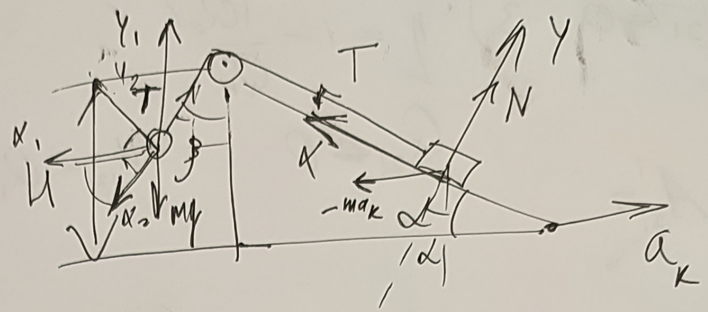
Часть 1

Олимпиада: **Физика, 11 класс (1 часть)**

Шифр: **21201944**

ID профиля: **370660**

Вариант 8



С.О. — клин:

С.О. неинерц. =>

$\vec{F}_{ин} = -ma_к$.

Брусок: $\boxed{T - 5mg\sin\alpha + ma_к\cos\alpha = 5ma_{отн}}$ (I)

$T = 5ma_{отн} + 5mg\sin\alpha - ma_к\cos\alpha$

шарик: Ox_1: $\boxed{ma_к\cdot\cos(90-\beta) - T + mg\cos\beta = ma_{отн}}$ IV

$T = ma_к\cos(90-\beta) + mg\cos\beta - ma_{отн}$

~~(I) (II) =>~~

~~$5ma_{отн} + 5mg\sin\alpha$~~

(I)+(II): $-5mg\sin\alpha + ma_к\cos\alpha + ma_к\cos(90-\beta) + mg\cos\beta = 5ma_{отн} + ma_{отн}$

$mg(\cos\beta - 5\sin\alpha) + ma_к(\cos\alpha + \cos(90-\beta)) = 6ma_{отн}$

$\boxed{g(5\sin\alpha - \cos\beta) + a_к(\cos\alpha + \cos(90-\beta)) = 6a_{отн}}$ ($\cos(90-\beta) = \sin\beta$)

Oy_1: $ma_к\cdot\cos\beta - mg\sin\beta = 0 \mid :m$

~~$a_к = g$~~ $a_к\cos\beta = g\sin\beta \mid :\cos$

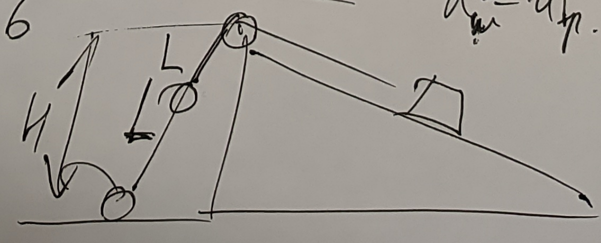
$\boxed{a_к = g\,tg\beta}$

$g(5\sin\alpha - \cos\beta) + g\,tg\beta(5\cos\alpha + \sin\beta) = 6a_{отн} \mid :6$

$a_{отн} = \frac{g((5\sin\alpha - \cos\beta) + tg(5\cos\alpha + \sin\beta))}{6}$

$L = \frac{H}{\cos\beta} = \frac{a_{отн}t^2}{2}$

$t = \sqrt{\frac{2H}{a_{отн}\cos\beta}}$



$a_{ш} = a_{бр}$.

чистовик

№2.

Дано:

$C_V = \frac{5}{2}R$

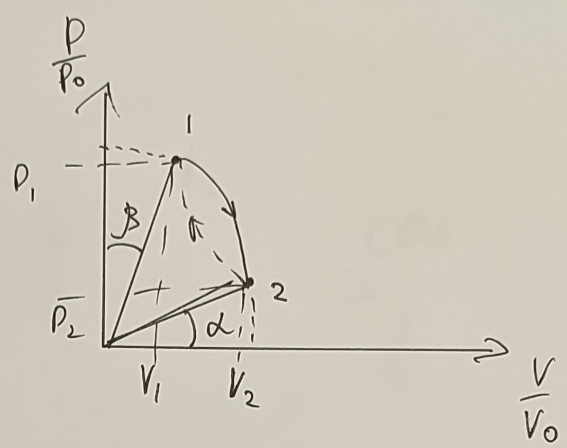
$\beta = 22,5$

$\alpha = 15^\circ$

Найти: 1) $\frac{T_1 - T_2}{T_2} = ?$

2) $\varphi = ?$

3) $\eta = ?$



Решение:

~~Ц.~~ Т.к. кривые процесс- дуга окр., то:

$$\left(\frac{p}{p_0}\right)^2 + \left(\frac{V}{p_0}\right)^2 = 1$$ (из ур-ия окружности)

