Часть 1

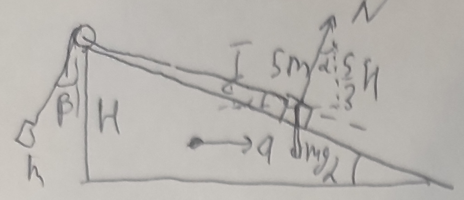
Олимпиада: **Физика, 11 класс (1 часть)**

Шифр: **21202159**

ID профиля: **336267**

Вариант 8

№1 Черновик

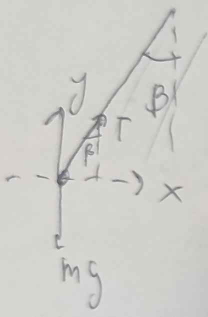


в ЦСО:

x) $\cancel{5ma = N\sin\alpha - T\cos\alpha}$

y) $\cancel{T\sin\alpha = mg - N\cos\alpha}$.

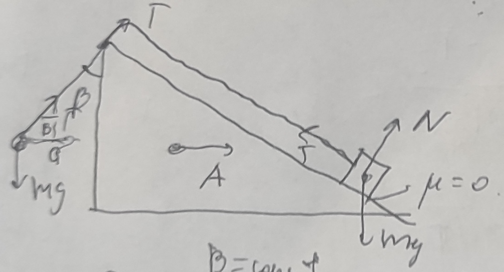
$$\begin{cases} \cancel{5ma = N\sin\alpha - T\cos\alpha} \\ \cancel{T\sin\alpha + N\cos\alpha = mg} \end{cases}$$



$\cancel{T\sin\beta = ma}$.

$\cancel{T\cos\beta = mg}$.

$a = g\,tg\beta$



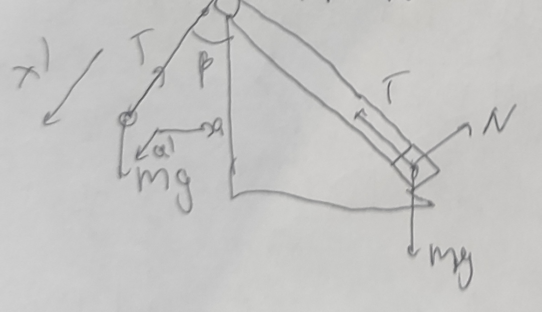
$\beta = const$.

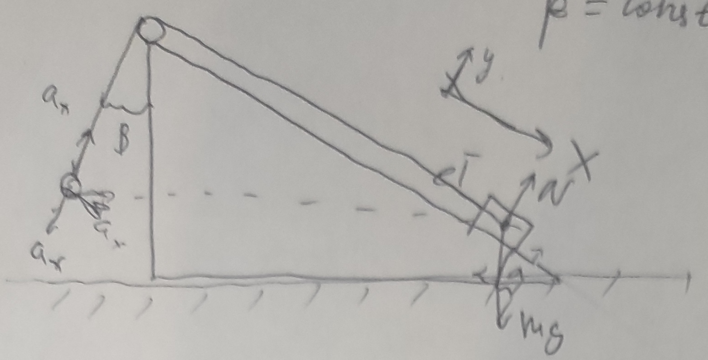
:

$T\sin\beta = ma$.

$T\cos\beta = mg$.

$tg\beta = \frac{a}{g}$ $a = g\,tg\beta$.





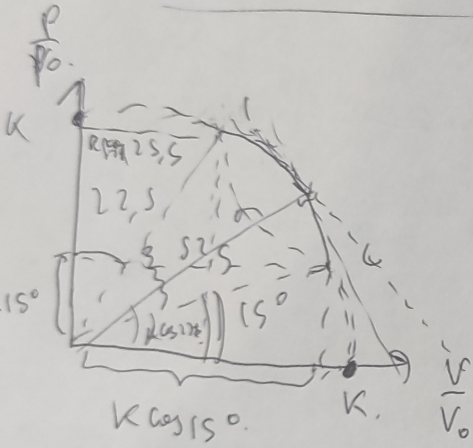
Т.к. силы трения нет, то ц. масс системы груз - шарик ост. неподвижным.

$$-mg\sin\alpha + T = ma_x$$

x) $T = ma_x + mg\sin\alpha.$

y) $\begin{cases} ma_y = N - mg\cos\alpha \\ ma_x = T - mg\sin\alpha \end{cases}$

$$\frac{0{,}41}{3{,}66 - 0{,}41} \; 3{,}26 \quad < 3$$



№2

$$\frac{T_1 - T_2}{T_2} - ?$$

61: $\frac{P_1}{P_0} = K \cdot \cos 22{,}5$

$P_1 = P_0 K \cos 22{,}5$

$V_1 = V_0 K \sin 22{,}5.$

$P_2 = P_0 K \cdot \sin 15°$

$V_2 = P_0 K \cos 15°$

$$C = \frac{dQ}{dT}$$

$$Q = A + \Delta U = PdV + \frac{3}{2}\nu R dT = PdV + \frac{3}{2} d(PV) -$$

$$= PdV + \frac{3}{2} dP V + \frac{3}{2} PdV -$$

$$= \frac{5}{2} PdV + \frac{3}{2} dP \cdot V.$$

$$T = \frac{PV}{\nu R}; \quad dT = \frac{PdV + dPV}{\nu R}.$$

$$C = \nu R \frac{\frac{5}{2} PdV + \frac{3}{2} dPV}{PdV + dPV} = \frac{\frac{5}{2} + \frac{3}{2}\frac{dP}{dV}\cdot\frac{V}{P}}{1 + \frac{dP}{dV} + \frac{V}{P}} = 0$$

