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FIZIKA HA'M MATEMATIKADAN FORMULALAR

No'kis
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«Fizika ha'm matematikadan formulalar» kitapshasi'ni'n' tiykari' maqseti fizika matematika kursi'n jaqsi'lap wo'zlestiriwde worta mekteplerdin' joqari' klass, licey, kolledj woqi'wshi'lari', joqarg'i' woqi'w worni' studentleri ushi'n tiykarg'i' qollanba retinde paydalani'wg'a arnalg'an.

Materiallar Wo'zbekstan Xali'q bilimlendiriw ministrligi tasti'yi'qlag'an bag'darlamag'a sa'ykes jaylasti'ri'lg'an. Kitapsha joqari' woqi'w worni'na kiriwshiler ha'm mekteplerdin' fizika, matematika woqti'wshi'lari' ushi'nda paydali' yekenligi so'zsiz.

Pikir bildiriwshiler:

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Matematika

Sha'rtli belgiler

N—natural sanlar ko'pligi 1, 2, …n

Z—pu'tin sanlar ko'pligi 0,±1, ±2, …±

Q—racional sanlar ko'pligi

R—haqi'yqi'y sanlar ko'pligi (barli'q racional ha'm irracional)

R$_+$—barli'q won' haqi'qi'y sanlar ko'pligi

$\varnothing$ —bos ko'beytiwshi

a∈A—*a, A* g'a tiyisli

A⊂B—*A B* g'a ko'beytiledi

A Υ B—*A B* ko'beytiwshilerdin' birikpesi

A Ι B—*A B* ko'beytiwshilerdin' kesilispesi

$A \Rightarrow B$—*A* dan *B* kelip shi'g'adi'

A ⇔ B — *A* menen *B* ni'n' shamasi' ten'

[*a, b*]— *a, b* ushlari'na iye jabi'q arali'q (kesindini)

$(a \leq x \leq b)$

(*a; b*) — ashi'q arali'q interval $(a < x < b)$

[*a; b*) (*a; b*] — yari'mlay ashi'q arali'q

$(a \leq x < b),\ \ (a < x \leq b)$

$(-\infty \quad +\infty)$ — sheksiz arali'q

f (x) — *x* noqati'ndag'i' funkciyani'n' ma'nisi

D(*f*) — *f* funkciyasi'ni'n' ani'qlaw oblasti'

E(*f*) — *f* funkciyasi'ni'n' ma'nisinin' oblasti'

$$l = \lim_{n \to \infty} \left(1 + \frac{r}{n}\right)^n = 2,7482818 \ ...$$

$$\ln a = \log_e a \quad \lg a = \log_{10} a$$

Da'rejeler

$n \in N$ ha'm $n > 1 a^n = a \cdot a \cdot a ... a$ $\qquad$ $n = 1$ de $a^n = a^1 = a$

$n = 0$ de ha'm $a \neq 0$ $a^n = a^o = 1$ $\qquad$ $n \in Z$ de ha'm $a \neq 0$ $a^{-n} = \dfrac{1}{a^n}$

$n \in Q$ da ha'm $a > 0$ $a^n = a^{\frac{p}{q}} = \sqrt[q]{a^p}$

1. $a^m \cdot a^n = a^{m+n}$ $\qquad$ 2. $a^m : a^n = a^{m-n}$ $\qquad$ 3. $\left(a^m\right)^n = a^{m \cdot n}$

4. $(a \cdot b)^n = a^n \cdot b^n$ $\qquad$ 5. $\left(\dfrac{a}{b}\right)^n = \dfrac{a^n}{b_n}$

Qi'sqarti'lg'an ko'beytiw formulalari'

1. $(a \pm b)^2 = a^2 \pm 2ab + b^2$

2. $(a \pm b)^3 = a^3 \pm 3a^2 b + 3ab^2 \pm b^3 = \left(a^3 \pm b^3\right) \pm 3ab \ (a \pm b)$

3. $a^3 \pm b^3 = (a \pm b) \cdot \left(a^2 \mp ab + b^2\right)$

4. $a^2 - b^2 = (a - b) \cdot (a + b)$

5. $a^n + b^n = (a + b) \cdot \left(a^{n-1} - a^{n-2} \cdot b + a^{n-3} \cdot b^2 - a^{n-4} \cdot b^3 + ... + b^{n-1}\right)$

6. $a^n - b^n = (a - b) \cdot \left(a^{n-1} + a^{n-2} \cdot b + ... + b^{n-1}\right)$

Modul (absolyut shama)

$a = \begin{cases} a, & \text{yeger } a \geq 0 \text{ bolsa} \\ -a, & \text{yeger } a < 0 \text{ bolsa} \end{cases}$

1. $|a| \geq 0$ $\qquad$ 2. $|a| = |-a|$ $\qquad$ 3. $|a \cdot b| = |a| \cdot |b|$

4. $\left|\dfrac{a}{b}\right| = \dfrac{|a|}{|b|}$ $\qquad$ 5. $\left|a^2\right| = a^2$ $\qquad$ 6. $|a + b| \leq |a| + |b|$

7. $\big||a| - |b|\big| \leq |a - b|$

Korenler

$\sqrt[2n]{a} = x$ $a > 0$ de, ha'm $n \in N$ yeger $x > 0$ $x^{2n} = a$

$\sqrt[2n+1]{a} = x$ yeger $x^{2n+1} = a$

1. $\sqrt[2n]{a^{2n}} = |a|$ **2.** $\sqrt[2n]{a^{mk}} = \sqrt[n]{a^m}$ $a \geq a$ **3.** $\sqrt[n]{a \cdot b} = \sqrt[n]{a} \cdot \sqrt[n]{b}$ $a \geq 0$ $b \geq 0$

4. $\sqrt[n]{\dfrac{a}{b}} = \dfrac{\sqrt[n]{a}}{\sqrt[n]{b}}$ $a \geq 0$ $b > 0$ **5.** $\sqrt[n]{\sqrt[k]{a}} = \sqrt[nk]{a}$ $a \geq 0$ **6.** $\left(\sqrt[n]{a}\right)^m = \sqrt[n]{a^m}$ $a \geq 0$

7. $a \cdot \sqrt[2n+1]{b} = \sqrt[2n+1]{a^{2n+1} \cdot b}$ **8.** $a \cdot \sqrt[2n]{b} = \begin{cases} -\sqrt[2n]{a^{2n}b} & \text{yeger} \quad a < 0 \\ \sqrt[2n]{a^{2n}b} & \text{yeger} \quad a \geq 0 \end{cases}$

9. $\sqrt{a \pm b\sqrt{c}} = \sqrt{\dfrac{a + \sqrt{a^2 - b^2 \cdot c}}{2}} \pm \sqrt{\dfrac{a - \sqrt{a^2 - b^2 \cdot c}}{2}}$

Logarifmler

$c = \log_a b$ $b > 0,$ $a > 0$ $a \neq 1$ yeger $a^c = b$ $a^{\log_a b} = b$

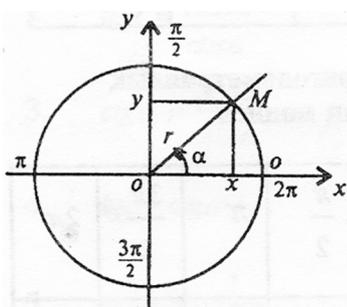**1.** $\log_a 1 = 0$ **2.** $\log_a = 1$ **3.** $\log_a bc = \log_a |b| + \log_a |c|$

4. $\log_a \dfrac{b}{c} = \log_a |b| - \log_a |c|$ **5.** $\log_a b^n = n \log_a b$ $(b > 0)$

6. $\log_a b = \dfrac{\log_c b}{\log_c a}$ $(c > 0, \quad c \neq 1)$ **7.** $\log_{a^m} b^n = \dfrac{n}{m} \log_a b$ $(a > 0, \quad b > 0, \quad a \neq 1)$

8. $a^{\log_b c} = c^{\log_b a}$

TRIGONOMETRIYA FORMULALARI'

1. Ani'qlama

$$\sin\alpha = \frac{y}{\sqrt{x^2 + y^2}} \qquad \cos\alpha = \frac{x}{\sqrt{x^2 + y^2}}$$

$$tg\alpha = \frac{y}{x} \quad (x \neq 0) \qquad ctg\alpha = \frac{x}{y} \quad (y \neq 0)$$

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2. Trigonometriyali'q funkciyalardi'n' belgileri

	$sin\alpha$	$cos\alpha$	$tg\alpha$	$ctg\alpha$
$0 < \alpha < \frac{\pi}{2}$	+	+	+	+
$\frac{\pi}{2} < \alpha < \pi$	+	-	-	-
$\pi < \alpha < \frac{3\pi}{2}$	-	-	+	+
$\frac{3\pi}{2} < \alpha < 2\pi$	-	+	-	-

3. Mu'yeshler ushi'n trigonometriyali'q funkciyalardi'n' ma'nisi

radianlar	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
Graduslar	0º	30º	45º	60º	90º	180º	270º	360º
$sin\alpha$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	0	-1	0
$cos\alpha$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	-1	0	1
$tg\alpha$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	-	0	-	0
$ctg\alpha$	-	$\sqrt{3}$	1	$\frac{\sqrt{3}}{3}$	0	-	0	-

Tiykarg'i' birdeylikler

1. $sin^2\alpha + cos^2\alpha = 1$ 　　　　 **2.** $tg\alpha = \frac{sin\alpha}{cos\alpha}$ 　$\left(\alpha \neq \frac{\pi}{2} + \pi n\right)$

3. $ctg\alpha = \frac{cos\alpha}{sin\alpha}$ 　$(\alpha \neq \pi n)$ 　　 **4.** $tg\alpha \cdot ctg\alpha = 1$ 　$\left(\alpha \neq \frac{\pi}{2} n\right)$

5. $sec\alpha = \frac{1}{cos\alpha}$ 　$\left(\alpha \neq \frac{\pi}{2} + \pi n\right)$ 　**6.** $cosec\alpha = \frac{1}{sin\alpha}$ 　$(\alpha \neq \pi n)$

7. $1 + tg^2\alpha = \frac{1}{cos^2\alpha}$ 　$\left(\alpha \neq \frac{\pi}{2} + \pi n\right)$ **8.** $1 + ctg^2\alpha = \frac{1}{sin^2\alpha}$ 　$(\alpha \neq \pi n)$ 　$(n \in Z)$

Keltiriw formulalari'

$$1.\ sin\left(\frac{\pi}{2}\pm\alpha\right)=cos\alpha \qquad 2.\ cos\left(\frac{\pi}{2}\pm\alpha\right)=\mp sin\alpha$$

$$3.\ tg\left(\frac{\pi}{2}\pm\alpha\right)=\mp ctg\alpha \qquad 4.\ ctg\left(\frac{\pi}{2}\pm\alpha\right)=\mp tg\alpha$$

$$5.\ sin\left(\pi\pm\alpha\right)=\mp sin\alpha \qquad 6.\ cos\left(\pi\pm\alpha\right)=-cos\alpha$$

$$7.\ tg\left(\pi\pm\alpha\right)=\pm tg\alpha \qquad 8.\ ctg\left(\pi\pm\alpha\right)=\pm ctg\alpha$$

$$9.\ sin\left(\frac{3\pi}{2}\pm\alpha\right)=-cos\alpha \qquad 10.\ cos\left(\frac{3\pi}{2}\pm\alpha\right)=\pm sin\alpha$$

$$11.\ tg\left(\frac{3\pi}{2}\pm\alpha\right)=\mp ctg\alpha \qquad 12.\ ctg\left(\frac{3\pi}{2}\pm\alpha\right)=\mp tg\alpha$$

Argumentlerdi qosi'w ha'm ali'w ushi'n formulalar

$$1.\ sin\left(\alpha\pm\beta\right)=sin\alpha\cdot cos\beta\pm cos\alpha\cdot sin\beta \qquad 2.\ cos\left(\alpha\pm\beta\right)=cos\alpha\cdot cos\beta\mp sin\alpha\cdot sin\beta$$

$$3.\ tg\left(\alpha\pm\beta\right)=\frac{tg\alpha\pm tg\beta}{1\mp tg\alpha\cdot tg\beta} \qquad 4.\ ctg\left(\alpha\pm\beta\right)=\frac{ctg\alpha\cdot ctg\beta\mp 1}{ctg\beta\pm ctg\alpha}$$

Yari'm argumenttin' formulalari'

$$1.\ sin\frac{\alpha}{2}=\pm\sqrt{\frac{1-cos\alpha}{2}} \qquad 2.\ cos\frac{\alpha}{2}=\pm\sqrt{\frac{1+cos\alpha}{2}}$$

$$3.\ tg\frac{\alpha}{2}=\pm\sqrt{\frac{1-cos\alpha}{1+cos\alpha}}=\frac{sin\alpha}{1+cos\alpha}=\frac{1-cos\alpha}{sin\alpha}$$

$$4.\ ctg\frac{\alpha}{2}=\pm\sqrt{\frac{1+cos\alpha}{1-cos\alpha}}=\frac{sin\alpha}{1-cos\alpha}=\frac{1+cos\alpha}{sin\alpha}$$

«+» yamasa «-» belgileri $\frac{\alpha}{2}$ mu'yeshinin' jaylasi'wi'na qaray saylap ali'nadi'.

Yeseli argumenttin' formulalari'

$$1.\ sin2\alpha=2sin\alpha\cdot cos\alpha=\frac{2tg\alpha}{1+tg^2\alpha}$$

$$2.\ cos\ 2\alpha=cos^2\alpha-sin^2\alpha=2cos^2\alpha-1=1-2sin^2\alpha=\frac{1-tg^2\alpha}{1+tg^2\alpha}$$

$$3.\ tg2\alpha=\frac{2tg\alpha}{1-tg^2\alpha}=\frac{2}{ctg\alpha-tg\alpha} \qquad 4.\ ctg2\alpha=\frac{ctg^2\alpha-1}{2ctg\alpha}=\frac{ctg\alpha-tg\alpha}{2}$$

5. $\cos 3\alpha = 4\cos^3\alpha - 3\cos\alpha$ **6.** $\sin 3\alpha = 3\sin\alpha - 4\sin^3\alpha$

7. $tg3\alpha = \dfrac{3tg\alpha - tg^3\alpha}{1 - 3tg^2\alpha}$ **8.** $ctg3\alpha = \dfrac{ctg^3\alpha - 3ctg\alpha}{3ctg^2\alpha - 1}$

Trigonometriyali'q funkciyalrdi'n' da'rejeleri

1. $\sin^2\alpha = \dfrac{1 - \cos 2\alpha}{2}$ **2.** $\cos^2\alpha = \dfrac{1 + \cos\alpha}{2}$

3. $\sin^3\alpha = \dfrac{3\sin\alpha - \sin 3\alpha}{4}$ **4.** $\cos^3\alpha = \dfrac{3\cos\alpha + \cos 3\alpha}{4}$

Trigonometriyali'q funkciyalardi' qosi'w ha'm ali'w formulalari'

1. $\sin\alpha + \sin\beta = 2\sin\dfrac{\alpha+\beta}{2}\cdot\cos\dfrac{\alpha-\beta}{2}$ **2.** $\sin\alpha - \sin\beta = 2\sin\dfrac{\alpha-\beta}{2}\cdot\cos\dfrac{\alpha+\beta}{2}$

3. $\cos\alpha + \cos\beta = 2\cos\dfrac{\alpha+\beta}{2}\cdot\cos\dfrac{\alpha-\beta}{2}$ **4.** $\cos\alpha - \cos\beta = -2\sin\dfrac{\alpha+\beta}{2}\cdot\sin\dfrac{\alpha-\beta}{2}$

5. $\cos\alpha \pm \sin\alpha = \sqrt{2}\sin\left(\dfrac{\pi}{4} \pm \alpha\right) = \sqrt{2}\cos\left(\dfrac{\pi}{4} \mp \alpha\right)$

6. $A\cdot\cos\alpha + B\sin\alpha = \sqrt{A^2 + B^2}\cdot\sin(\alpha + \beta)$

$A^2 + B^2 \neq 0$ $\sin\beta = \dfrac{A}{\sqrt{A^2 + B^2}}$, $\cos\beta = \dfrac{B}{\sqrt{A^2 + B^2}}$

7. $tg\alpha \pm tg\beta = \dfrac{\sin(\alpha \pm \beta)}{\cos\alpha\cdot\cos\beta}$ **8.** $ctg\alpha \pm ctg\beta = \dfrac{\sin(\beta \pm \alpha)}{\sin\alpha\cdot\sin\beta}$

9. $tg\alpha + ctg\beta = \dfrac{\cos(\alpha - \beta)}{\cos\alpha\cdot\sin\beta}$ **10.** $ctg\alpha - tg\beta = \dfrac{\cos(\alpha + \beta)}{\sin\alpha\cdot\cos\beta}$

Trigonometriyali'q funkciyalardi'n' ko'beymesi

1. $\sin\alpha\cdot\sin\beta = \dfrac{1}{2}\big[\cos(\alpha - \beta) - \cos(\alpha + \beta)\big]$

2. $\cos\alpha\cdot\cos\beta = \dfrac{1}{2}\big[\cos(\alpha - \beta) + \cos(\alpha + \beta)\big]$

3. $\sin\alpha\cdot\cos\beta = \dfrac{1}{2}\big[\sin(\alpha - \beta) + \sin(\alpha + \beta)\big]$

4. $\cos\alpha\cdot\sin\beta = \dfrac{1}{2}\big[\sin(\alpha + \beta) - \sin(\alpha - \beta)\big]$