$\frac{p_1}{p_0} = \cos\beta \qquad \frac{p_2}{p_0} = \cos\alpha$; $\quad p_1 = p_0\cos\beta \quad p_2 = p_0\cos\alpha$

$\frac{V_1}{V_0} = \sin\beta \qquad \frac{V_2}{V_0} = \sin\alpha$) $\quad V_1 = V_0\sin\beta$; $V_2 = V_0\sin\alpha$

$p_1V_1 = \nu R T_1$

$p_2V_2 = \nu R T_2$

$$\frac{\cancel{\nu R}(T_2 - T_1)}{\nu R T_1} = \frac{p_2V_2 - p_1V_1}{p_2V_2} = \frac{p_2V_2}{p_2V_2} - \frac{p_1V_1}{p_2V_2} = 1 - \frac{p_1V_1}{p_2V_2}$$

$$\frac{T_2 - T_1}{T_1} = 1 - \frac{p_1V_1}{p_2V_2} = 1 - \frac{\sin\beta\cos\beta}{\sin\alpha\cos\alpha} = 1 - \frac{\frac{1}{2}\sin 2\beta}{\frac{1}{2}\sin 2\alpha} =$$

$$= 1 - \frac{\sin 45^\circ}{\sin 30^\circ} = 1 - \frac{\sqrt{2}}{2} : \frac{1}{2} = 1 - \sqrt{2} \Rightarrow \frac{T_1 - T_2}{T_2} = \sqrt{2} - 1$$

Ответ: 1) $\frac{T_1 - T_2}{T_1} = \sqrt{2} - 1$

Чистовик. (1)

№1

Дано:

M – масса шарика

5m – масса бруска

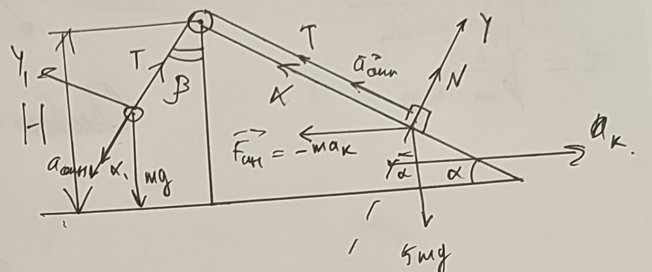
$\cos\alpha = \frac{3}{5}$

$\cos\beta = \frac{5}{13}$

Найти: 1) $a_к$ – ?

2) $a_{отн}$ – ?

3) t – ?



Решение:

С.О. – клин, неинерциальная => $\vec{F}_{ин} = -ma_к$ (сила инерции)

В С.О. – клин.

Брусок:

$OX: \; T - 5mg\sin\alpha + 5ma_к\cos\alpha = 5ma_{отн}$ (I)

Шарик:

$OX_1: \; ma_к\sin\beta - T + mg\cos\beta = ma_{отн}$ (II)

$OY_1: \; ma_к\cos\beta - mg\sin\beta = 0 \; |:m$

$a_к\cos\beta - g\sin\beta = 0 \; |:\cos\beta$

1) $\boxed{a_к = g\,tg\beta}$

(I)+(II): $\cancel{T} - 5mg\sin\alpha + 5ma_к\cos\alpha + ma_к\sin\beta - \cancel{T} + mg\cos\beta =$

$= 5ma_{отн} + ma_{отн}.$

$mg(\cos\beta - 5\sin\alpha) + ma_к(5\cos\alpha + \sin\beta) = 6ma_{отн} \; |:m$

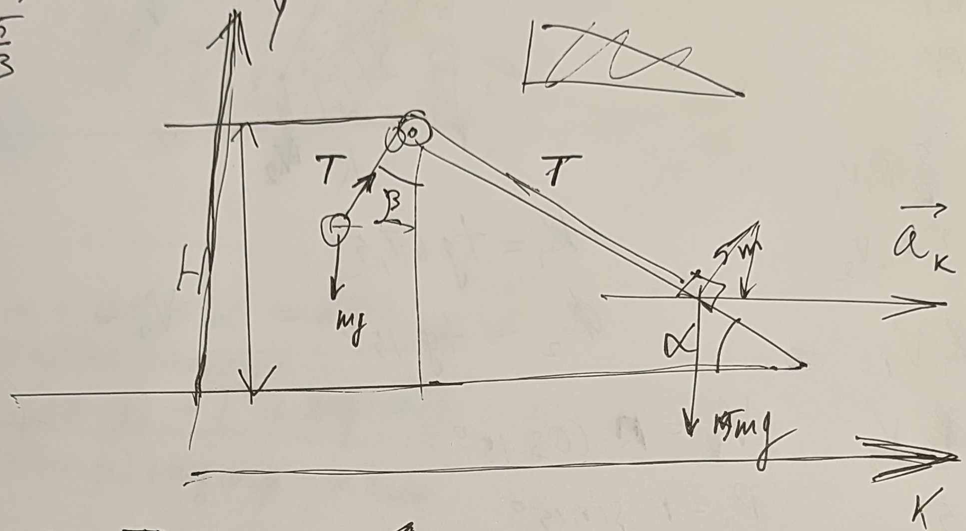
$g(\cos\beta - 5\sin\alpha) + g\,tg\beta(5\cos\alpha + \sin\beta) = 6a_{отн} \; |:6$

