-2	Metallar solishtirma qarshiligining temperaturaga bog'liqligi	$\rho = \rho_0(1+\alpha t)$	$\Omega \cdot m$
33-3	Qarshilikning temperatura koeffitsiyenti	$\alpha = \frac{R - R_0}{R_0 t}$	K^{-1}
33-4	Agar o'tkazgich qarshiligi t_1 haroratda R_1 bo'lsa, t_2 haroratda R_2	$R_2 = \frac{1+\alpha t_2}{1+\alpha t_1} R_1$	Ω

33-5	0^0C haroratdagi o'tkazgichni t^0 gacha qizdirganda qarshilik n marta oshadi	$t=\frac{n-1}{\alpha}$	^{0}C
33-6	Elektr o'tkazuvchanlik - elektr qarshilikka teskari kattalik. Birligi simens	$G=\frac{1}{R}$	S
	O'tkazgichlarni ketma-ket ulash		
33-7	Tok kuchi	$I_{um}=I_1=I_2=I_n$	A
33-8	Kuchlanish	$U_{um}=U_1+U_2+...+U_n$	V
33-9	Qarshilik	$R_{k.k}=R_1+R_2+...+R_n$	Ω
33-10	Agar qarshiliklar teng bo'lsa	$R_{k.k}=nR$	Ω
33-11	U kuchlanish manbaiga ketma-ket ulangan n ta qarshilikning ixtiyoriy k qarshilikdagi kuchlanish tushuvi	$U_k=\frac{R_k}{R_1+R_2+R_3+R_n}U$	
	O'tkazgichlarni parallel ulash		
33-12	Tok kuchi	$I_{um}=I_1+I_2+...+I_n$	A
33-13	Kuchlanish	$U_{um}=U_1=U_2=U_n$	V
33-14	Qarshilik	$\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}+...\frac{1}{R_N}$	Ω
33-15	Agar qarshiliklar teng bo'lsa	$R_P=\frac{R}{n}$	
33-16	Agar qarshiliklar 2 ta bo'lsa	$R_p=\frac{R_1R_2}{R_1+R_2}$	
33-17	Agar zanjirning tarmoqlanmagan qismidagi tok kuchi I bo'lsa, manbaga parallel ulangan n ta qarshilikning ixtiyoriy k qarshilikdagi tok kuchi	$I_k=\frac{I}{R_k\left(\frac{1}{R_1}+\frac{1}{R_2}+...\frac{1}{R_n}\right)}$	
33-18	Zanjirning tarmoqlanmagan qismidagi tok kuchi I bo'lsa, manbaga parallel ulangan R_1 va R_2 qarshiliklardagi tok	$I_1=\frac{R_2}{R_1+R_2}I;\quad I_2=\frac{R_1}{R_1+R_2}I$	

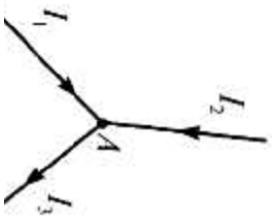
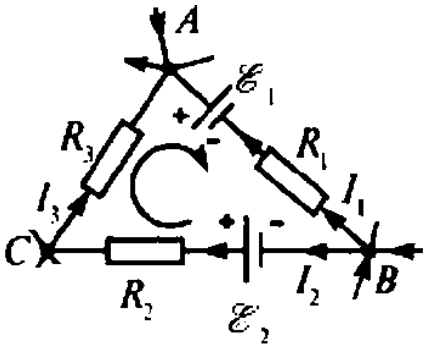
	kuchlari	
33-19	Voltmetrga qo'shimcha qarshilik ulash O'lchash chegarasini oshirish	$R_q = R_V(n-1); \qquad n = \frac{U_V}{U_o}$
33-20	Ampermetrga shunt ulash O'lchash chegarasini oshirish	$R_{sh} = \frac{R_A}{n-1}; \qquad n = \frac{I_A}{I_o}$
33-21	Agar R_1, R_2 qarshiliklar o'zaro ketma-ket ulanganda umumiy qarshilik a ga, parallel ulanganda umumiy qarshilik b ga teng bo'lsa	$R_{1,2} = \frac{a}{2} \pm \sqrt{\frac{a^2}{4} - ab}$
33-22		Barcha qismlarning qarshiligi R ga teng $\frac{1}{R_{AB}} = \frac{7}{26R_0} + \frac{7}{26R_0} \Rightarrow R_{AB} = \frac{13}{7}R_0$
33-23	 	$\frac{1}{R_{um}} = \frac{1}{3R} + \frac{1}{3R};$ $R_{um} = \frac{3}{2}R$
33-24		$R_{12} = \frac{R_1 \cdot R_2}{R_1 + R_2}; \quad R_{124} = R_{12} + R_4$ $R_{Um} = \frac{R_{124} \cdot R_3}{R_{124} + R_3}; \quad I = \frac{\varepsilon}{R + r}$
33-25		$\frac{1}{R_{BC}} = \frac{1}{2r} + \frac{1}{2r} = \frac{1}{r}$ $R_{BD} = r + 3r = 4r$ $\frac{1}{R_{BDK}} = \frac{1}{R_{KD}} + \frac{1}{R_{BD}} = \frac{1}{4r} + \frac{1}{4r} = \frac{2}{4r}$ $R_{BDKA} = R_{BDK} + R_{DA} = 2r + r = 3r$ $\frac{1}{R_{AB}} = \frac{1}{R_{BDKA}} + \frac{1}{R_{LA}} = \frac{1}{3r} + \frac{1}{3r} = \frac{2}{3r}$

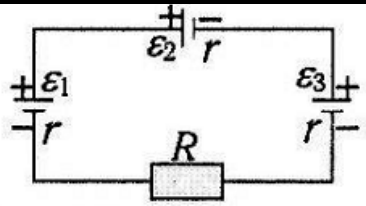
33-26		

$$\frac{1}{R_{CD}}=\frac{1}{R}+\frac{1}{R}=\frac{2}{R};\quad R_{CD}=\frac{R}{2};\quad \frac{1}{R_{EF}}=\frac{1}{R}+\frac{1}{R}=\frac{2}{R}\quad R_{EF}=\frac{R}{2}$$

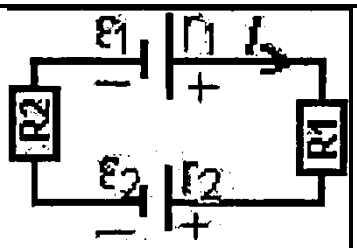
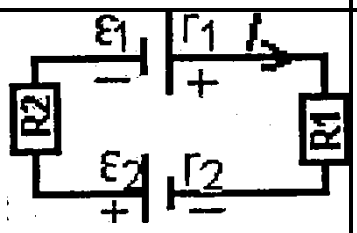
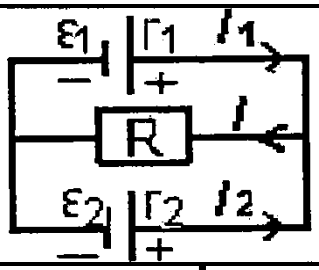
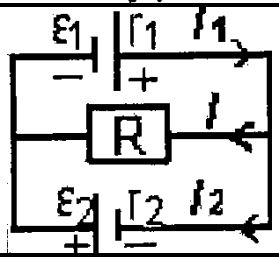
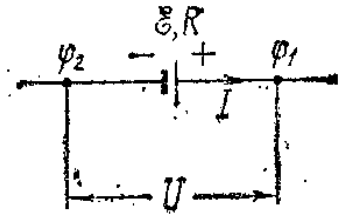
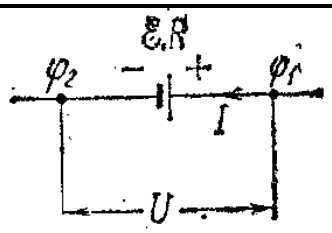
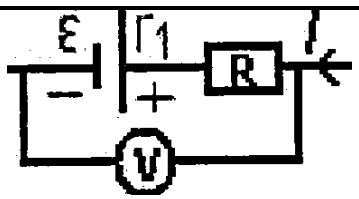
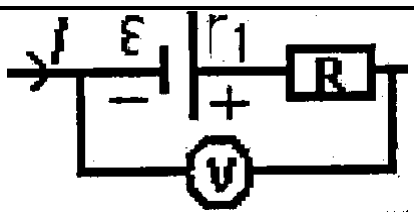
$$R_{CF}=R_{CD}+R_{EF}=\frac{R}{2}+\frac{R}{2}=R;\ \frac{1}{R_{AB}}=\frac{1}{R}+\frac{1}{R}=\frac{2}{R}\Rightarrow R_{AB}=\frac{R}{2}$$

34-§. Berk zanjir uchun Om qonuni

34-1	Kirxgofning 1-qoidasi	 $I_1+I_2-I_3=0$	A
34-2	Kirxgofning 2-qoidasi	$\sum_{\varepsilon=1}^{n}\varepsilon_i=\sum_{i=1}^{n}I_iR_i$	V
34-3	Kirxgofning ikkinchi qoidasini tatbiq qilish shartlari	 $I_2+I_3-I_1=0$ $\varepsilon=\varepsilon_2-\varepsilon_1$	
34-4	Zanjirning bir qismi uchun Omning umumlashgan formulasi	$I=\frac{\Delta\varphi+\varepsilon}{R}$	A
34-5	Manbaning elektr yurituvchi kuchi (EYuK)	$E=\frac{A}{q}$	V
34-6	To'liq zanjir uchun Om qonuni	$\varepsilon=U_t+U_i\qquad \varepsilon=IR+Ir$	

		$I = \dfrac{\varepsilon}{R+r}$
34-7	Manba ichida kuchlanish tushishi	$U_{man} = Ir$
34-8	O’tkazgichda (manba qutblarida) kuchlanish tushishi	$U_{o't} = IR;$
34-9	Agar manbaga R_1qarshilik ulanganda I_1 tok kuchi vujudga kelsa, R_2 qarshilik ulanganda I_2 tok kuchi vujudga kelsa, manbaning EYuKsi va ichki qarshiligi	$\varepsilon = \dfrac{R_1 - R_2}{I_2 - I_1} I_2 I_1;$
34-10		$r = \dfrac{I_1 R_1 - I_2 R_2}{I_2 - I_1};$
34-11	Agar manbaga biror qarshilik ulanganda I_1 tok kuchi vujudga kelib, o’tkazgichdagi kuchlanish tushuvi U_1 bo’lsa va boshqa qarshilik ulanganda I_2 tok kuchi vujudga kelib, o’tkazgichdagi kuchlanish tushuvi U_2 bo’lsa, manbaning EYuKsi va ichki qarshiligi hamda o’tkazgich qarshiliklari R_1 va R_2	$\varepsilon = \dfrac{U_1 I_2 - U_2 I_1}{I_2 - I_1};$
34-12		$r = \dfrac{U_1 - U_2}{I_2 - I_1};$
34-13		$R_1 = \dfrac{U_1}{I_1};\ R_2 = \dfrac{U_2}{I_2};$
34-14	Manba tashqi R qarshilikka ulansa, manba ichidagi kuchlanish tushuvi U_r va tashqi qarshilikdagi kuchlanish tushuvi U_R	$U_r = \dfrac{r}{R+r}\varepsilon;$
34-15		$U_R = \dfrac{R}{R+r}\varepsilon;$
34-16	Tok manbalarini ketma-ket ulash	$\varepsilon_{kk} = \varepsilon_1 + \varepsilon_2 + \cdots \varepsilon_n;\quad I_k = \dfrac{\varepsilon_{kk}}{R + r_{kk}}$
34-17		$r_{kk} = r_1 + r_2 + \ldots + r_n$
34-18		$I = \dfrac{\varepsilon_3 + \varepsilon_2 - \varepsilon_1}{R + 3r}$

34-19	n ta bir xil ketma-ket ulangan manbani R qarshilikka ulashda umumiy EYuK, umumiy qarshilik va umumiy tok kuchi	$\varepsilon_{um} = n\varepsilon \quad R_{um} = R + nr \qquad I_{um} = \frac{n\varepsilon}{R + nr}$
34-20	Tok manbalarini parallel ulash	$\varepsilon_p = \varepsilon_0 \qquad I_p = \frac{\varepsilon_p}{R + r_p}$
34-21	n ta bir xil parallel ulangan manbani R qarshilikka ulashda umumiy EYuK, umumiy qarshilik va umumiy tok kuchi	$\varepsilon_{um} = \varepsilon;\ R_{um} = R + \frac{r}{n};$ $I_{um} = \frac{\varepsilon}{R + r/n}$
34-22 34-23 34-24	n ta har xil parallel ulangan manbani R qarshilikka ulashda umumiy EYuK, umumiy qarshilik	$\frac{1}{r_{um}} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots + \frac{1}{r_n}$ $\frac{\varepsilon_{um}}{r_{um}} = \frac{\varepsilon_1}{r_1} + \frac{\varepsilon_2}{r_2} + \frac{\varepsilon_3}{r_3} + \ldots + \frac{\varepsilon_n}{r_n}$ $R_{um} = R + r_{um};$
2 ta har xil parallel ulangan manbani R qarshilikka ulashda umumiy EYuK, umumiy qarshilik, umumiy tok kuchi va I_1, I_2		
34-25-26-27-28	$\varepsilon_{um} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_2 + r_1};$	$R_{um} = R + r_{um} = R + \frac{r_1 r_2}{r_1 + r_2};$
	$I_{um} = I_1 + I_2;$	$I_1 = \frac{\varepsilon_1 - IR}{r_1}; I_2 = \frac{\varepsilon_2 - IR}{r_2};$

2 ta har xil teskari parallel ulangan manbani R qarshilikka ulashda umumiy EYuK, umumiy qarshilik, umumiy tok kuchi va I_1, I_2		
34-29-30	$\varepsilon_{um}=\dfrac{\varepsilon_1 r_2-\varepsilon_2 r_1}{r_2+r_1};\quad R_{um}=R+r_{um}=R+\dfrac{r_1 r_2}{r_1+r_2};$	
34-31	$I_1=\dfrac{\varepsilon_1-IR}{r_1};I_2=\dfrac{\varepsilon_2+IR}{r_2};$	$I_{um}=I_1-I_2;$
34-32		$(\varepsilon_1>\varepsilon_2)$ $\varepsilon_1-\varepsilon_2=I(R_1+R_2+r_1+r_2)$
34-33		$\varepsilon_1+\varepsilon_2=I(R_1+R_2+r_1+r_2)$
34-35-38		$\varepsilon_1=I_1r_1+IR;\quad \varepsilon_2=I_2r_2+IR;$ $\varepsilon_1-\varepsilon_2=I_1r_1-I_2r_2;\quad I=I_1+I_2;$
34-39-42		$\varepsilon_1=I_1r_1+IR;\quad \varepsilon_2=I_2r_2-IR;$ $\varepsilon_1+\varepsilon_2=I_1r_1+I_2r_2;\quad I=I_1-I_2;$
34-43-44	 $\varphi_1+\varphi_2=\varepsilon-IR$	 $\varphi_1+\varphi_2=\varepsilon+IR$
34-45-46	 $\varepsilon=U-I(R+r)$	 $\varepsilon=U+I(R+r)$

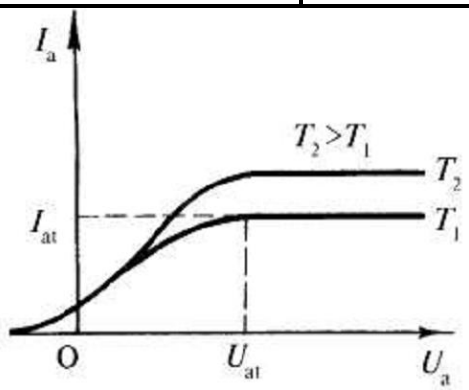
34-47	Akkumlyetorni zaryadlashda: U-zaryadlash kuchlanishi, I-zaryadlash toki.	$U_{razryad} = \varepsilon + I_{razryad} \cdot r$
34-48	Akkumlyatorni razryadlashda	$U_{razryad} = \varepsilon - I_{razryad} \cdot r$
34-49	Manbadagi tashqi qarshilikka parallel ulangan kondensator zaryadi	$q = C \cdot \frac{R \cdot \varepsilon}{R + r}$

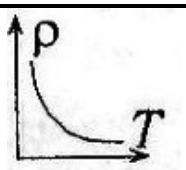
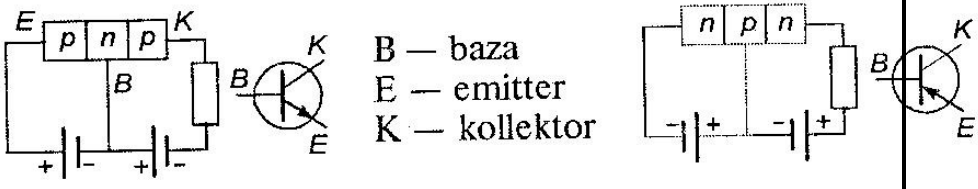
35-§. O'zgarmas tokning ishi va quvvati

35-1	O'zgarmas tokning ishi	$A = qU = I^2Rt = IUt = \frac{U^2}{R}t = Pt$
35-2	O'zgarmas tokning quvvati	$P = IU = I^2R = \frac{U^2}{R} = \frac{A}{t}$
35-3	Agar zanjirda mexanik ish bajaruvchi qurilma (masalan: motor) va kimyoviy reaksiya boruvchi qism (masalan: zaryadlanishga qo'yilgan akkumlyator) bo'lmasa, quyidagi ham o'rinli	$A = I^2(R+r)\Delta t = \frac{\varepsilon^2}{R+r}\Delta t$ $P = I^2(R+r) = \frac{\varepsilon^2}{R+r}$
35-4	Zanjirda ajraladigan to'la quvvat (tok manbayining quvvati)	$P = I^2(R+r) = \frac{\varepsilon^2}{R+r}$ $P = \varepsilon I$
35-5	Iste'molchida to'la quvvatning foydali qismi ajraladi	$P_f = \frac{\varepsilon^2}{(R+r)^2}R$
35-6	Quvvatning qolgan qismi esa tok manbayida va tok o'tkazuvchi simlarda isrof bo'ladi	$P_{ich} = \frac{\varepsilon^2}{(R+r)^2}r$
35-7	Iste'mo'lchining qarshiligi tok manbayining ichki qarshiligiga teng (R = r) bo'lganda tok manbayining quvvati maksimal bo'ladi	$P_{f\max} = \frac{\varepsilon^2}{4r}$
35-8	Joul-Lens qonuni	$Q = I^2Rt = IUt = \frac{U^2t}{R} = Pt$ J
35-9	Elektr zanjirning hamma qismida ajralib chiqadigan issiqlik miqdori	$Q = I^2(R+r)\Delta t$ J

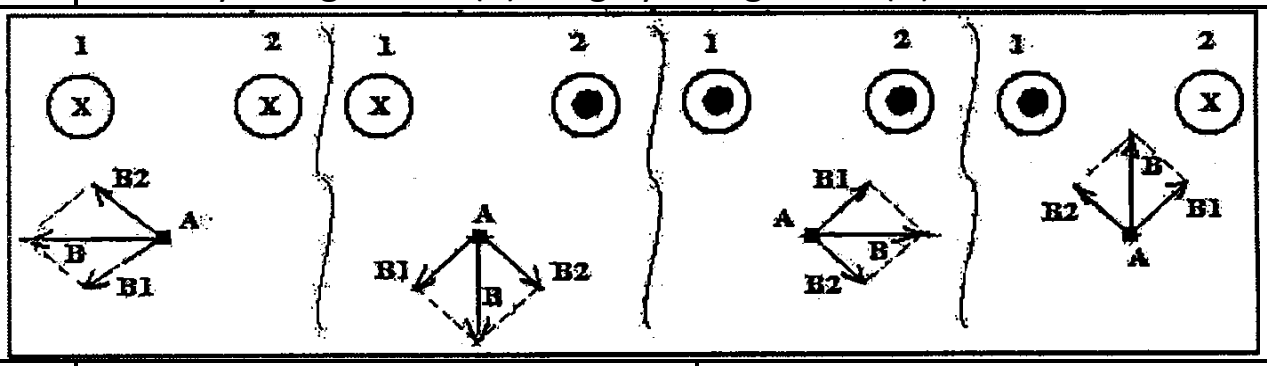
35-10	Massasi m, solishtirma issiqlik sig'imi c bo'lgan moddani FIK η bo'lgan elektr choynakda isitish	$\Delta T = \frac{I^2 R t \eta}{cm}$
35-11	Zanjirning biror qismida o'zgarmas tokning bajargan ishi zanjirning shu qismining energiya o'zgarishiga teng $W_f = A \Rightarrow$	$W_f = IUt = I^2 Rt = \frac{U^2}{R} t$
35-12	Manbadan tok olib o'tadigan va to'liq zanjirda t vaqt ichida ajralib chiqadigan energiya	$W_u = q\varepsilon = I\varepsilon t = I^2 (R+r)t = \frac{\varepsilon^2}{R+r} t$
35-13	O'zgarmas tokning foydali ish koeffisienti	$\eta = \frac{A}{W_T} = \frac{R}{R+r} = \frac{U}{\varepsilon};$
35-14	Agar 1-spiral choyni t_1 vaqtda, 2-spiral choyni t_2 vaqtda, 3-spiral choyni t_3 vaqtda…. qaynatsa, ular ketma-ket ulanganda t_{k-k} vaqtda, parallel ulanganda t_{par} vaqtda qaynatadi	$t_{k-k} = t_1 + t_2 + t_3 + \ldots + t_n$
35-15		$\frac{1}{t_{par}} = \frac{1}{t_1} + \frac{1}{t_2} + \frac{1}{t_3} + \ldots + \frac{1}{t_n}$
Ketma-ket ulanganda quvvat		
35-16	U kuchlanish manbayiga ketma-ket ulan-gan n ta qarshilikning ixtiyoriy k qarshilik-dagi quvvat P_k va umumiy quvvat P_{um}	$P_k = \frac{R_k}{(R_1 + R_2 + R_3 \ldots + R_n)^2} U_{um}^2$
35-17		$P_{um} = \frac{U_{um}^2}{R_1 + R_2 + R_3 \ldots + R}$
Ayni bir U kuchlanishga ulanganda $P_1, P_2, P_3, \ldots P_n$ quvvatlar hosil qiladigan istemolchilarni ketma-ket qilib o'sha U kuchlanishga ulaganda:		
35-18	tarmoqdagi umumiy quvvat	$\frac{1}{P_{um}} = \frac{1}{P_1} + \frac{1}{P_2} + \frac{1}{P_3} + \ldots + \frac{1}{P_n}$
35-19	ixtiyoriy k istemolchidagi quvvat	$P_k' = \frac{P_{um}^2}{P_k}$
35-19	ixtiyoriy k istemolchidagi kuchlanish	$U_k^{'} = \frac{P_{um}}{P_k} U$