5. $tg\alpha \cdot tg\beta = \dfrac{tg\alpha + tg\beta}{ctg\alpha + c\,tg\beta}$

6. $ctg\alpha \cdot c\,tg\beta = \dfrac{ctg\alpha + c\,tg\beta}{tg\alpha + tg\beta}$

7. $sin\ (\alpha + \beta)\ sin\ (\alpha - \beta) = cos^2\beta - cos^2\alpha$

8. $cos(\alpha - \beta)cos(\alpha + \beta) = cos^2\beta - sin^2\alpha$

Tiykarg'i' elementar funkciyalar

Si'zi'qli' funkciya   *y=kx+b*
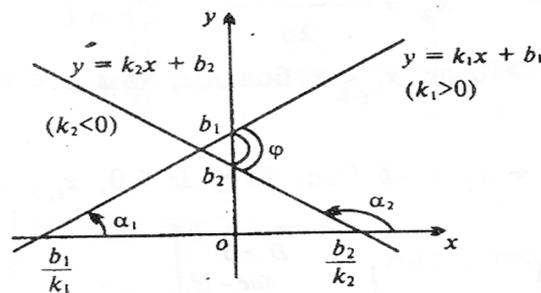
1. $k_1 = tg\,\alpha_1$

2. $k_2 = tg\,\alpha_2$

3. $tg\varphi = tg(\alpha_2 - \alpha_1) = \left| \dfrac{k_2 - k_1}{1 + k_2 k_1} \right|\ (k_1 \cdot k_2 \neq -1)$

4. $k_1 \cdot k_2 \neq -1$ tuwri'lardi'n' perpendikulyarli'q sha'rti

5. $D(Y) = (-\infty;\ +\infty)$ 6. $E(Y) = (-\infty;\ +\infty)$
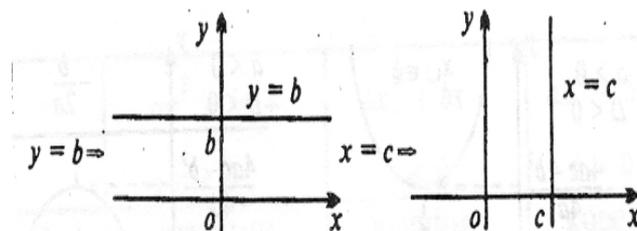
Kvadratli' funkciya $y = ax^2 + bx + c,\ \ a \neq 0$

Diskriminanat $D = b^2 - 4ac.$ Korenleri $x_1 = \dfrac{-b - \sqrt{D}}{2a}$ $x_2 = \dfrac{-b + \sqrt{D}}{2a}$

Yeger $D > 0, a > 0$ de $x_1 < x_2$ boladi', ha'm $a < 0$ de $x_1 > x_2$

Yeger $D = 0,\ x_1 = x_2 = -b/2a.$ Yeger $D < 0,\quad x_{1,2} \in \phi$
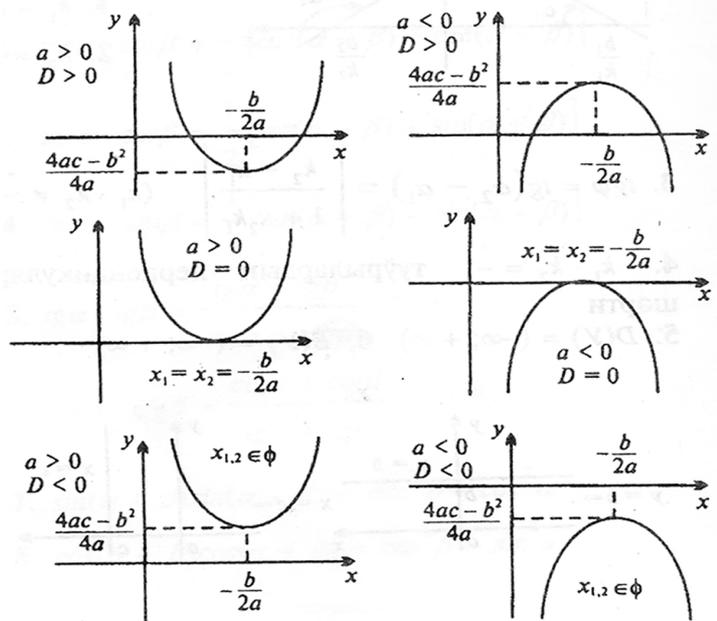
1. $D(y) = (-\infty;\ \ +\infty;)$

$$E(y) = \begin{cases} \left[\dfrac{4ac - b^2}{4a};\ \ +\infty\right], & \text{yeger}\ \ a > 0 \\[4mm] \left[-\infty;\ \ \dfrac{4ac - b^2}{4a};\ \ \right], & \text{yeger}\ \ a < 0 \end{cases}$$

2. $\begin{cases} x_1 + x_2 = -\dfrac{b}{a} \\[3mm] x_1 \cdot x_2 = -\dfrac{c}{a} \end{cases}$ Vieta teoremasi'

3. $ax^2 + bx + c = a(x - x_1)(x - x_2)$

4. $ax^2 + bx + c = a\left(x + \dfrac{b}{2a}\right)^2 + \dfrac{4ac - b^2}{4a}$

Tipli ma'selelerdi sheshiw

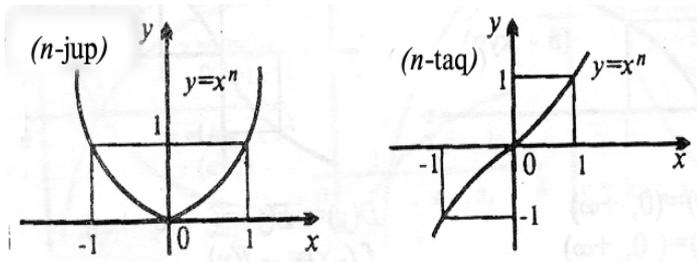|	$ax^2+bx+c<0$	$ax^2+bx+c\le 0$	$ax^2+bx+c=0$
$a>0$ $D<0$	Sheshimi joq	sheshimi joq	koreni joq
$a>0$ $D=0$	sheshimi joq	$x=-\dfrac{b}{2a}$	$x=-\dfrac{b}{2a}$
$a>0$ $D>0$	$\left(x_1;\ \ x_2\right)$	$\left[x_1;\ \ x_2\right]$	$x=x_1$ $x=x_2$
$a<0$ $D<0$	$\left(-\infty;\ \ +\infty;\right)$	$\left(-\infty;\ \ +\infty;\right)$	koreni joq
$a<0$ $D=0$	$\left(\infty;\ \ x_1;\right)$ $U\left(x_1;\ \ +\infty\right)$	$\left(-\infty;\ \ +\infty;\right)$	$x=-\dfrac{b}{2a}$
$a<0$ $D>0$	$\left(\infty;\ \ x_1;\right)$ $U\left(x_2;\ \ +\infty\right)$	$\left(-\infty;\ \ x_1;\right)$ $U\left(x_2;\ \ +\infty\right)$	$x=x_1$ $x=x_2$

	$ax^2+bx+c\ge 0$	$ax^2+bx+c>0$
$a>0\quad D<0$	$\left(-\infty;\ \ +\infty;\right)$	$\left(-\infty;\ \ +\infty;\right)$
$a>0\quad D=0$	$\left(-\infty;\ \ +\infty;\right)$	$\left(-\infty;\ \ x_1;\right)U\left(x_1;\ \ -\infty;\right)$
$a>0\quad D>0$	$\left(-\infty;\ \ x_1;\right)U\left(x_2;\ \ +\infty;\right)$	$\left(-\infty;\ \ x_1;\right)U\left(x_2;\ \ +\infty;\right)$
$a<0\quad D<0$	sheshimi joq	sheshimi joq
$a<0\quad D=0$	$x=-\dfrac{b}{2a}$	sheshimi joq
$a<0\quad D>0$	$\left(x_1;\ \ x_2\right)$	$\left(x_1;\ \ x_2\right)$

Da'rejeli funkciyalar $\left(y=x^n\right)$

1. $Y = x^n \left(n \in N \right)$

$$D\left(y\right) = \left(-\infty,\ 0\right] U \left(0,\ +\infty,\right) \qquad D\left(y\right) = \left(-\infty,\ 0\right] U \left(0,\ +\infty,\right)$$

$$E\left(y\right) = \left[0,\ +\infty\right) \qquad\qquad E\ (y) = \left[-\infty,\ 0\right)\ U\ (0,\ +\infty,)$$

$$f\left(-x\right) = f\left(x\right) \qquad\qquad f\left(-x\right) = -f\left(x\right)$$

2. $Y = x^{-n} = 1/x^n \left(n \in N \right)$

$$D\left(y\right) = \left(-\infty,\ 0\right] U \left(0,\ +\infty,\right) \qquad\qquad D\left(y\right) = \left(-\infty,\ 0\right] U \left(0,\ +\infty,\right)$$

$$E\ (y) = (0,\ +\infty) \qquad\qquad\qquad E\ (y) = (-\infty,\ 0)\ U\ (0,\ +\infty,)$$
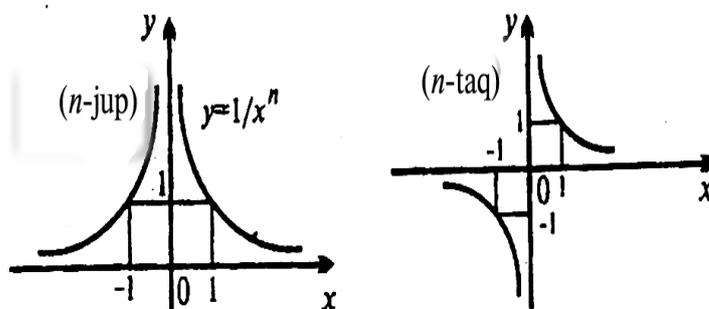
$$f\left(-x\right) = f\left(x\right) \qquad\qquad\qquad f\left(-x\right) = -f\left(x\right)$$

3. $Y = x^{1/n} = \sqrt[n]{x} \left(n \in N \right)$
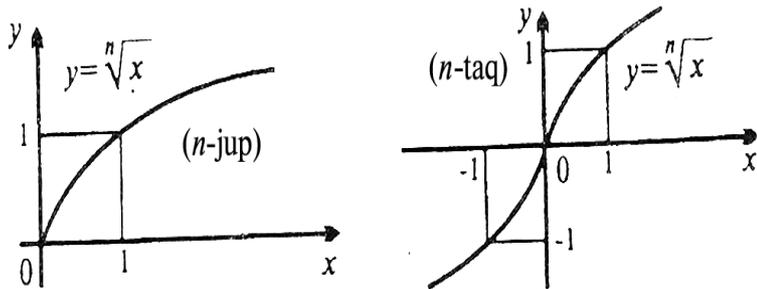
$$D\;(y) = (0,\;+\infty) \qquad D\Big(y\Big) = E\Big(y\Big) = \Big(-\infty,\;\;+\infty\Big)$$

$$E\Big(y\Big) = \Big[0,\;\;+\infty\Big) \qquad f\Big(-x\Big) = -f\Big(x\Big)$$

4. $Y = x^{p/q}$ $\big(p \in Z,\; q \in N\big)$
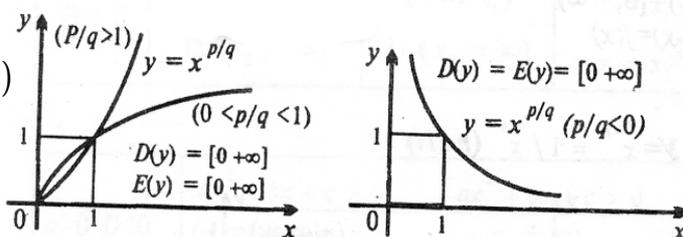
Ko'rsetkishli funkciya $y = a^x / a > 0,\quad a \neq 1/$
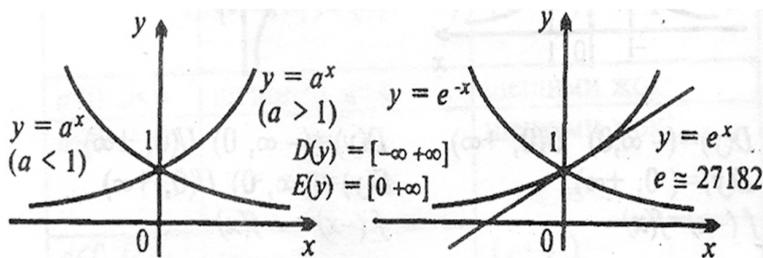
Logarifmli funkciya

$$Y = \log_a x \Big(a > 0,\quad a \neq 1\Big)$$

Trigonometriyali'q funkciyalar

1. $y = \sin x$

$$D\ (y) = (-\infty;\ +\infty) \qquad f\left(-x\right) = -f\left(x\right) \qquad E\left(y\right) = \left[-1, +1\right]$$

$$T = 2\pi \Rightarrow \sin x = \sin\left(x + 2\pi k\right), k \in Z$$

2. $y = \cos x$
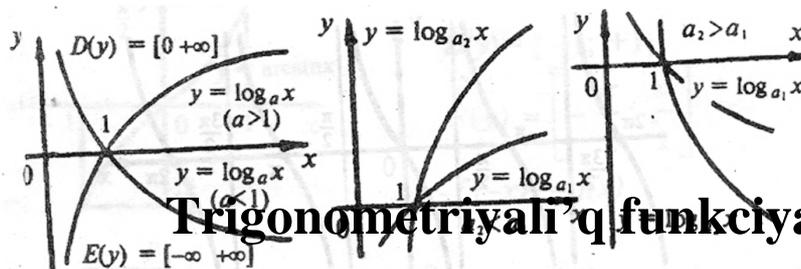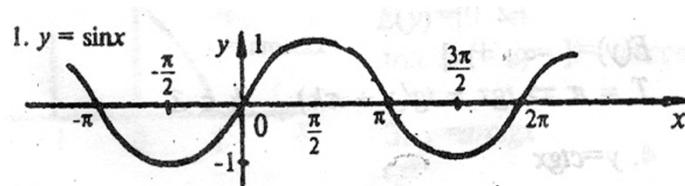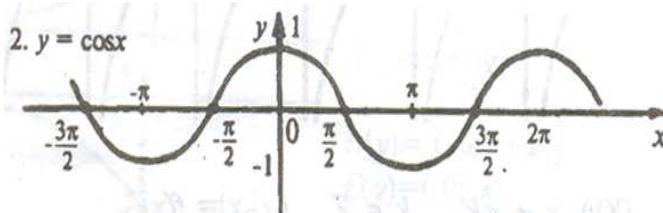
$$D\left(y\right) = \left(-\infty;\ +\infty;\right) \qquad f\left(-x\right) = -f\left(x\right) \qquad E\left(y\right) = \left[-1, +1\right]$$

$$T = 2\pi = \cos x = \cos\left(x + 2\pi k\right), k \in Z$$

3. $y = tgx$
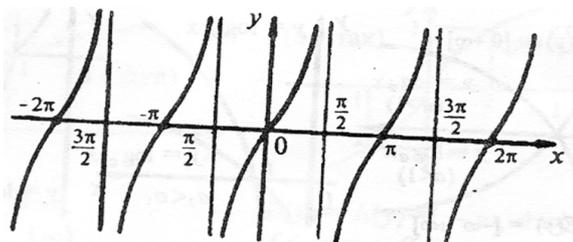
$$D(y)\, x \neq \frac{\pi}{2} + \pi k\ \ k \in Z \qquad f\left(-x\right) = -f\left(x\right) \qquad E\left(y\right) = \left(-\infty;\ +\infty;\right)$$

$$T = \pi \Rightarrow tg\,x = tgx\ \left(x + \pi k\right), k \in Z$$

4. $y = ctgx$
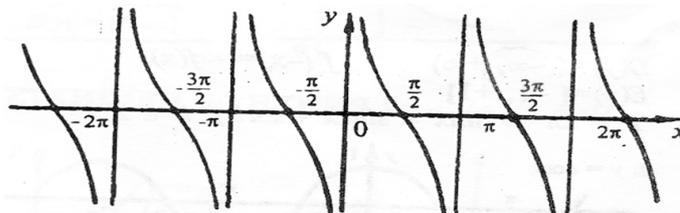
$$D\ (y)\cdot x \neq \pi k\ \ k \in Z \qquad f\left(-x\right) = -f\left(x\right) \qquad E\left(y\right) = \left(-\infty;\ +\infty;\right)$$

$$T = \pi \Rightarrow ctgx = ctg\left(x + \pi k\right), k \in Z$$

Keri trigonometriyali'q funkciyalar

1. $y = arcsinx$

$$D\left(y\right) = \left[-1; \ +1\right]$$

$$E\left(y\right) = \left[-\frac{\pi}{2}; \ \frac{\pi}{2}\right]$$

$$f\left(-x\right) = -f\left(x\right)$$

2. $y = arccosx$

$$D\left(y\right) = \left[-1; \ +1\right]$$

$$E\left(y\right) = \left[0, \ \pi\right]$$
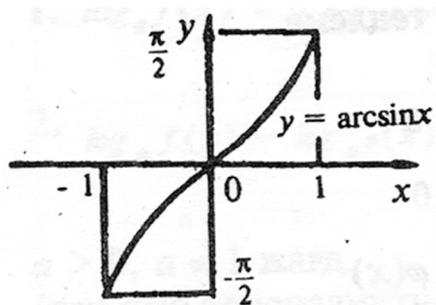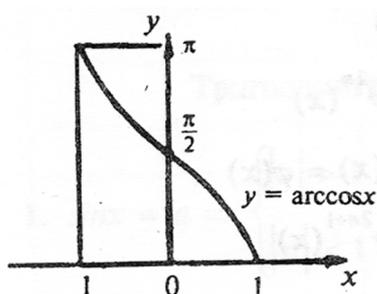
$$y = arccos\left(-x\right) = \pi - arccosx$$

3. $y = arctgx$
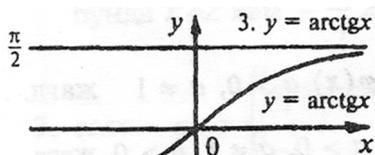
$$D\left(y\right) = \left[-\infty; \ +\infty\right] \qquad E\left(y\right) = \left[-\frac{\pi}{2}; \ \frac{\pi}{2}\right]$$

$$f\left(-x\right) = -f\left(x\right)$$

4. $y = arc\tilde{n}tgx$
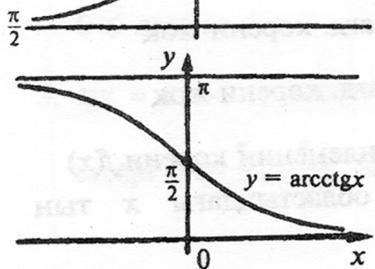
$$D\left(y\right) = \left[-\infty; \ +\infty\right] \qquad E\left(y\right) = \left[0, \ \pi\right]$$

$$arcctg\left(-x\right) = \pi - arcctgx$$

Ten'leme

Irracional ten'leme

$$\sqrt[2n]{f(x)} = \sqrt[2n]{\varphi(x)} \Leftrightarrow \begin{cases} f(x) \geq 0 \\ \varphi(x) \geq 0 \\ f(x) = \varphi(x) \end{cases}$$

$$\sqrt[2n]{f(x)} = \varphi(x) \Leftrightarrow \begin{cases} \varphi(x) \geq 0 \\ f(x) = \varphi^{2n}(x) \end{cases}$$

$$\sqrt[2n+1]{f(x)} = \sqrt[2n+1]{\varphi(x)} \Leftrightarrow f(x) = \varphi(x) \qquad \sqrt[2n+1]{f(x)} = \varphi(x) \Leftrightarrow f(x) = \varphi^{2n+1}(x)$$

Ko'rsetkishli ten'leme

1. $a^{f(x)} = a^{\varphi(x)} \Leftrightarrow f(x) = \varphi(x)$ $a > 0$, $a \neq 1$ jag'd.