$$\boxed{\frac{g(\cos\beta - 5\sin\alpha) + g\,tg\beta(5\cos\alpha + \sin\beta)}{6} = a_{отн}}$$

№1

$\cos\alpha = \frac{3}{5}$

$\cos\beta = \frac{5}{13}$

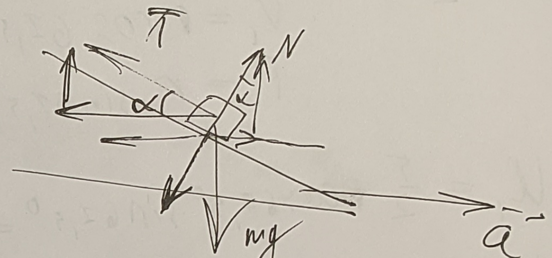


1)

шар: Ox: ~~sin~~ $T\sin\beta = m a_{шx}$

Oy: $\cancel{T\cos\beta = m}$

$T\cos\beta - mg = m a_{шy}$

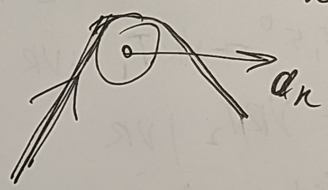


брусок: Ox: $-T\cos\alpha + N\sin\alpha = m a_{бр\,x}$

Oy: $-mg + N\cos\alpha = m a_{бр\,y}$

$a_ш \neq 0$

$a_{бр} \neq 0$



клин: $m a_K =$

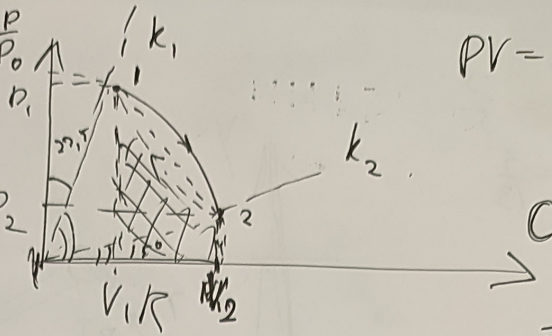
$a_ш = a_{бр}$ (нить нерастяжима)

N 2.

$C_V = \frac{5}{2}R$

$U = \frac{3}{2}\nu RT$

$U = \frac{5}{2}PV$



$PV = \nu RT$

$U_1 = \frac{5}{2}P_1V_1$

$U_2 = \frac{5}{2}P_2V_2$

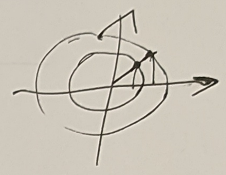
$k_1 = tg\,67{,}5$

$k_2 = tg\,15^\circ$

$V_2 =$

$P_1 = k_1 V_1$

$P_2 = k_2 V_2$



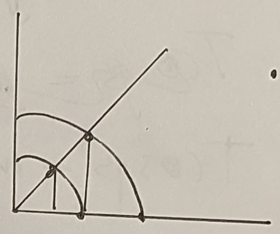
$U_1 = \frac{5}{2}$

$V_2 = R\cdot\cos 15^\circ$

$P_2 = r\cdot\sin 15^\circ$

$V_1 = r\cdot\cos 67{,}5^\circ$

$P_1 = r\cdot\sin 67{,}5^\circ$



$U_1 = \frac{5}{2}\, r\cos 67{,}5^\circ\cdot\sin 67{,}5^\circ = \frac{5}{2}\nu RT_1 \;\Big|:\frac{5}{2}$

$U_2 = \frac{5}{2}\, r\cos 15^\circ\sin 15^\circ = \frac{5}{2}\nu RT_2 \;\Big|:\frac{5}{2}$