35-20	Tarmoqdagi umumiy tok kuchi	$I_{um} = I_1 = I_2 = ...I_n = \frac{P_{um}}{U}$
Parallel ulanganda quvvat		
35-21	U kuchlanish manbaiga parallel ulangan n ta qarshilikning ixtiyoriy k qarshilikdagi quvvat P_k va umumiy quvvat P_{um}	$P_k = \frac{U_{um}^2}{R_k}$
35-22		$P_{um} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ... + \frac{1}{R_n}\right) U_{um}^2$
35-23	Agar qarshiliklar 2 ta bo'lsa, har bir qarshilikdagi quvvat va umumiy quvvat	$P_1 = \frac{U^2}{R_1}; \quad P_2 = \frac{U^2}{R_2};$
35-24		$P_{um} = P_1 + P_2 = \frac{R_1 + R_2}{R_1 R_2} U^2$
Ayni bir U kuchlanishga ulanganda $P_1,P_2,P_3,...P_n$ quvvatlar hosil qiladigan istemolchilarni parallel qilib o'sha U kuchlanishga ulaganda:		
35-25	tarmoqdagi umumiy quvvat	$P_{um} = P_1 + P_2 + P_3 + ... + P_n$
35-26	ixtiyoriy n istemolchidagi quvvat	$P_n' = P_n$
35-27	ixtiyoriy n istemolchidagi kuchlanish	$U_n^{'} = U$
35-28	ixtiyoriy n istemolchidagi tok kuchi	$I_n' = \frac{P_n}{U}$
35-29	tarmoqdagi umumiy tok kuchi	$I_{um} = \frac{P_{um}}{U}$
IX bob. Turli muhitlarda elektr toki **36-§. Suyuqliklarda elektr toki**		
36-1-2	Elektrolitlarning qarshiligi temperatura ortishi bilan chiziqli ravishda kamayadi	$R = R_0(1-\alpha t)$ $\rho = \rho_0(1-\alpha t)$
36-3-4	Elektroliz vaqtida elektrodlarda ajralgan moddaning massasi(Faradeyning 1-qonuni)	$m = \kappa \cdot q$ $m = kI\Delta t$ kg
36-5-6	Moddalarning elektroqimyoviy ekvivalenti ularning kimyoviy ekvivalentiga	$k = \frac{1}{F}\frac{A}{n}$ $\mathrm{F} = eN_A = 96485\frac{Kl}{mol}$

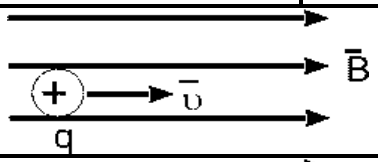
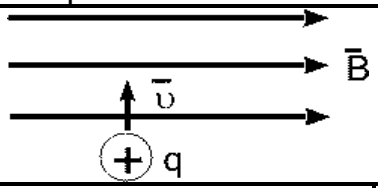
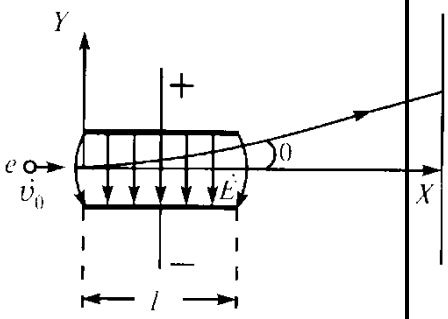
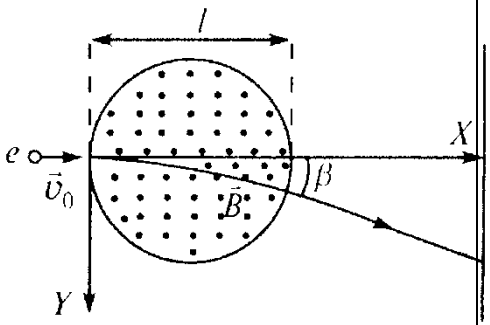
	proporsional (Faradeyning 2-qonuni)		
36-7-8	Faradeyning birlashgan qonuni	$m=\frac{1}{F}\frac{A}{n}It;\qquad m=\frac{1}{F}\frac{A}{n}q$	kg
36-9 36-10	Elektrolitdan o'tayotgan tokning zichligi j, ajralayotgan moddaning zichligi ρ, elektrokimyoviy ekvivalenti k bo'lsa, t vaqtda ajralib chiqqan moddaning qalinligi	$d=\frac{k\cdot j\cdot\Delta t}{\rho}$ $d=\frac{k\cdot I\cdot\Delta t}{S\cdot\rho}$	m
37-§. Gazlarda va vakuumda elektr toki			
37-1	Zarbdan ionlashish-elektronlarning zarb bilan to'qnashgan-dagi kinetik energiyasi W_k maydonning kuchlanganligi E ga va erkin yo'lining uzunligi λ ga proporsional	$W_k=eE\lambda$	J
37-2	Elektronning metaldan chiqish ishi	$A=e\cdot(\varphi_1-\varphi_2)$	J
37-3	Ionizatsiya ishi	$A=e\cdot U$	
37-4	Modda atomining ionizatsiya potensiali U bo'lsa, T temperaturada modda atomlari ionizatsiyasi uchun yetarli darajada ilgarilanma harakat o'rtacha kinetik energiyasiga ega bo'ladi.	$T=\frac{2eU}{3k}$	
37-5	Diodning volt-amper xarakteristikasi. To'yinish tokini oshirish uchun katodning cho'glanish temperaturasini ko'tarish kerak.		
37-6	Anod potensiali (U) ta'sirida elektron olgan tezlanish d- elektrodlar orasidagi masofa	$a=\frac{eU}{md};\qquad ma=\frac{eE}{d}$	
37-7	Anodga yetib borgan elektronning tezligi, anod potensiali va elektron olgan kinetik energiya	$\vartheta=\sqrt{\frac{2eU}{m_e}};\qquad U=\frac{m_e\vartheta^2}{2e};$ $E_k=\frac{m_e\vartheta^2}{2}=eU$	

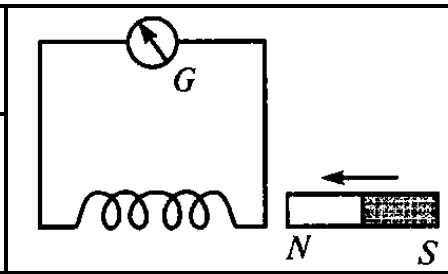
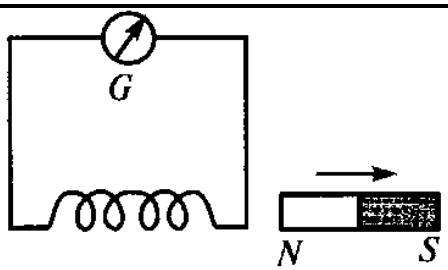
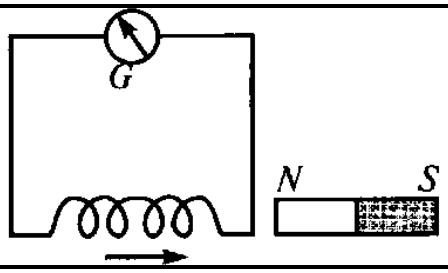
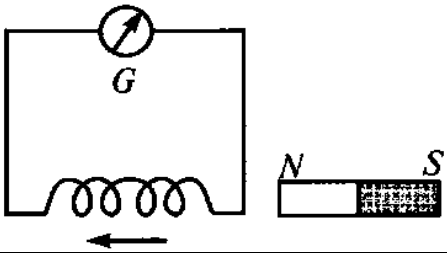
38-§. Yarim o'tkazgichlarda elektr toki		
38-1	Yarim o'tkazgichlar solishtirma qarshiligining temperaturaga bog'liqligi	
38-2	Sof yarim o'tkazgichdagi umumiy tok kuchi	$I_{um} = I_{kovak} + I_{elektron}$
38-3	**Tranzistor**– kristalldan ibo-rat yarim o't-kazgichli asbob	 B — baza E — emitter K — kollektor
X bob. Elektromagnetizm 39-§. Magnil maydon		
39-1	Induksiya vektori	$B = \frac{M_{max}}{P_M} = \frac{M_{max}}{IS}$ — Tl
39-2	Bir jinsli magnit maydonga joylashtirilgan yassi g'lataklarning birinchisi N_1 ta, ikkinchisi N_2 ta o'ramga ega bo'lsa	$\frac{M_1}{I_1 S_1 N_1} = \frac{M_2}{I_2 S_2 N_2}$
39-3	Konturning magnit momenti	$P_M = IS$ — Am^2
39-4	Elektronning orbital magnit momenti	$P_{m \cdot orb} = I_{orb} S = e \nu \pi r^2$ — Am^2
39-5	Maksimal aylantiruvchi momet(α- P va B vektorlar orasidagi burchak)	$M = BIS \sin\alpha$ — Nm
39-6	**Bio-Savar-Laplas qonuni:** I tok o'tayotgan o'tkazgich Δl elementini fazoning biror A nuqtasida hosil qilayotgan magnit maydoni induksiya vektori $\Delta\vec{B}$	$\Delta\vec{B} = \frac{\mu\mu_0 I \Delta l}{4\pi r^2} \sin\alpha$ — Tl
39-7	Muhitning magnit singdiruvchanligi	$\mu = \frac{B}{B_0}$
39-8	Magnit doimiysi yoki vakuumning absolut magnit singdiruvchanligi	$\mu_0 = 4\pi \cdot 10^{-7}$ — $\frac{N}{A^2}$
39-9	Magnit maydonning superpozitsiya prinsipi	$\vec{B}=\vec{B_1} + \vec{B_1}+\vec{B_2}+\vec{B_3}+...+\vec{B_n}$

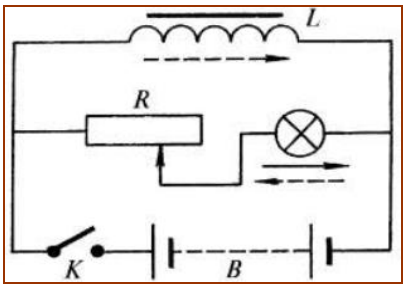
39-10	Magnit induksiya vektorlari bir xil yo'nalishda bo'lsa	$B=B_1+B_2$
39-11	Magnit induksiya vektorlari qarama-qarshi yo'nalishda bo'lsa	$B=B_1-B_2$
39-12	Magnit induksiya vektorlari o'zaro perpendikular yo'nalishda bo'lsa	$B=\sqrt{B_1^2+B_2^2}$
39-13	Magnit induksiya vektorlari ixtiyoriy α – burchak ostida yo'nalgan bo'lsa	$B=\sqrt{B_1^2+B_2^2+2B_1B_2\cos\alpha}$
39-14	**Magnit induksiyalarini qo'shish** bizdan yo'nalgan tok- (X), bizga yo'nalgan tok (●)	



39-15-16	Maydon induksiyasi va kuchlanganligi orasidagi bog'lanish	$B=\mu\mu_0 H;\quad H=\frac{B}{\mu\mu_0}$
39-17-18	Cheksiz uzun to'g'ri tok hosil qilgan magnit maydon induksiyasi va kuchlanganligi	$B=\frac{\mu\mu_0 I}{2\pi R}\quad H=\frac{I}{2\pi R}$
39-19-20	Aylanma tok markazidagi magnit induksiyasi va kuchlanganligi	$B=\frac{\mu\mu_0 I}{2R};\quad H=\frac{I}{2R};$
39-21 39-22	R radiusli doiraviy tokli kontur markazidan d masofada o'qda joylashgan nuqtadagi magnit induksiyasi va kuchlanganligi	$B=\frac{\mu\mu_0 R^2 I}{2(R^2+d^2)^{\frac{3}{2}}};\quad H=\frac{R^2 I}{2(R^2+d^2)^{\frac{3}{2}}};$
39-23 39-24	Tokli salenoid o'zagidagi magnit maydonning induksiyasi va kuchlanganligi	$B=\mu\mu_0 In=\mu\mu_0 I\frac{N}{l};\quad H=In$

39-25 39-26	Tokli toroid o'zagidagi magnit maydonning induksiyasi va kuchlanganligi	$B = \mu\mu_0 In = \mu\mu_0 I\dfrac{N}{2\pi R};\quad H = In$	
39-27-28	Magnit induksiya oqimi	$\Phi = BS\cos\alpha$ $\Phi = \dfrac{2W_M}{I};\qquad \Phi = \sqrt{2W_M \cdot L};$	W
39-29	Agar induksiya chiziqlari S sirtga perpendikular bo'lsa	$\Phi = BS$	
39-30	Agar induksiya chiziqlari S sirtga parallel bo'lsa	$\Phi = 0$	
40-§. Amper va Lorens kuchlari			
40-1	Amper kuchi	$F_A = IlB\sin\alpha$	N
40-2	Lorens kuchi	$F_L = \lvert q\rvert \upsilon B\sin\alpha$	
40-3		$F_L = 0$	
40-4		$F_L = \lvert q\rvert \upsilon B$	
40-5	Harakatlanayot-gan zaryadli zar-ralarning elektr maydonda og'ishi		$\mathrm{tg}\theta = \dfrac{e}{m}\cdot\dfrac{lE}{\upsilon_0^2}$
40-6	Harakatlanayot-gan zaryadli zarralarning magnit maydonda og'ishi		$\mathrm{tg}\beta = \dfrac{e}{m}\cdot\dfrac{lB}{\upsilon_0}$
40-7	Amper kuchlari tomoni-dan bajariladigan ish	$A = I(\Phi_2 - \Phi_1) = I\Delta\Phi$	J

40-8	Parallel toklarning o’zaro ta’sir kuchi	$F = \frac{\mu_0 \mu}{2\pi} \frac{I_1 I_2}{r} \Delta l$	N
40-9-10-11	Zarrachaning aylanish davri va traektoriyasining egrilik radiusi	$T = 2\pi \frac{m}{\lvert q \rvert B}; \quad R = \frac{m\vartheta}{\lvert q \rvert B} \quad R = \frac{1}{B}\sqrt{\frac{2Um}{q}}$	
40-12	Burchak ostida uchib kirgan zaryadning vintsimon harakatining aylanish radiusi	$R = \frac{m \cdot \vartheta}{q \cdot B} \cdot \sin\alpha$	
40-13	Spiral (vint) qadamining uzunligi	$S = \frac{2\pi \cdot m}{q \cdot B} \cdot \vartheta \cdot \cos\alpha$	
40-14	Magnit maydonda harakatlanayotgan zarrachaning tezligi	$\vartheta = \sqrt{\frac{2eU}{m}}$	m/s
40-15	Magnit maydonda harakatlanayotgan zarrachaning energiyasi	$E = eU$	
41-§. Elektromagnit induksiya			
41-1 41-2			
41-3 41-4			
41-5	Salenoiddan o’tuvchi magnit induksiya oqimi	$\Phi = \mu\mu_0 I \frac{N}{l} S;$	W
41-6	Agar solenoid ichiga 2 xil magnit singdiruvchanlikka ega o’zaklar kiritilsa, magnit induksiya oqimi	$\Phi = \frac{\mu_0 INS}{\frac{l_1}{\mu_1} - \frac{l_2}{\mu_2}};$	
41-7-8	Induktivlik	$L = \frac{\Phi}{I}; \quad L = \varepsilon_{o'z} \frac{\Delta t}{\Delta I}$	H
41-9-10	Solenoid induktivligi	$L = \mu_0 \mu n^2 V \Rightarrow \quad L = \mu\mu_0 \frac{N^2}{l} S; \quad S = \frac{\pi d^2}{4}$	

41-11	G’altakning uzunlik birligiga to’g’ri keluvchi o’ramlar soni	$n = \frac{N}{l}$	
41-12	G’altakning hajmi	$V = lS$	m^3
41-13	Tok ulanganda o’zinduksiya hodisasiga ko’ra tok kuchi quyidagicha ortadi	$I = I_m(1 - e^{-\frac{R}{L}t})$	A
41-14	Tok uzilganda g’altakdagi tok kuchi quyidagicha kamayadi	$I = I_m e^{-\frac{R}{L}t}$	
41-15	Induksion EYuK	$\varepsilon_i = -\frac{\Delta\Phi}{\Delta t}$	V
41-16	O’ramlar soni N ta bo’lgan galtakda vujudga keluvchi elektromagnit induksiya	$\varepsilon_i = -N\frac{\Delta\Phi}{\Delta t}$	
41-17	Magnit maydonga kiritilgan o’tkazgichda hosil bo’ladigan EYK	$\varepsilon_{ind} = \varepsilon_{\max}\sin\omega t \quad \varepsilon_i = Bl\vartheta\sin\alpha$	V
41-18		$\varepsilon_{ind} = N\cdot\omega\cdot B\cdot S\cdot\sin\omega t$	
41-19		α -tezlik va magnit induksiya vektorlari orasidagi burchak	
41-20	EYKning maksimal qiymati	$\varepsilon_{\max} = \omega\Phi = \omega B_{\max} S = \omega L I_{\max}$	
41-21	O’zinduksiya EYK	$\varepsilon_{o'z} = -L\frac{\Delta I}{\Delta t}$	V
41-22	Kalit uzilganda L g’altakda dastlabki tokni quvvatlab turuvchi o’zinduksiya EYK hosil bo’ladi. Natijada, zanjirning uzilish paytida iste’molchi (lampa) orqali dastlabki tokka (uzluksiz strelka) teskari yo’nalgan tok (uzuq strelka) o’tadi.		
41-23	Konturning o’zinduksiya magnit oqimi	$\Phi_{o'z} = LI$	W
42-§. Moddalarda magnit maydon			
42-1	Magnitlanish vektori - magnetiklarning magnitlanganlik darajasini xarakterlaydi	$\vec{J} = \frac{\sum \vec{P}_m}{\Delta V}$	A/m

42-2-7	Magnit maydonning eneriyasi	$W=\frac{LI^2}{2}=\frac{\Phi^2}{2L}=\frac{I\Phi}{2}=\frac{B^2V}{2\mu_0\mu}=\frac{HB}{2}V=\frac{\mu_0\mu H^2}{2}V$	
42-8-10	Magnit maydonning eneriya zichligi	$\omega_m=\frac{B^2}{2\mu_0\mu}=\frac{\mu_0\mu H^2}{2}=\frac{HB}{2}$	J/m^3
42-11-13	Elektr maydonning eneriyasi	$W_e=\frac{D^2}{2\varepsilon_0\varepsilon}V=\frac{\varepsilon_0\varepsilon E^2}{2}V=\frac{DE}{2}V$	J
42-14-16	Elektr maydonning eneriya zichligi	$\omega_e=\frac{D^2}{2\varepsilon_0\varepsilon}=\frac{\varepsilon_0\varepsilon E^2}{2}=\frac{DE}{2}$	J/m^3
42-17-18	Elektromagnit maydonning eneriyasi	$W_t=W_e+W_m=\frac{D^2}{2\varepsilon_0\varepsilon}V+\frac{B^2}{2\mu_0\mu}V=\frac{\varepsilon_0\varepsilon E^2}{2}V+\frac{\mu_0\mu H^2}{2}V$	
42-19-20	Elektromagnit maydon-ning eneriya zichligi	$\omega_t=\omega_e+\omega_m=\frac{D^2}{2\varepsilon_0\varepsilon}+\frac{B^2}{2\mu_0\mu}=\frac{\varepsilon_0\varepsilon E^2}{2}+\frac{\mu_0\mu H^2}{2}$	