2. $a^{f(x)} = b \Leftrightarrow f(x) = \log_a b$ $a > 0$, $a \neq 1$ $b > 0$ jag'd.

3. $a^{f(x)} = b$, $a > 0$, $b \leq 0$ jag'd. koreni joq

4. $a^{f(x)} = b$, $a = 1$, $b \neq 1$ jag'd. koreni joq

5. $a^{f(x)} = b$, $a = 1$, $b = 1$ Ten'lemenin' koreni $f(x)$

funkciyani'n' ani'qlani'w oblasti'ndag'i' x ti'n' ha'mme ma'nisi.

Logarifmli ten'leme

1. $\log_a f(x) = b \Leftrightarrow f(x) = a^b$ $a > 0$, $a \neq 1$ jag'd.

2. $\log_a f(x) = \log_a \varphi(x) \Leftrightarrow \begin{cases} f(x) = \varphi(x) \\ f(x) > 0 \\ \varphi(x) > 0 \end{cases}$

$a > 0$, $a \neq 1$ jag'd.

(tek bir ten'sizlikti qaldi'ri'w jetkilikli)

Trigonometriyali'q ten'lemeler

1. $\sin x = a \Leftrightarrow \begin{cases} |a| > 1 \Rightarrow x \in \varnothing \\ |a| \le 1 \Rightarrow x = (-1)^k \arcsin a + \pi k \end{cases}$.

bunda $k \in Z$ ha'm $-\dfrac{\pi}{2} \le \arcsin a \le \dfrac{\pi}{2}$

2. $\cos x = a \Leftrightarrow \begin{cases} |a| > 1 \Rightarrow x \in \varnothing \\ |a| \le 1 \Rightarrow x = \pm \arccos a + 2\pi k \end{cases}$.

3. $tg x = a \Rightarrow x = \operatorname{arcctg} a + \pi k$

$\operatorname{arctg} a \in \left(-\dfrac{\pi}{2}; \dfrac{\pi}{2} \right), \ a \in R$

4. $ctg x = a \Rightarrow x = \operatorname{arcctg} a + \pi k$

$\operatorname{arctg} a \in \left(0; \ \pi \right), \ a \in R$

α	$\sin x = a$	$\cos x = a$
0	$x = \pi k$	$x = \dfrac{\pi}{2} + \pi k$
1	$x = \dfrac{\pi}{2} + 2\pi k$	$x = 2\pi k$
-1	$x = -\dfrac{\pi}{2} + 2\pi k$	$x = \pi + 2\pi k$
$\dfrac{1}{2}$	$x = (-1)^k \dfrac{\pi}{6} + \pi k$	$x = \pm \dfrac{\pi}{3} + 2\pi k$
$-\dfrac{1}{2}$	$x = (-1)^{k+1} \dfrac{\pi}{6} + \pi k$	$x = \pm \dfrac{2\pi}{3} + 2\pi k$
$\dfrac{\sqrt{3}}{2}$	$x = (-1)^k \dfrac{\pi}{3} + \pi k$	$x = \pm \dfrac{\pi}{6} + 2\pi k$
$-\dfrac{\sqrt{3}}{2}$	$x = (-1)^{k+1} \dfrac{\pi}{3} + \pi k$	$x = \pm \dfrac{5\pi}{6} + 2\pi k$
$\dfrac{\sqrt{2}}{2}$	$x = (-1)^k \dfrac{\pi}{4} + \pi k$	$x = \pm \dfrac{\pi}{4} + 2\pi k$

$-\dfrac{\sqrt{2}}{2}$	$x=(-1)^{k+1}\dfrac{\pi}{4}+\pi k$	$x=\pm\dfrac{3\pi}{4}+2\pi k$
α	$tgx=a$	$ctgx=a$
0	$x=\pi k$	$x=\dfrac{\pi}{2}+\pi k$
1	$x=\dfrac{\pi}{4}+\pi k$	$x=\dfrac{\pi}{4}+\pi k$
-1	$x=-\dfrac{\pi}{4}+\pi k$	$x=\dfrac{3\pi}{4}+\pi k$
$\sqrt{3}$	$x=\dfrac{\pi}{3}+\pi k$	$x=\dfrac{\pi}{6}+\pi k$
$-\sqrt{3}$	$x=-\dfrac{\pi}{3}+\pi k$	$x=\dfrac{5\pi}{4}+\pi k$
$\dfrac{\sqrt{3}}{3}$	$x=\dfrac{\pi}{6}+\pi k$	$x=\dfrac{\pi}{3}+\pi k$
$-\dfrac{\sqrt{3}}{3}$	$x=-\dfrac{\pi}{6}+\pi k$	$x=\dfrac{2\pi}{3}+\pi k$

Ayi'ri'm tu'rlendiriwler

1. $(\sin x \pm \cos x)^2 = 1 \pm \sin 2x$

2. $\cos^4 x - \sin^4 x = \cos^2 x - \sin^2 x = \cos 2x.$

3. $\sin^4 x + \cos^4 x = \dfrac{1+\cos^2 2x}{2} = 1 - \dfrac{\sin^2 2x}{2} = \dfrac{3+\cos 4x}{4}.$

4. $\cos^6 x - \sin^6 x = \dfrac{1}{8}\left(5+3\cos 4x\right) = \dfrac{1}{4}\left(1+3\cos^2 2x\right).$

5. $\cos^6 x - \sin^6 x = \dfrac{1}{16}\left(15\cos 2x + \cos 6x\right).$

6. $\cos^8 x - \sin^8 x = \dfrac{1}{4}\cos 2x \cdot \left(3+\cos 4x\right).$

7. $\sin x \pm \cos x = \sqrt{2}\,\sin\left(x \pm \dfrac{\pi}{4}\right).$

8. $\sin x \pm \sqrt{3}\,\cos x = 2\,\sin\left(x \pm \dfrac{\pi}{3}\right).$

9. $\sqrt{3}\,\sin x \pm \cos x = 2\,\sin\left(x \pm \dfrac{\pi}{6}\right).$

Ten'sizlikler

$f(x) > g(x),\quad f(x) < g(x),\quad f(x) \geq g(x),\quad f(x) \leq g(x)$ tu'rinde qatnaslar—wo'zgermeli ten'sizlikler

1. $f(x) > g(x) \Leftrightarrow f(x) - g(x) > 0$ **2.** $f(x) > g(x) \Leftrightarrow af(x) > ag(x)$, $a>0$ bolsa

3. $f(x) > g(x) \Leftrightarrow af(x) < ag(x)$, $a<0$ bolsa **4.** $\begin{cases} f(x) \geq 0 \\ g(x) \geq 0 \end{cases} \Leftrightarrow \begin{cases} f(x) \geq 0 \\ g(x) > 0 \end{cases} U \begin{cases} f(x) \leq 0 \\ g(x) < 0 \end{cases}$

5. $\begin{cases} f(x) \leq 0 \\ g(x) \end{cases} \Leftrightarrow \begin{cases} f(x) \leq 0 \\ g(x) > 0 \end{cases} U \begin{cases} f(x) \geq 0 \\ g(x) < 0 \end{cases}$

6. $\dfrac{f(x)}{g(x)} > 0 \Leftrightarrow f(x)g(x) > 0$ $\dfrac{f(x)}{g(x)} < 0 \Leftrightarrow f(x)g(x) < 0$

7. $f(x)g(x) > 0 \Leftrightarrow \begin{cases} f(x) > 0 \\ g(x) > 0 \end{cases} U \begin{cases} f(x) < 0 \\ g(x) < 0 \end{cases}$ **8.** $f(x)g(x) < 0 \Leftrightarrow \begin{cases} f(x) > 0 \\ g(x) < 0 \end{cases} U \begin{cases} f(x) < 0 \\ g(x) > 0 \end{cases}$

Irracional ten'sizlikler

1. $\sqrt[2n]{f(x)} < g(x) \Leftrightarrow \begin{cases} f(x) \geq 0 \\ g(x) > 0 \quad n \in N \\ f(x) < g(x)^{2n} \end{cases}$

2. $\sqrt[2n]{f(x)} > g(x) \Leftrightarrow \begin{cases} g(x) < 0 \\ f(x) \geq 0 \end{cases} U \begin{cases} g(x) \geq 0 \\ f(x) > g(x)^{2n} \end{cases} \quad (n \in N)$

3. $\sqrt[2n+1]{f(x)} > g(x) \Leftrightarrow f(x) > g(x)^{2n+1} (n \in N)$

4. $\sqrt[2n+1]{f(x)} > g(x) \Leftrightarrow f(x) < g(x)^{2n+1} (n \in N)$

Ko'rsetkishli ten'sizlikler

1. $a^{f(x)} > a^{g(x)} \Leftrightarrow f(x) > g(x) \quad a>1$ de

2. $a^{f(x)} > a^{g(x)} \Leftrightarrow f(x) < g(x) \quad 0<a<1$ de

3. $a^{f(x)} > b \Leftrightarrow f(x) < log_a b \quad a>1 \quad b>1$ de

4. $a^{f(x)} > b \Leftrightarrow f(x) < log_a b \quad 0<a<1 \quad b<1$ de

5. $a^{f(x)} > b \quad a>0 \ b<0$ de

Ten'sizliktin' sheshiliwi *f(x)* funkciyasi'ni'n' ani'qlani'w oblasti' boladi'.

Logarifmli ten'sizlikler

1. $0<a<1, log_a f(x) < log_a g(x) \Leftrightarrow \begin{cases} f(x) > g(x) \\ g(x) > 0 \end{cases}$

2. $a>1, log_a f(x) < log_a g(x) \Leftrightarrow \begin{cases} f(x)g(x) \\ f(x) > 0 \end{cases}$

Ayri'm ten'lemeler ha'm ten'sizliklerdi sheshiw sxemasi'

$\updownarrow$ $|f|<\varphi$	$\updownarrow$ $|f|\leq\varphi$	$\updownarrow$ $|f|=\varphi$	$\updownarrow$ $|f|\geq\varphi$	$\updownarrow$ $|f|>\varphi$
	$\updownarrow$ $-\varphi\leq f\leq\varphi$		$\downarrow$ $f\leq-\varphi$ U $f\geq\varphi$	$\downarrow$
$-\varphi<f<\varphi$		$\begin{cases} \varphi\geq 0 \\ f=-\varphi U f=\varphi \end{cases}$		$f<-\varphi$ U $f>\varphi$
		$\updownarrow$		
$\updownarrow$	$\updownarrow$			
$\begin{cases} -\varphi<f \\ f<\varphi \end{cases}$	$\begin{cases} -\varphi\leq f \\ f\leq\varphi \end{cases}$	$\begin{cases} f<0, \\ f=-\varphi \end{cases} U \begin{cases} f\geq 0, \\ f=\varphi \end{cases}$		

$\updownarrow$ $|f|<|\varphi|$	$\updownarrow$ $|f|\leq|\varphi|$	$\updownarrow$ $|f|=|\varphi|$	$\updownarrow$ $|f|\geq|\varphi|$	$\updownarrow$ $|f|>|\varphi|$
	$\updownarrow$ $f^2\leq\varphi^2$	$\downarrow$	$\downarrow$	$\downarrow$
$f^2<\varphi^2$		$f=\varphi$ $U f=-\varphi$		
			$f^2\geq\varphi^2$	$f^2>\varphi^2$
		$\updownarrow$	$\updownarrow$	$\updownarrow$
$\updownarrow$	$\updownarrow$			

			$(f-\varphi)x$ $x(f+\varphi)\geq 0$	$(f-\varphi)x$ $x(f+\varphi)>0$
$(f-\varphi)x$ $x(f+\varphi)<0$	$(f-\varphi)x$ $x(f+\varphi)\leq 0$			

$\sqrt{f}<\varphi$	$\sqrt{f}\leq\varphi$	$|f|=|\varphi|$	$|f|\geq|\varphi|$	$|f|>|\varphi|$
$\begin{cases}\varphi>0\\ f\geq 0\\ f<\varphi^2\end{cases}$	$\begin{cases}\varphi\geq 0\\ f\geq 0\\ f\leq\varphi^2\end{cases}$	$\begin{cases}\varphi\geq 0\\ f=\varphi^2\end{cases}$	$\begin{cases}\varphi<0\\ f\geq 0\end{cases}$ $U\begin{cases}\varphi\geq 0\\ f\geq\varphi^2\end{cases}$	$\begin{cases}\varphi<0\\ f\geq 0\end{cases}$ $U\begin{cases}\varphi\geq 0\\ f>\varphi^2\end{cases}$

$\sqrt{f}<\sqrt{\varphi}$	$\sqrt{f}\leq\sqrt{\varphi}$	$\sqrt{f}=\sqrt{\varphi}$	$\sqrt{f}\geq\sqrt{\varphi}$	$\sqrt{f}>\sqrt{\varphi}$
$0\leq f<\varphi$	$0\leq f\leq\varphi$	$\begin{cases}f=\varphi\\ f\geq 0\end{cases}$ yamasa $\varphi>0$	$f\geq\varphi\geq 0$	$f>\varphi\geq 0$
$\begin{cases}f\geq 0\\ f<\varphi\end{cases}$	$\begin{cases}f\geq 0\\ f\leq 0\end{cases}$		$\begin{cases}f\geq\varphi\\ \varphi\geq 0\end{cases}$	$\begin{cases}f>\varphi\\ \varphi\geq 0\end{cases}$

$log_\varphi f_1<0$	$log_\varphi f\leq 0$	$log_\varphi f=0$	$log_\varphi f\geq 0$	$log_\varphi f>0$
$\begin{cases}(f-1)x\\ x(\varphi-1)<0\\ f>0\\ \varphi>0\end{cases}$	$\begin{cases}(f-1)x\\ x(\varphi-1)\leq 0\\ f>0\\ \varphi>0\\ \varphi\neq 1\end{cases}$	$\begin{cases}f=\varphi\\ \varphi>0\\ \varphi\neq 1\end{cases}$	$\begin{cases}(f-1)x\\ x(\varphi-1)\geq 0\\ f>0\\ \varphi>0\\ \varphi\neq 1\end{cases}$	$\begin{cases}(f-1)x\\ x(\varphi-1)>0\\ f>0\\ \varphi>0\end{cases}$

$log_\varphi f<log_\varphi f_2$	$log_\varphi f_1\leq log_\varphi f_2$		$log_\varphi f_1\geq log_\varphi f_2$	$log_\varphi f_1>log_\varphi f_2$

		$\log_\varphi f_1 = \log_\varphi f_2$ $\downarrow$		
$\begin{cases}(f_1-f_2)x \\ x(\varphi-1)<0 \\ f_1>0 \\ f_2>0 \\ \varphi>0\end{cases}$	$\begin{cases}(f_1-f_2)x \\ x(\varphi-1)\leq0 \\ f_1>0 \\ f_2>0 \\ \varphi>0 \\ \varphi\neq1\end{cases}$	$\begin{cases}f_1=f_2 \\ f_1>0 \\ f_2>0 \\ \varphi>0 \\ \varphi\neq1\end{cases}$ (yamasa	$\begin{cases}(f_1-f_2)x \\ x(\varphi-1)\geq0 \\ f_1>0 \\ f_2>0 \\ \varphi>0 \\ \varphi\neq1\end{cases}$	$\begin{cases}(f_1-f_2)x \\ x(\varphi-1)>0 \\ f_1>0 \\ f_2>0 \\ \varphi>0\end{cases}$

MATEMATIKALI'Q ANALIZDI'N' ELEMENTLERI

x noqati'ndag'i' *y=f(x)* funkciyasi'ni'n' tuwi'ndi'si'

$$y'=f'(x)=\lim_{\Delta x\to0}\frac{\Delta y}{\Delta x}=\lim_{\Delta x\to0}\frac{f(x+\Delta x)-f(x)}{\Delta x}$$

Geometriyali'q ma'nisi: $tg\alpha=f'(x_0)$
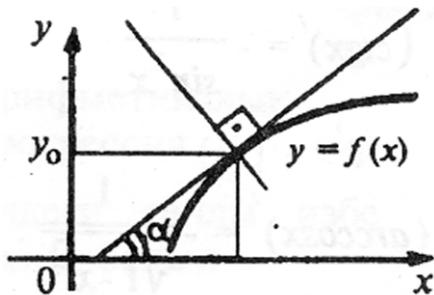
$y-y_0-f'(x_0)(x-x_0)$ — ten'leme $(x_0,\ y_0)$ noqati'nda *y=f(x)* iymekliginde uri'nba

$y-y_0=\dfrac{1}{f'(x_0)}(x-x_0)$ —ten'lemesi $(x_0,\ y_0)$ noqati'nda *y=f(x)* iymekligine normal.