$r\cos 67{,}5^\circ\cdot\sin 67{,}5^\circ = \nu RT_1 \;\Big|:\nu R$

$r\cos 15^\circ\cdot\sin 15^\circ = \nu RT_2 \;\Big|\,\nu R$

$$\begin{cases} T_1 = \dfrac{r\cos 67{,}5^\circ\sin 67{,}5^\circ}{\nu R} = \dfrac{r}{\nu R}\cdot\cos 67{,}5\cdot\sin 67{,}5 \ldots \\ T_2 = \dfrac{r\cos 15^\circ\sin 15^\circ}{\nu R} = \dfrac{r}{\nu R}\cos 15^\circ\cdot\sin 15^\circ \end{cases}$$

$$\frac{T_1 - T_2}{T_2} = \frac{\frac{r}{\nu R}\left(\cos 67{,}5\cdot\sin 67{,}5 - \cos 15^\circ\cdot\sin 15^\circ\right)}{\frac{r}{\nu R}\cdot\cos 15^\circ\cdot\sin 15^\circ} = \frac{0{,}383\cdot 0{,}924 - 0{,}966\cdot 0{,}259}{0{,}966\cdot 0{,}259} =$$

$$= \frac{0{,}353892 - 0{,}250194}{0{,}250194} = \frac{0{,}103698}{0{,}250194} = 0{,}413$$

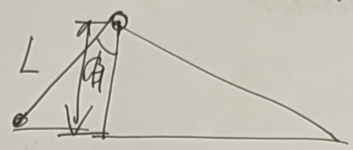
чистовик

(2)

$L - \frac{H}{\cos\beta}$ (~~.....~~ (как нити силы)

$\frac{H}{\cos\beta} = \frac{a_{отн} \cdot t^2}{2}$

$t = \sqrt{\frac{2H}{a_{отн} \cdot \cos\beta}}$



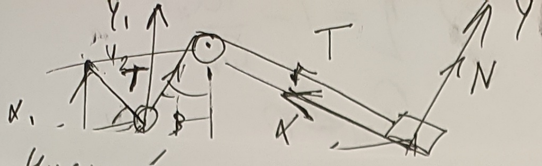
Ответ: 1) $a_x = g\,tg\beta$

~~2)~~

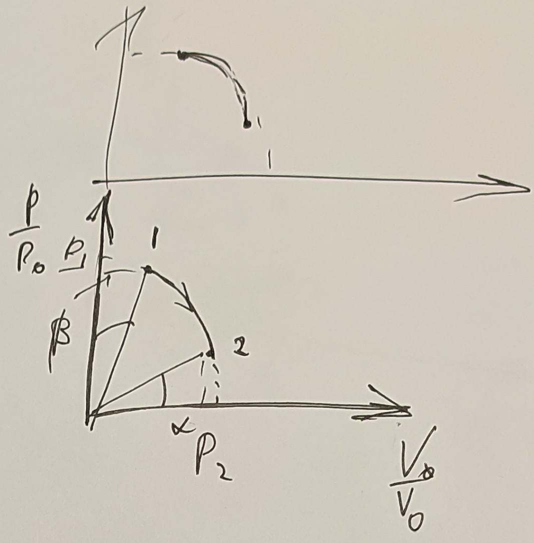
~~$a_{отн} = g(\cos\beta - 5\sin\alpha) + g\,tg\beta$~~

2) $a_{отн} = \frac{g(\cos\beta - 5\sin\alpha) + g\,tg\beta(5\cos\alpha + \sin\beta)}{6}$

3) $t = \sqrt{\frac{2H}{a_{отн} \cdot \cos\beta}}$



№2.



$$\left(\frac{P}{P_0}\right)^2+\left(\frac{V}{V_0}\right)^2=1$$

ур-

$$\frac{P_1}{P_0}=\cos\beta \qquad \frac{P_2}{P_0}=\cos\alpha$$

$$\frac{V_1}{V_0}=\sin\beta \qquad \frac{V_2}{V_0}=\sin\alpha$$

$$P_1V_1=\nu RT_1$$

$$P_2V_2=\nu RT_2$$

22,5

$$\frac{\nu R(T_2-T_1)}{\nu RT_2}=\frac{P_2V_2-P_1V_1}{P_2V_2}$$

$$\frac{T_2-T_1}{T_2}=1-\frac{P_1V_1}{P_2V_2}=1-\frac{\sin\beta\cos\beta}{\sin\alpha\cos\alpha}=1-\frac{\cancel{\frac{1}{2}}\sin2\beta}{\cancel{\frac{1}{2}}\sin2\alpha}=$$

$$=1-\frac{\sin45}{\sin30}=1-\frac{\sqrt{2}}{2}:\frac{1}{2}=1-\frac{\sqrt{2}}{2}\cdot2=1-\sqrt{2}$$

$$\frac{T_1-T_2}{T_2}=\sqrt{2}-1$$

Часть 2

Олимпиада: **Физика, 11 класс (2 часть)**

Шифр: **21201944**

ID профиля: **370660**

Вариант 8

$b = \frac{2}{3} d$; m; V_0; R; B

листовка. 3 Вариант 11-08.