$-5\,tg\,\alpha = 3p'$

$3p'c$

$tg\,\alpha = -\frac{3}{5}p'$

$$\frac{5}{2} + \frac{3}{2}\frac{dP}{dV}\frac{V}{P} = 0$$

$$\frac{3}{2}p'\,ctg\,\alpha = -\frac{5}{2}$$

$$ctg\,\alpha = -\frac{5}{3p'}$$

$$\frac{T_1 - T_2}{T_2} = \frac{\frac{P_1V_1}{\nu R} - \frac{P_2V_2}{\nu R}}{\frac{P_2V_2}{\nu R}} = \frac{P_0V_0K^2 \sin 22{,}5 \cos 22{,}5 - P_0V_0K^2 \sin 15° \cos 15°}{\sin 15° \cos 15°}$$

$$= \frac{\sin 22{,}5° \cos 22{,}5° - \sin 15° \cos 15°}{\sin 15° \cos 15°}$$

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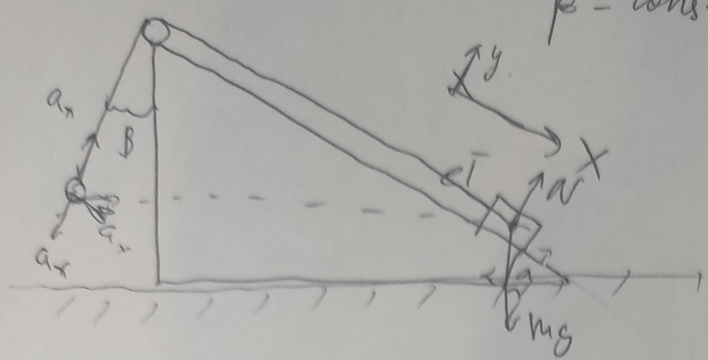


$p = const$

$-mg\sin\alpha + T = ma_x$

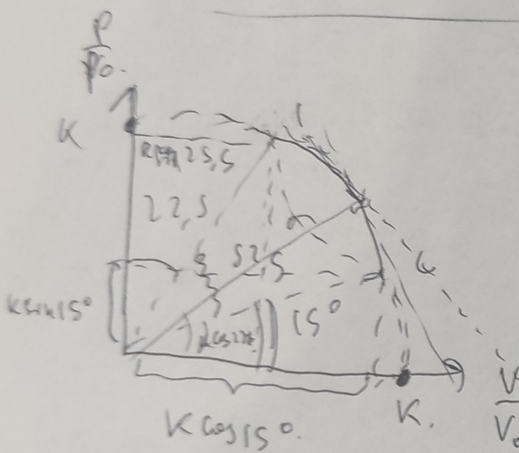
x) $T = ma_x + mg\sin\alpha$.

y) $\begin{cases} ma_y = N - mg\cos\alpha \\ ma_x = T - mg\sin\alpha \end{cases}$

Т.к. силы трения нет, то ц. масс системы груз - шарик ост. неподвижным.

$$\frac{0{,}41}{3{,}66 - 0{,}41} \approx 3 \qquad 3{,}26$$

№2



$\frac{T_1 - T_2}{T_2}$ — ?

б1: $\frac{P_1}{P_0} = K \cdot \cos 22{,}5$

$P_1 = P_0 K \cos 22{,}5$

$V_1 = V_0 K \sin 22{,}5$.

$P_2 = P_0 K \cdot \sin 15°$

$V_2 = P_0 K \cos 15°$

$C = \frac{dQ}{dT}$

$Q = A + \Delta U = PdV + \frac{3}{2}\nu R dT = PdV + \frac{3}{2} d(PV) =$

$= PdV + \frac{3}{2} dPV + \frac{3}{2} PdV =$

$= \frac{5}{2} PdV + \frac{3}{2} dP \cdot V$.

$T = \frac{PV}{\nu R}$; $dT = \frac{PdV + dPV}{\nu R}$.

$C = \nu R \frac{\frac{5}{2} PdV + \frac{3}{2} dPV}{PdV + dPV} = \frac{\frac{5}{2} + \frac{3}{2}\frac{dP}{dV}\cdot\frac{V}{P}}{1 + \frac{dP}{dV} + \frac{V}{P}} = 0$

$-5\operatorname{tg}\alpha = 3p'$

$3p'c$

$\operatorname{tg}\alpha = -\frac{3}{5}p'$

$\frac{5}{2} + \frac{3}{2}\frac{dP}{dV}\frac{V}{P} = 0$.