Tuwi'ndi'lar kestesi

1. $c' = 0 \ (c = const)$

2. $\left(x^a\right)' = ax^{a-1} \Leftrightarrow x' = 1,$ $\left(\dfrac{1}{x}\right)' = -\dfrac{1}{x^2},$ $\left(\sqrt{x}\right)' = \dfrac{1}{2\sqrt{x}}.$

3. $\left(a^x\right)' = a^x \ln a$

4. $\left(e^x\right)' = e^x$

5. $\left(\log_a x\right)' = \dfrac{1}{x \ln a}$

6. $\left(\ln x\right)' = \dfrac{1}{x}$

7. $\left(\sin\right)' = \cos x$

8. $\left(\cos x\right)' = -\sin x$

9. $\left(tgx\right)' = \dfrac{1}{\cos^2 x}$

10. $\left(ctgx\right)' = -\dfrac{1}{\sin^2 x}$

11. $\left(\arcsin x\right)' = \dfrac{1}{\sqrt{1-x^2}}$

12. $\left(\arccos x\right)' = -\dfrac{1}{\sqrt{1-x^2}}$

13. $\left(arcctgx\right)' = \dfrac{1}{1+x^2}$

14. $\left(arcctgx\right)' = -\dfrac{1}{1+x^2}$

Differenciallaw qa'deleri

Yeger $U = U(x), \vartheta = \vartheta(x),$ —differenciyalani'wshi' funkciya bolsa, $c = const$ wonda

1. $\left(cu\right)' = cu'$

2. $\left(u + \vartheta\right)' = u' \pm \vartheta$

3. $\left(u\vartheta\right)' = u'\vartheta + u\vartheta'$

4. $\left(\dfrac{u}{\vartheta}\right)' = \dfrac{u'\vartheta - u\vartheta'}{\vartheta} \Rightarrow \left(\dfrac{ñ}{\vartheta}\right) = -\dfrac{ñ\vartheta}{\vartheta^2}$

5. $y = f(u) \ \ u = u(x) \to y'_x = f'_x u'_x$

<>

Progressiyalar

Arifmetikali'q

Arifmetikali'q progressiya $\{a_n\}$ —tu'rindegi sanli' izbe— izlik boli'p $a_1, a_2, ... an, ... n \in N$ bul $\forall n > 1 \ a_n = a_{n-1} + d$ (*d*—ayi'rmashi'li'q)

1. $a_{n+1}, a_n + d$

2. $a_n = \dfrac{a_{n-1} + a_{n+1}}{2} (n > 1)$

3. $a_n = a_1 + (n-1)d$

4. $a_n = a_k + d(n-k)$ $1 \le k \le n-1$

5. $a_n = \dfrac{a_{n-k} + a_{n+1}}{2}$ $1 \le k \le n-1$

6. $a_n + a_m = a_k + a_p$

yeger *n+m=k+p* bolsa

7. $a_1 = a_n - d(n-1)$

8. $d = \dfrac{a_n - a_1}{n-1} (n > 1)$

9. $n = \dfrac{a_n - a_1}{d} + 1$

10. $S_n = a_1 + a_2 + ... + a_n$ **11.** $S_n = \dfrac{a_1 + a_n}{2}n$ **12.** $S_n = \dfrac{2a_1 + d(n-1)}{2}n$

13. $S_n - S_{k-1} = a_k + a_{k+1} + ... + a_n = \dfrac{a_k + a_n}{2}(n-k+1)$ $\quad 1 < k \le n (n,\, k,\, m,\quad p \in N)$

Geometriyali'q

Geometriyali'q progressiya $\{b_n\}$ —tu'rindegi sanli' izbe-izlik boli'p

$b_1, b_2, ... b_n, ... n \in N$ **bul** $b_1 \ne 0$ **ha'm** $\forall n > 1$ $\quad bn = b_{n-1} \cdot q$ q-**bo'lim**

1. $b_{n+1} = b_n q$ **2.** $b_n^2 = b_{n-1}b_{n+1}\,(n \to 1)$ **3.** $b_n = b_1 q^{n-1}$

4. $b_n = b_k q^{n-k}$ $\quad 1 \le k \le n-1$ **5.** $b_n = b_{n-k} q^k$ $\quad 1 \le k \le n-1$

6. $b_{n+1} = b_n q^k$ **7.** $b_n^2 = b_{n-m}b_{n+m}$ $1 \le m \le n-1$ **8.** $b_n b_m = b_k b_p$ **yeger** $n+m=k+p$ bolsa

9. $S_n = b_1 + b_2 + ... + b_n$ **10.** $S_n = \begin{cases} b_1 \dfrac{1-q^n}{1-q}, & q \ne 1 \\ b_1, n, & q=1 \end{cases}$ **11.** $S_n = \dfrac{b_n q - b_1}{q-1}$ $\quad q \ne 1$

12. $S_n = \lim\limits_{n \to \infty} S_n = \dfrac{b_1}{1-q}$ $\quad$ yeger $0 < |q| < 1 (n,k,m,p \in N)$

PLANIMETRIYA

Yerkin u'shmu'yeshlik
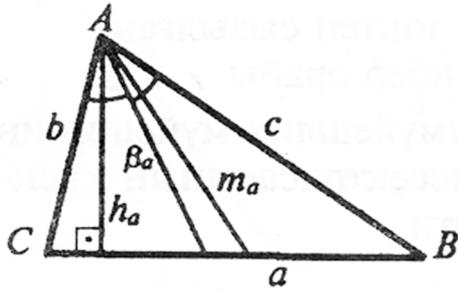
a,b,c —ABC_Δ ta'replerinin' uzi'nli'g'i'

$P=\frac{a+b+c}{2}$ — yari'mperimetr S— maydan, R è r ishten ha'm si'rttan si'zi'lg'an shen'ber radiusi'; h_a, β_a, m_a—a ta'repine ju'rigizilgen biyiklik, mediana, bessektrisa uzi'nli'g'i'.

Sinuslar teoremasi'

$$\frac{a}{sinA}=\frac{b}{sinB}=\frac{s}{sinS}=2R$$

Kosinuslar teoremasi'

$$a^2 = b_2 + c^2 - 2bc \ cosA$$

Geron formulasi'

$$S \equiv \sqrt{P(p-a)(p-b)(p-c)}$$

$$S = 1/2ah_a; \ \ S = 1/2ab\sin C$$

$$S = abc/4R; \ \ S = p \cdot r$$

U'shmu'yeshliktegi a'hmiyetli si'zi'q ha'm noqatlar
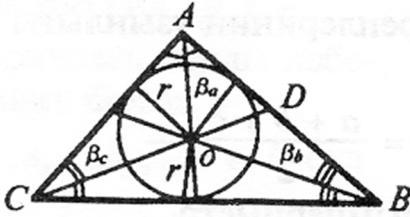
Bissekrisalar

o—ishten si'zi'lg'an shen'ber worayi' $r=Sp$

U'shmu'yeshlik mu'yeshinin' bissektrisasi'ni'n' qa'siyeti

$AD/DB=AC/BC$

Medianalar
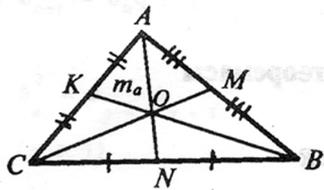
o—u'shmu'yeshliktin' awi'rli'q worayi'

$OK/OB=/OM/OC=ON/OA=1/2$

$$m_a = 1/2\sqrt{2b^2 + 2c^2 - a^2}$$
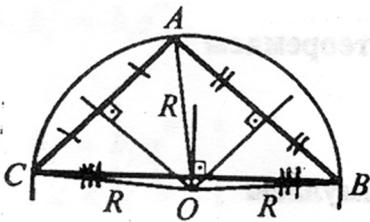
Ta'repler wortasi'nan ju'rgizilgen perpendikulyarlar

o—si'rttan ju'rgizilgen shen'ber worayi' $R = \dfrac{a\ b\ c}{4\ C}$

Tuwri'mu'yeshli u'shmu'yeshlik
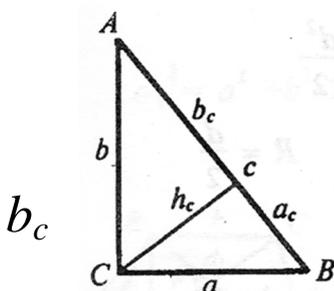
a ha'm b katetler; c— gipotenuza a_c ha'm b_c gipotenuzadag'i' katetler proekciyasi'

$a^2+b^2=c^2$— Pifagor teoremasi' $S=1/2ab$; $S=1/2ch_c$;

$$r = \frac{a+b-c}{2} \quad R = c/2$$

$$h_c^2 = a_c b_c \quad a^2 = ca_c \quad b^2 = cb_c$$

$$a = c\sin A = c\cos B = b\,\mathrm{tg}A = b\,\mathrm{ctg}B$$

Ten'ta'repli u'shmu'yeshlik
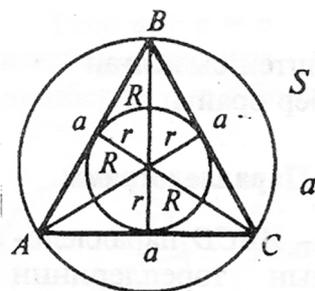
$$S = \frac{a^2\sqrt{3}}{4} \qquad a = R\sqrt{3} \qquad a = 2r\sqrt{3} \qquad r = \frac{a\sqrt{3}}{6}$$

$$R = \frac{a\sqrt{3}}{3}$$

Yerkin do'n'es to'rtmu'yeshlik
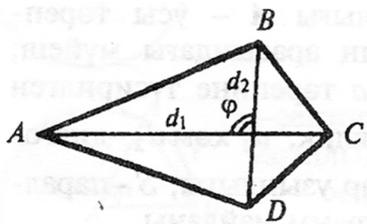
d_1 ha'm d_2 –diagonal uzi'nli'g'i', φ— wolar arasi'ndag'i' mu'yesh,
S—maydan

$S=1/2 \cdot d_1 \cdot d_2 \cdot sin\varphi$

Kvadrat
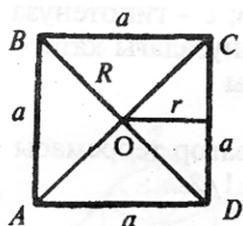
$$d_1 = d_2 \quad d_1 \perp d_2 \qquad S = a^2 = \frac{d^2}{2} \qquad r = \frac{a}{2} \qquad R = \frac{d}{2}$$

Romb
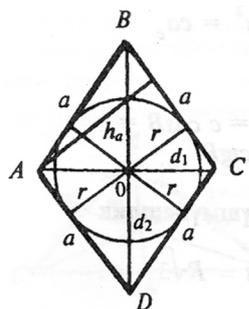
$$d_1 = d_2 \qquad S = a \cdot h_a \qquad S = a^2 \cdot \sin A \qquad S = 1/2\, d_1 d_2 \qquad r = h_{a/2}$$

$$d_1^2 + d_2^2 = 4a^2$$

o—ishten si'zi'lg'an shen'ber worayi'.

Parallelogramm
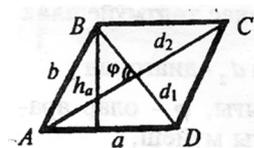
a ha'm *b*—*ABCD* parallelogrammi'ni'n' ta'replerinin' uzi'nli'g'i' *A*—usi ta'replerdi'n' arasi'ndag'i' mu'yesh; h_a—*a* ta'repine tu'sirilgen biyiklik; d_1 ha'm d_2—diagonallar uzi'nli'g'i'; *S*—parallelogramm maydani'

$$h_a = b \cdot \sin A \qquad S = a \times h_a \qquad S = a \cdot b \sin A \qquad S = 1/2\, d_1 d_2 \sin\varphi$$

$$d_1^2 = a^2 + b^2 - 2ab\cos A \qquad d_1^2 + d_2^2 = 2\left(a^2 + b^2\right)$$

Trapeciya
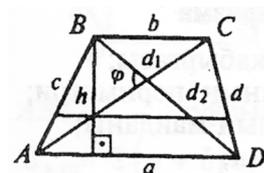
a, b –ultanlari'; *c, d*—qaptal ta'repleri; *h*—biyiklik; d_1, d_2—diagonallar uzi'nli'g'i';

L—wortasha uzi'nli'q; φ—diagnollar arasi'ndag'i' mu'yesh; *S*—maydan.

$$I = \frac{a+b}{2} \qquad S = \frac{a+b}{2} \cdot h \qquad S = \frac{d_1 d_2}{2} \sin\varphi$$

Yeger $a+b=c+d$ bolsa, wonda trapeciya ishine shen'ber si'zi'wg'a boladi'. Trapeciya si'rti'na shen'berdi $c=d$ bolg'an jag'dayda si'zi'wg'a boladi'.

Shen'ber, do'n'gelek
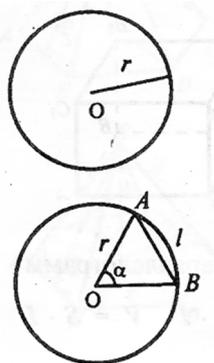
r—shen'ber radiusi'; C—shen'ber uzi'nli'g'i'; S—do'n'gelek maydani'

$$C = 2\pi r \qquad\qquad S = \pi r^2$$

Sektor, segment

l—sektor menen shegaralang'an dog'a uzi'nli'g'i'; S—sektor maydani';

$n°$—worayli'q mu'yeshtin' gradusli'q wo'lshemi; a—worayli'q mu'yeshtin' radianli'q wo'lshemi.

$$l = \frac{\pi r n°}{180°} = r \cdot \alpha \qquad S = \frac{\pi r^2 n°}{360°} = \frac{1}{2} r^2 \alpha \qquad S_{seg} = S_{AIV} = S_{AOVl} \, S_{\Delta AOV}$$

Stereometriya

Yerkin prizma
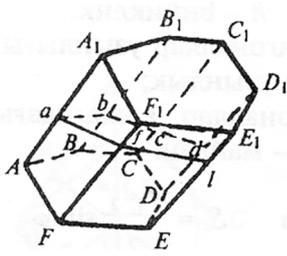
I—qaptal qabi'rg'asi';

P—ultani'ni'n' perimetri;

S—ultanini'n' maydani';

H—biyiklik;

P_{kes}—perpinduklyar kesimnin' perimetri;

S_{qap}—qaptal betinin' maydani';

V—ko'lem; S_{kes}—perpinduklyar kesiminin' maydani'

$$V=S_{kes} \cdot I \qquad V=S \cdot H \qquad S_{qap}=P_{kes} \cdot I$$
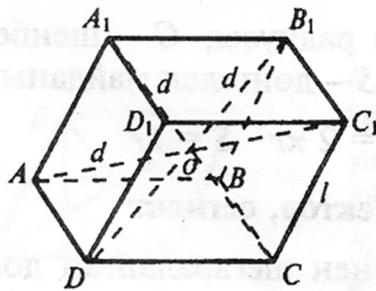
Parallelepiped   Tuwri' parallelepiped

$$S_{qap}=P_{kes} \cdot I$$
$$V=S \cdot H$$
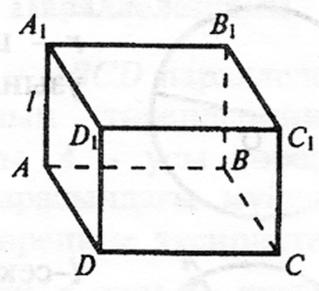
$ABCD$—parallelogramm

$$S_{qap}=P \cdot I \qquad V=S \cdot I$$

Tuwri' mu'yeshli   parallelepiped   Kub
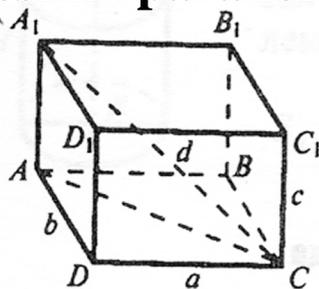
ABCD—tuwri'mu'yeshlik   ABCD—kvadrat

$$S_{qap} = 2(a+b)c \qquad C_{qap} = 4a^2 \qquad\qquad V = a^3$$
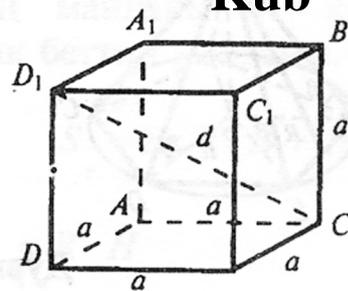
$$V = abc \quad d^2 = a^2 + b^2 + c^2 \qquad\qquad d = a\sqrt{3}$$