$$\frac{1}{d_б} + \frac{1}{x} = -\frac{1}{5x}$$

$$\frac{1}{d_б} = -\frac{1}{5x} + \frac{1}{x}$$

$$\frac{1}{d_б} = -\frac{1}{5x} + \frac{5}{5x}$$

$$\frac{1}{d_б} = \frac{4}{5x}$$

$$d_б = \frac{5x}{4}$$

$$x = \frac{4}{5} d_б = 25 \cdot \frac{4}{5} = \frac{100}{5} = 20 \text{ см.}$$

$$D_2 = -\frac{1}{x} = -\frac{1}{0,2} = -5 \text{ дптр.}$$

2) $D_к + D_г = \frac{1}{d_к} + \frac{1}{f_0}$ (IV)

(IV) − (III)

$$D_к - D_1 - \frac{1}{d_к} - \frac{1}{d_б}$$

$$D_к = D_1 + \frac{1}{d_к} - \frac{1}{d_б} = \frac{1}{5} D_2 - \frac{1}{d_к} - \frac{1}{d_б} = \frac{1}{5} \cdot (-5) - \frac{1}{0,5} - \frac{1}{0,25} =$$

$$= -1 - 2 - 4 = -3 - 4 = -7 \text{ дптр.}$$

Ответ: 1) $x = 20$ см

$D_2 = -5$ дптр.

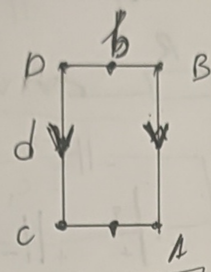
2) $D_к = -7$ дптр.

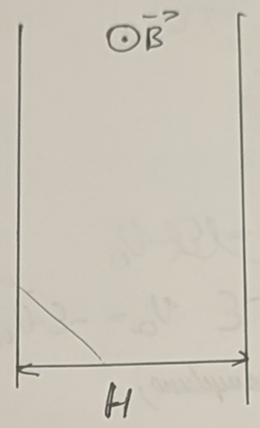
вариант 11-09.

№4.

d ; m ; V_0 ; R ; B ;

$b = \frac{2}{3} d$





$F_л = q v B$

$F_A = l I B$

$\boxed{U_{AB} = v B d}$

$I = \frac{U_{AB}}{R} = \frac{v B d}{R}$

$a = vBl \cdot \frac{dIB}{M} = \frac{d^2 B^2 v}{MR}$ I

$F_A = d I B$

$\frac{м^2 \cdot \frac{м}{с} \cdot Тл \cdot Ом}{м}$

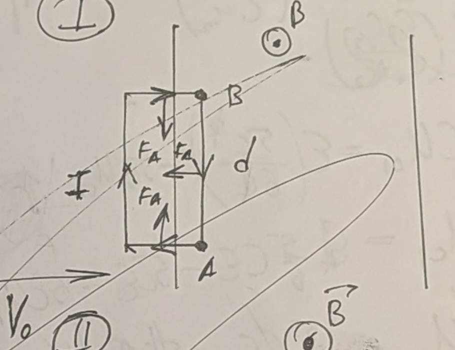
$v_1 = v_0 - at$

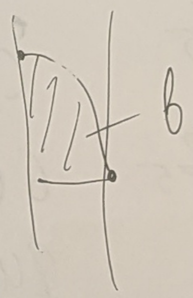
$\Delta X = v_0 t - \frac{at^2}{2} = b$

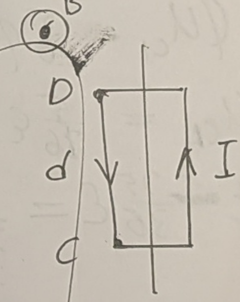
$\frac{at^2}{2} = b - v_0 t$

$-\frac{at^2}{2} + v_0 t - b = 0 \quad |\cdot 2$

$D = v_0^2 - 2ab$





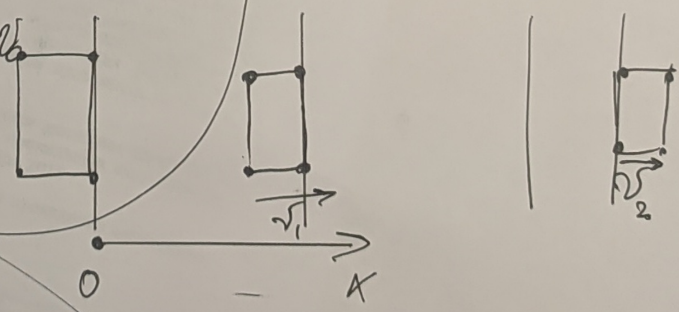


$-at^2 + 2v_0 t - 2b = 0$

$D_1 = v_0^2 - 2ab$

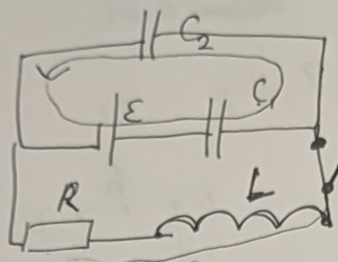
$t_1 = \frac{-v_0 + \sqrt{v_0^2 - 2ab}}{-a} = \frac{v_0 - \sqrt{v_0^2 - 2ab}}{a}$