TEBRANISHLAR VA TO'LQINLAR
XI bob. Tebranishlar va to'lqinlar
43-§. Mexanik tebranishlar

43-1-3	Tebranish davri	$T=\frac{t}{N}=\frac{1}{\nu}=\frac{\lambda}{\vartheta}$	s
43-4-6	Tebranish chastotasi	$\nu=\frac{N}{t}=\frac{1}{\mathrm{T}}=\frac{\vartheta}{\lambda}$	Hz
43-7-9	Siklik chastota(Burch akli tezlik)	$\omega=2\pi\nu=\frac{2\pi}{\mathrm{T}}=\frac{2\pi\nu}{\lambda}$	1/s
43-10 43-11 43-12	Vaqtning ixtiyoriy paytida siljish kattaligi X_0 – amplituda; ω - siklik chastota; α – boshlang'ich faza; (ωt + α) – faza.	$X=X_0\sin(\omega\cdot t+\varphi_0)$ $X=X_0\sin(2\pi\nu t+\varphi_0)$ $X=X_0\sin(\frac{2\pi}{T}t+\varphi_0)$	m
43-13	Garmonik tebranish-larda tezlik	$X'=\vartheta\Rightarrow$ $\vartheta=X_0\omega\cos(\omega t+\varphi_0)$	
43-	Tezlikning ampli-	$\vartheta_{\max}=\omega x\Rightarrow$ $\vartheta=\vartheta_{\max}\cos(\omega t+\varphi_0)$	

14	tuda qiymati	
43-15	Garmonik tebranish-larda tezlanish	$X''=\vartheta'=a\Rightarrow \quad a=-X_0\omega^2\sin(\omega t+\varphi_0)$
43-16	Tezlanishning ampli-tuda qiymati	$a_{max}=-\omega^2 x\Rightarrow \quad a=a_{max}\sin(\omega t+\varphi_0)$
43-17	So'nmas garmonik tebranishlarda	$X_0,T,\nu,\omega=const \quad X,\varphi,\upsilon,a\neq const$

Prujinali mayatnik

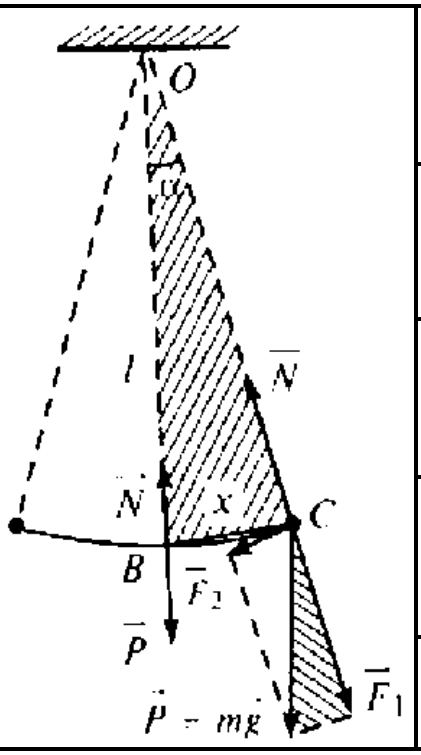
43-18-19	Teranish davri	$T=2\pi\sqrt{\frac{m}{k}}=\frac{t}{N}$	s
43-20-21	Tebranish chastotasi	$\nu=\frac{1}{2\pi}\sqrt{\frac{k}{m}}=\frac{N}{t}$	Hz
43-22	Siklik chastotasi	$\omega=\sqrt{\frac{k}{m}}$	1/s
43-23-25	Yuk massasi	$m=\frac{kt^2}{4\pi^2N^2}=\frac{kT^2}{4\pi^2}=\frac{k}{4\pi^2\nu^2}$	kg
43-26	Prujinali mayatnik yukining massasi Δm ga oshirilganda davri n marta oshsa, yukning dastlabki massasi	$m_0=\frac{\Delta m}{n^2-1}$	
43-27	Prujinali mayatnik yukining massasi Δm ga kamaytirilganda davri n marta kamaysa, yukning dastlabki massasi	$m=\frac{n^2\cdot\Delta m}{n^2-1}$	

Prujinaga mahkamlangan jismning harakat tenglamalari

43-28	Harakati muvozanat vaziyatidan (sinus) va muvozanatdan eng chetki nuqtadan (kosinus) boshlangan holatlar uchun tebra-nuvchi prujinaga mahkamlangan jismning harakat tenglamasi	$X=X_0\sin\left(\sqrt{\frac{k}{m}}\cdot t\right)$
43-29		$X=X_0\cos\left(\sqrt{\frac{k}{m}}\cdot t\right)$
43-30	Tezligi	$\vartheta=-X_0\sqrt{\frac{k}{m}}\sin\left(\sqrt{\frac{k}{m}}\cdot t\right);$
43-31		$\vartheta_{max}=X_0\sqrt{\frac{k}{m}}$

43-32 43-33	Tezla-nishi	$a = -X_0 \frac{k}{m} \cos\left(\sqrt{\frac{k}{m}} \cdot t\right) = -\frac{k}{m} x; \quad a_{max} = -X_0 \frac{k}{m};$

Matematik mayatnik

43-34		Tebranish davri	$T = 2\pi\sqrt{\frac{l}{g}}$ s
43-35		Tebranish chastotasi	$\nu = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$ Hz
43-36		Siklik chastotasi	$\omega = \sqrt{\frac{g}{l}}$ 1/s
43-37		Potensial energiyasi	$W_p = \frac{mg}{l}\frac{x^2}{2}$ J
43-38		Sharcha tezlanishi	$a = -g\sin\alpha$ m/s^2
43-39	Matematik mayatnikni muvozanat vaziyatiga qaytaruvchi kuch		$F = mg \cdot \sin\alpha$ N
43-40 43-41	Harakat muvozanat vaziyatidan (sinus) va muvozanatdan eng chetki nuqtadan (kosinus) boshlangan holatlar uchun tebranuvchi jismning harakat tenglamalari		$X = X_0 \sin\omega t$ $X = X_0 \cos\omega t$ m

Muvozanat vaziyatidan chiqarib qo'yib yuborilgan sharcha uchun

43-42	Harakat tenglamasi	$X = X_0 \cos\left(\sqrt{\frac{g}{l}} \cdot t\right)$ m
43-43-44	Tezligi	$\vartheta = -X_0\sqrt{\frac{g}{l}} \sin\left(\sqrt{\frac{g}{l}} \cdot t\right); \quad \vartheta_{max} = X_0\sqrt{\frac{g}{l}}$
43-45-46	Tezlanishi	$a = -X_0 \frac{g}{l} \cos\left(\sqrt{\frac{g}{l}} \cdot t\right) = -\frac{g}{l} x \quad a_{max} = -X_0 \frac{g}{l};$
43-47	Muvozanat vaziyatidan α burchakka og'dirib	$\vartheta_{max} = \sqrt{2gl(1-\cos\alpha)};$

43-48	qo'yib yuborilgan mayatnikning eng katta tezligi va taranglik kuchi	$F_T = mg(3-2\cos\alpha);$	
43-49	l_1 va l_2 uzunlikdagi mayatniklarning davrlari mos ravishda T_1 va T_2 bo'lsa, $l_3 = l_1 \pm l_2$ uzunlikdagi mayatnikning davri	$T_3 = \sqrt{T_1^2 \pm T_2^2}$	
Garmonik tebranishda kinetik va potensial energiya			
43-50-51	$W_K = \frac{mX_0{}^2\omega^2}{2}\cos^2\omega t$	$W_p = \frac{mX_0{}^2\omega^2}{2}\sin^2\omega t$	
43-52-55	To'liq energiya	$W_T = \frac{mX_0{}^2\omega^2}{2} = \frac{kX_0^2}{2} = \frac{m\vartheta_m^2}{2} = \frac{2\pi^2 X_0{}^2 m}{T^2}$	J
43-56	Eng yuqori ko'tarilish nuqtasida(Amplituda)	$W_{P\max} = mgh_{\max} \quad W_K = 0 \quad \vartheta = 0$	
43-57-58	Eng yuqori ko'tarilish nuqtasidan balandlik kamaygan sari	$W_P = mgh; \quad W_K = \frac{m\vartheta^2}{2}; \quad W = W_P + W_k; \vartheta > 0$	
43-59	Muvozanat vaziyatida	$W_P = 0; \quad W_{K\max} = \frac{m\upsilon_{\max}{}^2}{2}; \quad W = W_{k\max}; \vartheta = \vartheta_{\max} \quad h = 0$	
43-60	Muvozanat vaziyatidan oldin	$W_P = mgh; \quad W_K = \frac{m\vartheta^2}{2}; \quad W = W_P + W_k; \vartheta < \vartheta_{\max}; \quad h > 0$	
44-§. Mexanik to'lqinlar			
44-1	To'lqin uzunligi	$\lambda = \vartheta \cdot \mathrm{T}$	m
44-2	To'lqinning tarqalish tezligi	$\vartheta = \lambda\nu = \frac{\lambda}{\mathrm{T}}$	m/s
44-3	Metallarda tovush to'lqinining tarqalish tezligi	$\vartheta = \sqrt{\frac{E}{\rho}}$	
44-4	Gazlarda tovush to'lqinining tarqalish tezligi μ-gazning molyar massasi, R-universal gaz doimiysi, T-absolyut harorat, $\gamma = C_P / C_V$-Puasson koeffisiyenti.	$\vartheta = \sqrt{\frac{\gamma \cdot R \cdot T}{\mu}}$	

44-5	To'lqin manbaidan $l_1$va l_2 masofada yotuvchi ikki nuqtaning fazalar farqi	$\varphi_1 - \varphi_2 = 2\pi \frac{l_1 - l_2}{\lambda}$	rad
44-6	To'lqin energiya zichligi	$\omega = \frac{1}{2}\rho\omega^2 X_0^2$	J/m^3
44-7	Tarqalayotgan to'lqinning o'rtacha energiyasi	$\overline{W} = \frac{1}{2}m\omega^2 X_0^2$	J
44-8	To'lqin intensivligi	$I = \frac{W}{St}$ $I = \omega\upsilon = \frac{1}{2}\rho\upsilon\omega^2 X_0^2$	$\frac{J}{m^2 s}$
44-9	To'lqinning o'rtacha quvvati	$\overline{P} = IS$	W
44-10	Torning asosiy ton chastotasi	$\nu = \frac{1}{2l}\sqrt{\frac{F}{\rho S}}$	Hz
44-11	Tovushning qattiqligi I- tovushning intensivligi I_0- eshitish bo'sag'asidagi intensivligi.	$L = \lg\frac{I}{I_0}$	B
	45-§. Elektromagnit tebranishlar va to'lqinlar		
45-1	Tomson formulasi. Elektromagnit tebranishlarning davri	$T = 2\pi\sqrt{LC} = \frac{2\pi}{\omega_0}$	s
45-2	Chastotasi	$\nu = \frac{1}{2\pi\sqrt{LC}} = \frac{\omega_0}{2\pi}$	Hz
45-3	Siklik chastotasi	$\omega_0 = 2\pi\nu = \frac{2\pi}{\mathrm{T}} = \frac{1}{\sqrt{LC}}$	1/s
45-4	Tebranishlar konturidagi zaryadning vaqtga bog'lanishi	$q = q_m \cos\omega_0 t$	
45-5-6	Tebranishlar konturidagi tokning vaqtga bog'lanishi	$i = -q_m\omega_0 \sin\omega_0 t$ $i = I_m \cos(\omega_0 t + \frac{\pi}{2})$	
45-7	Tok kuchi tebranishlarining amplitudasi	$I_m = q_m\omega_0$	A
45-8-9	Tebranish konturi to'liq energiyasi	$W = \frac{q^2}{2C} + \frac{Li^2}{2} = \frac{LI_m^2}{2} = \frac{q_m^2}{2C}$	J

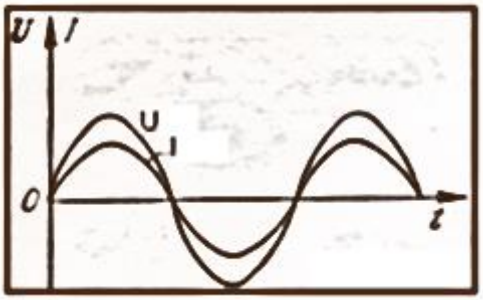
45-10-12	Kondensa-tor zaryadi-ning mak-simal qiymati	$q_0 = I_0\sqrt{LC};$	$q_0 = \frac{T}{2\pi} I_0;$	$q_0 = \frac{I_0}{\omega}$
45-13-15		$q_0 = \frac{I_0}{2\pi\nu};$	$q_0 = \frac{LI_0^2}{U_0};$	$q_0 = \sqrt{2CW_{\max}}$
45-16-18	Konden-satordagi kuchla-nishni maksimal qiymati	$U_0 = \omega \cdot LI_0;$	$U_0 = 2\pi\nu LI_0;$	$U_0 = \frac{2\pi LI_0}{T}$
45-19-21		$U_0 = I_0 \cdot \sqrt{\frac{L}{C}};$	$U_0 = \frac{LI_0^2}{q_0};$	$U_0 = \sqrt{\frac{2W_{\max}}{C}}$
45-22-24	G'altakda-gi tok kuchini maksimal qiymati	$I_0 = \frac{q_0}{\sqrt{LC}};$	$I_0 = U_0\sqrt{\frac{C}{L}};$	$I_0 = \sqrt{\frac{q_0 U_{0C}}{L}}$
45-25-28		$I_0 = \omega \cdot q_0$	$I_0 = 2\pi\nu q_0$	$I_0 = \sqrt{\frac{2W_{\max}}{L}};$ $I_0 = \frac{2\pi q_0}{T}$
45-29	E kuchlanganlik vektori va B induksiya vektori orasidagi bog'lanish		$\frac{E}{B} = c$	m/s^2
45-30	Elektromagnit to'lqinning muhitdagi to'lqin uzunligi		$\lambda = \frac{\lambda_0}{\sqrt{\varepsilon\mu}}$	m
45-31	Maksvellning elektromagnit maydon nazariyasiga ko'ra E va H vektorlarining modullari o'zaro boglangan		$\frac{E}{H} = \frac{\sqrt{\mu\mu_0}}{\sqrt{\varepsilon\varepsilon_0}}$	
45-32-33	Elektromagnit to'lqinlarning muhitda tarqalish tezligi		$\vartheta = \frac{c}{\sqrt{\varepsilon\mu}} = \frac{c}{n}$	m/s
45-34-36	n -muhitning apsolyut sindirish ko'rsatgichi		$n = \frac{c}{\vartheta} = \sqrt{\varepsilon\mu} = \frac{c}{\nu\lambda}$	
45-37	Energiya zichligi		$\varpi = \frac{EB}{\upsilon\mu_0\mu}$	J/m^3
45-38	Elektromagnit to'lqin intensivligi		$I = \varpi\vartheta = \frac{EB}{\mu_0\mu}$	$\frac{J}{m^2 s}$

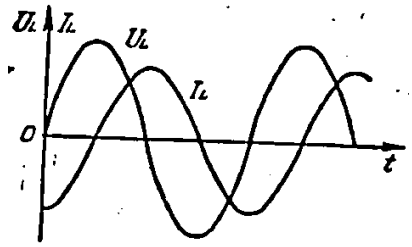
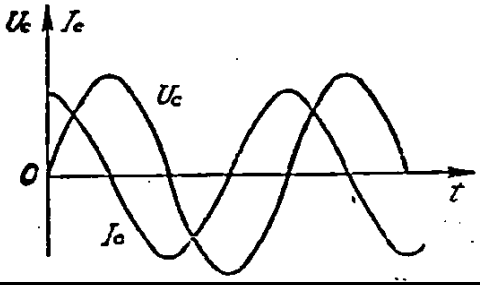
45-39	To'lqinning chastotasi	$\nu = \frac{1}{2\pi\sqrt{LC}}$		Hz
45-40-42	To'lqin uzunligi	$\lambda = \frac{c}{\nu}$ $\lambda = \frac{\vartheta n}{\nu}$ $\lambda = 2\pi c\sqrt{LC}$		m
45-43-44	G'altakning induktivligi L o'zgarmaganda	$\frac{\lambda_2}{\lambda_1} = \sqrt{\frac{C_2}{C_1}}$	kondensator sig'imi C o'zgarmaganda	$\frac{\lambda_2}{\lambda_1} = \sqrt{\frac{L_2}{L_1}}$
45-45	To'lqin soni yoki fazoviy chastota - 2π masofadagi uzunlik birligida joylashadigan to'lqin uzunliklari soni		$k = \frac{2\pi}{\lambda}$	$\frac{rad}{\text{m}}$
45-46-49	l uzunlikdagi masofaga N ta to'lqin joylashsa	$\lambda = \frac{l}{N};\quad N = \frac{l}{\lambda};\quad N = \frac{l\nu}{c};\quad N = \frac{l\nu}{\vartheta n}$		
45-50	Lokator va impulsni qaytargan nishon orasidagi masofa		$S = \frac{ct}{2}$	m
45-51	t vaqtda lokatordan N ta impuls chiqayotgan bo'lsa		$S = \frac{c \cdot t}{2N}$	m

46-§. O'zgaruvchan tok

46-1	EYK ning oniy qiymati	$\varepsilon = \varepsilon_m \sin(\omega t + \alpha_0)$	V
46-2	Tok kuchining oniy qiymati	$i = I_m \sin(\omega t + \alpha_0)$	A
46-3	EYK	$\varepsilon = -L\frac{dI}{dt} = -\varepsilon_m \cos\omega t = U$ $\varepsilon_m = I_m \omega L$	

O'zgaruvchan tok zanjirida aktiv qarshilik

46-4	Aktiv qarshilik - kuchlanish va tok kuchi fazalari bir-biriga mos keladigan o'tkazgichning qarshiligi		
46-5	Kuchlanishning oniy qiymati (U_m- kuchlanishning amplitudasi)	$u = U_m \sin\omega t$	V

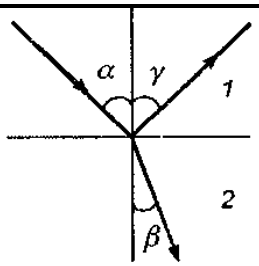
46-6	Tok kuchining oniy qiymati (I_m -tok kuchining amplitudasi)	$i = I_m \sin \omega t$	A
46-7	EYuK ning oniy qiymati (ε_m - EYuK ning amplitudasi)	$\varepsilon = \varepsilon_m \sin \omega t$	V
46-8	Zanjirga faqat aktiv qarshilik bo'lganda Joui-Lens qonuniga ko'ra ajralgan issiqlik miqdori	$Q = I_m^2 RT \sin \omega t = I_{ef}^2 RT$	J
46-9	O'zgaruvchan tok kuchi va kuchlanishining ta'sir (effektiv yoki samarador) qiymatlari	$I = \frac{I_m}{\sqrt{2}} \quad U = \frac{U_m}{\sqrt{2}}$	
O'zgaruvchan tok zanjirida Induktiv qarshilik			
46-10	Induktiv qarshilikda tok kuchi faza jihatidan kuchlanishdan $\pi/2$ ga orqada qoladi		
46-11	Induktiv qarshilik	$X_L = \omega L = 2\pi \nu L$	Ω
46-12	Kuchlanishning oniy qiymati	$U = U_m \cos \omega t$	V
46-13	Tok kuchining oniy qiymati	$i = I_m \sin \omega t = I_m \cos(\omega t - \frac{\pi}{2})$	A
O'zgaruvchan tok zanjirida sig'im qarshilik			
46-14	Sig'im qarshilikda tok kuchi faza jihatidan kuchlanishdan $\pi/2$ ga oldinga ketadi		
46-15	Sig'im qarshilik	$X_C = \frac{1}{\omega \cdot C} = \frac{1}{2\pi \cdot \nu \cdot C}$	Ω
46-16	Kuchlanishning oniy qiymati	$U = U_m \cos \omega t$	V
46-17	Tok kuchining oniy qiymati	$i = I_m \cos(\omega t + \frac{\pi}{2})$	A
46-18	Kondensator zaryadi-	$q = q_m \cos \omega t \qquad q_m = CU_m$	C

	ning o’zgarishi		
46-19	Zaryaddan vaqt bo’yicha olingan bi-rinchi tartibli hosila tok kuchiga teng	$I=\frac{dq}{qt}\Rightarrow i=I_m\sin\omega t;$ $I_m=q_m\omega$	
O’zgaruvchan tok zanjiri uchun Om qonuni (ketma-ket ulanganda)			
46-20	Kuchlanishning maksimal qiymati rezistor, kondensator va galtakdagi maksimal kuch-lanishlar bilan bog’lanishi	$U_m=\sqrt{U_{mR}^2+(U_{mL}-U_{mC})^2}$	
46-21 46-22 46-23	Ketma-ket ulangan rezistor, kondensator va galtakdan iborat o’zgaruvchan tok zan-jirida rezistor, kondensator va galtakdagi kuchlanishning amplituda qiymatlari	$U_{mR}=I_mR$ $U_{mC}=\frac{I_m}{\omega C}$ $U_{mL}=I_{mL}\omega L$	
46-24	Tokning amplitudasi va fazasi aktiv, sig’im va induktiv qarshiliklarda bir xil bo’ladi	$I_m=I_{mR}=I_{mC}=I_{mL}$	
46-25	Zanjirdagi maksimal tok kuchi	$I_m=\frac{U_m}{\sqrt{R^2+\left(\omega L-\frac{1}{\omega C}\right)^2}}$	A
46-26-27	Kuchlanish va tok kuchi tebranishlari orasidagi fazalar farqi	$\varphi=arctg\frac{\omega L-\frac{1}{\omega C}}{R}=arctg\frac{X_L-X_C}{R}$	
46-28	Tok faza bo’yicha kuchlanishdan orqada qolganda	$X_L>X_C\Rightarrow\varphi>0$	
46-29	Tok faza bo’yicha kuchlanishdan oldinda bo’lganda	$X_L<X_C\Rightarrow\varphi<0$	
46-30-31	Tok kuchi va kuchlanishning amplitudalari va effektiv qiymatlari orasidagi bog’lanish	$I_m=\frac{U_m}{Z};\quad I=\frac{U}{Z}$	
46-32-33	O’zgaruvchan tok zanjirining to’la qarshiligi	$Z=\sqrt{R^2+(X_L-X_C)^2}=\sqrt{R^2+(\omega L-\frac{1}{\omega C})^2}$	
46-34 46-	Ketma-ket ulangan rezistor(aktiv qarshilik) va kondensatorda umumiy qarshilik, tok kuchi va kuchlanish orasidagi fazalar siljishi	$Z=\sqrt{R^2+(\frac{1}{\omega C})^2}$	