Yerikli piramida
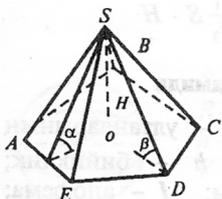
S—ultan maydani', H—biyiklik; V—ko'lem; S_{qap}—qaptal ta'rep maydani'; α—qaptal qabi'rg'a menen ultan maydani' arasi'ndag'i' mu'yesh; I—apofema; P—ultan perimetri.
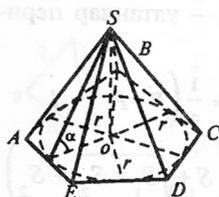
O—ishten ha'm si'rttan si'zi'lg'an shen'berler worayi'.

$$S = S_{qap} \cdot \cos\alpha$$

$$S_{qap} = \frac{1}{2}P \cdot l$$
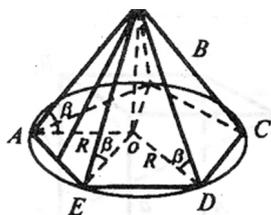
O—si'rttan shen'berler worayi'

31
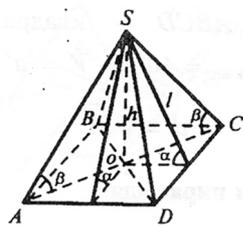
Duri's piramida

ABCD—duri's ko'pmu'yeshlik

$$S_{qap} = \frac{1}{2} P \times l \qquad S = S_{qap} \times \cos\alpha$$

$$V = \frac{1}{3} S \cdot H$$

Duri's kesik piramida
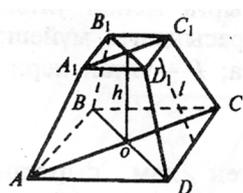
S_1 ha'm S_2—ultanlari'ni'n' maydani'; h— biyiklik; V—ko'lem; I—apofema; P_1ha'm P_2—ultanlar perimetri

$$S_{qap} = \frac{1}{2}(P_1 + P_2) \times l \qquad V = \frac{1}{3} h\left(S_1 + \sqrt{S_1 \times S_2} + S_2\right)$$

Cilindr
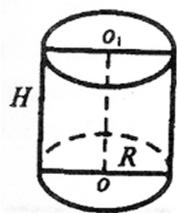
R—ultanni'n' radiusi'; S_{qap}—qaptal ta'repinin' maydani'; V—ko'lem, S_t—toli'q bettin' maydani'.

$$S_{qap} = 2\pi RH \qquad S_t = 2\pi R(R+H) \qquad V = \pi R^2 H$$

Konus
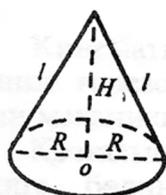
$$S_{qap} = \pi Rl \qquad S_t = \pi R(R+l) \qquad V = \frac{1}{3}\pi R^2 H$$

Shar, shar segmenti

S—shar betinin' maydani';
R—shar radiusi';
h—segment biyikligi;
V—ko'lem
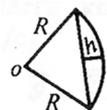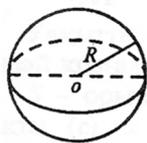
$$S=4\pi R^2 \qquad V=\frac{4}{3}\pi R^3 \qquad V=\frac{2}{3}\pi R^2 h$$

FIZIKA

MEXANIKA

Kinematika tiykari'

Kinematika dep qozg'ali'sti' payda yetiwshi sebepke g'a'rezsiz, qozg'ali's ni'zamlari'n u'yrenetug'i'n mexanikani'n' bo'limine ayti'ladi'.

Qozg'ali's ilgermeli, aylanbali' boli'p yekige bo'linedi. Ilgermeli qozg'ali's ten' wo'lshewli tuwri' si'zi'qli' ha'm ten' tezleniwshi tuwri' si'zi'qli' boli'p bo'linedi.

1. Tuwri' si'zi'qli' ten' wo'lshewli qozg'ali's

Waqi'tti'n' wo'tiwi menen tezlik wo'zgermese, wonday qozg'ali's ten' wo'lshewli boladi'.

S—wori'n awi'sti'ri'w, jol (m); t—qozg'ali's waqti' (s); x—denenin' t waqi't momentindegi koordinatasi'; x_o—denenin' $t_o=0$ waqi't momentindegi koordinatasi'; ϑ—birzamatli'q tezlik(m/c)

$\vec{\vartheta}=\dfrac{\vec{s}}{t}$; $\vec{S}=\vec{\vartheta}\cdot t$ vector tu'rinde

$x=x_0 \pm \vartheta t$ skalyar tu'rinde

2. Tuwri' si'zi'qli' ten' wo'zgeriwshi qozg'ali's

Waqi't birligi ishinde tezlik birdey shamag'a arti'p yamasa kemip barsa, bunday qozg'ali's ten' wo'lshewli tezleniwshi yamasa a'steleniwshi qozg'ali's boladi'.

ϑ_0—da'slepki tezlik; a—tezleniw (m/c^2)

$$\vec{S}=\vec{\vartheta}_0\, t+\frac{\vec{at}^2}{2};\qquad \vec{\vartheta}=\vec{\vartheta}_0+\vec{at};\qquad \vec{a}=\frac{\vec{\vartheta}-\vec{\vartheta}_0}{t};$$

$$x = x_0 \pm \vartheta_0 t \pm \frac{at^2}{2}; \qquad \vartheta = \vartheta_0 + at; \qquad \vartheta_{or} = \frac{\vartheta - \vartheta_0}{2};$$

Da'slepki tezlik bolmasa $\vartheta_0 = 0$;

$$S = +\frac{\vartheta t}{2}; \qquad S = +\frac{at^2}{2}; \qquad \vartheta = at; \qquad \vartheta = \sqrt{2as};$$

3. Yerkin tu'siw

h—wori'n awi'stri'w; *g*—yerkin tu'siw tezleniwi *y*—dene koordinatasi'; y_0—da'slepki koordinata

$$h = \vartheta_0 t \pm \frac{gt^2}{2}; \qquad \vartheta = \vartheta_0 \pm gt; \qquad \vartheta = 0; \quad h = \frac{gt^2}{2}; \qquad \vartheta = gt; \qquad y = y_0 \pm \vartheta_0 t + \frac{gt^2}{2};$$

4. Gorizont penen mu'yesh jasap i'laqti'ri'lg'an denenin' qozg'ali'si'

$\alpha - \vartheta_0$—tezliginin' *x* ko'sheri menen jasag'an mu'yeshi;

x_0, y_0—denenin' $t = 0$ momentindegi koordinatasi'

$$x = x_0 + (\vartheta_0 \cos\alpha)t; \qquad y = y_0 + (\vartheta_0 \sin\alpha)t = \frac{gt^2}{2}; \quad t = \frac{x}{\vartheta_0 \cos\alpha}$$

5. Noqatti'n' shen'ber boyi'nsha ten' wo'lshewli qozg'ali'si'

φ—aylani'w mu'yeshi(rad); ω—mu'yeshklik tezlik; (rad/c); T—aylani'w da'wiri (s); v—aylani'w jiyiligi (s^{-1}) *R*—radius; *S*—dog'ani'n' uzi'nli'g'i'; ϑ—si'zi'qli'q tezlik; α—worayg'a umti'li'wshi' tezleniw (m/s^2)

$$\varphi = \omega t; \qquad S = \vartheta \times t; \qquad \omega = \frac{\varphi}{t} = \frac{2\pi}{t} = 2\pi v; \qquad \vartheta = \frac{s}{t} = \frac{2\pi R}{T} = 2Rv; \qquad \vartheta = \omega R;$$

$$a = \frac{\vartheta^2}{R} = \omega^2 R; \qquad S = R\varphi$$

Dinamikani'n' tiykarg'i' ni'zamlari'

1. Nyutonni'n' birinshi ni'zami'
(inerciya ni'zami') qa'legen dene basqa dene menen ta'sirlespese wo'zinin' ti'ni'shli'q yamasa tuwri' si'zi'qli' ten' wo'lshewli qozg'ali's hali'n saqlaydi'.

2. Nyutonni'n' yekinshi ni'zami'
$\overline{F}$—denege ta'sir yetiwshi ku'sh (ku'shler summasi'); m— dene massasi' (kg); a—tezleniw

$$\vec{a} = \frac{\vec{F}}{m}; \qquad \vec{F} = m\vec{a}$$

Denenin' alg'an tezleniwi ku'shke tuwri' proporcional, massag'a keri proporcional.

3. Nyutonni'n' u'shinshi ni'zami'
$\vec{F}_{12}$—birinshi denenin' yekinshige ta'sir ku'shi;

$\vec{F}_{21}$—yekinshi denenin' birinshige

$$\vec{F}_{12} = -\vec{F}_{21}$$

Bir denenin' yekinshi denege ta'sir yetiw ku'shi shama jag'i'nan ten' bag'i'ti' boyi'nsha qarama-qarsi'.

4. Pu'tkil du'nyali'q tarti'li's ni'zami'
F—tarti'li's ku'shi; $m_1 m_2$—deneler massasi'; R—yeki dene woraylari'ni'n' qashi'qli'g'i'; G—gravitaciya turaqli'si'; M_o—Jer massasi'; R_o—Jer radiusi'; g—Jer betindegi yerkin tu'siw tezleniw (9,8 m/s^2); h—Jer betinen biyiklik; g_n—h—biyikliktegi yerkin tu'siw tezleniwi.

$$F = G\frac{m_1 m_2}{R^2} \qquad g_0 = G\frac{M}{R_0^2} \qquad g_h = G\frac{M_0}{(R+h)^2} = g_0\frac{R_0^2}{(R_0+h)^2}$$

Yeki dene arasi'ndag'i' tarti'li's ku'shi deneler massalri'ni'n' ko'beymesine tuwra proporcional, ara qashi'qli'g'i'ni'n' kvadrati'na keri proporcional.

5.Ti'g'i'zli'q

m—dene massasi'; V—dene ko'lemi; ρ—ti'g'i'zli'q

$$\rho = \frac{m}{V}$$

Dene ti'g'i'zli'g'i' dene massasi'na proporcional woni'n' ko'lemine keri proporcional.

6. Guk ni'zami'

F—serpimlik ku'shi; K—prujinani'n' qatti'li'q koefficienti (n/m); X—absolyut sozi'li'w (m); ΔL—absolyut sozi'li'w (m); l_o—da'slepki uzi'nli'q; δ—mexanikali'q kernew $\left(Pa = \frac{N}{M^2} \right)$; ε—sali'sti'rmali' sozi'li'w (m); E—serpimlilik (YUNG) moduli (Pa)

$$F = -kx \; ; \quad \delta = \frac{F}{S}; \quad \varepsilon = \frac{\Delta l}{l_0}; \quad \delta = E \cdot \varepsilon \; ; \quad \frac{F}{S} = E \frac{\Delta l}{l_0};$$

7. Su'ykeliw ku'shi

F—su'ykeliw ku'shi (N); μ—ji'lji'p su'ykeliw koefficienti; N—normal basi'm ku'shi (N)

$$F = \mu N \; ; \quad \mu = \frac{F}{N};$$

Qi'ya tegisliktegi ji'lji'p su'ykeliw koefficienti $\mu = tg\alpha$; α — qi'yali'q mu'yeshi

8. Statika

M—ku'sh momenti ($N \cdot M$); *l* yamasa *d*—ku'sh iyini (m)

$M = F \cdot l$

Saqlani'w ni'zamlari'

1. Ku'sh ha'm impuls. Impulstin' saqlani'w ni'zami'

$m\vartheta$—dene impulsi ($kg \times m/s$); $\left(m\vartheta_1 - m\vartheta_0 \right)$;—dene impulsinin' wo'zgerisi; $F\Delta t$—ku'sh impulsi (Nc)

$F\Delta t = \left(m\vartheta_1 - m\vartheta_0 \right)$ Jabi'q sistema ushi'n

$m_1 \vec{\vartheta}_1 + m_2 \vec{\vartheta}_2 + ... + m_n \vec{\vartheta}_n = const$

2. Jumi's ha'm energiya

A—jumi's (Dj); α—ku'sh bag'i'ti' menen wori'n awi'sti'ri'w arasi'ndag'i' mu'yesh; h_1—denenin' da'slepki hali' (m); h_2—denenin' son'g'i' hali' (m) $F_{su'y}$—su'ykelis ku'shi (N); E_n—potencial energiya (Dj); E_k—kinetikali'q energiya (Dj); *E, W*—toli'q mexanikali'q energiya.

a) $A = F \cdot S$; $A = F \cdot S cos\alpha$;

b) salmaq ku'shin jen'iw ushi'n islengen jumi's:

$A_s = mgh$; $A_s = - mg \left(h_2 - h_1 \right)$;

v) Su'ykeliste islengen jumi's

$A_{su'y} = - F_{su'y} S$; $A_{su'y} = \mu F_H \cdot S$;

g) Serpimli deformaciyada islengen jumi's

$A = -K \left(\dfrac{x_2^2}{2} - \dfrac{x_1^2}{2} \right)$; $A = \dfrac{1}{2} kx^2$;

d) Potencial, kinetikali'q ha'm toli'q energiyalar

$$E_n = mgh \; ; \quad E_k = \frac{1}{2}m\vartheta^2 \; ; \quad E = E_n + E_k \; ;$$

e) Mexanikali'q energiyani'n' saqlani'w ni'zami'

$$\frac{m\vartheta_1^2}{2} + mgh_1 = \frac{m\vartheta_2^2}{2} + mgh_2 \; ;$$

3. Quwatli'li'q

N_{or}—wortasha quwatli'li'q (Vt); N—bir zamatli'q quwatli'li'q (Vt)

$$N_{or} = \frac{A}{t} = F \cdot \vartheta_{or} \; ; \quad N = F \cdot \vartheta$$

4. Paydali' ta'sir koefficienti

A_n—paydali' jumi's; At—toli'q islengen jumi's

$$\eta = \frac{A_n}{A_t} \cdot 100\%$$

5. Denelerdin' inerciya momentleri

I—inerciya momenti (kg.m^2);
R—radius (m)
a) Juqa saqi'yna, gewek cilindr $I = mR^2$
b) Tutas cilindr $I = \frac{1}{2}mR^2$ v) Shar $I = \frac{2}{5}mR^2$

g) Gewek shar $I = \frac{2}{3}mR^2$

d) l uzi'nli'g'i'ndag'i' jin'ishke sterjen $I = \frac{1}{12}mR^2$

e) Deneden si'rttag'i' ko'sher do'gerindegi aynalg'anda inerciya momenti Shteyner formulasi' menen ani'qlanadi'. I_o—awi'rli'q worayi'nda aynalg'anda inerciya momenti, r—awi'rli'q worayi'nan ko'sherge shekemgi qashi'qli'q.

$$I = I_0 + mr^2$$

Mexanikali'q terbelisler ha'm tolqi'nlar

X—noqatti'n' ten'salmaqli'q haldan awi'si'wi' (m);
A—amplituda (m); φ_0 —da'slepki faza (rad/c);

ϑ_{max}—tezliktin' amplitudali'q ma'nisi;

ω — ciklli terbelis jiyiligi (rad/s)

a_{max} —tezleniwdin' amplitudali'q ma'nisi;

F_{max}—ku'shtin' amplitudali'q ma'nisi; T—terbelis da'wiri
(s); l—mayatnik uzi'nli'g'i'; m—ju'k massasi'; k—qatti'li'q
koefficienti; λ —tolqi'n uzi'nli'g'i' (m); ϑ—tolqi'n tezligi
(m/s); v—terbelis jiyligi (s^{-1})

$$X = A\sin\left(\omega t + \varphi_0\right) = A\sin\left(\frac{2\pi}{T}t + \varphi_0\right)$$

$$\vartheta = A\omega\cos\left(\omega t + \varphi_0\right); \quad \vartheta_{max} = A\omega \quad a_{max} = A\omega^2$$

$$F = ma = -m\omega^2 x; \quad F_{max} = mA^2\omega^2;$$

$$T = 2\pi\sqrt{\frac{L}{g}}$$ —matematikali'q mayatniktin' terbeliw da'wiri

$$T = 2\pi\sqrt{\frac{m}{k}}$$ — prujinali' mayatniktin' terbeliw da'wiri $\quad \lambda = \vartheta t \quad v = \frac{1}{T}$

Suyi'qli'q ha'm gazlar

1. Basi'm

P—basi'm (Pa=N/m^2); *F*—betke perpendikulyar ku'sh (N); *S*—bet maydan $P=\dfrac{F}{S}$

2. Suyi'qli'qti'n' i'di's diywali'na basi'mi'

P—teren'liktegi basi'm (Pa):h—teren'lik (m); *S*—suyi'qli'q ti'g'i'zli'g'i' (kg/m^3); $P=\rho g h$

3. Qatnas i'di'slar ni'zami'

h$_1$, *h$_2$*—suyi'qli'qlar qa'ddi; ρ_1 ,ρ_2—suyi'qli'qlari' ti'g'i'zli'qlar $\dfrac{h_1}{h_2}=\dfrac{\rho_1}{\rho_2}$

4. Toricelli formulasi'

$\vartheta=\sqrt{2gh}$, *h*—i'di'stag'i' tesiktin' teren'ligi;

ϑ—suyi'qli'qti'n' ag'i'w tezligi

5.Arximed ni'zami'

F$_A$—Arximed ku'shi (N); *V*—i'g'isti'ri'p shi'g'arg'an suyi'qli'q ko'lemi (m^3) $F_A=\rho g V$