$\frac{3}{2}p' \operatorname{tg}\alpha = -\frac{5}{2}$

$\operatorname{ctg}\alpha = -\frac{5}{3p'}$

$$\frac{T_1 - T_2}{T_2} = \frac{\frac{P_1V_1}{\nu R} - \frac{P_2V_2}{\nu R}}{\frac{P_2V_2}{\nu R}} = \frac{P_0V_0K^2 \sin 22{,}5 \cos 22{,}5 - P_0V_0K^2 \sin 15° \cos 15°}{\sin 15° \cos 15°} =$$

$$= \frac{\sin 22{,}5° \cos 22{,}5° - \sin 15° \cos 15°}{\sin 15° \cos 15°}$$

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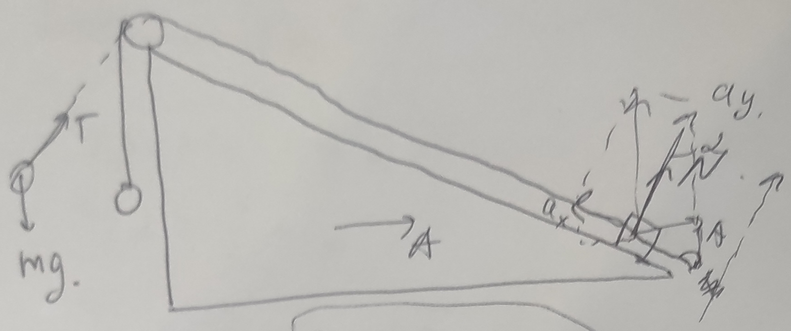
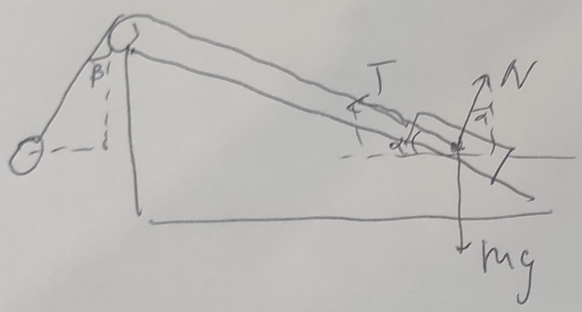
$$\frac{L\cos\alpha}{v_h} = \frac{L}{v_\delta}$$

$$a_k = a_\delta \cos\alpha$$



$$\boxed{\begin{aligned} a_y \sin\alpha &= A \\ a_\delta \cos\alpha &= A \end{aligned}}$$

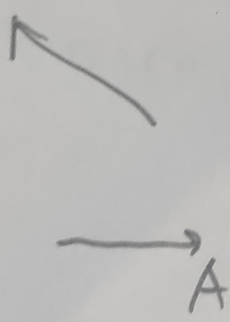
$\longrightarrow x \quad a = 0.$



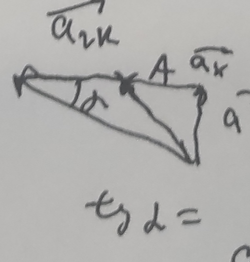
$N \sin\alpha = T\cos\alpha$

$$a_{a\delta} = a_{a0} + a_{0\delta} = a_{a0} - a_{\delta 0}$$

$$a_{2k} = a_{23} + a_{k3}.$$

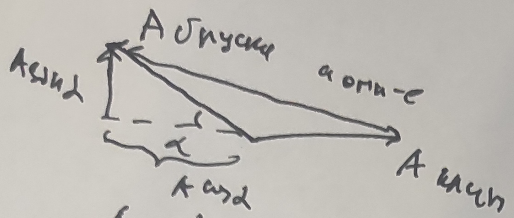


$\uparrow a_x \quad \uparrow a_y = A\sin\alpha$



$$\operatorname{tg}\alpha = \frac{a_y}{a}$$

Чистовик (4)

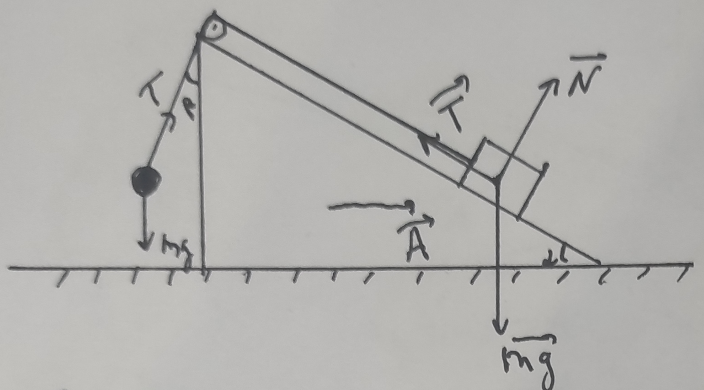


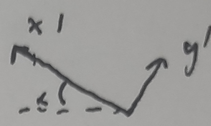
$$A^2_{\text{отн-с}} = (A\cos\alpha + A)^2 + (A\sin\alpha)^2$$

$$A_{\text{отн-с}} = A\sqrt{(\cos\alpha + 1) + \sin^2\alpha} = A\sqrt{2\cos\alpha + 2}.$$

Инкремент 1

№1



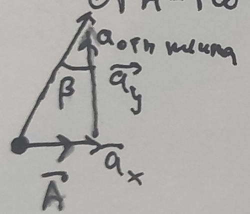


в исо: по 2му зак-ну Ньютона (для шарика)

$y)\ ma_y = mg - T\cos\beta$

$x)\ ma_x = T\sin\beta$

Отн-но клина шарик движется покоится



$\vec{a}_{\text{отн клина}} = \vec{a}_{\text{отн земли}} - \vec{A}$ ← ускор. клина.