$t_2 = \frac{-v_0 - \sqrt{v_0^2 - 2ab}}{-a} = \frac{v_0 + \sqrt{v_0^2 - 2ab}}{a}$



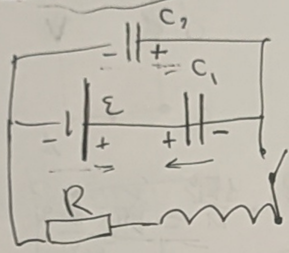
21201944 (U370660 M1266463)

N3 $C_1 = C$
$C_2 = 5C$



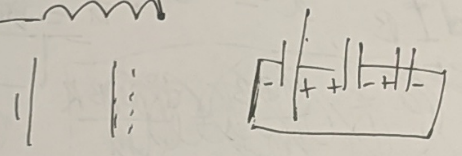
1) $C_0 = \frac{C_1 C_2}{C_1 + C_2}$

$q_1 = q_2 = \cancel{\ }= |\mathcal{E}| - U_{c1}$



$U_{c1} + U_{c2} = -\mathcal{E}$ $U_{c2} = -\mathcal{E} - U_{c1}$

$q_{c1} = q_{c2}$ (попарно)

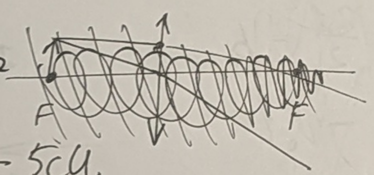


$q = CU$

$C_1 U_{c1} + C_2 U_{c2} = \mathcal{E} \cdot \left(\frac{C_1 C_2}{C_1 + C_2}\right)$

$\cancel{CU_{c1} = \mathcal{E}\left(\frac{C_1C_2}{C_1+C_2}\right)} -$

$CU_{c1} = \mathcal{E}\left(\frac{5C^2}{6C}\right) - 5CU_{c2}$



N5

$CU_{c1} = \frac{5}{6}C\mathcal{E} - 5C\mathcal{E} - 5CU_1$

$\frac{D_1}{D_2} = 5$

$6CU_{c1} = \frac{5}{6}C\mathcal{E} - 5C\mathcal{E} \; |:6$

$CU_{c1} = \frac{5}{36}\mathcal{E} - \frac{5}{6}\mathcal{E} = \frac{5}{36}\mathcal{E} - \frac{30}{36}\mathcal{E} = -\frac{25}{36}\mathcal{E}$

$U_{c2} = -\mathcal{E} + \frac{25}{36}\mathcal{E} = \frac{11}{36}\mathcal{E}$

$36 - 25 = 11$

чистовик ② вариант 11-08

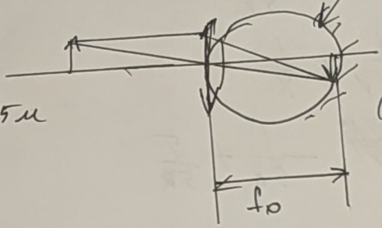
№5

Дано:

$d_б = 25 см = 0,25 м$; $d_к = 50 см = 0,5 м$

$\frac{D_2}{D_1} = 5$ D_2 – очки для дали

D_1 – очки для текста



Найти:

1) x – ?

D_2 – ?

2) $D_к$ – ?

Решение:

$$D_Г = \frac{1}{F_Г} = \frac{1}{f_0} + \frac{1}{x} \quad \text{I}$$

оптическая сила глаза

$$\frac{D_2}{D_1} = 5 \Rightarrow D_2 = 5D_1$$

$$\frac{1}{5} D_2 = D_1$$

$$D_2 + D_Г = \frac{1}{d_\infty} + \frac{1}{f_0}$$

$d_\infty >> f_0$;

$$d_\infty \to \infty \Rightarrow \frac{1}{d_\infty} \to 0 \Rightarrow D_2 + D_Г = \frac{1}{f_0} \quad \text{II}$$