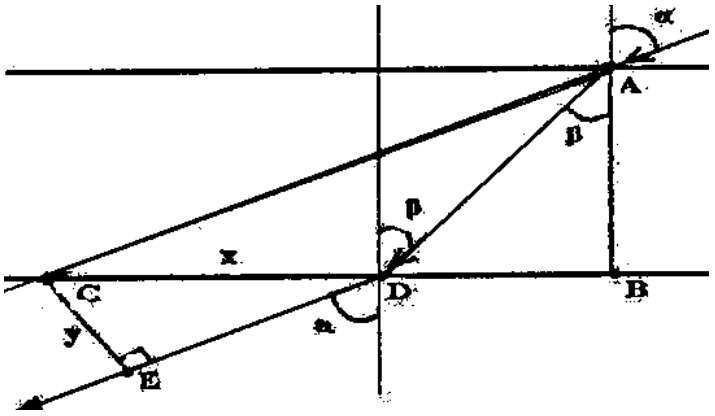
35		$tg\varphi = \frac{1}{R\omega C}$
46-36 46-37	Ketma-ket ulangan aktiv qarshilik va g'altakda umumiy qarshilik, tok kuchi va kuchlanish orasidagi fazalar siljishi	$Z = \sqrt{R^2 + (\omega L)^2}$ $tg\varphi = \frac{\omega L}{R}$
46-38 46-39	Ketma-ket ulangan kondensator va g'altakda umumiy qarshilik, tok kuchi va kuchlanish orasidagi fazalar siljishi	$Z = \left\lvert \omega L - \frac{1}{\omega C} \right\rvert$ $\varphi = 90^0$
O'zgaruvchan tok zanjiri uchun Om qonuni (parallel ulanganda)		
46-40 46-41 46-41	Parallel ulangan rezistor, kondensator va galtakdan iborat o'zgaruvchan tok zanjirida rezistor, kondensator va galtakdagi tok kuchining amplituda qiymatlari	$I_{mR} = \frac{U_m}{R}$ $I_{mC} = U_m \omega C$ $I_{mL} = \frac{U_m}{\omega L}$
46-43	Kuchlanishning amplitudasi va fazasi aktiv, sig'im va induktiv qarshiliklarda bir xil bo'ladi	$U_m = U_{mR} = U_{mC} = U_{mL}$
46-44	Tok kuchining maksimal qiymati rezistor, kondensator va galtakdagi maksimal tok kuchlari bilan bog'lanishi	$I_m = \sqrt{I_{mR}^2 + (I_{mC} - I_{mL})^2}$
46-45	Zanjirdagi maksimal tok kuchi	$I_m = U_m \sqrt{\frac{1}{R^2} + \left(\omega C - \frac{1}{\omega L}\right)^2}$
46-46 46-47	Parallel ulangan aktiv qarshilik, kondensator va g'altakda umumiy qarshilik, tok kuchi va kuchlanish orasidagi fazalar siljishi	$\frac{1}{Z} = \sqrt{\frac{1}{R^2} + \left(\omega \cdot C - \frac{1}{\omega \cdot L}\right)^2}$ $tg\varphi = \left\lvert \omega \cdot C - \frac{1}{\omega \cdot L} \right\rvert R$
46-48 46-49	Parallel ulangan aktiv qarshilik va kondensatorda umumiy qarshilik, tok kuchi va kuchlanish orasidagi fazalar	$Z = \frac{R}{\sqrt{(R\omega C)^2 + 1}};$ $tg\varphi = R\omega C;$

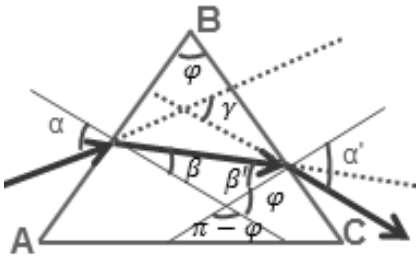
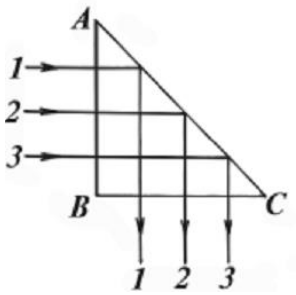
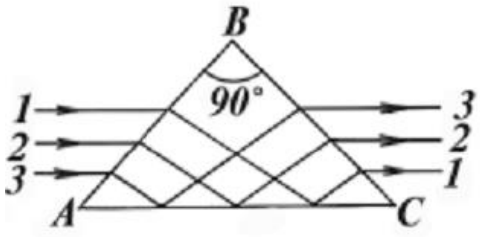
	siljishi		
46-50 46-51	Parallel ulangan aktiv qarshilik va g'altakda umumiy qarshilik, tok kuchi va kuchlanish orasidagi fazalar siljishi	$Z = \frac{R\omega L}{\sqrt{R^2 + (\omega L)^2}}$ $tg\varphi = \frac{R}{\omega L}$	
46-52	Parallel ulangan kondensator va g'altakda umumiy qarshilik, tok kuchi va kuchlanish orasidagi fazalar siljishi	$\frac{1}{Z} = \sqrt{\left\|\omega C - \frac{1}{\omega L}\right\|}$ $tg\varphi = 0^0$	
46-53	Ketma-ket ulangan rezistor, kondensator va galtakdan iborat o'zgaruvchan tok zanjirida tebranish davri	$T = \frac{2\pi}{\sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2}}$	s
46-54	Agar R=0 bo'lsa so'nmas tebranish hisoblanadi	$T = 2\pi\sqrt{LC}$	s
46-55	O'zgaruvchan tokning chastotasi	$\nu = \frac{1}{2\pi\sqrt{LC}}$	Hz
46-56	Rezonans siklik chastota	$X_L = X_C \Rightarrow \quad \omega = \frac{1}{\sqrt{LC}}$	1/s
46-57	Agar aktiv qarshilik noldan farqli bo'lsa, konturning xususiy tebranishlar chastotasi	$\omega_0 = \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$	
46-58	Agar R noldan farqli bo'lsa so'nuvchi tebranish bo'lib, kuchlanish quyidagicha kamayadi	$U = U_0 e^{-\frac{R}{2L}t}\cos\omega t$	
46-59	Zanjirning ayrim qismlaridagi kuchlanishlarning yig'indisi tashqi kuchlanishga teng bo'ladi	$U = U_R + U_L + U_C$	
46-60	Kuchlanish rezonansi	R=0; $X_L = X_C \Rightarrow \quad Z_{\min} = R;\quad I_{\max} = \frac{U}{R}$	
46-61-62	$U_{m.C} = I_{m.rez}\frac{1}{\omega C} = I_{m.rez}\sqrt{\frac{L}{C}};\ U_{m.L} = I_{m.rez}\omega L = I_{m.rez}\sqrt{\frac{L}{C}};$		
46-63-64	O'zgaruvchan tok zanjirida quvvat	$p = \frac{I_m U_m}{2}\cos\varphi = I_{ef}U_{ef}\cos\varphi$	W

46-65	Tok va kuchlanish orasidagi fazalar siljishi bo'lmaganda zanjirda ajralib chiqadigan quvvat maksimal bo'ladi.	$P = I_{ef} U_{ef}$ (aktiv qarshilikda)	
46-66	Quvvat koeffisienti	$\cos\varphi = R / \sqrt{R^2 + (X_L - X_C)^2}$	rad
46-67-68	Issiqlik isrofi orqali yo'qolgan quvvat	$\Delta P = \frac{P^2}{U^2 \cos^2\varphi} \cdot R;$ $\Delta P = \frac{\Delta P_0}{\cos^2\varphi}$	
Transformator			
46-69	Chulgamlardagi induksion EYuKlar ulardagi o'ramlar soniga to'g'ri proporsional	$\frac{\varepsilon_1}{\varepsilon_2} = \frac{n_1}{n_2}$	
46-70	Transformasiya koeffisienti	$\kappa = \frac{U_1}{U_2} \approx \frac{I_2}{I_1} \approx \frac{N_1}{N_2}$	
46-71	Foydali ish koeffisenti	$\eta = \frac{I_2 U_2}{I_1 U_1}$ $\eta = \frac{P_2}{P_1}$	%
46-72	**Elektr o'tkazuvchi liniyalar-ning energiyasi isrofi va FIK** Q_1 - tokni I_1 tok kuchi bilan uzatilganda yo'lda ajralib chiqqan issiqlik. Q_2 - tokni I_2 tok kuchi bilan uzatilganda yo'lda ajralib chiqqan issiqlik. R-liniyaning qarshiligi.	$\frac{Q_2}{Q_1} = \frac{I_2^2 R \Delta t}{I_1^2 R \Delta t} = \left(\frac{I_2}{I_1}\right)^2 = \left(\frac{U_1}{U_2}\right)^2$	
46-73		$\eta = \frac{P - P_1}{P} 100\%$ $R = 2\rho l / S$	
46-74		$P = I_{ef} U_{ef} \cos\varphi$ $P_1 = I_{ef}^2 R$ P-uzatilgan, P_1-isrof bo'lgan quvvat	
46-75	Simlarning qizishiga sarflanadigan energiya quyidagiga proporsional	$1/cos^2\varphi$	
OPTIKA **XII bob. Geometrik optika** **47-§. Yorug'likning qaytish va sinish qonunlari**			
47-1	Bir jinsli muhitda yo'lning optikaviy uzunligi shu yo'lning geometrik uzunligi S bilan muhitning sindirish ko'rsatkichi n ning ko'paytmasiga teng	**L=nS**	m

47-2	Sinish qonuni	$\frac{\sin\alpha}{\sin\beta}=n_{21}=\frac{n_2}{n_1}$	
47-3-6	Muhitning absolyut sindirish ko'rsatkichi	$n=\frac{c}{\vartheta}$ $\quad n=\frac{n_2}{n_1}=\frac{\vartheta_1}{\vartheta_2}=\frac{\lambda_1}{\lambda_2}$	
47-7		$\alpha-$tushish burchagi $\gamma-$qaytish burchagi $\beta-$sinish burchagi	
47-8	Orasidagi burchak α bo'lgan 2 ta ko'zgu orasiga jism joylashtirilganda ko'rinadigan tasvirlar soni	$N=\frac{360^0}{\alpha}-1$	

48-§. Yorug'likning to'la ichki qaytishi

48-1	Yorug'likning to'la ichki qaytishi hodisasi	$n=\frac{1}{\sin\alpha_0}$ $\quad \frac{n_2}{n_1}=\frac{1}{\sin\alpha_0}$ $n_1>n_2\Rightarrow\beta>\alpha$ $n_1<n_2\Rightarrow\beta<\alpha$
48-2	Yorug'likning yassi-parallel plastinkadan o'tishda siljishi $x=\left(tg\alpha-\frac{\sin\alpha}{\sqrt{n^2-\sin^2\alpha}}\right)d$	
48-3	$y=\left(tg\alpha-\frac{\sin\alpha}{\sqrt{n^2-\sin^2\alpha}}\right)\cos\alpha\cdot d$	
48-4	**Yorug'likning uchburchakli prizmadan o'tishi**	$\beta'=\varphi-\beta$ $\quad \gamma=\alpha+\alpha'-\varphi$
48-5		$n=\frac{\sin\alpha}{\sin\beta}$ $\quad n=\frac{\sin\beta'}{\sin\alpha'}$
48-6		$\sin\alpha'=\sin\varphi\sqrt{n^2-\sin^2\alpha}-\cos\varphi\cdot\sin\alpha$

48-7	 φ - prizmaning sindirish burchagi; γ - nurning dastlabki yo'nalishidan og'ish burchagi.	α – 1- yoniga tushish burchagi; α‘ – 2-yonidan chiqish burchagi; β – 1- yonidan sinish burchagi; β′ – 2-yoniga ichki tarafdan tushish burchagi;
48-8	Buruvchi va ag'daruvchi prizmalar	 

49-§. Linzalar

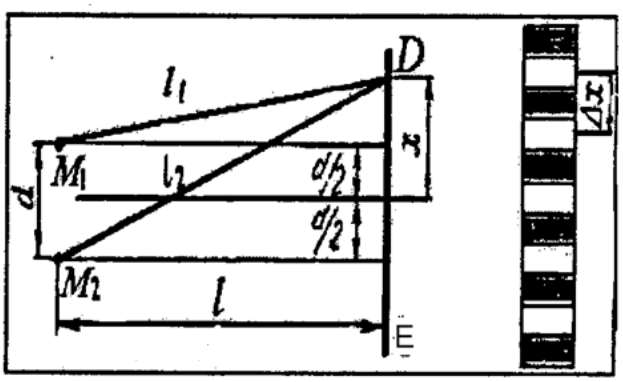
49-1	Linzaning D optik kuchi uning F fokus masofasiga teskari bo'lgan kattalik.	$D=\frac{1}{F}$	dptr D
49-2-3	Sferik ko'zguning fokus masofasi	$\pm\frac{1}{F}=\frac{1}{d}\pm\frac{1}{f};\quad F=\pm\frac{R}{2}$	m
49-4	**d>F holatda yig'uvchi linza (botiq ko'zgu) ning fokus masofasi** d- buyumdan linzagacha (ko'zgugacha), f- linzadan (ko'zgudan) tasvirgacha bo'lgan masofa.	$\frac{1}{F}=\frac{1}{d}+\frac{1}{f}$	m
49-5	**d<F holatda yig'uvchi linza (botiq ko'zgu) ning fokus masofasi**	$\frac{1}{F}=\frac{1}{d}-\frac{1}{f}$	
49-6	**Sochuvchi linza (qavariq ko'zgu) ning fokus masofasi**	$-\frac{1}{F}=\frac{1}{d}-\frac{1}{f}$	
49-7	Linzaning va sferik ko'zguning kattalashtirishi h — buyumning chiziqli o'lchami; H— tasvirning chiziqli o'lchami.	$K=\frac{H}{h}=\frac{f}{d}$	
49-8	Linzalar, sferik sirtlar va sferik ko'zgular markazlash-tirilgan sistemasining ko'ndalang kattalashtirishi	$K=K_1\cdot K_2\cdot K_3\cdot\ldots$	

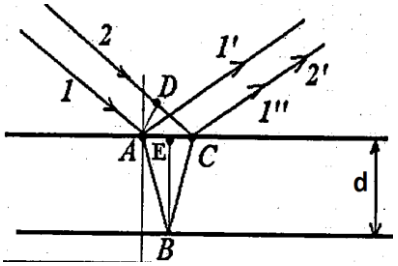
49-9	Agar yig'uvchi linzada d<F bo'lsa	$f=(k-1)F;\quad d=\frac{k-1}{k}F;$
49-10	Agar yig'uvchi linzada d>F bo'lsa	$f=(k+1)F;\quad d=\frac{k+1}{k}F;$
49-11	Sochuvchi linzada	$f=(1-k)F;\quad d=\frac{1-k}{k}F;$
49-12	Sferik sirtning kattalashtirishi n_1-buyum turgan muhitning, n_2-sferik sirtning boshqa tomonidagi muhitning sindirish ko'rsatgichlari.	$K=-\frac{n_1 f}{n_2 d}$
49-13	Linza fokus masofasining egrilik radiusi va linza va muhit sindirish ko'rsatgichlariga bog'liqligi	$F=\frac{1}{(\frac{n_L}{n_M}-1)(\frac{1}{R_1}+\frac{1}{R_2})};$
49-14	Agar linza $n_M=1$ bo'lgan (havo, vakuum) muhitda joylashgan bo'lsa	$F=\frac{1}{(n_L-1)(\frac{1}{R_1}+\frac{1}{R_2})};$
49-15 49-16	Agar linza simmetrik bo'lsa $R_1=R_2$ bo'ladi	$F=\frac{R}{2(n_L-1)};$ $D=(n_L-1)\frac{2}{R};$
49-17	Agar havoda yoki vakuumda (n=1)turgan, fokus masofasi F_1 bo'lgan yig'uvchi linzani sindirish ko'rsatkichi n_M bo'lgan muhitga kiritsak, fokus masofasi F_2	$F_2=\frac{n_L-1}{\frac{n_L}{n_M}-1}F_1$
49-18	Linzaning va sferik ko'zguning burchak kattalashtirishi	$\gamma=\frac{1}{K}=\frac{h}{H}=\frac{\lvert d\rvert}{\lvert f\rvert}$
49-20	Ikkita yupqa linzadan iborat sistemaning fokus masofasi (l-linzalar orasidagi masofa)	$F=\frac{F_1F_2}{F_1+F_2-l}$
49-21	Ikkita yupqa linzadan iborat sistemaning optik kuchi masofasi	$D=D_1+D_2-D_1D_2l$

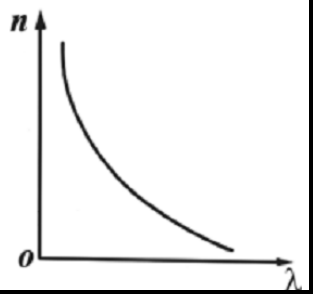
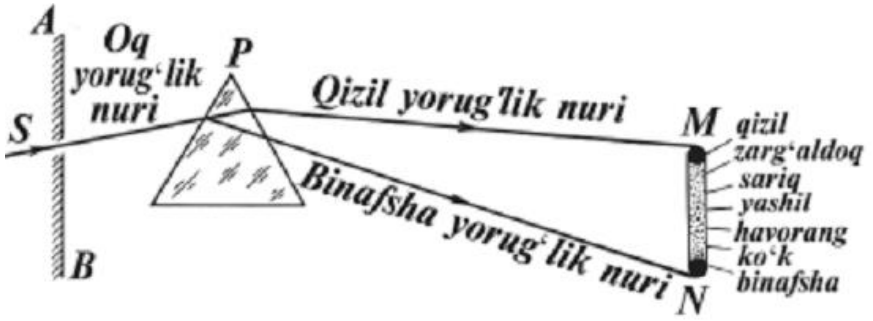
49-22	Ekran yonib turgan shamdan l masofada. Sham bilan ekran orasiga linza joylashtirib, ekranda shamning aniq tasvirini linzaning bir-biridan a masofaga uzoqlashgan ikkita vaziyatida hosil qilish mumkin. Bu holda linzaning bosh fokus masofasi	$F=\frac{l^2-a^2}{4l}$
50-§. Ko'z. Optik asboblar		
50-1	D - ko'zoynakning optik kuchi (d_1 - o'quvchi ko'zini zo'riqtirmasdan o'qiydigan masofa. D_0=25sm	$D=\frac{1}{D_0}-\frac{1}{d_1}$
50-2	Lupaning kattalashtirishi	$K=\frac{D_0}{F}$ optimal kattalashtirish k'=K+1
50-3-4	Mikraskopning ko'rinma kattalashtirishi $\delta-tubusning\quad uzunligi$	$K_M=K_{ob}\cdot K_{ok}=\frac{\delta}{F_{ob}}\frac{D_0}{F_{ok}}$
50-5	Ko'rish trubasining (durbin) ko'rinma kattalashtirishi	$K_{tr}=\frac{F_{ob}}{F_{ok}}$
50-6	Diaskop-buyumning shaffof rasmlari tushirilgan diopozitivlarni kattalashtiradigan proeksion apparat. Kattalashtirishi	$\mathrm{K}=\frac{\mathrm{f}}{F}$
50-7-8	Buyum tasvirga olinganda obyektiv fokus masofasidan ancha uzoqda turib olinadi. Bunda obyektivning kattalashtirishi	$K=\frac{f}{d}\approx\frac{F}{d}$
50-9	Suratga olinayotgan binodan fotoapparat obyektivigacha masofa	$d=F\frac{h+H}{H}$
Agar buyumni d_1 masofadan tasvirga olinganda tasvir balandligi H_1, d_2 masofadan tasvirga olinganda tasvir balandligi H_2 bo'lsa, u holda buyumning balandligi h, optik kuchi D, fokus masofasi F quyidagicha		
50-10-12	$h=\frac{(d_1-d_2)H_1H_2}{d_2H_2-d_1H_1};\quad D=\frac{H_2-H_1}{d_2H_2-d_1H_1};\quad F=\frac{d_2H_2-d_1H_1}{H_2-H_1};$	
50-13	Teleskopning kattalashtirishi	$K_t=\frac{F_{ob}}{F_{ok}}=\frac{tg\gamma}{tg\varphi}$