$tg\beta = \dfrac{A + a_x}{a_y}.$

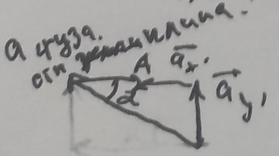
$a_{\text{отн клина шарик}} = a_{\text{отн клина груз}}$ (т.к. нить нерастяжима

$x')\ 5ma_{x'} = T - mg\sin\alpha.$

$5ma_{y'} = N - mg\cos\alpha.$, Заметим $\vec{a}_{y'\,\text{груза}} = \vec{A}_{y'\,\text{клина}}$

$A_{y'} = A\sin\alpha \Rightarrow a_{y'} = A\sin\alpha.$

Тогда



$tg\alpha = \dfrac{a_{y'}}{A + a_{x'}} = \dfrac{A\sin\alpha}{A + a_{x'}}$

$\dfrac{1}{\cos\alpha} = \dfrac{A}{A + a_{x'}}$

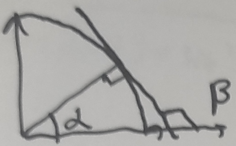
$\dfrac{A + a_{x'}}{\cos\alpha} = \dfrac{A + a_x}{\sin\beta} \Rightarrow A\sin\beta + a_x\sin\beta = A\cos\alpha + a_x\cos\alpha.$

Чистовик ②

$$5 + 3\frac{dP}{dV}\cdot\frac{V}{P} = 0$$

$$3\frac{dP}{dV} = -5\frac{P}{V}.$$

$\frac{dP}{dV}$ – тангенс касат. к окр-ти, $\frac{P}{V}$ – тангенс искомого угла



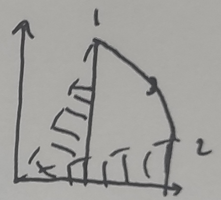
$$tg\,\beta = +\frac{dP}{dV}$$
$$tg\,\alpha = \frac{P}{V}. \Rightarrow 3\,tg\,\beta = -5\,tg\,\alpha.$$

$$tg\,\beta = -\,ctg\,\alpha \Rightarrow tg^2\alpha = \frac{3}{5}$$

$$tg\,\alpha = \frac{\sqrt{15}}{5}$$

3)

$$\eta = \frac{A}{Q} = \frac{A}{A + \Delta U} = \frac{1}{1 + \frac{\Delta U}{A}}$$



$$\Delta U = \frac{3}{2}(P_1V_1 - P_2V_2)$$

$$A = S_{сектора} - S_{\Delta_1} + S_{\Delta_2}.$$

$S_{сектора} = \pi\cdot k^2 P_0V_0\cdot\frac{\alpha^\circ}{360^\circ}$, $\alpha = 90 - 22{,}5 - 15 = 52{,}5$

$S_{\Delta_1} = P_1V_1\cdot\frac{1}{2}$, $P_1V_1 = k^2P_0V_0\cdot\frac{1}{2}\sin 45^\circ$

$S_{\Delta_2} = P_2V_2\cdot\frac{1}{2}.$ $P_2V_2 = k^2P_0V_0\,\frac{1}{2}\sin 30^\circ$

Получим:

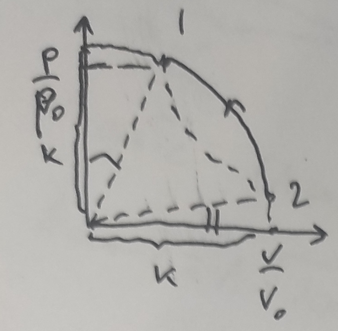
$$\frac{\Delta U}{A} = \frac{3}{2}\,\frac{P_1V_1 - P_2V_2}{\frac{\alpha\pi}{360}k^2P_0V_0 - (P_1V_1 + P_2V_2)\frac{1}{2}} = \frac{3}{2}\,\frac{\frac{1}{2}(\sin 45^\circ - \sin 30^\circ)}{\frac{\alpha\pi}{360} - \frac{1}{2}\cdot\frac{1}{2}(\sin 45^\circ - \sin 30^\circ)} =$$

$$= \frac{3}{2}\,\frac{\frac{\sqrt{2}}{2} - \frac{1}{2}}{\frac{\alpha\pi}{180} - \frac{1}{2}\cdot\left(\frac{\sqrt{2}}{2} - \frac{1}{2}\right)} = \frac{3}{2}\,\frac{\sqrt{2} - 1}{\frac{\alpha\pi}{90} - \left(\frac{\sqrt{2}}{2} - \frac{1}{2}\right)} = \frac{2(\sqrt{2} - 1)}{\frac{\alpha\pi}{45} - (\sqrt{2} - 1)}\,\frac{3}{2} = 0{,}38$$

Чистовик ③

Чистовик ①

№2



k – радиус окр-ти

в т. 1: $\frac{P_1}{P_0} = k\cos 22{,}5$

$\frac{V_1}{V_0} = k\sin 22{,}5.$

в т. 2

$\frac{P_2}{P_0} = k\sin 15^\circ$

$\frac{V_2}{V_0} = k\cos 15^\circ.$

Тогда:

$P_1 = P_0 k\cos 22{,}5$, $P_2 = P_0 k\sin 15^\circ$

$V_1 = V_0 k\sin 22{,}5$, $V_2 = V_0 k\cos 15^\circ$

1) $$\frac{T_1 - T_2}{T_2} = \left(\text{из ур-ея Менд.-Клап}\right) = \frac{\frac{P_1V_1}{\nu R} - \frac{P_2V_2}{\nu R}}{\frac{P_2V_2}{\nu R}} = \frac{\cos 22{,}5 \sin 22{,}5 - \cos 15 \sin 15}{\sin 15 \cos 15} =$$

$$= \frac{\sin 45^\circ - \sin 30^\circ}{\sin 30^\circ} = \frac{\frac{\sqrt{2}}{2} - \frac{1}{2}}{\frac{1}{2}} = \sqrt{2} - 1 \approx 0{,}41$$

2) Вспомним: $C = \frac{dQ}{\nu dT}$

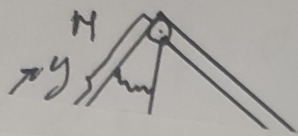
$$dQ = \underbrace{PdV}_{dA} + \underbrace{\frac{3}{2} d(PV)}_{dU}.$$

$$dT = \frac{d(PV)}{\nu R}$$

$$C = \frac{PdV + \frac{3}{2}PdV + \frac{3}{2}dPV}{\cancel{\nu}\, PdV + dPV} \cdot \nu R = R \cdot \frac{\frac{5}{2}PdV + \frac{3}{2}dPV}{PdV + dPV} =$$

$$= \frac{\frac{5}{2} + \frac{3}{2}\frac{dP}{dV}\frac{V}{P}}{1 + \frac{dP}{dV}\frac{V}{P}} = 0 \Rightarrow$$

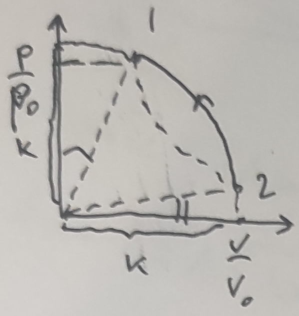
Дальше



Чистовик (3)

Чистовик (1)

№2



в т. 1: $\frac{P_1}{P_0} = k \cos 22{,}5$

$\frac{V_1}{V_0} = k \sin 22{,}5.$

в т. 2

$\frac{P_2}{P_0} = k \sin 15°$

$\frac{V_2}{V_0} = k \cos 15°.$

k – радиус окр-ти

Тогда :

$P_1 = P_0 k \cos 22{,}5$, $P_2 = P_0 k \sin 15°$

$V_1 = V_0 k \sin 22{,}5$, $V_2 = V_0 k \cos 15°$

1) $$\frac{T_1 - T_2}{T_2} = \left(\text{из ур-ея менд. клап}\right) = \frac{\frac{P_1 V_1}{\nu R} - \frac{P_2 V_2}{\nu R}}{\frac{P_2 V_2}{\nu R}} = \frac{\cos 22{,}5 \sin 22{,}5 - \cos 15 \sin 15}{\sin 15 \cos 15} =$$

$$= \frac{\sin 45° - \sin 30°}{\sin 30°} = \frac{\frac{\sqrt{2}}{2} - \frac{1}{2}}{\frac{1}{2}} = \sqrt{2} - 1 \approx 0{,}41$$

2) Вспомним: $C = \frac{dQ}{\nu dT}$

$$dQ = \underbrace{PdV}_{dA} + \underbrace{\frac{3}{2} d(PV)}_{dU}.$$

$$dT = \frac{d(PV)}{\nu R}$$

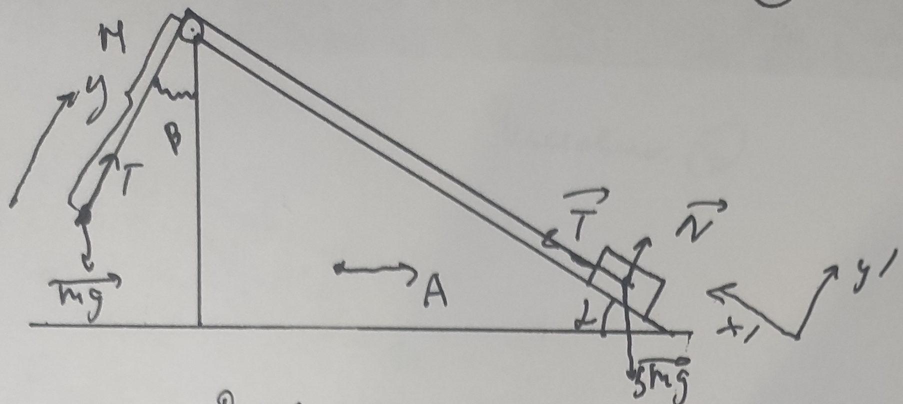
$$C = \frac{PdV + \frac{3}{2} PdV + \frac{3}{2} dPV}{\nu \, PdV + dPV} \cdot \nu R = R \cdot \frac{\frac{5}{2} PdV + \frac{3}{2} dPV}{PdV + dPV} =$$

$$= \frac{\frac{5}{2} + \frac{3}{2} \frac{dP}{dV} \frac{V}{P}}{1 + \frac{dP}{dV} \frac{V}{P}} = 0 \Rightarrow$$

Далее

21202159 (U336267 M1264137)

Чистовик ③



Для того, чтобы грузик мог спокойно двигаться по клину, проекция $a_{грузика}$ на $Oy' = A_{клин}$ на y'

$$a_{y'_{гр}} = A \sin\alpha .$$

$$a_{полн_{гр}} = \frac{a_{y'}}{\sin\alpha} = A \Rightarrow a_{x'} = A\cos\alpha .$$

По 2-му зак-ну Ньютона:

x') $5m a_{x_{гр}} = T - 5mg\sin\alpha$.