$\cancel{D_2 + D_Г}$

$$D_1 + D_Г = \frac{1}{d_б} + \frac{1}{f_0} \quad \text{III}$$

$$\text{III} - \text{I}: \quad D_1 + \cancel{D_Г} - \cancel{D_Г} = \frac{1}{d_б} + \cancel{\frac{1}{f_0}} - \cancel{\frac{1}{f_0}} - \frac{1}{x} \quad -\frac{1}{5x}$$

$$\underline{D_1 = \frac{1}{d_б} - \frac{1}{x}} = \frac{1}{5} D_2 = \cancel{\frac{1}{5}\left(\frac{1}{d_б} - \frac{1}{x}\right) = \frac{1}{5d_б} = \frac{1}{5x}}$$

$$\text{II} - \text{I}: \quad D_2 + \cancel{D_Г} - \cancel{D_Г} = \cancel{\frac{1}{f_0}} - \frac{1}{x} - \cancel{\frac{1}{f_0}}$$

$\cancel{D_2 = -\frac{1}{x} =}$

$$D_1 = \frac{1}{d_б} - \frac{1}{x} = \frac{1}{5} D_2 = -\frac{1}{5x} \qquad \frac{1}{5} D_1 = -$$

N4

2) $m\frac{dv_x}{dt} = -\frac{d^2B^2v}{mR}$

$\int v\,dt$

$\int_{v_0}^{v_1} dv_x = \int_{t_0}^{t_1} -\frac{d^2B^2v}{mR}\,dt = -\frac{d^2B^2}{mR}\cdot\int_0^H dx =$

$= -\frac{d^2B^2}{mR}\cdot(H-0) = -\frac{d^2B^2H}{mR} = v_1 - v_0$

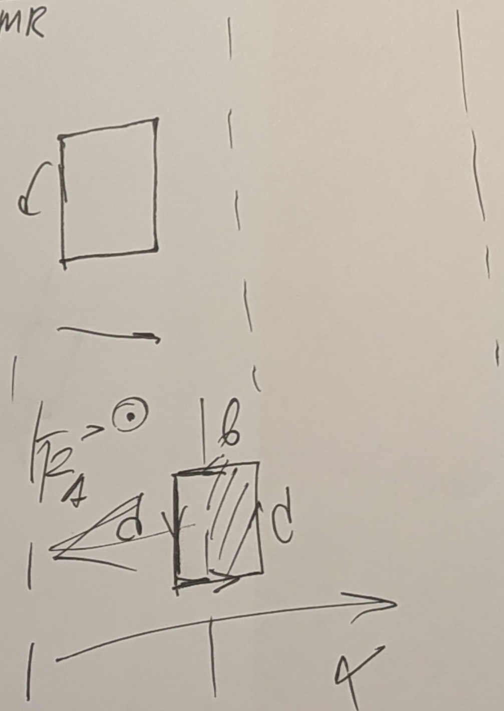
$v_1 - v_0 = -\frac{d^2B^2H}{mR}$

$v_1 = -\frac{d^2B^2H}{mR} + v_0 = v_0 - \frac{d^2B^2H}{mR}$

$= v_0 - \frac{d^2B\cdot 3d}{mR} = v_0 - \frac{3d^3B}{mR}$

3)

$ma_x = -BI_id = -\frac{v_xB^2d^2}{Rb} = m\frac{dv_x}{dt}$



$V_0; R; B$

$\odot \vec{B}$

$$\frac{1}{d_б} = \frac{5}{5к} - \frac{1}{5к}$$

$$\frac{1}{d_б} = \frac{4}{5к}$$

$$d_б = \frac{5к}{4}$$

$$к = d_б \cdot \frac{4}{5} = 25 \cdot \frac{4}{5} = \frac{100}{5} = 20 \text{ см.}$$

$$D_2 = \cancel{-\frac{1}{20}} - \frac{1}{0{,}2} = -5 \text{ дптр.}$$

2) $D_0 + D_г = \frac{1}{d_к} + \frac{1}{f_0}$ IV $(d_к = 0{,}5м)$

IV - 3

$$D_0 + \cancel{D_г} - D_1 - \cancel{D_г} = \frac{1}{d_к} + \cancel{\frac{1}{f_0}} - \frac{1}{d_б} - \cancel{\frac{1}{f_0}}$$

$$D_0 - D_1 = \frac{1}{d_к} - \frac{1}{d_б}$$

$$D_0 = \frac{1}{d_к} - \frac{1}{d_б} + D_1 = 2 - 4 + 1 =$$

$$= -2 - 1 = -3$$

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$U_{AB} = vBd$

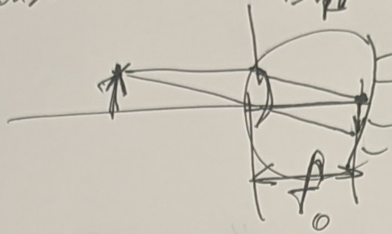
№5

$D_{гл} = \frac{1}{F_{гл}} = \frac{1}{f_0} + \frac{1}{d_2}$ (I)

$f_0 = const$

$D_{гл}$ D_2 – вдаль.