6. Bernulli ten'lemesi

P$_o$—qozg'ali'wshi' suyi'qli'q basi'mi' (Pa); ϑ —suyi'qli'q tezligi; ρ—suyi'qli'q ti'g'i'zli'g'i'; *h*—teren'lik

$$\rho g h+\frac{\rho \vartheta^2}{2}=P_0$$

7. Molekulyar—kinetikali'q teoriyani'n' tiykari'

N_A—Abagadro sani'; R—universal gaz turaqli'si'; K—Balcman turaqli'si'; E—molekulani'n' ji'lli'li'q qozg'ali'si'ni'n' wortasha kinetikali'q energiyasi' (Dj); T—absolyut temperaturasi'; ϑ—molekukani'n' wortasha kvadratli'q tezligi; μ—molekulyar massa; m_o—bir molekulani'n' massasi'; N—gaz molekulasi'ni'n' sani'; P—gaz basi'mi'; n—molekulani'n' koncentraciyasi'; m—gaz massasi'; V—gaz ko'lemi

$$N_A = 6,002 \cdot 10^{23} mol^{-1} \quad R = 8,31 \frac{Dj}{K \cdot mol} \quad K = 1,38 \cdot 10^{-23} \frac{DJ}{K};$$

$$K = \frac{R}{N_A}; \quad E = \frac{3}{2}kT \quad \vartheta^2 = \frac{3RT}{\mu} \quad \mu = m_0 N_A \quad P = \frac{1}{3}m_0 \vartheta^2 \frac{N}{V} \quad P = nkT \quad n = \frac{N}{V}$$

Ideal gaz ten'lemesi yamasa Mendeleev—Klapeyron ten'lemesi $PV = \frac{m}{\mu}RT$

8. Izoprocessler

a) izotermikali'q T=const PV=const $\quad \dfrac{P_1}{P_2} = \dfrac{V_2}{V_1}$

b) izoxorli'q V=const $\dfrac{P}{T} = const \quad \dfrac{P_1}{P_2} = \dfrac{T_1}{T_2}$

v) izobarli'q P=const $\dfrac{V}{T} = const \quad \dfrac{V_1}{V_2} = \dfrac{T_1}{T_2}$

9. Dalton ni'zami'

P—gaz aralaspasi'ni'n' basi'mi' (Pa); $P_1, P_2 \ldots P_n$
porcial basi'mlar $P = P_1 + P_2 + \ldots \ldots + P_n$

10. Hawani'n' i'g'alli'g'i'

f—absolyut i'g'alli'q (kg/m³) F_{maks}—maksimal i'g'all. (kg/m³) *V*—hawani'n' sali'stirmali' i'g'alli'g'i' (%)

$$V = \frac{f}{F} \cdot 100\%$$

11.Real gaz hali'ni'n' ten'lemesi

a, b—Van—der Vaals turaqli'si'(proporcionalli'q koef)

$$\left(P + \frac{am^2}{V^2} \right)(V - bm) = mRT \qquad \text{Van—der Vaals ten'lemesi.}$$

Termodinamika tiykarlari'

1.Termodinamikani'n' birinshi ni'zami'

ΔU—sistemani'n' ishki energiyasi'ni'n' wo'zgerisi (Dj); *A*—sistemadag'i' si'rtqi' ku'shtin' islegen jumi'si'; *Q*—sistemag'a berilgen ji'lli'li'q mug'dari'.

$$\Delta U = A + Q$$

$\Delta U = Q - A$ yeger sistema wo'zi jumi's islese.

2. Izobarli'q ken'eyiwde gazdi'n' jumi'si'

ΔV—turaqli' basi'mda gaz ko'leminin' wo'zgerisi;
μ—molekulyar massa; *R*—universal gaz turaqli'si';
ΔT—temperatura wo'zgerisi (K)

$$A = \rho(V_2 - V_1) \qquad A = \frac{m}{\mu} R\Delta T$$

3. Ji'lli'li'q dvigatelinin' P. T. K.

η —paydali' ta'sir koefficenti (P. T. K.)

Q_1—qi'zdi'rg'i'shtan ali'ng'an ji'lli'li'q (Dj)
Q_2—suwi'tqi'shqa berilgen ji'lli'li'q;
T_1—qi'zdi'rg'i'shti'n' temperaturasi';
T_2—suwi'tqi'shti'n' temperaturasi'

$$\eta = \frac{Q_1 - Q_2}{Q_1} \qquad \eta = \frac{T_1 - T_2}{T_1}$$

4. Ji'lli'li'q almasi'w

C—sali'sti'rmali' ji'lli'li'q si'yi'mli'li'q (Dj/kg.K); Q_e—yeriw ji'lli'li'g'i' (Dj);

λ —sali'sti'rmali' yeriw ji'lli'g'i' (Dj/kg); Q_n—puw payda boli'w ji'lli'li'g'i' (Dj); L—puw payda boli'wdi'n' sali'sti'rmali' ji'lli'li'g'i' (Dj/kg)

$$Q = ct(T_2 - T_1); \qquad Q = ct\Delta T; \qquad Q_e = \lambda m; \qquad Q_n = Lm;$$

5. Denelerdin' i'ssi'li'qtan si'zi'qli' ha'm ko'lemge ken'eyiwi

l_o—denenin' T_o=273K uzi'nli'g'i'; l—T temperaturadag'i' uzi'nli'g'i'; α —si'zi'qli' ken'eyiw koefficenti (k^{-1}); V_o—T_o=273K degi ko'lem (m^3); V—T temperaturadag'i' ko'lem; β—ko'lemlik ken'eyiw koefficienti (m^3/K)

$$l = l_0 \left[1 + \alpha \left(T - T_0 \right) \right]; \quad V = V_0 \left[1 + \beta \left(T - T_0 \right) \right]; \quad \beta = 3\alpha;$$

6. Suyi'qli'qti'n' bet kerim koefficienti

F—bet kerim ku'shi (N); δ —bet kerim koefficienti (N/m); *Δl*—suyi'qli'q shegarasi'ni'n' uzinli'g'i' (m); *E*—bet kerim energiyasi'; S—suyi'qli'q betinin' maydani'; P_C—iymek betke jaqi'n wori'ndag'i' suyi'qli'q basi'mi'; Pa — iymeklikke jaqi'n wori'ndag'i' atmosfera basi'mi'; θ— shegarali'q mu'yesh, *R*—suyi'qli'q betinin' iymeklik radiusi'; *h*—suyi'qli'qti'n' ko'teriliw biyikligi; P_{puw}— ko'biktegi toyi'ng'an puw basi'mi'; P_o—atm. basi'mi'; *h*— ko'bik turg'an wori'n teren'ligi; *R*—ko'bik radiusi'.

$$F=\sigma\Delta l \quad E=\sigma S \quad P_s-P_a=\frac{2\delta}{R} \quad h=\frac{2\delta\cos\theta}{R\rho g} \quad \text{eger} \quad \theta=0^O \quad h=\frac{2\delta}{R\rho g}$$

qaynawdi'n' baslani'w sha'rti:

$$P_{toy}>P_0+\rho gh+\frac{2\delta}{R}$$

Elektrodinamika

Elektrostatika

1. Elektr zaryadi'ni'n' saqlani'w ni'zami'

Jabi'q sistemada elektr zaryadlari'ni'n' summasi' turaqli' boladi'.

$$\sum q_i = q_1 + q_2 + ... + q_n = const$$

2.Kulon ni'zami'

q₁, q₂—ta'sirlesiwshi zaryadlar mug'dari' (Kl); *r*— zaryadlardi'n' qashi'qli'g'i'; ε_0 —elektr turaqli'si' $\varepsilon_0=8,85\cdot10^{-12}\frac{Kl^2}{H\cdot m^2}$; ε —wortali'qti'n' dielektrik sin'irgishligi

$$F = k \frac{q_1 \cdot q_2}{r^2} \qquad K = \frac{1}{4\pi\varepsilon_0} \qquad F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 q_2}{r^2} \qquad —\text{Vakkum ushi'n.}$$

$$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 q_2}{\varepsilon \cdot r^2} —\text{qa'legen wortali'q ushi'n.}$$

3. Noqatli'q zaryadti'n' elektr maydani'ni'n' kernewliligi

$\vec{E}$—maydan kernewliligi (N/Kl yamasa V/m);

q—maydang'a a'kelingen zaryad (Kl); Q—maydan payda yetiwshi zaryad; r—zaryadtan maydan wo'lshenetug'i'n wori'ng'a shekemgi qashi'qli'q.

$$\vec{E} = \frac{\vec{F}}{q} \qquad \vec{E} = K \frac{Q}{\varepsilon r^2}$$

4. Birdey zaryadlang'an sheksiz tegisliktin' maydani'ni'n' kernewliligi

δ—betlik ti'g'i'zli'q (Kl/m^2); S—maydan, q—zaryad

$$\delta = \frac{q}{S} \qquad E = \frac{\delta}{2\varepsilon_0\varepsilon}$$

5. Superpoziciya principi

$\vec{E}$—juwmaqlawshi' maydan kernewliligi;

$\vec{E}_1$;$\vec{E}_2$—jeke maydan kernewliligi

$$\vec{E} = \vec{E}_1 + \vec{E}_2 + ... + \vec{E}_n$$

6. Potenciallar ayi'rmasi' (kernewlilik)

φ—maydandag'i' berilgen noqatti'n' potenciali'; A—q zaryadi'n qozg'ag'andag'i' jumi's; U—kernewlilik; (V) d—noqatlardi'n' qashi'qli'g'i'.

$$\varphi=\frac{A}{q}; \qquad \varphi=\frac{q}{4\pi\varepsilon_0\varepsilon r}; \qquad U=\left(\varphi_1-\varphi_2\right)=Ed$$

7. Elektr si'yi'mli'li'g'i'

C—elektr si'yi'mli'li'g'i' (Farada ϕ); q—wo'tkizgishtin' zaryadi' (Kl); φ—wo'tkizgishtin' potenciali' (V); R—shar radiusi'; S—kondensatordi'n' ha'r bir plastinasi'ni'n' maydani'; d—plastinalardi'n' ara qashi'qli'g'i'; U—kernew (V)

$$C=\frac{q}{\varphi}$$

Shardi'n' si'yi'mli'li'g'i' $\quad C=4\pi\varepsilon\varepsilon_0 R$

tegis kondensator si'y. $\quad C=\dfrac{\varepsilon\varepsilon_0 S}{d}$

kondensator energiyasi'

$$W=\frac{q^2}{2C}=\frac{qU}{2}=\frac{CU^2}{2}$$

8. Kondensatordi' tutasti'ri'w

C_i—i—shi kondensatordi'n' elektr si'yi'mli'li'g'i' (ϕ); C—kondensatorlar sistemasi'ni'n' elektr si'yi'mli'lig'i'; q_i—i—shi kondensator zaryadi', q—uli'wma zaryad (Kl); U—i—shi kondensatordag'i' kernew. Kondensatordi' izbe—iz tutasti'rg'anda

$$\frac{1}{C} = \frac{1}{C_1} = \frac{1}{C_2} + ... + \frac{1}{C_n}, \qquad q = q_1 = q_2 = ... q_n$$

kondensatordi' parallel tutasti'rg'anda

$$C = C_1 + C_2 + ... + C_n \qquad U = U_1 = U_2 = ... = U_n$$

9. Turaqli' tok ni'zamlari' ha'm elektr shi'nji'ri'

I—tok ku'shi (A); R—qarsi'li'q (Om); r—tok ko'zinin' ishki qarsi'li'g'i'; ε—E.Q.K. (V); A_s—si'rtqi' ku'shtin' jumi'si' (Dj); ρ —sali'stri'mali' qarsi'li'q (Om/m); l—wo'tkizgishtin' uzi'nli'g'i'; s —kese kesim maydani' R_{ul}—wo'tkizgishtin' uli'wma qarsi'li'g'i'; i—tok ti'g'i'zli'g'i' (A/m^2); t—waqi't; q—zaryad, R_o—$T_o = 273K$ degi qarsi'li'q; T—temperatura (K); α—qarsi'li'qti'n' temperaturali'q koefficienti (gradus^{-1}); n—elementler sani'.

$$I = \frac{q}{t} \qquad i = \frac{I}{S}$$

Om ni'zami' $\quad I = \dfrac{U}{R} \qquad I = \dfrac{\varepsilon}{R+r}$

$R = \rho \dfrac{l}{S}$ —wo'tkizgish qarsi'li'g'i'ni'n' materiali'na baylani'sli'g'i'

$R = R_0 \left[1 + \alpha \left(T - T_0 \right) \right]$ —qarsi'li'qti'n' wo'tki'zgishtin' temperaturasi'na baylani'sli'g'i'

Izbe—iz tutasti'ri'wda uluwma qarsi'li'q, kernew, toq:

$$R = R_1 + R_2 + \ldots + R_n \qquad U = U_1 + U_2 + \ldots + U_n$$

$$\frac{U_2}{U_1} = \frac{R_2}{R_1} \qquad\qquad I = \frac{nE}{R + nr}$$

Paralel tutastri'wda uluwma qarsi'li'q, ha'm toq:

$$I = I_1 + I_2 + \ldots + I_n \qquad \frac{1}{R} = \frac{1}{R_1} = \frac{1}{R_2} + \ldots + \frac{1}{R_n} \qquad \frac{I_1}{I_2} = \frac{R_2}{R_1} \qquad I = \frac{E}{R + \dfrac{r}{n}}$$

10. Tokti'n' jumi'si' ha'm quwati'

A—jumi's (Dj); *I*—tok ku'shi (A); *U*—kernew (V); *t*—waqi't, *R*—qarsi'li'q (Om); *Q*—wo'tkizgishten bo'linip shi'qqan ji'lli'li'q mug'dari' (Dj); P—turaqli' tok quwatli'g'i' (Vt); *E*—e.q.k.

$$A = IUt \,;\qquad A = I^2 Rt \,;\qquad P = IU \,;\qquad P = I^2 R = \frac{U^2}{R} \,;$$

$$A = EJt \,, P = E_i$$

Djoul—Lenc ni'zami' $\qquad\qquad Q = I^2 Rt = JUt = \dfrac{U^2 t}{R}$

11. Elektroliz (Faradey) ni'zami'

m—bo'linip shi'qqan zat massasi' (kg);
k—elektroximiyali'q ekvivalent; *n*—valentlik; *F*—faradey sani' (96500 kl/mol); *e*—elektron zaryadi' $\left(1{,}6 \cdot 10^{-19}\ kl \right)$; N_A—

Avagadro sani'; *x*—ximiyali'q ekvivalent; *M*—zatti'n' molyar (atomli'q)massasi'

$m=kJt=Rq;$ $\quad \dfrac{k}{x}=\dfrac{1}{F};$ $\quad x=\dfrac{M}{n};$ $\quad m=\dfrac{1}{F}\dfrac{M}{n}It;$ $\quad e=\dfrac{F}{N_A};$ $\quad k=\dfrac{M}{neN_A};$

12. Magnit maydani'. Elektromagnitlik indukciya

$\vec{B}$—magnit indukciyasi' (Tesla Tl) *F*—magnitlik ag'i'm (Veber, vb=Tlm^2=Vc); μ_0—magnitlik turaqli'li'q $\left(4\pi\cdot10^{-7}\,\text{Genri}; \; \text{Gn/m}=12{,}56\cdot10^{-7}\,\text{Bc/Am}\right)$ μ— wortali'qti'n' magnit sin'irgishligi; *r*—wo'tkizgishlerdin' ara qashi'qli'g'i'; *F*—ku'sh; *q*—zaryad mug'dari'; α–*B* ha'm *I* arasi'ndag'i' ϑ ha'm *V* arasi'ndag'i' mu'yesh ϑ–zaryadti'n' qozg'ali'w tezligi; α–*B* vektori' menen *S* maydani'nda tu'sirilgen normal arasi'ndag'i' mu'yesh; *l*—wo'tkizgishtin' aktiv uzi'nli'g'i'; *L*—induktivlik (Genri—Gn); *W*—magnit maydani'ni'n' energiyasi' (Dj)

$$F=BS\cos\alpha,$$

Amper ku'shi $\qquad F=IB\sin\alpha,$

Lorenc ku'shi $\qquad F_l=q\vartheta\sin\alpha,$

Parallel toklardi'n' wo'z—ara ta'siri $\quad F=\mu_0\,\mu\dfrac{I_1 I_2}{2\pi r}\,l$

Elektrromagnitli indukciyani'n' tiykarg'i' ni'zami'

$$E=-\dfrac{\Delta\phi}{\Delta t}$$

Qozg'ali'wshi' wo'tkizgishtegi e.q.k $\qquad E=Bl\vartheta$

Wo'zlik indukciyani'n' e.q.k $\qquad E=-L\dfrac{\Delta l}{\Delta t}, \quad W=\dfrac{LI^2}{2},$

13.Elektromagnitli terbelisler

T—menshikli terbelis da'wiri (s); *C*—kondensator si'yi'mli'li'g'i' (ϕ); *L*—katushkani'n' induktivligi (Gn); q_o—kondensator plastinalari'ndag'i' da'slepki zaryad; ω—terbelis jiyiligi (rad/c); E—indukciya e.q.k. (B); ϕ—magnit ag'i'mi' (Vb); *S*— ramka maydani'; B—maydan indukciyasi'.