$5mA\cos\alpha = T - 5mg\sin\alpha$

$a_y = a_{x_{гр}} = A\cos\alpha$, т.к. нить нерастяжима.

y) $m a_y = -T + mg\cos\beta$.

$$\begin{cases} 5mA\cos\alpha = T - 5mg\sin\alpha \\ mA\cos\alpha = -T + mg\cos\beta \quad | \cdot(-1) \end{cases}$$

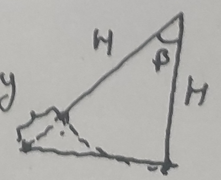
$5\cancel{mA}\cos\alpha - \cancel{mA}\cos\alpha = \cancel{mg\cos\beta} - \cancel{5mg\sin\alpha}$.

$\cancel{A \cdot 4m\cos\alpha = mg(\cos\beta - 5\sin\alpha)}$

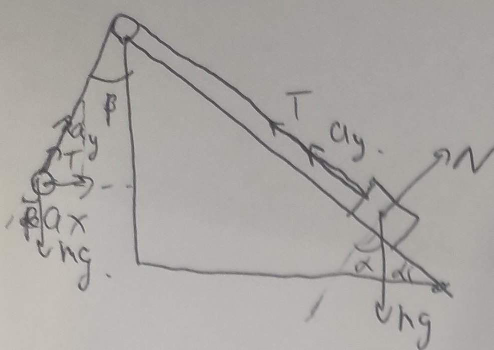
$6mA\cos\alpha = -mg(5\sin\alpha + \cos\beta)$

1) $|A| = g\,\frac{5\sin\alpha + \cos\beta}{6\cos\alpha}$.

3) $y = \frac{H}{\cos\beta} - H = H\,\frac{1-\cos\beta}{\cos\beta}$.



$$\frac{a_y t^2}{2} = y \Rightarrow t = \sqrt{\frac{2y}{a_y}} = \sqrt{\frac{2H(1-\cos\beta)}{a_y\cos\beta}} = \boxed{\sqrt{\frac{2H(1-\cos\beta)}{g(5\sin\alpha+\cos\beta)\cos\beta}}}$$



$$\sin\beta = \frac{a_x}{a_y}$$

$$\begin{cases} m\,\cancel{a_y} = T - mg\cos\beta \\ 5ma_y = T - mg\sin\alpha \end{cases}$$

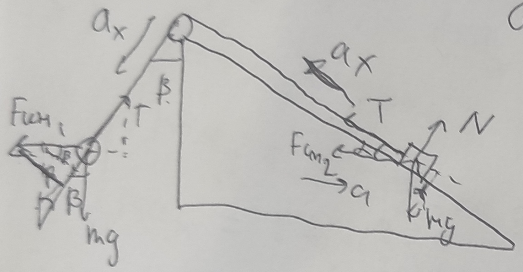
$$\begin{cases} -ma_y = -T + mg\cos\beta \\ 5ma_y = T - mg\sin\alpha \end{cases}$$

$$5ma_y = mg(\cos\beta - \sin\alpha)$$

$$a_y = \cancel{\frac{g(\cos\beta - \sin\alpha)}{5}}$$

$$a_x = a_y \sin\beta$$

B hello.

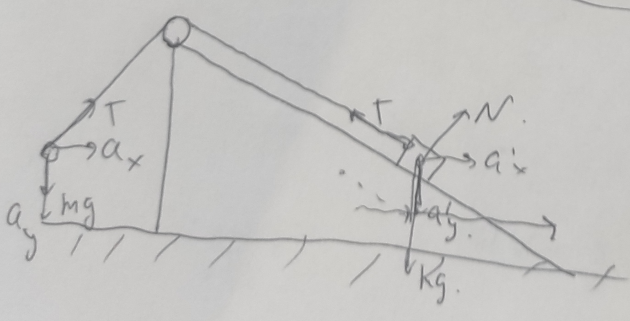


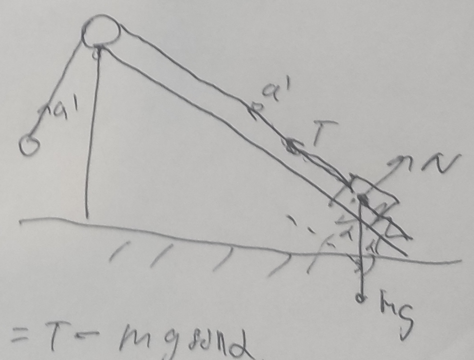
$$5ma_x = F_{ин_2}\cos\alpha + T - mg\sin\alpha \qquad F_{ин_1} = mA$$

$$ma_x = mg\cos\beta + F_{ин_1}\sin\beta - T \qquad F_{ин_2} = 5mA$$

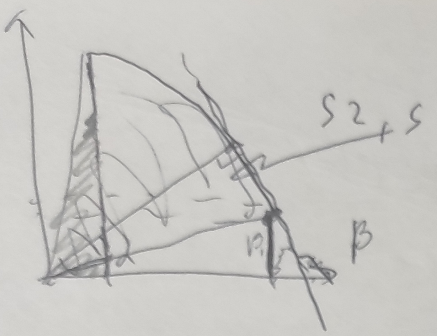
$$6ma_x = F_{ин_2}\cos\alpha + F_{ин_1}\sin\beta + mg(\cos\beta - \sin\alpha)$$

$$a'_x = \frac{5mA\cos\alpha + mA\sin\beta + mg(\cos\beta - \sin\alpha)}{}$$





$$5ma' = T - mg\sin\alpha$$



$tg\,\beta = p' = -tg\,\beta_1$

$tg\,\alpha = \frac{5}{3}\,tg\,\beta_1$

$tg^2\alpha = \frac{5}{3} \quad tg\,\alpha = \sqrt{\frac{5}{3}} \approx 59^\circ.$