D_1 – тень.



$D_2 + D_г = \frac{1}{d_\infty} + \frac{1}{f_0}$ (II)

$\frac{1}{5}D_2 = D_1$

$D_2 = 5D_1$

$\frac{D_2}{D_1} = 5$

d_∞ – удалённ. предм.;

$d_\delta = 25$ см $= 0{,}25$.

$d_\infty >> f$ $d_\infty \approx \infty$

очень много

$D_1 + D_г = \frac{1}{d_\delta} + \frac{1}{f_0}$ (III)

$x - d_{гл}$ – ? – рисун. бд очень.

d

(III) – (I) : $D_1 + \cancel{D_г} - \cancel{D_г} = \frac{1}{d_\delta} + \cancel{\frac{1}{f_0}} - \cancel{\frac{1}{f_0}} + \frac{1}{d_г}$

$D_1 = \frac{1}{d_\delta} + \frac{1}{d_г}$; $\boxed{D_1 = d_\delta + \frac{1}{x}}$ $\frac{1}{d_\infty} \approx 0$ т.к. $d_\infty \approx \infty$.

(II) – (I) : $D_2 + \cancel{D_{гл}} - \cancel{D_г} = \frac{1}{d_\infty}^0 + \cancel{\frac{1}{f_0}} - \cancel{\frac{1}{f_0}} + \frac{1}{d_г}$

$\boxed{D_2 = -\frac{1}{x}}$ $| : (-1)$

$\frac{1}{5}D_1 = -\frac{1}{x}$

$D_1 - \frac{1}{d_\delta} - \frac{1}{x} = \frac{1}{5}D_2 = -\frac{1}{5x}$

$D_2 = -\frac{1}{x}$

$D_1 = \frac{1}{d_\delta} + D_2 \Rightarrow$

$= 4$ диопт.

$\frac{1}{d_\delta} - \frac{1}{x} = -\frac{1}{5x}$

$\frac{1}{d_\delta} = \frac{1}{x} - \frac{1}{5x}$

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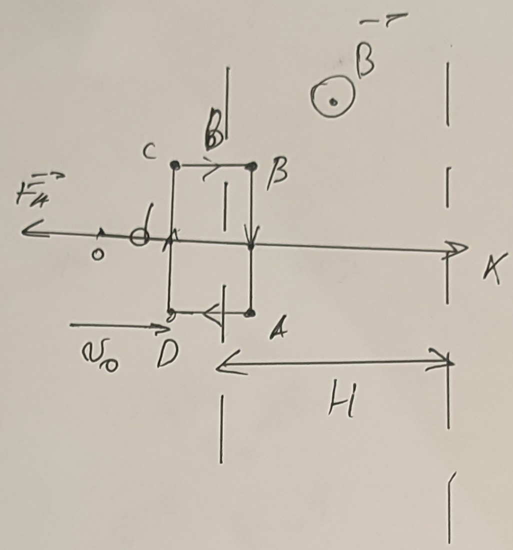
Чистовик ① вариант 11-08.

№ 4



Дано:

$b = \frac{2}{3}d$; $H = 3d$

v_0; m; B; R

Найти:

1) $a = ?$

2) $v_1 = ?$

3) $v_2 = ?$

Решение:

1) $U_{AD} = vBd$

$I_i = \frac{U_{AD}}{R} = \frac{vBd}{R}$ (з-н. Ома для пол. цепи)

$F_A = dI_iB = \frac{vB^2d^2}{R}$

$ma = \frac{vB^2d^2}{R} \;|:m$ (2-з-н. Ньютона)

$$\boxed{a = \frac{vB^2d^2}{Rm}}$$

2) Ox: $ma_x = -\frac{d^2B^2v}{mR}$

$m\frac{dv_x}{dt} = -\frac{d^2B^2v}{mR}$

$$\int_{v_0}^{v_1} dv_x = \int_{t_0}^{t_1} -\frac{d^2B^2v}{mR}\cdot dt = -\frac{d^2B^2}{mR}\cdot\int_0^H dx$$

$v_1 - v_0 = -\frac{d^2B^2}{mR}\cdot(H-0)$

$v_1 - v_0 = -\frac{d^2B^2H}{mR}$ ~~$\frac{d^2B^2}{}$~~

$v_1 = v_0 - \frac{d^2B^2H}{mR} = v_0 - \frac{3d^3B^2}{mR}$

~~Ответ: 1) $a = \frac{vB^2d^2}{}$~~ Ответ: 1) $a = \frac{vB^2d^2}{Rm}$; 2) $v_1 = v_0 - \frac{3d^3B^2}{mR}$.