Terbelmeli kontur $T=2\pi\sqrt{LC}$

$$q=q_0\cos\omega t \qquad \omega=\sqrt{\frac{1}{LS}}$$

Togi bar ramkani'n' awlandi'ri'w menen

$$Ei=-\phi^1 \qquad \phi=B{\cdot}S\cos\omega t \qquad E=BS\omega\sin\omega t$$

14. Wo'zgermeli tok shi'nji'rdag'i' si'yi'mli'li'q ha'm induktivlik

U—katushkadag'i' birzamatli'q kernew; U_c—kondensatordag'i' birzamatli'q kernew; U_m—kernew amplitudasi'; I_m—tok ku'shinin' amplitudasi'; χ_L—induktivlik qarsi'li'q; χ_S—si'yi'mli'li'q qarsi'li'q; I_e—tok ku'shinin' ha'rekettegi (effektiv) ma'nisi; U_e—kernewdin' effektiv ma'nisi, *Z*—uli'wma qarsi'li'q; $-\varphi-I$ ha'm *U* arasi'ndag'i' fazani'n' ji'lji'wi'.

$$i=I_m\cos\omega t \qquad U_L=U_m\cos\left(\omega t+\frac{\pi}{2}\right) \qquad U_m=I_m L_m \qquad X_L=\frac{Um}{I_m}L\omega$$

$$U_s = Um\cos\left(\omega t - \frac{\pi}{2}\right) \quad U_m = \frac{Um}{\omega s}; \quad X_L = \frac{Um}{I_m} = \frac{1}{\omega S}; \quad I_e = \frac{I_m}{\sqrt{2}} \quad U_e = \frac{U_m}{\sqrt{2}}$$

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega s}\right)^2} \qquad P = U_m I_m \cos\varphi$$

Optika

1. Jaqti'li'qti'n' si'ni'wi' ha'm toli'q ishki shag'i'li'siw

α—nurdi'n' tu'siw mu'yeshi; β—nurdi'n' si'ni'w mu'yeshi; n—wortali'qti'n' si'ni'w ko'rsetkishi; c—vakuumdag'i' jaqti'li'qti'n' tarali'w tezligi; ϑ—wortali'qtag'i' jaqti'li'qti'n' tarali'w tezligi; α_0—toli'q ishki shag'li'si'wdi'n' shekli mu'yeshi;

$$\frac{sin\alpha}{sin\beta}=n \qquad \frac{sin\alpha}{sin\beta}=\frac{n_2}{n_1} \qquad n=\frac{n_2}{n_1} \qquad n=\frac{S}{\vartheta} \qquad sin\alpha_0=\frac{n_2}{n_1} \qquad sin\alpha_0=\frac{1}{n}$$

2. Linzalar

R_1 ha'm R_2—sferali'q iymeklik radiuslari'; D—linzani'n' optikali'q ku'shi (dioptriya—dptr); F—fokus qashi'qli'g'i'; d—zatqa deyingi qashi'qli'q; f—sa'wleleniwge (keskenge) deyingi qashi'qli'q; G—u'lkeytiw; g—si'ni'w ko'rsetkishi;

$$D=\frac{1}{F} \qquad G=\frac{f}{d} \qquad \frac{I}{F}=\frac{I}{f}+\frac{I}{d}$$

haqi'yqi'y sa'wleleniw $f>$o
jori'ma sa'wleleniw $f<\hat{\imath}$
ji'ynawshi' linza $f>$o; $d>$oshashi'rati'wshi' linza $f<$o;

$$d>\text{o} \quad \frac{1}{F}=(n{-}1)\left(\frac{1}{R_1}\pm\frac{1}{R_2}\right)$$

3. Jaqti'li'qti'n' difrakciyasi'

d—difrakciyali'q tordi'n' (reshetkani'n') da'wiri; λ—tolqi'n uzi'nli'g'i' (m); φ—difrakciya mu'yeshi; *k*—spektrdi'n' ta'rtibi; d_2—d_1—interferenciyada nurlardi'n' ju'risinin' ayi'rmashi'li'g'i $d\sin\varphi=k\lambda$ (*k*=0; 1; 2; …) amplitudani'n' maksimumli'q sha'rti

$$\left(d_2 - d_1\right) = 2n\frac{\lambda}{2} \qquad (n=0; 1; 2; …)$$

amplitudani'n' minimumli'q sha'rti

$$\left(d_2 - d_1\right) = (2n+1)\frac{\lambda}{2} \quad (n=0; 1; 2; …)$$

Sali'sti'rmali' teoriyasi'ni'n' elementleri

m_o—ti'ni'shli'qtag'i' massa; *p*—dene impulsi; $m-\vartheta$—tezligi menen qozg'ali'wshi' dene massasi'; l_o—ti'ni'shli'qtag'i' dene uzi'nli'g'i'; *l*—qozg'ali'wshi' dene uzi'nli'g'i'; ϑ—dene (bo'lekshe) tezligi *C*—vakuumdag'i' jaqti'li'qti'n' tezligi (2,99·10 ^{8} *m/s*)

Uzi'nli'qti'n' sali'sti'rmali'li'g'i' $l = l_0\sqrt{1 - \frac{\vartheta^2}{s^2}}$

Tezliklerdi qosi'wdi'n' relyativistlik ni'zami'

$$\vartheta = \frac{\vartheta_1 + \vartheta_2}{1 + \frac{\vartheta_1 \times \vartheta_2}{c^2}}$$

Relyativistlik massa $\qquad m = \dfrac{m_0}{\sqrt{1 - \dfrac{\vartheta^2}{c^2}}}$

Relyativistlik impuls $\qquad P = \dfrac{m_0 \vartheta}{\sqrt{1 - \dfrac{\vartheta^2}{c^2}}}$

Massa ha'm energiya arasi'ndag'i' baylani's

$$\Delta E = \Delta mc^2$$

Kvant fizikasi'ni'n' elementleri

E—foton (kvant) energiyasi'; m—foton massasi'; v—jiyilik; h—Plank turaqli'si'; $h = 6{,}65 \cdot 10^{-24}\, Dj \cdot s$ p—impuls; λ—tolqi'n izi'nli'g'i'.

$$E = hv; \quad m = \frac{E}{c^2} = \frac{hv}{c^2} \quad P = mc = \frac{hv}{c} \quad E = \frac{hc}{\lambda}$$

Fotoeffekt ushi'n Eynshteyn ten'lemesi

h—Plank turaqli'si'; v—jiyilik; A—shi'g'i'w jumi'si'; E—elektronni'n' kinetikali'q energiyasi'; m—elektron massa; ϑ—elektron tezligi; $v_{qi\,{}'z}$—fotoeffektin' qi'zi'l shegarasi'.

$$hv = A + \frac{m\vartheta^2}{2} \qquad \vartheta_{min} = \frac{A}{h}$$

Bordi'n' atomli'q modeli

E_m—u'lken energiyadag'i' stacionar jag'day energiyasi';
E_n—kishi energiyadag'i' stacionar jag'day energiyasi';
M—atomni'n' qozg'ali's mug'dari'ni'n' momenti;
ϑ—elektron tezligi; r—orbita radiusi'; n—kvant sani'

$$hv = E_m - E_n \qquad h = \frac{h}{2\pi} \qquad m = hn = n\frac{h}{2\pi} \quad M = m\vartheta r \quad n = 1, 2, 3$$

Radiaktivlik i'di'raw ni'zami' ha'm atom yadrosi'ni'n' baylani's energiyasi'

N_o—$t = 0$ waqti'ndag'i' radioaktivli atom sani';

N—t waqi't wo'tkennen keyin atom sani';

T—yari'mlaw i'di'raw da'wiri,

Δm —defekt massa;

c—jaqti'li'qti'n' vakuumdag'i' tezligi;

$$N=N_0 \ 2^{\frac{t}{T}} \qquad \Delta E = \Delta mc$$

Birliklerdi tu'rlendiriw kestesi

Shama	wo'lshem ati'	belgilewi	Ci birligindegi ma'nisi
Uzi'nli'q Massa	Angstrem atomli'q massa birl.	^oA a.m.b.	10^{-10}m $1{,}66057.10^{-17}$ kg
Ko'lem	Litr	l	$10^{-3} \ m^3$
Jumi's Energiya	electron- volt	Ev	$1{,}60219.10^{-19}$ Dj
Quwatli'q Ji'lli'li'q mug'dari'	at ku'shi kalloriya	a.k. kal	735,499 Vt 4,1868 Dj
Temperatura	Gradus Celsiya	^oC	$T=t+T_o$ $T_o=273K$

Basi'm	bar	bar	10^5 Pa
	mm.suw Bag'anasi'	mm.s.bag'	9,80665 Pa
	mm.si'nap Bag'an	mm.sn. Bag'.	133,322 Pa
	Texnikali'q atmosf.	at	$9,80665 \cdot 10^4$ Pa
	fizikali'q atmosf.	atm	101325 Pa

Wonli'q qosi'mtalar

ati'	belgilewi	basli' birlikke qatnasi'	ati'	belgilewi	basli' birlikke qatnasi'
Piko	P	$10-^{12}$	tera	t	10^{12}
nano	N	10^{-9}	giga	g	10^9
mikro	Mk	10^{-6}	mega	m	10^6
milli	M	10^{-3}	kilo	k	10^3

Universal fizikali'q turaqli'lar

Yerkin tu'siw tezleniw	$d=9,80665^{m}/s^2 \approx 9,8 m/s^2$
Tarti'w gravitaciya turaqli'si'	$f=6,67 \cdot 10^{-11}$ m^3/kg $\cdot$ s^2
Normal atmosfera basi'mi'	$P_o=101325$ N/m^2 $\approx$ 1,013 $\cdot$ 10^5N/m^2
Avagadro sani'	$N=6,023 \cdot 10^{26}$ Kmol^{-1}
	$n_o=2,7 \cdot 10^{25}$ m^{-3}

Loshmidt sani'	$273,16^o$ K (0° C)
Muzdi'n' yeriw tockasi'	$273,16°$K (0,01°C);
Suwdi'n' u'shlik tockasi'	4,6mm.sn.bag'
Bolcman turaqli'si'	K=$1,38 \cdot 10^{-23}$
Universal gaz turaqli'si'	R=$8,314 \cdot 10^3$ Dj/grad
Elektrlik turaqli'si'	kmol.grad
Elekton zaryadi'	Eo=$8,85 \cdot 10^{-12}$ F/m
Elekton massasi'	e=$1,602 \cdot 10^{-19}$ k
Proton massasi'	m_e=$9,11 \cdot 10^{-31}$ kg
	m_p=$1,67 \cdot 10^{-27}$ kg
Massani'n' atomli'q birligi	1a.b.=$1,66 \cdot 10^{-27}$ kg (1a.b. 931.3 Mev energiyag'a sa'ykes)
Faradey sani'	
Magnitlik turaqli'	F=$9,65 \cdot 10$ ^{7} K/kgekV=$9,65 \cdot 10^4$ Kl/mol
Vakuumdag'i' jaqti'li'q tezligi	$\mu°$=$4\pi \cdot 10^{-7}$ om.s/m
Plank turaqli'si'	C=299792,5 km/s≈3.10^8 m/s
Quyash turaqli'si'	h=$6,62 \cdot 10^{-34}$ dj.s
Stefan-Volcman turaqli'si'	J_q=1370 dj/m^2.s
Vina turaqli'si'	δ=$5,67 \cdot 10^{-8}$ dj/m2 grad^4. S
Ridberg turaqli'si'	b=0,0029 m.grad
	R=10967758 M^{-1}

Xali'qarali'q sistemadag'i' (Si) tiykarg'i' ha'm qosi'msha birlikler

Shama atlari'	Birlikler		
	atlari'	belgilewi	
		qaraqalpaqsha	xali'qarali'q
Uzi'nli'q	metr	m	m
Massa	kilogram	kg	kg
Waqi't	sekund	s	s
Elektr tog'i'ni'n' ku'shi	amper	A	A
Termodinamikali'q temperatura	kalvin	K	K
Zat mug'dari'	mol	mol	mol
Jaqti'li'q ku'shi	kandela	kd	cd
Tegis mu'yesh	radian	rad	rad
Denelik mu'yesh	steradian	sr	sr

Xali'qarali'q sistemada tuwi'ndi' birlikleri

Shama atlari'	formula si'	birlikler	
		atlari'	belgiliwi
		Qaraqalpaqsha	xali'qarali'q

		Ken'islik ha'm waqi't		
Maydan Ko'lem Tezlik Tezleniw		metr kvadrat metr kub sekundtag'i' metr sekund kvadrattag'i' metr	m^2 m^3 m/s m/s^2	m^2 m^3 m/c m/s^2
Aylanbali' qozg'ali'stag'i' jiylik Aylani'w jiyligi		Gerc sekundti'n' minus bir da'rejesi	Gts S^{-1}	HZ S^{-1}
Mu'yeshlik tezlik Mu'yeshlik tezleniw		Sekundtag'i' radian sekund kvadrattag'i'	rad/s rad/s^2	rad/s rad/s^2
		Mexanikali'q shamalar		
Ti'g'i'zli'q Impuls (ha'reket mug'dari') Ku'sh,		metr kubtag'i' kilogram sekundtag'I' kilogram:metr nyuton	kg/m^3 kgm/c H	kg/m^3 kgm/s N

salmaq				
Ku'sh momenti Basi'm, mexanikali'q kernew		Nyuton metr Paskal	H·M Pa	N·m Pa
Bet kerimi Jimi's, energiya Quwatli'li'q		Nyutonni'n' metrge qatnasi' Djoul Vatt	H/m Dj Vt	N/m J W
Akustikali'q shamalar				
Ses quwati' Ses intensivligi Ses basi'mi'		Vatt vatti'n' metr kvadr.qatnasi' Paskal	Vt Vt/m^2 Pa	W W/m^2 Pa
Ji'lli'li'q shamalari'				
1. Ji'lli'li'q mug'dari' 2.Sali'sti'r mali' ji'lli'li'q mug'dari'; sali'st yeriw ji'lli'li'g'i', puw payda boli'w,		Djoul kilogrammd ag'i' djoul Kilogram kelvindegi	Dj Dj/kg Dj/(kgK)	J j/kg j/(kg.K)

woti'ni'n' jani'wi' 3.Sali'stri'ma li' ji'lli'li'q si'yi'mli'li'q 4.Temperatur ali'q koeff		djoul Kelvin minus bir da'reje	K^{-1}	K^{-1}
Elektr ha'm magnitlik shamalar				
Elektr tog'i'ni'n' ti'g'i'z li'g'i' Elektr mug'dari', zaryadi' Elektr zaryadi'ni'n' bet ti'g'i'zli'g'i'		kvadrat metrdegi amper kulon kvadratr metrdegi kulon	A/m^2 Kl Kl/m^2	A/m^2 C C/m^2
Elektr kernewliligi;		volt	V	V
elektr potencial, elektr potenciali' ayi'rmasi', e.q.k. Elektr maydani'		volt metrdegi volt Farada	V F	V F

kernewi Elektr si'yi'mli'li'g'i'				
Absolyut dielektrik sin'irgishlik; elektrlik turaqli'li'q Elektr qarsi'li'g'i' Sali'strmali' elektr qarsi'li'g'i'		metrdegi fara Om Om metr	F/m Om Om.m	F/m Ω Ω.m
Elektr wo'tkizgishlik Sali'strmali' elektr wo'tkizgishlik		Simens metrdegi simens	Sm Sm/m	S S/m
Magnit ag'i'mi' Magnit indukciyasi'		veber tesla	Vb T	Wb T
Induktivlik Absolyut magnet sin'irgish lik; magnitlik turaqli' Elektromag		Genri metrdegi genri djoul vatt	G G/m Dj Vt	H H/m J W

nitlik energiya Aktiv quwatli'q Toli'q quwatli'q		volt amper	V.A.	V.A.