XIII bob. Fizik optika
51-§. Yorug'likning to'lqin tabiati. Yorug'lik interferensiyasi

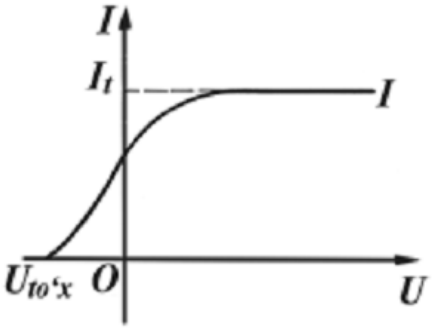
51-1	Chastotasi ν , g'ildirakdagi tishlar soni N bo'lsa. Tishlar orasidan yuborilgan nur ko'zgudan qaytib kelganda g'ildirak k ta tish masofasiga burilib, yana tirqishga to'g'ri kelib qolgan bo'lsa, yorug'lik tezligi (Fizo usuli)	$c = \frac{2 \cdot N \cdot \nu \cdot l}{k}$ $c = 3 \cdot 10^8 m/s$
51-2-5	Yorug'likning to'lqin uzunligi, chastotasi, tebranish davri va muhitdagi tarqalish tezligi orasidagi bog'lanish (bo'shliqda tezlik c ga teng)	$\lambda = \frac{\vartheta}{\nu} = \vartheta \mathrm{T}; \quad \nu = \frac{\vartheta}{\lambda} = \frac{1}{\mathrm{T}}$ $\mathrm{T} = \frac{\lambda}{\vartheta} = \frac{1}{\nu}; \quad \vartheta = \lambda\nu = \frac{\lambda}{\mathrm{T}};$
51-6-8	Yorug'lik to'lqinining biror muhitdagi va bo'shliqdagi parametrlari orasidagi bog'lanish	$\lambda = \frac{\lambda_0}{n}; \quad \nu = \nu_0; \quad \mathrm{T} = \mathrm{T}_0$
51-9	Yorug'lik to'lqinining biror muhitdagi tezligi	$\vartheta = c/n$
51-10	To'lqinlarning fazalar farqi (Δl - yo'llar farqi, λ_0- vakuumdagi to'lqin uzunligi)	$\Delta\varphi = \frac{2\pi\Delta l}{\lambda_0}$ rad
51-11 51-12	Biri n_1 sindirish ko'rsatkichli muhitda s_1 yo'l o'tgan, ikkinchisi n_2 sindirish ko'rsatkichli muhitda s_2 yo'l o'tgan ikki to'lqin yo'llari-ning optik uzunliklari farqi ΔL va fazalar farqi $\Delta\varphi$	$\Delta L = L_2 - L_1 = n_2 s_2 - n_1 s_1$ $\Delta\varphi = \frac{2\pi}{\lambda}(L_2 - L_1) + \varphi_2 - \varphi_1$
51-13	$\vec{\mathrm{E}}_1, \vec{\mathrm{E}}_2$ vektorlari bir yo'nalishga ega bo'lgan ikki to'lqinning qo'shilishi natijasida hosil bo'ladigan to'lqinning amplitudasi	$\mathrm{E}_0^2 = \mathrm{E}_{01}^2 + \mathrm{E}_{02}^2 + 2\mathrm{E}_{01}\mathrm{E}_{02}\cos\Delta\varphi$
51-14	Intensivliklari I_1, I_2 bo'lgan ikki kogirent to'lqinning qo'shilishidan hosil bo'ladigan to'lqinning intensivligi	$I = I_1 + I_2 \pm 2\sqrt{I_1 I_2}\cos\Delta\varphi$

51-15-17	Maksimum-lar sharti	$\Delta\varphi = 2\kappa\pi \quad yoki \quad \Delta l = 2\kappa\frac{\lambda}{2};(k = 0,1,2,3...)$ $k\lambda = 2d\sqrt{n^2 - \sin^2\alpha} + \frac{\lambda}{2} \qquad k\lambda = \frac{r_m^2}{R} + \frac{\lambda}{2}$			
51-18-20	Minimum-lar sharti	$\Delta\varphi = (2\kappa+1)\pi \quad yoki \quad \Delta l = (2\kappa+1)\frac{\lambda}{2};;(k = 0,1,2,3...)$ $\frac{2k-1}{2}\lambda = 2d\sqrt{n^2 - \sin^2\alpha} + \frac{\lambda}{2}$ $\frac{(2k+1)\lambda}{2} = \frac{r_m^2}{R} + \frac{\lambda}{2}$			
51-21	Maksimal intensivlik $\cos\varphi = 1$ bo'ladigan nuqtalarda kuzatiladi	$I_{max} = I_1 + I_2 + 2\sqrt{I_1 I_2}$			
51-22	Minimal intensivlik $\cos\varphi = -1$ bo'ladigan nuqtalarda kuzatiladi	$I_{min} = I_1 + I_2 - 2\sqrt{I_1 I_2}$			
51-23	**Ekrandagi interferensiyani hisoblash** Ekrandan l masofada, bir-biri-dan d masofada joylashgan 2 ta M_1 va M_2 manbalar kogerent nurlar chiqarsin.				
51-24	2 ta qo'shni maksimumlar orasidagi masofa 2 ta qo'shni minimumlar orasidagi masofaga teng		$\Delta x = \lambda\frac{l}{d}$	m	
51-25-26	Nurlar interferensiyalanuvchi D nuqta man-balardan l_1 va l_2 maso-fada, ekranning mar-kaziy chizig'idan x masofada joylashgan bo'lsa		$l_1^2 = l^2 + \left(x - \frac{d}{2}\right)^2$ $l_2^2 = l^2 + \left(x + \frac{d}{2}\right)^2$		
51-27-28	Yo'llar farqi	$\Delta l = \frac{2xd}{l_1 + l_2}$	agar l>>d bo'lsa	$x = \frac{\Delta l \cdot l}{d}$	m

51-29	Ekran markazidan ixtiyoriy m tartibli maksimumgacha masofa	$x_m = k\lambda\frac{l}{d}$	m
51-30	Ekran markazidan ixtiyoriy m tartibli minimumgacha masofa	$x_m = \frac{(2k+1)\lambda}{2}\frac{l}{d}$	
51-31	1-va 2-nurning optik yo'llar farqi 	Qalinligi d o'zgarmas plastinkani monoxromatik nur bilan yoritilganda ham interferensiya kuzatiladi	
		$\Delta l = l_{1optik} - l_{2optik}$	
		$\Delta l = 2d\sqrt{n^2 - \sin^2\alpha} + \frac{\lambda}{2}$	
51-32	Maksimumlar sharti	$k\lambda = 2d\sqrt{n^2 - \sin^2\alpha} + \frac{\lambda}{2}$	
51-33	Minimumlar sharti	$\frac{2k-1}{2}\lambda = 2d\sqrt{n^2 - \sin^2\alpha} + \frac{\lambda}{2}$ k=0,1,2,3,…. n-plastinkaning sindirish ko'rsatkichi	
Nyuton halqalari			
51-34	Qaytgan yorug'likda yorug' halqalar radiusi	$r_{yo} = \sqrt{(2\kappa-1)\lambda R/2n}$	
51-35	Qaytgan yorug'likda qorong'u halqalar radiusi	$r_q = \sqrt{\kappa\lambda R/n}$	
51-36	O'tgan yorug'likda yorug' va xira halqalarning joylashish tartibi qaytgan yorug'likdagiga nisbatan o'rin almashadi	$r_{yo} = \sqrt{\kappa\lambda R/n}$	
51-37		$r_q = \sqrt{(2\kappa-1)\lambda R/2n}$	
51-38	Agar qurlima havoda turgan bo'lsa	$r_q = \sqrt{(2\kappa-1)\lambda R/2}$	$r_{yo} = \sqrt{\kappa\lambda R}$
52-§. Yorug'lik difraksiyasi va dispersiyasi			
52-1	**Tirqishda bo'ladigan difraksiyaning sharti** a - tirqishning kengligi; b - to'siqning kengligi;	$d\sin\varphi = m\lambda \quad (m = \pm1;\pm2;...)$ φ -og'ish burchagi; d =a+b - panjara doimiysi(davri);	
52-	Kichik	$tg\,\varphi \approx \sin\varphi \Rightarrow$	$dtg\varphi = m\lambda$

2	burchaklarda			
52-3-4	Optik yo'llar farqi	$\Delta l = d\sin\varphi$	$\Delta l = m\lambda$	m
52-5	Bosh maksimumlarning eng katta tartibi	$m_{\max} = [d/\lambda]$		
52-6	Panjara doimiysi(davri)	$d = m\lambda/\sin\varphi$	$d = \Delta l/\sin\varphi$	m
52-7	Difraksion panjaradan o'tganda N ta bosh maksimum hosil bo'ladi	$N = 2\left[\frac{d}{\lambda}\right]+1$		
52-8	**Dispersiya hodisasi** 			
53-§. Yorug'likning qutblanishi. Spektral asboblar. Spektr turlari				
53-1	Tabiiy yorug'lik 	Qisman qutblangan yorug'lik 	Yassi (yoki to'g'ri chiziqli) qutblangan yorug'lik 	
53-2	**Malyus qonuni** (I-qutblantirgichdan o'tgan yassi qutblangan yorug'likning intensivligi, I_0-qutblantirgichga tushayotgan yassi qutblangan yorug'likning intensivligi;	$I = I_0 \cos^2 \alpha.$		
	α-qutblantirgich bosh tekisligi bilan unga tushayotgan yorug'likning qutblanish tekisligi orasidagi burchak).			
53-3	**Bryuster qonuni**-Ikki muhitning nisbiy sindirish ko'rsatgichi yo-rug'lik tushish burchagining tan-gensiga teng bo'lganida qaytgan nur to'la qutblangan bo'ladi.	$n = \frac{\sin\alpha}{\sin\beta} = \frac{\sin\alpha}{\sin\left(\frac{\pi}{2}-\alpha\right)} = tg\,\alpha$		
53-4	Agar yuzasi S bo'lgan sirtga t vaqtda tushgan W yorug'lik energiyasining hammasi yuzadan qaytsa (absolyut oq jism) yorug'likning sirtga beradigan bosimi	$P = \frac{2W}{cSt}$		

53-5	Agar yuzasi S bo'lgan sirtga t vaqtda tushgan W yorug'lik energiyasining hammasi yuzada yutilsa (absolyut qora jism) yorug'likning sirtga beradigan bosimi	$P = \frac{W}{cSt}$	
53-6	Absolyut qora jismning nurlanish qobiliyati haroratining 4 darajasiga to'g'ri proporsional $\sigma -$ Stefan-Bolsman doimiysi.	$E_q = \sigma \cdot T^4$	
53-7	Rentgen trubkasida U potensiallar farqini o'tgan elektronning erishgan tezligi	$\vartheta = \sqrt{\frac{2eU}{m_e}} \approx 5.93 \cdot 10^5 \sqrt{U}$	
54-§. Fotometriya			
54-1	Yorug'lik oqimi	$\Phi = \frac{W}{t}$	lm
54-2	Yorug'lik kuchi	$I = \frac{\Phi}{4\pi}$	kd
54-3	Fazoviy burchak	$\Omega = \frac{S}{r^2} = 4\pi$	sr
54-4	Yoritilganlik	$E = \frac{\Phi}{S}$	lk
54-5	Yorqinlik	$R = \frac{\Delta\Phi}{\Delta S}$	lk
54-6	Ravshanlik	$\mathrm{B} = \frac{\mathrm{I}}{S}$	nit
54-7	Agar yorug'lik ixtiyoriy yo'nalishda chiqayotgan bo'lsa	$B = \frac{I}{\Delta S \cos\varphi}$	
54-8	**lambert manbalari** yoki **kosinusli manbalar -** ravshanligi hamma yo'nalishlar bo'yicha bir xil bo'lgan manbalar.	$R = \pi B$ (B=const)	
54-9	Yoritilganlikning birinchi qonuni	$E = \frac{I}{r^2}$	
54-10	Yoritilganlikning ikkinchi qonuni	$E = E_0 \cos\alpha$	
54-11	**Yoritilganlikning birlashgan qonuni** Nuqtaviy yorug'lik manbai hosil qiladigan yoritilganlik	$E = \frac{I\cos\alpha}{R^2}$	lk
KVANT FIZIKASI **XIII bob. Kvant fizikasi elementlari**			

55-§.Yorug'likning kvant nazariyasi. Fotoeffekt			
55-1-2	Fotonning energiyasini mos elektromagnit to'lqinning chastotasi (to'lqin uzunligi) orqali ifodalash	$\mathrm{E} = h\nu = \frac{hc}{\lambda}$	J
55-3-5	$E=mc^2$ ga ko'ra fotonning massasini $h\nu=m_Fc^2$ tenglikdan aniqlash mumkin	$m_F = \frac{h\nu}{c^2} = \frac{\mathrm{E}}{c^2} = \frac{h}{\lambda c}$	
55-6-9	Fotonning absolyut qora sirtga beradigan impulsi	$P_F = m_F c = \frac{h\nu}{c} = \frac{h}{\lambda} = \frac{\mathrm{E}}{c}$	Kgm/s
55-10-13	Fotonning absolyut oq sirtga beradigan impulsi	$P_F = 2m_F c = 2\frac{h\nu}{c} = 2\frac{h}{\lambda} = 2\frac{\mathrm{E}}{c}$	
55-14-16	Nurlanish kvantlari soni	$N = \frac{m\cdot c^2}{h\nu} = \frac{mc\lambda}{h} = \frac{P_F\Delta t}{h\nu}$	
55-17-20	To'lqin uzunligi	$\lambda = \frac{h}{P} = \frac{h}{m\vartheta} = \frac{h}{mc} = \frac{hc}{Nt}$	m
55-21	Fotoeffektning volt-amper xarakteristikasi-fototokning anod kuchlanishiga bog'liqligi		$\frac{m\upsilon^2}{2} = eU_{\mathrm{t}}$
55-22			$\upsilon = \sqrt{\frac{2eU_t}{m}}.$
55-23	Tashqi fotoeffekt uchun Eynshteyn tenglamasi(Energiyaning saqlanish qonuni)		$h\nu = A + \frac{m\vartheta^2}{2}$
55-24	Fotoelektronlar anodga yetib bormasligi uchun fotoelektronlarni katoddan anodga ko'chirishda elektr kuchlariga qarshi bajarilgan ish katoddan elektronlarning uchib chiqishida olgan kinetik energiyasiga teng bo'ladi		$\frac{hc}{\lambda} = A + eU$
55-25	Tashqi fotoeffekt uchun Eynshteyn tenglamasining fotoeffektning qizil chegarasi orqali ifodasi		$h\nu = h\nu_q + \frac{m\vartheta^2}{2}$
55-26			$h\nu = \frac{hc}{\lambda_{\max}} + \frac{m\vartheta^2}{2}$

55-27	Agar metall sirtlari λ_1 va λ_1 to'lqin uzunlikli nurlanish bilan galma-gal yoritilsa, fotoelertronlarning tezliklari bir-biridan N marta farq qiladi. Bu metaldan elektronlarning chiqish ishi A ($\lambda_1 < \lambda_2$)	$A = \frac{hc}{N^2 - 1}\left(\frac{N^2}{\lambda_2} - \frac{1}{\lambda_1}\right)$	
55-28	Elektronning maksimal kinetik energiyasi	$E_k = h\nu - A$	J
55-29	Elektronning metalldan chiqish ishi(U-potensial)	$A = eU$	
55-30	Fotoeffektning qizil chegarasi	$\nu_q \geq \frac{A}{h}$	Hz
55-31	Yorug'likning fotoeffekt ro'y berishi mumkin bo'lgan eng kichik chastotasi	$\nu_{\min} = \frac{A}{h}$	
55-32-33	Eng katta to'lqin uzunligi	$\lambda_{\max} = \frac{c}{\nu_{\min}} = \frac{hc}{A}$	m
55-34	Sirtdan urib chiqarilgan elektronning tezligi	$\vartheta = \sqrt{\frac{2(h\nu - A)}{m}}$	m/s
56-§. Maxsus nisbiylik nazariyasi			
56-1	**Uzunlikning relyativistik qisqarishi** (l_0-tinch holatdagi jism uzunligi, l- ϑ tezlik bilan harakatlanayotgan jism uzunligi)	$l = l_0\sqrt{1 - \frac{\vartheta^2}{c^2}}$	m
56-2	**Massaning relyativistik ortishi** (m — jism-ning sanoq sistemasiga nisbatan ϑ tezlik bilan harakatlanayotgandagi massasi, m_0 — jismning tinch holatdagi massasi.	$m = \frac{m_0}{\sqrt{1 - \frac{\vartheta^2}{c^2}}}$	kg
56-3	**Vaqtning relyativistik sekinlashuvi** Jismning t_0 «xususiy vaqti» unga biriktirilgan soat bo'yicha o'lchanadi. Yerdagi kuzatuvchi soati jismga nisbatan harakatlanuvchi sistemaga biriktirilgan, shu sababli uning yordamida o'lchangan vaqt t ga teng.	$t = \frac{t_0}{\sqrt{1 - \frac{\vartheta^2}{c^2}}}$	s

56-4	Relyativistik impuls	$\vec{P} = m\vec{\vartheta} = \frac{m_0\vec{\vartheta}}{\sqrt{1-\frac{\vartheta^2}{c^2}}}$	Kgm/s
56-5	Agar jismning tinchlikgagi zichligi ρ_0 bo'lsa, harakatdagi zichligi	$\rho = \frac{\rho_0}{1-\frac{\vartheta^2}{c^2}}$	Kg/m^3
56-6-7	**Tezliklarni qo'shishning relativistik qonuni** ϑ ϑ_2 -mos ravishda jismning birinchi va ikkinchi sanoq sistemadagi tezliklari, ϑ_1 – ikkinchi sanoq sistemaning birinchi sanoq sistemaga nisbatan tezligi.	$\vartheta = \frac{\vartheta_2 + \vartheta_1}{1+\frac{\vartheta_2 \cdot \vartheta_1}{c^2}}$ $\vartheta_2 = \frac{\vartheta - \vartheta_1}{1-\frac{\vartheta \cdot \vartheta_1}{c^2}}$	
56-8	Energiya va massaning o'zaro bog'lanishi	$E = mc^2 = \frac{m_0c^2}{\sqrt{1-\frac{\vartheta^2}{c^2}}} = \frac{E_0}{\sqrt{1-\frac{\vartheta^2}{c^2}}}$	J
56-9	Jismning tinchlikdagi energiyasi	$E_0 = m_0c^2$	
56-10-11	Massa orttirmasi	$\Delta m = m - m_0 = \frac{\Delta E}{c^2}; \qquad \Delta E = \Delta mc^2$	
56-12-13	Harakatdagi jismning kinetik energiya	$E_к = E - E_0 = mc^2 - m_0c^2 = m_0c^2\left(\frac{1}{\sqrt{1-\frac{\vartheta^2}{c^2}}} - 1\right)$	
56-14	Relativistik energiya va relativistik impuls orasidagi bog'lanish	$E = \sqrt{P^2c^2 + m_0^2c^4}$	J
56-15	Elektron tezligi ϑ ni tashkil qilishi uchun u tezlashtiruvchi potensiallar ayirmasidan o'tishi lozim	$U = \frac{m_0 \cdot c^2}{e}\left(\frac{1}{\sqrt{1-\frac{\upsilon^2}{c^2}}} - 1\right)$	V

56-16	Jism ΔT haroratga qizdirilsa uning massasi Δm ga ortadi	$\Delta m = \frac{c_s m \Delta T}{c^2}$	kg
56-17	Jism h balandlikdan tushsa uning massasi Δm ga ortadi	$\Delta m = \frac{mgh}{c^2}$	

ATOM VA YADRO FIZIKASI
XIV bob. Atom fizikasi
57-§. Atom tuzilishi

57-1	**Rezerford formulasi** N -folganing 1 sm^2 yuzasiga 1 s da tushgan α-zarralar-ning soni; n - folganing 1 sm^3 hajmdagi atomlar soni; l- folga markazidan E ekrangacha bo'lgan masofa; b - folganing qalinligi; m_a—α zarraning massasi; q=Ze — atom yadrosining zaryadi; ΔN-1 s da θ burchak ostida sochilayotgan α zarralarning soni;	$\Delta N = \frac{nNb}{l^2}\left(\frac{2Ze^2}{m_\alpha \cdot \upsilon^2}\right)^2 \frac{1}{4\sin^4\frac{\theta}{2}}$ e — elementar zaryadning absolyut qiymati; Z— mazkur kimyoviy elementning davriy sistemadagi tartib nomeri.