$\eta = \frac{A}{Q} = \frac{A}{\Delta U + A} = \frac{1}{\frac{\Delta U}{A} + 1}$

$\frac{\Delta U}{A} = \frac{\frac{3}{2}\nu R \Delta T}{}$

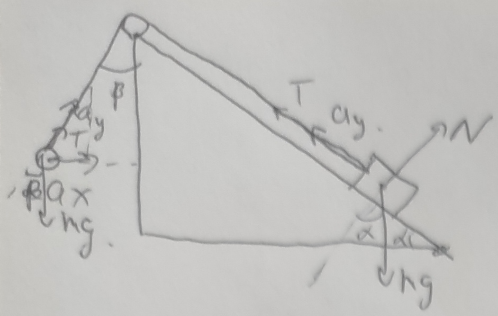
$\frac{360}{2\pi} = \frac{52{,}5}{\alpha}$

$A = S_{сектора} - S_{\Delta 1} + S_{\Delta 2}.$

$\alpha = \frac{52{,}5}{360} \cdot 2\pi \approx 0{,}92$

$S_{сектора} = \frac{\alpha}{2} R^2 = k^2 P_0 V_0 \approx$

$\approx 0{,}46 k^2 P_0 V_0.$



$\sin\beta = \dfrac{a_x}{a_y}$.

$\begin{cases} \cancel{m a_y = T - mg\cos\beta} \\ 5 m a_y = T - mg\sin\alpha. \end{cases}$

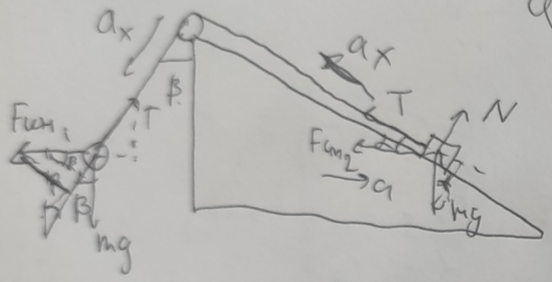
$\begin{cases} -m a_y = -T + mg\cos\beta. \\ 5 m a_y = T - mg\sin\alpha. \end{cases}$

$5 m a_y = mg(\cos\beta - \sin\alpha)$

$a_y = \cancel{\dfrac{g(\cos\beta - \sin\alpha)}{5}}$

$a_x = a_y \sin\beta$.

B hello.

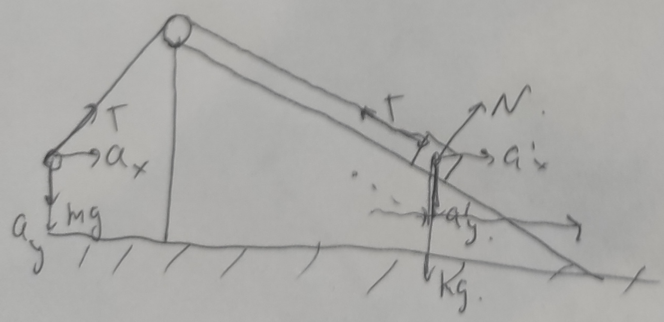


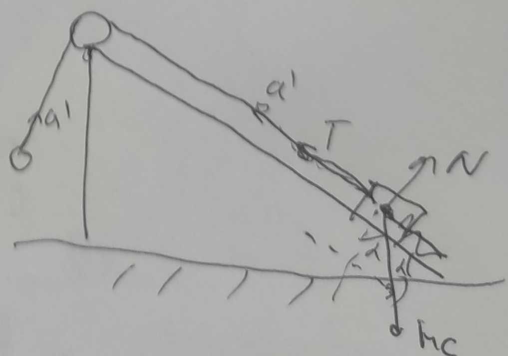
$5 m a_x = Fun_2 \cos\alpha + T - mg\sin\alpha$. $\quad Fun_1 = mA$

$m a_x = mg\cos\beta + Fun_1 \sin\beta - T$. $\quad Fun_2 = 5mA$

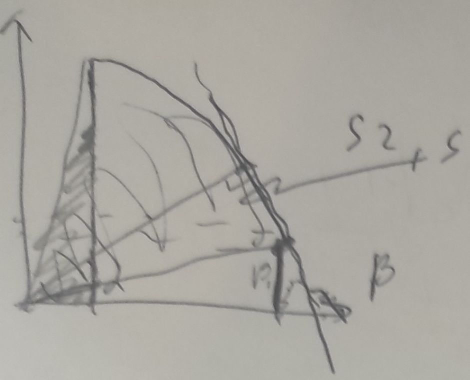
$6 m a_x = Fun_2 \cos\alpha + Fun_1 \sin\beta + mg(\cos\beta - \sin\alpha)$

$a'_x = \dfrac{5mA\cos\alpha + mA\sin\beta + mg(\cos\beta - \sin\alpha)}{}$.