Jaqti'li'q shamalari'				
Jaqti'li'q ag'i'mi' Jaqti'lani'w Jarqi'rawshi'li'q		Lyumen Lyuks kvadrat metrdegi kandela	Lm Lk Kd/m^2	Lm Lx cd/m^2

Ayri'm astronomiyali'q shamalar

Atlari'	Shamasi'(wortasha ma'niste)
Jer radiusi'	$6,37 \cdot 10^6$ m
Jer massasi'	$5,98 \cdot 10^{24}$ kg
Quyash radiusi'	$6,95 \cdot 10^8$ m
Quyash massasi'	$1,98 \cdot 10^{30}$ kg
Ay radiusi'	$1,74 \cdot 10^6$ m
Ay massasi'	$7,33 \cdot 10^{22}$ kg
Jer worayi'nan quyash worayi'na shekemgi arali'q	$1,49 \cdot 10^{11}$ m
Jer worayi'nan Ay worayi'na shekemgi arali'q	$3,84 \cdot 10^8$ m

Qatti' denelerdi'n' ti'g'i'zli'g'i'

Qatti' dene	ti'g'i'zli'q ρ; kg/m^3	Qatti' dene	ti'g'i'zli'q ρ kg/m^3
Alyuminiy	2,7 ·10^3	Temir	7,8 ·10^3
Bariy	3,5 ·10^3	Tas ko'mir	1,3 ·10^3
Vanadiy	6,0 ·10^3	Gerbish	1,8 ·10^3
Vismut	9,8 ·10^3	Jez	8,5 ·10^3
Alti'n	19,3 ·10^3	Muz	0,9 ·10^3
Almaz	3,5 ·10^3	Mi's	8,9 ·10^3
Antracit	1,5 ·10^3	Por	2,4 ·10^3
Qayi'n'(qurg'aq)	0,7 ·10^3	Mramor	2,7 ·10^3
Beton	2,2 ·10^3	Nikelin, nikel	8,8 ·10^3
Volfram	19,0 ·10^3	Qalayi'	7,3 ·10^3
Grafit	2,1 ·10^3	Parafin	0,9 ·10^3
Granit	2,6 ·10^3	Qurg'aq qum	1,5 ·10^3
Yemen(qurg'aq)	0,8 ·10^3	Platina	21,5 ·10^3
Shi'rsha(qurg'aq)	0,6 ·10^3	As duzi'	2,1 ·10^3
Probka	0,2 ·10^3	Qorg'asi'n	11,4 ·10^3
Gu'mis	10,5 ·10^3	Polat	7,9 ·10^3
Ayna shiyshesi	2,5 ·10^3	Farfor	2,3 ·10^3
Cink	7,1 ·10^3	Shoyi'n	7,0 ·10^3

Suyi'qli'qlardi'n' ti'g'i'zli'g'i'
(15-20°C temperaturada)

Suyi'q dene	ti'g'i'zli'q ρ, kg/m^3	Suyi'q dene	ti'g'i'zli'q ρ, kg/m^3
Benzin	$0,70 \cdot 10^3$	Spirt	$0,80 \cdot 10^3$
Glicerin	$1,26 \cdot 10^3$	suyi'q azot(-196°C)	$0,79 \cdot 10^3$
Kerosin	$0,80 \cdot 10^3$	suyi'q kislorod(-182°C)	$1,14 \cdot 10^3$
Ku'kirt kislotasi'	$1,84 \cdot 10^3$	suyi'qhawa(-194°C)	$0,86 \cdot 10^3$
Mazut	$0,90 \cdot 10^3$	suw(4°C)	$1,00 \cdot 10^3$
May(maylaw mayi')	$0,90 \cdot 10^3$	su't (0°C) ten'iz suwi'	$1,03 \cdot 10^3$
Neft	$0,80 \cdot 10^3$	si'nap (0°C)	$13,60 \cdot 10^3$
Skipidar	$0,87 \cdot 10^3$	Efir	$0,71 \cdot 10^3$

Gazlardi'n' ti'g'i'zli'g'i' (0°Cda ha'm)

Gaz	ti'g'i'zli'q, ρ kg/m^3	Gaz	ti'g'i'zli'q ρ, kg/m^3
Azot	1,25	Metan	0,72
Ammiak	0,77	Neon	0,90
Acetilen	1,17	Ozon	2,14
Vodorod	0,09	Uglekisli gaz	1,98
Geliy	0,18	Xlor	3,21
Kislorod	1,43	Hawa	1,29

Metallardi'n' mexanikali'q qa'siyetleri

Material	Serpimlik(Yung) Moduli, E, N/m²	Ag'i'wshi'li'q shegi σ_a N/m²	Bekkemlilik shegi σ_b N/m²
Alyuminiy	$7 \cdot 10^{10}$	$0,5 \cdot 10^8$	$0,9 \cdot 10^8$
Latun	$1,1 \cdot 10^{11}$	$1,12 \cdot 10^8$	$4,0 \cdot 10^8$
Qorg'asi'n	$1,7 \cdot 10^{10}$	$0,075 \cdot 10^8$	$0,18 \cdot 10^8$
Mi's	$1,0 \cdot 10^{11}$	$0,7 \cdot 10^8$	$2,0 \cdot 10^8$
Polat(temir)	$2,1 \cdot 10^{11}$	$1,25 \cdot 10^8$	$3,0 \cdot 10^8$

Suyi'qli'qlardi'n' bet keriminin' koeffiecienti

Suyi'qli'q	koefficient σ, N/m	Suyi'qli'q	koefficient σ, N/m
Aceton	0,024	sabi'n	0,040
Benzin	0,029	yertindisi	0,470
Glicerin	0,059	si'nap	0,072
Kerosin	0,024	suw	0,027
Kostorov	0,033	skipidar	0,022
mayi'	0,074	etil spiri	0,017
Mi's		etil efiri	
kuporasi'			

Qatti' ha'm suyi'q denelerdin' sali'strmali' ji'lli'li'q si'yi'mli'li'g'i'

Zat	$C, \dfrac{10^3 Dj}{kg.grad}$	$C, \dfrac{kkal}{kg.grad}$	Zat	$C, \dfrac{10^3 Dj}{kg.grad}$	$C, \dfrac{kkal}{kg.grad}$
Ag'ash(shi'rsha, (qarag'ay)	2,7	0,65	Nikel	0,46	0,11
Alti'n	0,12	0,03	Parafin	3,2	0,77
Alyuminiy	0,88	0,21	Polat	0,46	0,11
Beton	0,88	0,21	Polietilen	2,3	0,55
Gerbish	0,75	0,18	Spirt	2,4	0,58
Glicerin	2,4	0,58	Suw	4,19	1,00
Gu'mis	0,2	0,05	Su't	3,9	0,94
Kerosin	2,1	0,50	Si'nap	0,1	0,03
Qalayi'	0,23	0,055	Temir	0,46	0,11
Qorg'asi'n	0,13	0,031	Temir(1500-3000°Cda)	0,83	0,20
Latun	0,38	0,090	Ti'g'i'n	2,0	0,49
Mazut	2,1	0,50	Cink	0,38	0,091
Mashina mayi'	2,1	0,50	Cement	0,08	0,092
Muz	2,1	0,50	Shiyshe	0,83	0,20
Mi's	0,39	0,093	Shoyi'n	0,54	0,13
			Efir	2,3	0,56

Gazlardi'n' sali'strmali' ji'lli'li'q si'yi'mli'li'g'i' (normal basi'mda)

Zat	$C, \frac{10^3 Dj}{kg.grad}$	$C, \frac{kkal}{kg.grad}$	Zat	$C, \frac{10^3 Dj}{kg.grad}$	$C, \frac{kkal}{kg.grad}$
Azot	1,0	0,25	Kislorod	0,92	0,22
Ammiak	2,1	0,51	Suw	2,2	0,51
Vodorod	14,3	3,41	puwi'	0,83	0,20
Geliy	5,21	1,25	Uglekisli gaz	1,0	0,24
			Hawa		

Woti'nni'n' ji'lli'li'q beriw uqi'bi'

Woti'n	Q		Woti'n	Q	
	kkal/kg	dj/kg		kkal/kg	dj/kg
Benzin	11000	$4,6 \cdot 10^7$	Kerosin	11000	$4,31 \cdot 10^7$
Qon'i'r ko'mir	4000	$9,3 \cdot 10^6$	Neft	11000	$4,6 \cdot 10^7$
Ag'ash	3000	$8,4 \cdot 10^6$	Mi'lti'q da'ri	900	$3,0 \cdot 10^6$
Ag'ash ko'miri	8000	$2,97 \cdot 10^7$	Spirt	7000	$2,7 \cdot 10^7$
Tas ko'mir	7000		Torf	3500	$1,5 \cdot 10^7$

Zatlardi'n' yeriw temperaturasi' ha'm sali'strmali' yeriw ji'lli'li'g'i'

Zat	t_{er}°C	λ, dj/kg	Zat	t_{er}°C	λ, dj/kg
Alyuminiy	659	$3,8 \cdot 10^5$	Si'nap	-39	$1,25 \cdot 10^4$
Suw, Muz	0	$3,35 \cdot 10^5$	Qorg'asi'n	327	$2,5 \cdot 10^4$
Awi'r Suw	3,82	$3,16 \cdot 10^5$	Ku'kirt	112,8	$5,5 \cdot 10^4$
Volfram	3410	$2,6 \cdot 10^4$	Gu'mis	960	$8,8 \cdot 10^4$
Temir	1530	$2,7 \cdot 10^5$	Polat	1400	$2,1 \cdot 10^5$
Alti'n	1064	$6,6 \cdot 10^4$	Cink	419	$1,18 \cdot 10^5$
Mi's	1083	$1,8 \cdot 10^5$	Shoyi'n: aq qon'i'r	1200 1150	$1,30 \cdot 10^5$ $9,7 \cdot 10^4$
Naftalin	80	$1,51 \cdot 10^5$			
Qalayi'	232	$5,8.10^4$			

Zatlardi'n' qaynaw temperaturalari' ha'm sali'strmali' puw payda boli'w ji'lli'li'g'i'

Zat	t_q,°C	r,dj/kg	Zat	t_q,°C	R,dj/kg
Ammiak	-33,4	$1,37 \cdot 10^6$	Si'nap	357	$2,85 \cdot 10^5$
Aceton	56,2	$5,2 \cdot 10^5$	Skipidar	160	$2,94 \cdot 10^5$
Benzin	150	$3 \cdot 10^5$	Freon-12	-29,8	$1,68 \cdot 10^6$
Suw	100	$2,26 \cdot 10^6$	Etil spiriti	78	$8,57 \cdot 10^5$
Awi'r suw	101,43	$2,06 \cdot 10^6$	Etil efiri	35	$3,52 \cdot 10^5$
Hawa	-192	$2,1 \cdot 10^5$			
Temir	3050	$5,8 \cdot 10^4$			

Qatti' denelerdin' uzi'nli'qqa ken'eyiw koefficienti

Zat	α, grad^{-1}	Zat	α, grad^{-1}
Alyuminiy, dyur alyuminiy	$2,3 \cdot 10^{-5}$	Mi's	$1,7 \cdot 10^{-5}$
Beton, cement	$(10 \div 14) \cdot 10^{-6}$	Nikel	$1,28 \cdot 10^{-5}$
Bronza	$1,8 \cdot 10^{-5}$	Qalayi'	$2,1 \cdot 10^{-5}$
Volfram	$4 \cdot 10^{-6}$	Platina	$9 \cdot 10^{-6}$
Temir	$1,2 \cdot 10^{-5}$	Platinit	$9 \cdot 10^{-6}$
Alti'n	$1,4 \cdot 10^{-5}$	Qorg'asi'n	$2,9 \cdot 10^{-5}$
Invar	$6 \cdot 10^{-7}$	Shiyshe	$9 \cdot 10^{-6}$
Kvarc	$4 \cdot 10^{-7}$	Cink	$2,9 \cdot 10^{-5}$
Latun	$1,9 \cdot 10^{-5}$	Shoyi'n	$1,0 \cdot 10^{-5}$
		Ebonit	$7,0 \cdot 10^{-5}$

Suyi'qli'qlardi'n' ko'lemge ken'eyiw koeffiecienti

Zat	β, grad^{-1}	Zat	β, grad^{-1}
Aceton	$1,2 \cdot 10^{-3}$	Kerosin	$1,0 \cdot 10^{-3}$
Benzin	$1,0 \cdot 10^{-3}$	Transformator	$6,0 \cdot 10^{-4}$
Suw 5-10°C	$5,3 \cdot 10^{-5}$	mayi'	$1,0 \cdot 10^{-3}$
10-20°C	$1,5 \cdot 10^{-4}$	Neft	$1,8 \cdot 10^{-4}$
20-40°C	$3,02 \cdot 10^{-4}$	Si'nap	$5,7 \cdot 10^{-4}$
40-60°C	$4,58 \cdot 10^{-4}$	Ku'kirt	$1,1 \cdot 10^{-3}$
60-80°C	$5,87 \cdot 10^{-4}$	kislotasi'	$1,6 \cdot 10^{-3}$
80-100°C	$7,02 \cdot 10^{-4}$	Etil spirti	
Glicerin	$5,0 \cdot 10^{-4}$	Etil efiri	

Ses tezligi

Zat	t,°C	ϑ, m/s	Zat	t,°C	ϑ, m/c
Alyuminiy	20	6260	Muz	-4	3980
Temir	20	5850	Almaz	20	18350
Alti'n	20	3200	Suw	0	1403
				20	1483
Mi's	20	4700	Si'nap	20	1450
Shoyi'n	20	3850	Spirt	20	1180
Shiyshe:			Efir	25	985
flint	20	4450			985
kron	20	5220			

Sali'strmali' dialektrik sin'irgishlik

Zat	ε	Zat	ε
Anilin	84	Mramor	8÷9
Benzin	2,3	Parafin	2,2
Vakuum	1	Parafinlengen qag'az	2,0
Suw	81	Rezina	2÷3
Suw(0°Cda)	88	Rutil	130
Vodorod	1,0003	Ku'kirt	3,6÷4,3
Hawa(1atm)	1,0006	Slyuda	6÷9
Vosk	5,8	Shiyshe	5÷10
Glicerin	39	Faffor	4÷7
Kerosin	2,0	Evonit	2,7
Muz(-18°Cda)	3,2	Yantar	2,8
Transpormator mayi'	2,2 ÷2,5		

Sali'strali' qarsi'li'q

Zat	ρ, Om.m	Zat	ρ, Om.m
Alyuminiy	$2{,}7{\cdot}10^{-8}$	Qalayi'	$1{,}13{\cdot}10^{-7}$
Volfram	$5{,}3{\cdot}10^{-8}$	Osmiy	$9{,}5{\cdot}10^{-8}$
Temir	$9{,}9{\cdot}10^{-8}$	Platina	$1{,}05{\cdot}10^{-7}$
Alti'n	$2{,}2{\cdot}10^{-8}$	Reotan	$4{,}5{\cdot}10^{-7}$
Konstantan	$4{,}7{\cdot}10^{-7}$	Si'nap	$9{,}54{\cdot}10^{-7}$
Latun	$6{,}3{\cdot}10^{-8}$	Qorg'asi'n	$2{,}07{\cdot}10^{-7}$
Manganin	$3{,}9{\cdot}10^{-7}$	Gu'mis	$1{,}58{\cdot}10^{-8}$
Mi's	$1{,}68{\cdot}10^{-8}$	Ko'mir	$(4{\div}5){\cdot}10^{-5}$
Nikelin	$4{,}2{\cdot}10^{-7}$	Fexral	$1{,}1{\cdot}10^{-6}$
Nikel	$7{,}3{\cdot}10^{-8}$	Cink	$5{,}95{\cdot}10^{-8}$
Nixrom	$1{,}05{\cdot}10^{-6}$		

Qarsi'li'qti'n' temperaturali'q koefficienti

Zat	α, grad^{-1}	Zat	α, grad^{-1}
Volfram	0,005	Nixrom	0,0002
Konstantan	0,000005	Reotan	0,0004
Manganin	0,000008	Fexral	0,0002
Nikelin	0,0001		

Elektroximiyali'q ekvivalentler

Zat	k,kg/k	Zat	k,kg/k
Alyuminiy	$9{,}32 \cdot 10^{-8}$	Nikel(yeki valentli)	$3{,}04 \cdot 10^{-7}$
Vodorod	$1{,}044 \cdot 10^{-8}$	Nikel(u'sh valentli)	$2{,}03 \cdot 10^{-7}$
Alti'n	$6{,}81 \cdot 10^{-7}$	Si'nap	$2{,}072 \cdot 10^{-6}$
Kaliy	$4{,}052 \cdot 10^{-7}$	Qorg'asi'n	$1{,}074 \cdot 10^{-6}$
Kalciy	$2{,}077 \cdot 10^{-7}$	Gu'mis	$1{,}118 \cdot 10^{-6}$
Kislorod	$8{,}29 \cdot 10^{-8}$	Xlor	$3{,}67 \cdot 10^{-7}$
Magniy	$1{,}26 \cdot 10^{-7}$	Cink	$3{,}388 \cdot 10^{-7}$
Mi's	$3{,}294 \cdot 10^{-7}$		
Natriy	$2{,}383 \cdot 10^{-7}$		

Si'ndi'ri'w koefficienti (ko'rsetkishi)

Zat	n	Zat	n
Almaz	2,42	Qant	1,56
Anilin	1,59	Ku'kirtli uglerod	1,63
Aceton	1,36	Silvin	1,49
Benzol	1,50	Skipidar	1,51
Suw	1,33	Spirt (metilli)	1,33
Hawa	1,0003	Spirt (etilli)	1,36
Glicerin	1,47	Shiyshe (jen'il kron)	1,50
Tas duzi'	1,54	Shiyshe	1,60÷1,80

		(flint)	
Kvarc	1,54	To'rt xlorli' uglerod	1,46
Muz	1,31		

Jen'il izotoplardi'n' atomli'q massasi'

Izotop	belgileni wi	massa(a.m. b.)	Izotop	belgileni wi	massa(a.m. b.)
Neytron	${}_0n^1$	1,00867	Bor	${}_5B^{10}$ ${}_5B^{11}$	10,01294 11,00930
Vodorod	${}_1H^1$ ${}_1H^2$ ${}_1H^3$	1,00783 2,01410 3,01605	Uglerod	${}_6C^{12}$ ${}_6C^{13}$ ${}_6C^{14}$	12,00000 13,00335 14,00324
Geliy	${}_2He^3$ ${}_2He^4$	3,01603 4,00260	Azot	${}_7N^{14}$	14,00307
Litiy	${}_3Li^6$ ${}_3Li^7$	6,01513 7,01601	Kislorod	${}_8O^{16}$ ${}_8O^{17}$	15,99491 16,99913
Berilliy	${}_4Be^7$ ${}_4Be^9$	7,01693 9,01219			

Elementar bo'lekshelerdi'n' massasi' ha'm ti'ni'shli'qtag'i' energiyasi'

Bo'lekshe	M_o		E_o	
	Kg	a.m.b.	Dj	Mev
Elektron	$9,11 \cdot 10^{-31}$	0,00055	$8,16 \cdot 10^{-14}$	0,511
Proton	$1,672 \cdot 10^{-27}$	1,00728	$1,50 \cdot 10^{-10}$	938
Neytron	$1,675 \cdot 10^{-27}$	1,00867	$1,51 \cdot 10^{-10}$	939
Deytron	$3,35 \cdot 10^{-27}$	2,01355	$3,00 \cdot 10^{-10}$	1876
α-bo'lekshe	$6,64 \cdot 10^{-27}$	4,00149	$5,96 \cdot 10^{-10}$	3733
Neytral π-mezon	$2,41 \cdot 10^{-28}$	0,14498	$2,16 \cdot 10^{-11}$	135