57-2	Atomning W_m energiyali statsionar holatdan $W_n < W_m$ energiyali statsionar holatga o'tishida chiqaradigan elektromagnit nurlanish kvantining chastotasi va energiyasi	$\nu = \frac{W_m - W_n}{h}$	Hz
57-3		$h\nu = W_m - W_n$	J
57-4	Energiyani kvantlash qoidasi: Atomning to'liq W energiyasi elektronning yadro bilan bo'ladi-gan o'zaro ta'sirining potensial energiyasi bilan elektronning orbital harakatidagi kinetik energiyasi yig'indisiga tengdir	$W = \frac{m_e \vartheta^2}{2} + \left(-\frac{e^2}{4\pi\varepsilon_0 r}\right)$	
57-5	Elektronni radiusi r bo'lgan orbitada tutib turuvchi markazga intilma kuch elektron bilan yadroning o'zaro tortishishidagi Kulon kuchidan iborat	$\frac{m_e \vartheta^2}{r} = \frac{e^2}{4\pi\varepsilon_0 r^2}$	
57-6	Yadro va elektrondan iborat atomning n-statsionar holatida elektronning tezligi ϑ_n bilan uning aylanma orbitasining	$m\vartheta_n r_n = n\frac{h}{2\pi} = n\hbar$	

	radiusi r_n quyidagicha bog'langan		
57-8-9	Vodorod atomining n-statsionar orbitasi bo'ylab aylanayotgan elektronning to'la energiyasi	$W = -\frac{m_e e^4}{8\varepsilon_0^2 h^2 n^2} = -\frac{e^2}{8\pi\varepsilon_0 r_n}$	
57-10	Vodorod atomining asosiy holati energiyasi	$W_1 = -\frac{m_e e^4}{8\varepsilon_0^2 h^2} = -13.60eV$	J
57-11	Vodorod atomining n-statsionar holat energiyasi	$W_n = \frac{W_1}{n^2}$	
57-12	Birinchi statsionar orbitasi radiusi	$r_1 = \frac{\varepsilon_0 h^2 n^2}{\pi \cdot me^2} = 5.3 \cdot 10^{-11} m$	m
57-13	n- statsionar orbitasi radiusi	$r_n = r_1 n^2$	
57-14	Birinchi statsionar orbita bo'ylab harakat tezligi	$\vartheta_1 = \frac{e^2}{2\varepsilon_0 hn} = 2.2\frac{Mm}{s}$	m/s
57-15	n-statsionar orbita bo'ylab harakat tezligi	$\vartheta_n = \frac{\vartheta_1}{n}$	
57-16	Vodorod atomi nurlanishining mumkin bo'lgan chastotalari	$\nu_{mn} = \frac{W_m}{h} - \frac{W_n}{h} = \frac{m_0 e^4}{8\varepsilon_0^2 h^3}\left(\frac{1}{n^2} - \frac{1}{m^2}\right),$	
57-17	Balmerning vodorod atomining nurlanish spektrining ko'rinadigan qismida yotgan spektral chiziqlarning chastotasini hisoblash empirik formulasi	$\nu = R\left(\frac{1}{2^2} - \frac{1}{m^2}\right)$	
57-18	Spektrning ultrabinafsha qismida Layman seriyasi R=1.1·10^7 m^{-1} –vodorod atomi uchun Ridberg doimiysi.	$\nu = R\left(\frac{1}{1^2} - \frac{1}{m^2}\right)$	
57-19	Spektrning infraqizil qismida Pashen seriyasi	$\nu = R\left(\frac{1}{3^2} - \frac{1}{m^2}\right)$	
57-20	Bolmerning umumlashgan formulasi n=1,2,3...; m=n+1 R=3,29·10^{15} s^{-1} Ridberg doimiysi.	$\nu = R\left(\frac{1}{m^2} - \frac{1}{n^2}\right)$	

XV bob. Yadro fizikasi

58-§. Atom yadrosining tarkibi. Atom yadrosini xarakterlovchi asosiy kattaliklar

58-1	Yadroning tinchlikdagi massasi M_y uning tarkibiga kiruvchi hamma zarralar massalarining yig'indisidan hamisha kichik bo'ladi.	$M_y < [Zm_P + Nm_n]$
58-2	Massa deffekti	$\Delta m = (Zm_P + Nm_n) - M_y = Zm_P + (A-Z)m_n - M_y$
58-3	Yadroning bog'lanish energiyasi	$W_b = \Delta mc^2 = [Zm_P + (A-Z)m_n - M_y]\cdot c^2$
58-4	Yadroning bog'lanish energiyasi(MeV)	$W_b = 931\ \{[Zm_p + (A-Z)\ m_n] - m_{ya}\}$ MeV.
58-5	Atom yadrosining solishtirma bog'lanish energiyasi (Bitta nuklonga to'g'ri keluvchi bog'lanish energiyasi)	$\varepsilon = \frac{W_b}{A}$
58-6	Massa sonlari A_1 va A_2 bo'lgan izotoplar aralashmasidan tashkil topgan qotishmaning massa soni A, tarkibiy qismlarining massa ulushlari	$A = \eta_1 A_1 + \eta_2 A_2$ $\eta_1 = \frac{A - A_2}{A_1 - A_2}$ $\eta_2 = \frac{A_1 - A}{A_1 - A_2}$

59-§. Radioaktivlik. Alfa, beta va gamma nurlar

59-1	α yemirilish natijasida yadro +2e zaryad yo'qotadi, uning massasi 4 m.a.b ga kamayadi. Element davriy sistemaning boshiga qarab ikki katak suriladi.	${}_Z X^A \rightarrow^{\alpha} {}_{Z-2}Y^{A-4} + {}_2He^4$ Alfa yemirilishda yadrodan geliy atomi uchib chiqadi.
59-2	Beta yemirilishda yadroning zaryadi +e ga ortadi, massasi esa deyarli o'zgarmay-di. Natijada element davriy sistemaning oxiriga qarab bir katak siljiydi.	${}_Z X^A \rightarrow^{\beta-} {}_{Z+1}Y^A + {}_{-1}e^0 + \tilde{\nu};$ - β yemirilishda yadrodan elektron uchib chiqadi.
59-3	+ Beta yemirilishda yadroning zaryadi +e ga ga kamayadi, massasi esa deyarli o'zgarmaydi.	${}_Z X^A \rightarrow^{\beta+} {}_{Z-1}Y^A + {}_{+1}e^0 + \nu;$ + β yemirilishda yadrodan

	Natijada element davriy sistemaning boshiga qarab bir katak siljiydi.	pozitron uchib chiqadi.
59-4	Beta yemirilishda yadrodagi 1ta neytron proton, elektron, va antineytrino(og'ir massali foton)ga aylanadi	$n \to p + e^- + \tilde{\nu}$
59-5	+ Beta yemirilishda yadrodagi 1ta proton neytron, pozitron va neytrinoga aylanadi	$p \to n + e^+ + \nu$
59-6	Elektron yutishda yadro e ga teng musbat zaryad yo'qotadi, protonlar soni 1 taga kamayadi, yadro massasi deyarli o'zgar-maydi natijada element davriy sistema-ning boshiga qarab bir katak siljiydi.	${}_Z X^A + e^- \to {}_{Z-1}Y^A + \nu$ $p + e^- \to n + \nu$
59-7	γ -nurlanish	Bunda yadro zaryadi o'zgarmaydi, massasi esa juda kam o'zgaradi.
59-8	Radioaktiv yemirilishning asosiy qonuni	$N = N_0 e^{-\lambda t} = N_0 2^{-\frac{t}{T}} = N_0 e^{-\frac{0.693t}{T}} = N_0 / e$ N_0 -boshlang'ich t=0 vaqtda mavjud atomlar soni. N -t vaqtdagi mavjud atomlar soni.
59-9	ΔN – t vaqtda yemirilgan atomlar soni	$\Delta N = N_0 - N$ $t << T \Rightarrow$ $\Delta N \approx N_0 \frac{0.693t}{T}$
59-10-11	Yarim emirilish davri	$T = \frac{t}{\log_2(N_0 / N)};$ $T = (0.693/\lambda) \approx \tau \ln 2 \approx 0.693\tau;$
59-12	Radioaktiv yadrolarning o'rtacha yashash vaqti	$\tau = (T / \ln 2) \approx 1.4427T;$ — s
59-13-14	Radioaktiv yemirilish doimiysi	$\lambda = \frac{\ln 2}{T} = \frac{0,693}{T}$ $\tau = \frac{1}{\lambda}$
59-15-18	Radioaktiv manbaning aktivligi $1Ki = 3.7 \cdot 10^{10} Bk;$	$A = \frac{dN}{dt} = \lambda N = \frac{N}{\tau} = \frac{N}{T} \ln 2$ — Bk
60-§. Zarralarni kuzatish. Yadro reaksiyalari		

60-1	Yadro reaksiyasida elektr zaryadining hamda massa sonining saqlanish qonuni	$${}^{A_1}_{Z_1}a + {}^{A_2}_{Z_2}b \rightarrow {}^{A_3}_{Z_3}c + {}^{A_4}_{Z_4}d$$ **$Z_1+Z_2=Z_3+Z_4$ va $A_1+A_2=A_3+A_4$**
60-2	Birinchi sun'iy yadro reaksiyasi	${}^{14}_{7}\mathrm{N} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{18}_{9}\mathrm{F} \rightarrow {}^{17}_{8}\mathrm{O} + {}^{1}_{1}\mathrm{H}.$
60-3	Sun'iy radioaktiv moddalar ichida tabiiy radioaktiv elementlarga xos bo'lmagan pozitronlar chiqarish bilan bo'ladigan yemirilish mavjud.	${}^{30}_{15}\mathrm{P} \rightarrow {}^{30}_{14}\mathrm{Si} + {}^{0}_{+1}e + {}^{0}_{0}\nu.$
60-4	**Yadro reaksiyasi vaqtida ajraladigan energiya** (m_1, m_2 reaksiyaga kirishayotgan, m_3, m_4 reaksiya natijasida hosil bo'lgan moddalarning massalari)	$W = (m_1 + m_2 - m_3 - m_4) \cdot c^2$
	61-§. Yadro energiyasi	
61-1	**Neytronlarning ko'payish koeffitsiyenti** - reaksiyaning birorta bosqichida yadrolarning bo'linishini vujudga keltiradigan neytronlar soni N_i ning bundan avvalgi bosqichda bo'linishini vujudga keltirgan neytronlar soni N_{i-1} ga nisbati.	$k = \frac{N_i}{N_{i-1}}$
61-2	**$m_{yoqilg'i} < m_{kritik}$ k<1** bo'linish reaksiyasi asta-sekin so'nadi. **$m_{yoqilg'i} = m_{kritik}$ k=1** zanjir reaksiya o'zgarmas intensivlikda davom etadi. **$m_{yoqilg'i} > m_{kritik}$ k>1** zanjir reaksiya boshqarib bo'lmaydi-gan darajada avj oladi va portlash ro'y beradi.	
61-3	Yadro yoqilg'isi	${}^{235}_{92}U, {}^{238}_{92}U, {}^{239}_{94}Pu$
61-4	**Termoyadro reaksiyasi** - yuqori haro-ratlarda(10^7-10^9 K) yengil yadrolar-ning birikib, og'ir yadro hosil qilishi	${}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n + 17.5MeV$ **Yadro sintezi** - yengil yadrolarning qo'shilib, og'irroq yadro hosil qilishi.
61-5	Tritiy termoyadro reaktorining o'zida litiyni neytronlar bilan bombardimon qilish orqali	${}^{6}_{3}\mathrm{Li} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{3}_{1}\mathrm{H}.$

	sun'iy yo'l bilan olinadi	
61-6	Yadro bir marta bo'linganda W_1 energiya ajralib chiqsa, m massali modda bo'linganida ajraladigan energiya	$W = \frac{m}{\mu} N_A W_1$

62-§. Elementar zarralar

61-1	**Ba'zi elementar zarrachalar** Elektronning yuqorisidagi 0 indeks uning massasini m.a.b ga nisbattan hisobga olmaslik mumkinligini bildiradi.	${}_0n^1 - neytron;$ ${}_1P^1 - proton;$ ${}_{-1}e^0 - elektron;$ ${}_1e^0 - pozitron;$ $\tilde{\nu} - antineytrino;$ $\nu - neytrino;$ $\gamma - foton;$
62-2	Elementar zarrachalar tinchlikdagi massalariga ko'ra 4 ta guruhga bo'linadi:	1. Fotonlar $m_0=0$
		2. Leptonlar (yengil zarrachalar) $0<m_0<m_e$
		3. Mezonlar (o'rta og'irlikdagi zarrachalar) $m_e<m_0<m_p$
		4. Barionlar (og'ir zarrachalar) $m_p<m_0<m_d$
62-3	Elementar zarrachalarning spini	$\hbar = \frac{h}{2\pi}$
62-4	Annigilyatsiyada ajralgan energiya	$E = (m_1 + m_2)c^2$
62-5	Juftlar anigilyatsiyasida proton va antiprotonning pinol mezonga aylanishi	$p + \tilde{p} \rightarrow 2\pi^0$
62-6	Fotonning elektron va pozitronga aylanishi	$\gamma \rightarrow e^+ + e^-$
62-7	Yadrodagi 1 ta neytron elektron, proton va antineytrino (og'ir massali foton)ga aylanadi	$n \rightarrow p + e^- + \tilde{\nu}$
62-8	Yadrodagi 1ta proton pozitron va neytrino chiqarib neytronga aylanadi	$p \rightarrow n + e^+ + \nu$
62-9	Elektron va pozitronning fotonlarga aylanishi	$e^+ + e^- \rightarrow 2\gamma$

ILOVALAR

1-ILOVA

Xalqaro sistema (си) da fizik kattaliklarning o'lchov birliklari			
Kattalik-ning nomi	**Kattalikning o'lchov birligi**		
	Nomi	**Belgisi**	**Tarifi**
1	2	3	4
Uzunlik	Metr	M	Kripton-86 $2P_{10}$ va 5D5 satxlari orasidagi o'tishga mos bo'lgan vakumdagi nurlanishning 1 650 763 730 to'lqin uzunligi 1 metr deb qabul qilingan.
Massa	Kilogram	Kg	Xalqaro kilogram protipining massasini 1 kg deb qabol qilingan
Vaqt	Sekund	C	Seziy-133 atomi asosiy holatining ikki o'ta nozik satxlari orasidagi o'tishga mos bo'lgan 9 192 631 770 nurlanish davri 1 sekund deb qabul qilingan.
Tok kuchi	Amper	A	Amper- vakumda bib-biridan 1 metr masofada joylashgan ikki parallel cheksiz uzun va kesimi juda kichik to'g'ri o'tkazgichlardan tok o'tganda o'tkazgichning har bir metr uzunligida $2*10^{-7}$ H O'zaro ta'sir kuchi hosil qiladigan o'zgarmas tok kuchidir.
Absalyut temperatura	Kelvin	K	Suvning o'lchanma nuqtasini xarekterlovchi termodinamik temperaturaning 1/273,16 ulushi 1 kelvin deb qabul qilingan.
Modda miqdori	Mol	Mol	Uglerod-12 ning 0,012 kg massasidagi atomlar soniga teng element (atom, molekula, ion…) lardan tashkil topgan sistemadagi modda miqdori 1 mol deb qabul qilingan.
Yorug'lik kuchi	Kandela	Kd	101325 Pa bosim ostidagi platinaning qotish tempereturasiga

			teng temperaturadagi to'la nurlanishning 1/600000 m^2 yuzidan perpendikulyar ravishda chiqarilayotgan yorug'lik kuchi 1 kandela deb qabul qilingan.
Yassi burchak	Radian	Rad	Uzunligi radiusga teng yoyga tiraluvchi markaziy burchak 1 radian deb qabul qilingan.
Fazoviy burchak	Steradian	Sr	Uchi sfera markazida bo'lgan va shu sfera markazidan radius kvadratiga teng yuzli sirtni ajratadigan fazoviy burchakni 1 steradian deb qabul qilingan.
Yuza	Mter kvadrat	M2	1 M^2 - tomonlarining uzunligi 1m da bo'lgan kvadratning yuzi.
Hajm	Metr kub	M^3	1 m^3 -qirrqlarining uzunligi 1m dan bo'lgan kubning hajmi.
Tezlik	Metr teqsim sekund	M/c	To'g'ri chiziqli tekis harakat qilqyotgan moddiy nuqta 1c da 1m masofaga ko'chsa , uning tezligi 1 m/c ga teng.
Tezlanish	Metr taqsim sekund kvadrat	M/c^2	To'g'ri chiziqli tekis tezlanuvchan harakat qilayotgan moddiy nuqta 1c da o'z tezligini 1m/c ga o'zgarsa, uning tezlanishi $1m/c^2$ ga teng.
Burchak tezlik	Radian taqsim sekund	Rad/c	Tekis aylanma harakat qilayotgan jismning barcha nuqtalari 1c da 1rad ga burilsa, uning burchak tezligi 1rad/c ga teng
Zichlik	Kilogram taqsim sekund	Kg/c	$1kg/m^3$ shunday bir jinsli moddaning zichligi, mazkur moddaning ajratib olingan $1m^3$ hajmning massasi 1kg bo'ladi.
Impuls	Kilogram metr taqsim sekund	Kg m/c	1kg m/c - tezligi 1m/c bo'lgan 1kg massali moddiy nuqtaning impulsi.
Impuls momenti	Klogram metr	Kg m^2/c	1 kg m^2/c - radiusi 1mterli aylana bo'ylab harakatlanayotgan impulsi

	kvadrat taqsim sekund		1kg*m/c bo'lgan moddiy nuqtaning impuls moment.
Kuch	Kilogram metr taqsim sekund	H	1H massasi 1 n kg jismga ta'sir qilib, shu ta'sir yo'nalishida jismga $1m/c^2$ tezlanish beradigan kuch.
Kuch momenti	Nyuton metr	H*m	1H*m - kuchning ta'sir chizig'ida 1m masofada joylashgan nuqtaga nisbatan qiymati 1H bo'lgan kuchning moment.
Kuch impulsi	Nyuton sekund	H*c	1H*c -1c davomida ta'sir etuvchi 1h kuchning impulse.
Bosim	Paskal	Pa	1pa-1h kuchning kuch yo'nalishiga perpendikulyar bo'lgan $1m^2$ yuzaga beradigan bosim.
Sirt taranglik koeffisenti	Nyuton taqsim metr	N/m	1N/m - shunday suyuqlikning sirt tarang-ligiki, bu suyuqlik erkin sirtini chegaralovchi kountrning 1m uzunligiga 1N ta'sir qiladi.
Ish (energiya)	Joul	j	1J -1N kuch ta'sirida va kuch yo'nalishida jismni 1m masofaga ko'chirishda bajarilgan ish.
Quvvat	Vatt	Vt	1Vt-1c davomida 1j ish bajaradigan mashinaning quvvati.
Selsiy temperatura	Selsiy gradus	^0c	Selsiy o'lchov jihatidan Kelvinga teng.
Issiqlik miqdori	Joul	j	1J -kattaligi 1J bo'lgan mexanik ishga ekvivalent issiqlik miqdori.
Issiqlik sig'imi	Joul taqsim kelvin	J/c	1J/C – shunday sistemaning issiqlik sig'imiki, bu sistemaga 1j issiqlik miqdori berilganda uning temperaturasi 1k ga ortadi.
Solishtirma issiqlik sig'imi	Joul taqsim kilogram kelvin	J/(kg k)	1J/(kg K)-massasi 1kg bo'lgan holda issiqlik sig'imi 1J/K bo'ladigan jismning solishtirma issiqlik sig'imi.
Zaryad	Kulon	C	1Kl – tok kuchi 1A bo'lgan

miqdori			ko'ndalang kesimdan 1c davomida o'tgan elektr zaryad miqdori.
Elektron maydon kuchlanganligi	Volt taqsim metr	V/m	1V/M-kuchlangalik chizig'i bo'ylab bir-biridan 1m uzoqlikda joylashgan ikki nuqtasining potentsiallar farqi 1v bo'lgan bir jinsli elektr maydon kuchlanganligidir. Bunday maydonga kiritilgan 1kl zaryadga 1n kuch ta'sir qiladi.
Elektr induktsiyasi (siljish)	Kulon taqsim metr kvadrat	Kl/m^2	1 Kl/m^2 - yuzi 1m^2 li ko'ndalang kesimdan 1Kl gat eng elektr induktsiya oqimi o'tadigan xoldagi elektr induktsiyasidir.
Magnit induktsiyasi	Tesla	T	1Tl -yuzi 1m^2 li ko'ndalang kesimdan 1Vb gat teng magnit oqim o'tadigan xoldagi magnit induktsiyasidir.
Magnit maydon kuchlanganligi	Amper taqsim metr	A/м	1 A/M -magnit maydon shunday nuqtqsining kuchlanganligiki, bu nuqtadagi magnit induktsiyasi 4п*10^{-7} Tl bo'ladi.
Magnit oqimi	Veber	Vb	1Vb –shunday magnit oqimiki, uning nolgacha kamayib boorish jarayonida mazkur magnit oqimi bilan tutilgan elektr qarshiligi 1Om bo'lgan elektr zanjirning ko'ndalang kesimidan 1Kl zaryad o'tadi.
Induktivlik	Genri	Gn	1Gn- shundayo'tkazgich induktivlikki, undan 1a tok o'tganda vujudga keladigan to'la magnit oqimi 1Vb ga teng.
Elektr qarshilik	Om	Om	1Om- ikki uchidan potentsiallar farqi 1V bo'lganda 1A tok o'tadigan o'tkazgichning elektr qarshiligi.
Elektr kuchlanish	Volt	V	1V-o'zgarmas tok kuchi 1A bo'lganda elektr zanjirning 1Vt quvvat sarflanadigan qismidagi kuchlanish.
Elektr sig'im	Farada	F	1F-1Kl zaryad berilganda potensiali 1V ga ortadigan o'tkazgichning elektr sig'imi.

Solishtirma elektr qarshilik	Om-metr	Om*m	1 Om*m-ko'ndalang kesimi 1m^2, uzunligi 1m bo'lganda 1Om elektr qarshilikka ega bo'ladigan o'tkazgichning solishtirma elektr qarshiligi.
Davriy jarayon chastotasi	Herz	Hz	1Hz-1s davomida davriy jarayonning bitta sikli amalga oshadigan holdagi davriy jarayon chastotasi.
Yorug'lik oqimi	Lyumen	Lm	1Lm-yorug'lik kuchi 1kd bo'lgan nuqtaviy manbadan 1 sr fazoviy burchakda chiqarilayotgan yorug'lik oqimi.
Yorug'lik energiyasi	Lyumen*sekund	Lm*s	1Lm*s- 1s davomida ta'sir etuvchi 1Lm yorug'lik oqimida mujassamlashgan yorug'lik energiyasi.
Ravshanlik	Kandella/metr kvadrat	Kd/m^2	1 Kd/m^2-yorug'lik kuchi 1 kd bo'lgan 1m^2 yuzli yorug'lik tarqatadigan sirtning ravshanligi.
Yorituvchanlik	Lyumen/metr kvadrat	Lm/m^2	1 Lm/m^2-1Lm yorug'lik oqimi chiqaradigan 1m^2 yuzli sirtning yorituvchanligi.
Yoritilganlik	luks	Lk	1 Lk-yuzi 1m^2 bo'lgan sirtga 1Lm yorug'lik oqimi tushishi tufayli vujudga keladigan yoritilganlik.

2-ILOVA

Zichlik					
Qattiq jismlar $\cdot 10^3 kg/m^3$					
Alyuminiy	2.7	Oltin	19.3	Kumush	10.5
Muz	0.9	Qo'rg'oshin	11.3	Po'lat	7.8
Mis	8.9	Qalay	7.3	Xrom	7.2
Suyuqliklar $\cdot 10^3 kg/m^3$					
Benzin	0.7	Kerosin	0.8	Simob	13.6
Suv	1	Neft	0.8	Spirt	0.79

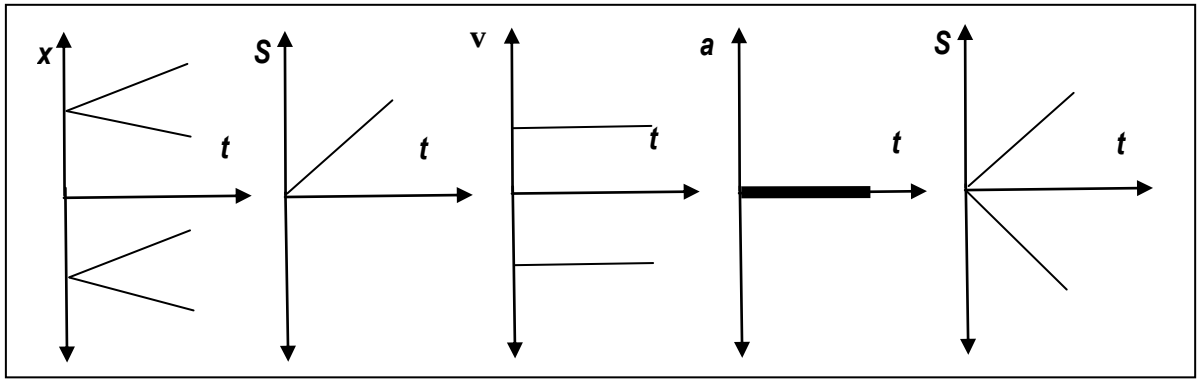
Gazlar(normal sharoitlarda) kg/m^3					
Azot	1.25	Havo	1.29		
Vodorod	0.09	Kislorod	1.43		

3-ILOVA

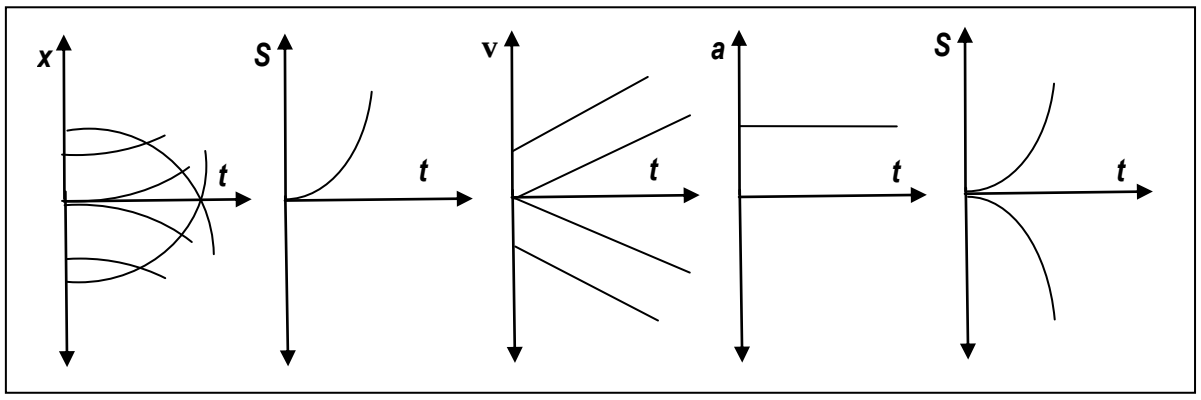
Cho’zilishga puxtalik chegarasi(σ) va elastiklik moduli E		
Modda	**σ (MPa)**	**E(GPa)**
Alyuminiy	100	70
Mis	400	120
Qalay	20	50
Qo’rg’oshin	15	15
Kumush	140	30
Po’lat	500	200

4-ILOVA

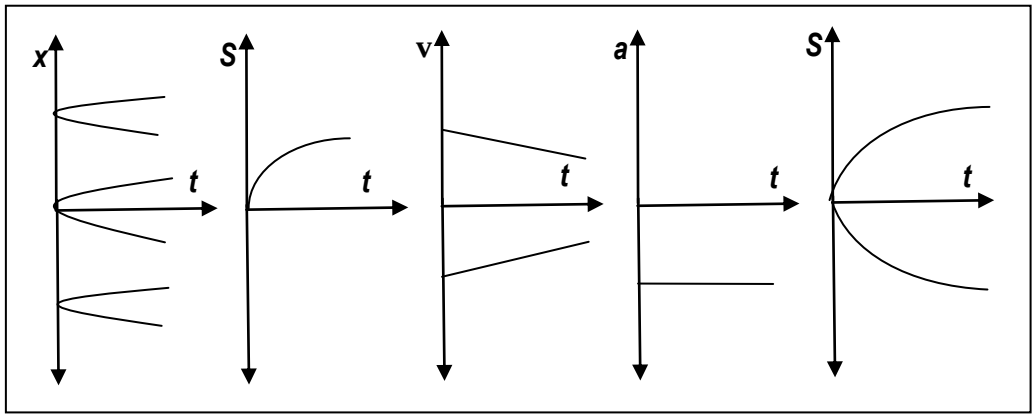
To`g`ri chiziqli tekis harakat grafiklari:



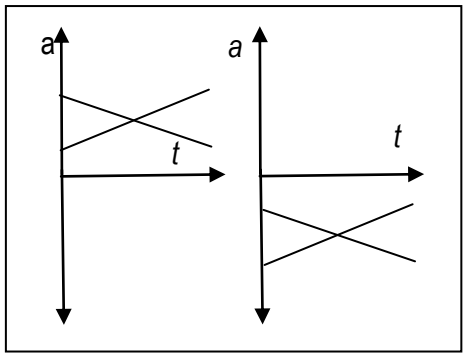
To`g`ri chiziqli tekis tezlanuvchan harakat:



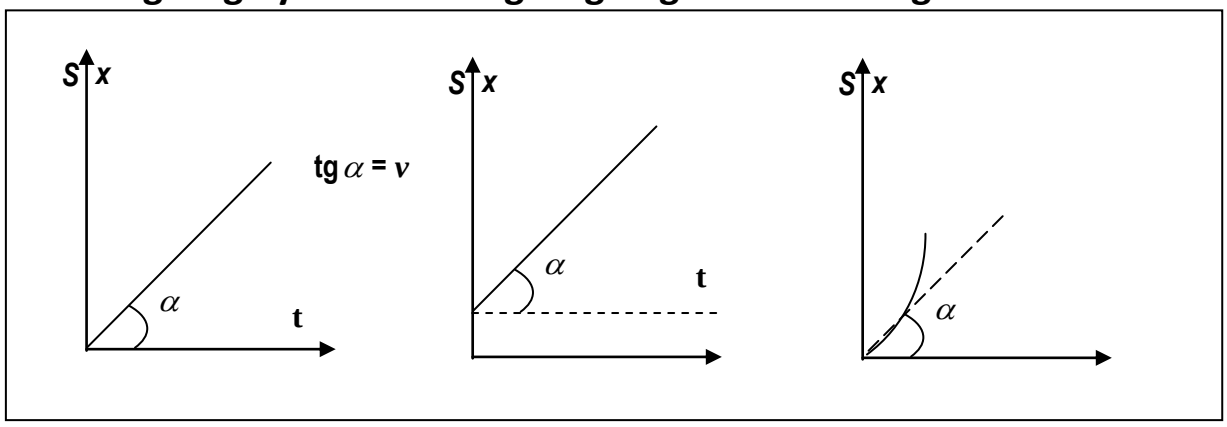
To`g`ri chiziqli tekis sekinlanuvchan harakat:



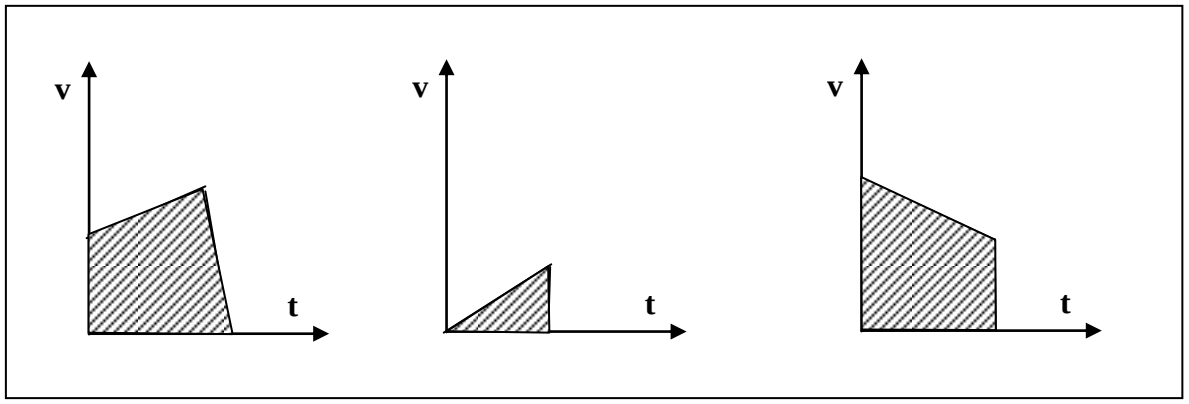
Tezlanuvchan va sekinlanuvchan harakat:

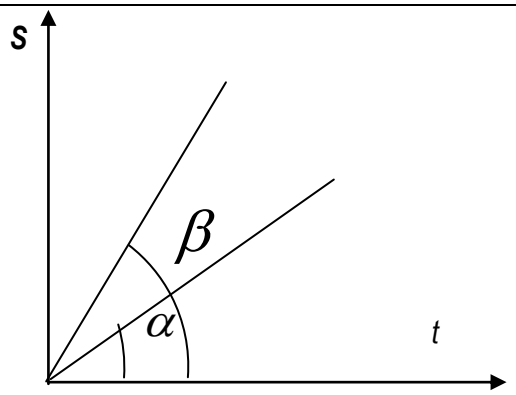
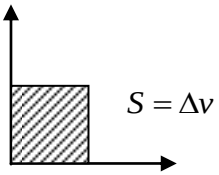
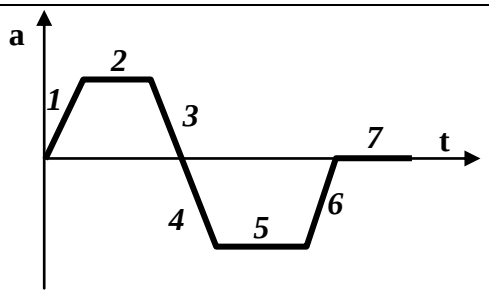
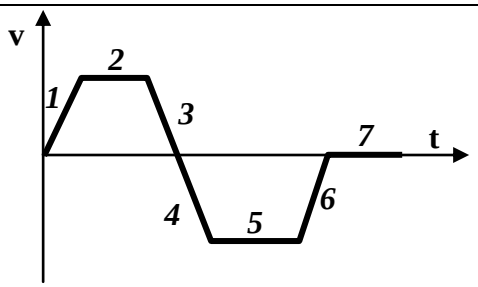


Y`ol grafiga yoki harakat grafigidagi burchak tangensi tezlikni beradi

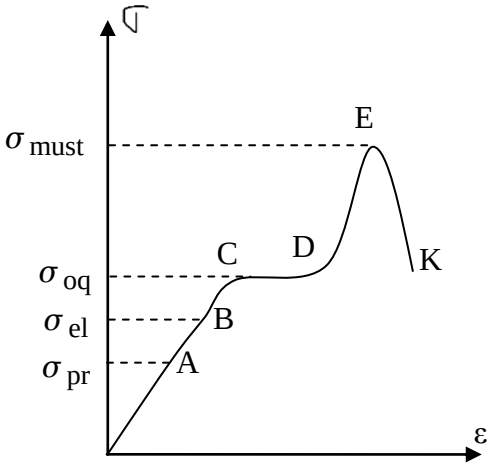


Tezlik grafigidagi yuza yo`lni beradi S=*L*



Burchak kattasining tezligi katta bo`ladi.(***t*** bilan) $\vartheta(\alpha)=\frac{S}{t}<\vartheta(\beta)=\frac{S}{t}$	
Tezlanish grafigidagi yuza tezlikni o`zgarishini beradi.	
1- tezlaniuvchan harakat 2- tekis tezlanuvchan harakat 3- tezlanuvchan harakat 4- sekinlanuvchan harakat 5- tekis sekinlanuvchan harakat 6- sekinlanuvchan harakat 7- tekis harakat yoki tinch turibdi	
1- tekis tezlanuvchan harakat 2- tekis harakat 3- tekis sekinlanuvchan harakat 4- tekis tezlanuvchan harakat 5- tekis harakat 6- tekis sekinlanuvchan harakat 7-tinch turibdi	

5-ILOVA

	OA–oraliqda Guk qonuni bajariladi va jism elastic bo`ladi. AB–oraliqda Guk qonuni bajarilmaydi. Ammo jism elastic bo`laveradi. BC–oraliqda qoldiq deformatsiya CD-oraliqda oquvchanlik E-nuqta mustahkamlik chegarasi K–nuqta uzulish nuqtasi σ_{pr}–mexanik kuchlanishning orsionallik koeffisiyenti

	σ_{el}– mexanik kuuchlanishning elastiklik chegarasi σ_{oq}–oquvchanlik mexanik kuchlanishi σ_{must}–mustahkamlikni mexanik kuchlanish chegarasi

6-ILOVA

Molyar massa			
Azot mole-kulasi N_2	$28\cdot10^{-3}$ kg/mol	Kislirod molekulasi O_2	$32\cdot10^{-3}$ kg/mol
Argon Ar	$40\cdot10^{-3}$ kg/mol	Kislirod atomi O	$16\cdot10^{-3}$ kg/mol
Vodorod H_2	$2\cdot10^{-3}$ kg/mol	Neon Ne	$20\cdot10^{-3}$ kg/mol
Suv H_2O	$18\cdot10^{-3}$ kg/mol	Kumush Ag	$108\cdot10^{-3}$ kg/mol
Geliy He	$4\cdot10^{-3}$ kg/mol	Uglekislarod gazi CO_2	$44\cdot10^{-3}$ kg/mol
Havo	$29\cdot10^{-3}$ kg/mol		

7-ILOVA

Moddalarning issiqlik xossalari			
Qattiq jismlar			
Modda	**Solishtirma issiqlik sig'imi, kJ/(kg*K)**	**Erish harorati ^{0}C**	**Solishtirma erish issiqligi, kJ/kg**
Alyuminiy	0.88	600	380
Muz	2.1	0	330
Mis	0.38	1083	180
Qalay	0.23	232	59
Qo'rg'oshin	0.13	327	25
Kumush	0.23	960	87
Po'lat	0.46	1400	82
Suyuqliklar			
Modda	**Solishtirma issiqlik sig'imi, kJ/(kg*K)**	**Qaynash harorati ^{0}C**	**Bug' hosil bo'-lish solish-tirma issiqligi, MJ/kg**
Suv	4.2	100	2.3
Simob	0.12	357	0.29

Spirt	2.4	78	0.85
Gazlar			
Modda	**Solishtirma issiqlik sig'imi, kJ/(kg*K)**		**Kondensatsiya harorati ^{0}C**
Azot	1		-196
Vodorod	1.4		-253
Havo	1		
Kislorod	0.92		-183

8-ILOVA

To'yingan suv bugining turli haroratlardagi bosimi va ularning zichligi					
t, ^{0}S	P_0, **mm.sim.ust**	ρ_0 g/m^3	**t, ^{0}S**	P_0, **mm.sim.ust**	ρ_0 g/m^3
0	4,6	4,8	16	13,6	13,6
1	4,9	5,2	17	14,5	14,5
2	5,3	5,6	18	15,5	15,4
3	5,7	6,0	19	16,5	16,3
4	6,1	6,4	20	17,5	17,3
5	6,6	6,8	21	18,7	18,3
6	7,0	7,3	22	19,8	19,4
7	7,5	7,8	23	21,1	20,6
8	8,0	8,3	24	22,4	21,8
9	8,6	8,8	25	23,8	23,0
10	9,2	9,4	26	25,2	24,4
11	9,8	10,0	27	26,7	25,8
12	10,5	10,7	28	28,4	27,2
13	11,2	11,4	29	30,0	28,7
14	12,0	12,1	30	31,8	30,3
15	12,8	12,8			

9-ILOVA

Suyuqliklarning sirt taranglik koeffisiyenti(20^{0}C),mN/m					
Suv	73	Sovun eritmasi	40	Simob	510
Kerosin	24	Neft	30	Spirt	22

10-ILOVA

Yoqilg'ining solishtirma yonish issiqligi, MJ/kg					
Benzin	46	Toshko'mir	29	Spirt	29
Yog'och	10	Kerosin	46	Shartli yoqilg'i	29
Dizel yoqilg'i	42	Porox	3.8		

11-ILOVA

Moddalarning dielektrik singdiruvchanligi					
Suv	81	Moy	2.5	Slyuda	6
Kerosin	2.1	Parafin	2.1	Shisha	7

12-ILOVA

Metallar va qotishmalarning solishtirma qarshiligi(ρ)(20^0C) va qarshiliklarning temperatura koeffisienti(α)					
Modda	ρ ,10^{-8} Om*m	α ,K^{-1}	Modda	ρ ,10^{-8} Om*m	α ,K^{-1}
Alyuminiy	2.8	0.0042	Nixrom	110	0.0001
Volfram	5.5	0.0048	Qo'rg'oshin	21	0.0037
Jez	7.1	0.001	Kumush	1.6	0.004
Mis	1.7	0.0043	Po'lat	12	0.006
Nikelin	42	0.0001			

13-ILOVA

Moddalarning elektrokimyoviy ekvivalenti, mg/C					
Alyuminiy(Al^{3+})	0.093	Mis(Cu^{2+})	0.33	Kumush(Ag^{+})	1.12
Vodorod(H^{+})	0.0104	Qalay(Sn^{2+})	0.62	Xrom(Cr^{3+})	0.18
Kislorod(O^{2-})	0.083	Nikel(Ni^{2+})	0.30	Rux(Zn^{2+})	0.34

14-ILOVA

O‘zbekistondagi eng yirik gidroelektr stansiyalari

Nomi	O‘rnatilgan quvvatlar MW	Turbinalar soni	Qurilgan yillar	Suv manbayi
Chorvoq GES	620,5	4	1970—1972	Chirchiq
Xo‘jakent GES	165	3	1976	Chirchiq
G‘azalkent GES	120	3	1980—1981	Chirchiq
Farhod GES	126	4	1948—1949	Sirdaryo

15-ILOVA

Yirik issiqlik elektr markazlari

Nomi	O‘rnatil-gan quvvatlar, MW	Qurilgan yillar	Joylashgan shahar	Izohlar
Farg‘ona IEM	330	1956—1979	Qirguli	Loyiha quvvati 140 MW
Muborak IEM	60	1985—1988	Muborak	
Toshkent IEM	30	1939—1954	Toshkent	

16-ILOVA

O‘zbekistondagi eng yirik issiqlik elektr stansiyalari

Nomi	O‘rnatil-gan quvvatlar, MW	Agregatlar soni	Qurilgan yillar	Joylashgan shahar	Izoh
Sirdaryo IES	3000	10	1972—1981	Shirin	Loyiha quvvati 240 MW
Yangi Angren IES	1800	6	1985-yilda boshlangan	Nurobod	Loyiha quvvati 320 MW
Toshkent IES	1860	12	1963—1971	Toshkent	
Navoiy IES	1250	11	1963—1981	Navoiy	
Angren IES	484	8	1957—1963	Angren	
Taxiatosh IES	730	5	1961—1990	Taxiatosh	
Tallimar-jon IES	—	—	1984- yilda boshlangan	Nuriston	

17-ILOVA

Sindirish ko’rsatgichi(ko’rinadigan nurlar uchun)					
Olmos	2.4	Muz	1.31	Shisha	1.6
Suv	1.3	Uglerod sulfid	1.63	Etil spirt	1.36
Havo	1.00029				

18-ILOVA

Elektronlarning chiqish ishi, eV					
Volfram	4.5	Bariy oksid	1	Kumush	4.3
Kaliy	2.2	Platina	5.3	Rux	4.2
Litiy	2.4				

19-ILOVA

Turli xil birliklar orasidagi munosabat	
Harorat	0 K = – 273,15°C
massaning atom birligi	1m.a.b. = $1{,}66\cdot10^{-27}$ kg
1 massaning atom birligi ekvivalent	931,5 MeV
1 elektron-volt	1 eV = $1{,}6\cdot10^{-19}$ J
1 Angestrum	$1A=10^{-10}m$
1 parsek	$1\ parsek=3.1\cdot10^{16}m$
1astronomik birlik	$1a.b=1.5\cdot10^{9}m$
1 yorug'lik yili	$9.5\cdot10^{15}m$
1 ot kuchi	736Vt
1000Vt	1.36 ot kuchi
1elektron volt	$1eV=1.6\cdot10^{-19}J$
1 kalloriya	1 kal=4.19 J

20-ILOVA

Elementar zarrachalarning masslari	
elektron	$9{,}1\cdot10^{-31}$кg ≈ $5{,}5\cdot10^{-4}$ m.a.b.
proton	$1{,}673\cdot10^{-27}$ кg ≈ 1,007 m.a.b.
neytron	$1{,}675\cdot10^{-27}$ кg ≈ 1,008 m.a.b.

21-ILOVA

O'lchov asboblari			
Nomlanishi	**Qaysi kattalikni o'lchashi**	**Nomlanishi**	**Qaysi kattalikni o'lchashi**
Ampermetr	Tok kuchi	Elekrto kuchlanish	Zaryadlaydi va potensiallar farqi hosil qiladi
Altmetr	Samolyotda balandlikni	Fazometr	Quvvat koeffisiyenti
Areometr	Suyuqlik zichligi	Gigrometr	Shudring nuqtasi
Aneroid barometr	Atmosfera bosimi	Galvonometr	Tok kuchi va kuchlanish
Avomert	Elektr qarshilik	Menzurka	Suyuqlik hajmi
Akselomert	Tezlanish	Monometr	Idishdagi gaz bisimi
Bolometr	Metallar harorati	Psixrometr	Nisbiy namlik
Sesmograf	Zilzila	Ruletka	Uzunlik
Staglometr	Sirt taranglik koeffisienti	Termometr	Harorat
Spidometr	Tezlik	Termistr	Harorat
Simobli barometr	Atmosfera bosimi	Taxometr	Burovchi moment(dvigatel vali aylanish chastotasi)
Dinamometr	Kuch	Vyazkozimetr	Qovushqoqlik
Elektraskop	Zaryad miqdori	Voltmetr	Kuchlanish

22-ILOVA

Atom massasi			
azot $^{14}_{7}N$	14,0067 m.a.b.	deyteriy $^{2}_{1}H$	2,0141 m.a.b.
berelliy $^{8}_{4}Be$	8,0053 m.a.b.	litiy $^{6}_{3}Li$	6,0151 m.a.b.
vadarod $^{1}_{1}H$	1,0087 m.a.b.	litiy $^{7}_{3}Li$	7,0160 m.a.b.
geliy $^{3}_{2}He$	3,0160 m.a.b.	uglerod $^{12}_{6}C$	12,0000 m.a.b.
geliy $^{4}_{2}He$	4,0026 m.a.b.	uglerod $^{13}_{6}C$	13,0034 m.a.b.

23-ILOVA

Tinchlikdagi energiya			
neytron	939,6 MəB	elektron	0,5 MəB
praton	938,3 MəB	Foton	0
Ba'zi yadrolarning tinchlikdagi energiyasi			
azot $^{14}_{7}N$	13040,3 MəB	kislorod $^{17}_{8}O$	15830,6 MəB
alyuminiy $^{27}_{13}Al$	25126,6 MəB	kremniy $^{30}_{14}Si$	27913,4 MəB
argon $^{38}_{18}Ar$	35353,1 MəB	litiy $^{6}_{3}Li$	5601,5 MəB
berelliy $^{8}_{4}Be$	7454,9 MəB	litiy $^{7}_{3}Li$	6535,4 MəB
berelliy $^{9}_{4}Be$	8394,9 MəB	magniy $^{24}_{12}Mg$	22342,0 MəB
bor $^{10}_{5}B$	9327,1 MəB	natriy $^{23}_{11}Na$	21414,9 MəB
vodorod $^{1}_{1}H$	938,3 MəB	natriy $^{24}_{11}Na$	22341,9 MəB
geliy $^{3}_{2}He$	2808,4 MəB	tritiy $^{3}_{1}H$	2808,9 MəB
geliy $^{4}_{2}He$	3728,4 MəB	uglerod $^{12}_{6}C$	11174,9 MəB
deyteriy $^{2}_{1}H$	1876,1 MəB	uglerod $^{13}_{6}C$	12109,5 MəB
kislorod $^{15}_{8}O$	13971,3 MəB	fosfor $^{30}_{15}P$	27917,1 MəB

24-ILOVA

Grek alifbosi			
Bosma harflar	**O'qilishi**	**Bosma harflar**	**O'qilishi**
A α	Alfa	N ν	Nyu
B β	Beta	Ξ ξ	Ksi
Г γ	Gamma	O o	Omikron
Δ δ	Delta	П π	Pi
E ε	Epsilon	P ρ	Ro
Z ζ	Dzeta	Σ σ ς	Sigma
H η	Eta	T τ	Tau
Θ ϑ	Teta	Y υ	Ipsilon
I $\imath$	Yota	Ф φ	Fi
K κ	Kappa	X χ	Xi
Л λ	Lambda	Ψ ψ	Psi
M μ	My	Ω ω	omega

Karrali va ulushli birliklarni hosil qilish uchun ishlatiladigan ko’paytuvchilar va old qo’shimchalar		
Old qo’shimcha		**Ko’paytuvchi**
Nomi(Nomlanishi)	**Belgisi**	
Eksa(kvintillion)	E	10^{18}=1 000 000 000 000 000 000
Peta(kvadrillion)	P	10^{15}=1 000 000 000 000 000
Tera(Trillion)	T	10^{12}=1 000 000 000 000
Giga(Milliard)	G	10^{9}=1 000 000 000
Mega(Million)	M	10^{6}=1 000 000
Kilo(Ming)	k	10^{3}=1 000
Gekto(Yuz)	g	10^{2}=1 00
Deka(O'n)	da	10^{1}=1 0
Detsi(O'ndan bir)	d	10^{-1}=0, 1
Santi(Yuzdan bir)	s	10^{-2}=0, 01
Milli(Mingdan bir)	m	10^{-3}=0, 001
Mikro(Milliondan bir)	µ	10^{-6}=0, 000 001
Nano(Milliarddan bir)	n	10^{-9}=0, 000 000 001
Piko(Trilliondan bir)	p	10^{-12}=0, 000 000 000 001
Femto(Kvadrillion dan bir)	f	10^{-15}=0, 000 000 000 000 001
Atto(Kvintilliondan bir)	a	10^{-18}=0, 000 000 000 000 000 001

26-ILOVA

Fizik doimiylar	
Yerda erkin tushish tezlanishi(taqriban)	$g_{ekvator} \approx 9.78 \frac{m}{s^2}$; $g_{qutb} \approx 9.832 \frac{m}{s^2}$
Gravitatsiya doimiysi	G = 6,67·10^{-11} N·m^2/кg^2
Universal gaz doimiysi	R = 8,31 J/(mol·K)
Boltsman doimiysi	k = 1,38·10^{-23} J/K
Avagadro doimiysi	N_A = 6·10^{23} 1/mol
Vakuumda yorug'lik tezligi	c = 3·10^8 m/s
Kulon qonunida proporsionallik koeffisiyenti	$\kappa = 1/4\pi\varepsilon_0 = 9\cdot10^9$ N·m^2/C^2
Elektronning zaryadi	e = – 1,6·10^{-19} C
Stefan-Bolsman doimiysi	$\sigma = 5.67\cdot10^{-3} Vt/(m^2\cdot K^4)$
Plank doimiysi	h = 6,63·10^{-34} J·s
Plank doimiysi	$\hbar = 1.05\cdot10^{-34} Js$
Yerning massasi	6·10^{24} кg
Quyoshning massasi	2·10^{30} кg
Yer va quyosh orasidagi masofa 1 astronomik birlik	1 a.b. ≈ 150 million км ≈ 1,5·10^{11} m
1 yil (taqriban)	3·10^7 s
Elektr doimiysi	$\varepsilon_0 = 8.85\cdot10^{-12} F/m$
Magnit doimiysi	$\mu_0 = 4\pi\cdot10^{-7} Gn/m$
Faradey soni	F=96500C/mol
Loshmidt soni	$N_0=N_A/V_0=2.686\cdot10^{25}$ m^{-3}
Ridberg doimiysi	R=3.27·10^{15} Hs
Normal sharoitda 1 mol gaz hajmi	V_0=22.414 l/mol

27-ILOVA

Elektromagnit to'lqinlar shkalasi

№	Turlarning nomi	To'lqin uzunligi (m)	To'lqin chastotasi (Hz)	Nurlanish manbayi
1.	Past chastotali to'lqinlar	$> 10^4$	$\leq 3\cdot10^{-4}$	O'zgaruvchan tok generatori
2.	Radioto'lqinlar	$10^4 \div 10^{-1}$	$3\cdot10^4 \div 3\cdot10^{10}$	Tebranish konturi va Gers vibratori
3.	Ultraradio to'lqinlar	$10^{-1} \div 10^{-4}$	$3\cdot10^{10} \div 3\cdot10^{12}$	Yalpi tarqatkich
4.	Infraqizil nurlar	$10^{-4} \div 7{,}7\cdot10^{-7}$	$3\cdot10^{12} \div 4\cdot10^{14}$	Lampalar
5.	Yorug'lik nurlari	$7{,}7\cdot10^{-7} \div 4\cdot10^{-7}$	$4\cdot10^{14} \div 7{,}5\cdot10^{14}$	Lampalar
6.	Ultrabinafsha nurlar	$4\cdot10^{-7} \div 10^{-8}$	$7{,}5\cdot10^{14} \div 3\cdot10^{16}$	Lampalar
7.	Rentgen nurlari	$10^{-8} \div 10^{-11}$	$3\cdot10^{16} \div 3\cdot10^{19}$	Pentgen trubkasi
8.	Gamma nurlari	$< 10^{-11}$	$>3\cdot10^{19}$	Radioaktiv yemirilish

28-ILOVA

O'zaro ta'sirlarning turlari

O'zaro ta'sir turlari	Ta'sirlashuvchi zarralar	Maksimal ta'sir radiusi	Qaysi zarralar orqali amalga oshadi
Kuchli	Nuklonlar	10^{-15} m	Gluonlar
Elektromagnit	Zaryadli zarralar	∞	Fotonlar
Kuchsiz	Kvarklar	10^{-17} m	-
Gravitatsion	Hamma zarralar	∞	Gravitonlar

Elementar zarrachalarning turlari

		Zarralarning nomi	zarra	anti-zarra	Massasi, elektron massasi hisobida	*Elektr zaryadi e hisobida*	O'rtacha yashash vaqti, sekund-larda	*Spini h birligida*
Foton			γ	γ	0	0	stabil	1
Leptonlar		Elektron neytrinosi	ν_e	$\bar{\nu}_e$	0	0	stabil	1/2
		Myu-mezon neytrinosi		$\bar{\nu}_\mu$	0	0	stabil	1/2
		Tau-mezon neytrinosi	ν_τ	$\bar{\nu}_\tau$	0	0	stabil	1/2
		Elektron	e^-	e^+	1	-1	stabil	1/2
		Myu-minus-mezon	μ^-	μ^+	206,7	-1	$2{,}2\cdot10^{-6}$	1/2
		Tau-minus-mezon	τ^-	τ^+	352,8	-1	$2{,}8\cdot10^{-13}$	1/2
Mezonlar		Pi-nol-mezon	π°	π°	264,1	0	$0{,}8\cdot10^{-16}$	0
		Pi-plus-mezon	π^+	π^-	273,1	+1	$2{,}6\cdot10^{-8}$	0
		Ka-plus-mezon	κ^+	K_s	966,4	+1	$1{,}22\cdot10^{-8}$	0
		Ka-nol-mezon	κ°		974,2	0	$1\cdot10^{-10}$	0
		Eta-nol-mezon	η°	η°	1074	0	10^{-19}	0
Barionlar	*Nuk-lonlar*	Proton	p	$\bar{p}$	1836,1	+1	stabil	1/2
		Neytron	n	$\bar{n}$	1838,6	0	$1{,}01\cdot10^{3}$	1/2
	Giperonlar	Lyambida-nol-giperon	Λ°	$\bar{\Lambda}^\circ$	2183	0	$2{,}5\cdot10^{-10}$	1/2
		Sigma-plus-giperon	Σ^+	$\bar{\Sigma}^+$	2327,7	+1	$8{,}1\cdot10^{-11}$	1/2
		Sigma-nol-giperon	Σ°	$\bar{\Sigma}^\circ$	2331,8	0	10^{-14}	1/2
		Sigma-minus-giperon	Σ^-	$\bar{\Sigma}^-$	2340,6	-1	$1{,}65\cdot10^{-10}$	1/2
		Ksi-nol-giperon	Ξ°	$\bar{\Xi}^\circ$	2572	0	$3\cdot10^{-10}$	1/2
		Ksi-minus-giperon	Ξ^-	$\bar{\Xi}^-$	2585	-1	$1{,}75\cdot10^{-10}$	1/2
		Omega-minus-giperon	Ω^-	$\bar{\Omega}^-$	3273	-1	$1{,}5\cdot10^{-10}$	3/2

30-ILOVA

Matematikadan bir qancha ma’lumotlar
Oddiy integrallar

$$\int 0 \cdot dx = C, \quad C = \text{const}, \qquad \int \frac{dx}{x^2} = -\frac{1}{x} + C,$$

$$\int 1 \cdot dx = \int dx = x + C, \qquad \int e^x dx = e^x + C,$$

$$\int x dx = \frac{x^2}{2} + C, \qquad \int a^x dx = \frac{a^x}{\ln a} + C,$$

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C, \qquad \int \sin x dx = -\cos x + C,$$

$$\int \frac{dx}{x} = \ln x + C, \qquad \int \cos x dx = \sin x + C.$$

31-ILOVA

Trigonometrik funksiyalarning ba’zi qiymatlari

Функция	burchag grad(rad)					
	0	30 (π/6)	45 (π/4)	60 (π/3)	90 (π/2)	180 (π)
$\sin\alpha$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	0
$\cos\alpha$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	−1
$\operatorname{tg}\alpha$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	–	0
$\operatorname{ctg}\alpha$	–	$\sqrt{3}$	1	$\frac{\sqrt{3}}{3}$	0	–

Asosiy elementar funksiyalarning hosilalari

$f(x)$	$f'(x)$	$f(x)$	$f'(x)$
C (C = const)	0	$\sqrt{x}$	$\frac{1}{2\sqrt{x}}$, $x > 0$
x	1	$\frac{1}{x}$	$-\frac{1}{x^2}$
x^n	nx^{n-1}	$\ln x$	$\frac{1}{x}$
e^x	e^x	$\sin x$	$\cos x$
a^x	$a^x \ln a$	$\cos x$	$-\sin x$
$\log_a x$	$\frac{1}{x \ln a}$	$\operatorname{tg} x$	$\frac{1}{\cos^2 x}$
x^2	$2x$	$\operatorname{ctg} x$	$-\frac{1}{\sin^2 x}$

Foydalanilgan manbalar

1. Ismoilov M. Elementar fizika kursi. Toshkent, O’qituvchi. 1990.
2. Nu’monxo’jaev A.S va boshqalar. Fizika (akademik liseylar uchun). Toshkent, O’qituvchi. 2001.
3. Turdiev N. Fizika ma’lumotnoma. Toshkent, Bilim. 2004.
4. Ishlinskiy A.Yu. Politexnika lug’ati. Toshkent, 1989.
5. Yarovskiy B.M...Spravochnoe rukovodstvo po fizike. Moskva, Nauka 1979.
6. O’lmasova Mexanika va molekular fizika. Toshkent, 2010.
7. O’lmasova Elektrodinamika. Tebranishlar va to’lqinlar. Toshkent, 2010.
8. O’lmasova Optika, Atom va yadro fizikasi. Toshkent, 2010.
9. Tursunmetov K. A. Fizikadan masalalar to’plami. Toshkent, 2001
10. N.E.Savchenko. Zadachi po fizike c analizom ix resheniya. Moskva, Nauka 1981.
11. M.B.Do’stmuratov. Oliy o’quv yurtlariga kiruvchilar uchun fizika fanidan o’quv qo’llanma. Toshkent 2006.
12. Landsberg G.S. Optika. Toshkent, O’qituvchi. 1991.
13. Bekjonov R. Atom yadrosi va zarralar fizikasi. Toshkent, 1995.
14. Mallin R.X. Klassik elektrodinamika. Toshkent, O’qituvchi. 1978.
15. Nazarov M. Elementar fizikadan ma’lumotnoma. Buxoro. 2006.
16. O’z.Res. O’MKHTM. Fizika. Proeksion ko’rgazmalar komplekti. «El»OAJ, 2001
17. Internet saytlari: www.pioneership.narod.ru/, www.fabox.ru/ prosv.informika.ru, window.edu.ru, festival.1september.ru, Prezentacli.com