$5ma' = T - mg\sin\alpha$.



$tg\,\beta = p' = -tg\,\beta_1$

$tg\,\alpha = \frac{5}{3}\,tg\,\beta_1$

$tg^2\alpha = \frac{5}{3} \quad tg\,\alpha = \sqrt{\frac{5}{3}} \approx 59^\circ$

$$\eta = \frac{A}{Q} = \frac{A}{\Delta U + A} = \frac{1}{\frac{\Delta U}{A} + 1}$$

$$\frac{\Delta U}{A} = \frac{\frac{3}{2}\nu R \Delta T}{}$$

$$\frac{360}{2\pi} = \frac{52,5}{\alpha}$$

$$\alpha = \frac{52,5}{360} \cdot 2\pi \approx 0,92$$

$A = S_{сектора} - S_{\Delta 1} + S_{\Delta 2}$.

$S_{сектора} = \frac{\alpha}{2} R^2 = K^2 P_0 V_0 \approx$

$\approx 0,46 K^2 P_0 V_0$.

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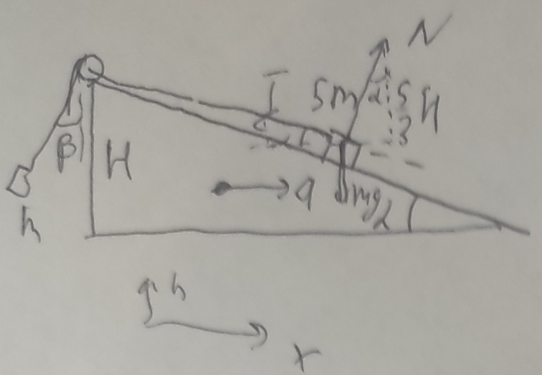
№1 Черновик

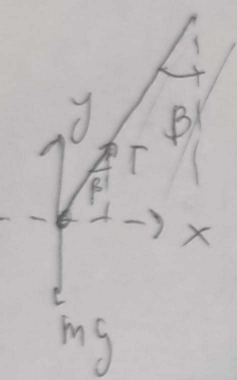


в исо:

$\cancel{x)\quad 5ma = N\sin\alpha - T\cos\alpha}$

$\cancel{y)\quad T\sin\alpha = mg - N\cos\alpha}$

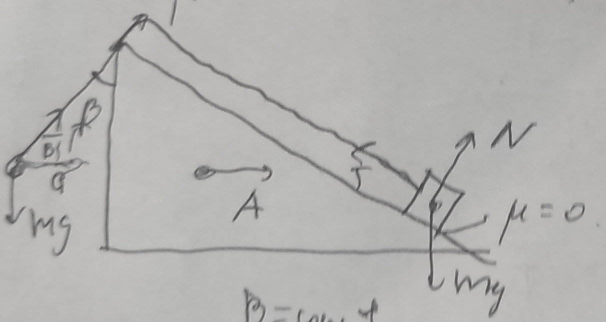
$$\cancel{\begin{cases} 5ma = N\sin\alpha - T\cos\alpha \\ T\sin\alpha + N\cos\alpha = mg \end{cases}}$$



$\cancel{T\sin\beta = ma}$

$\cancel{T\cos\beta = mg}$

$a = g\,tg\,\beta$

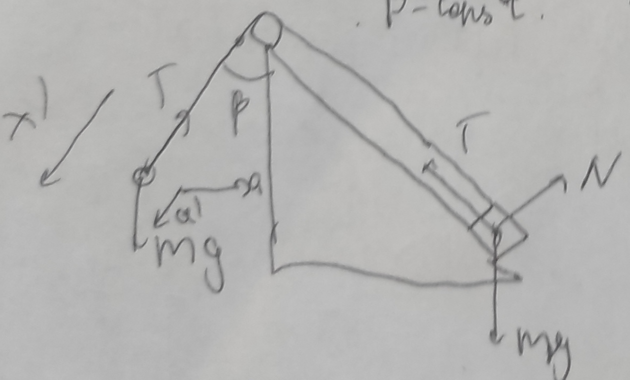


$\beta = const.$

$T\sin\beta = ma$

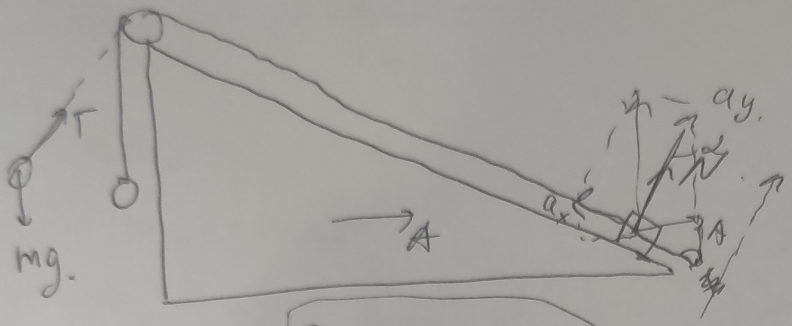
$T\cos\beta = mg$

$tg\,\beta = \frac{a}{g} \quad a = g\,tg\,\beta$



$$\frac{L\cos\alpha}{v_h} = \frac{L}{v_g}$$

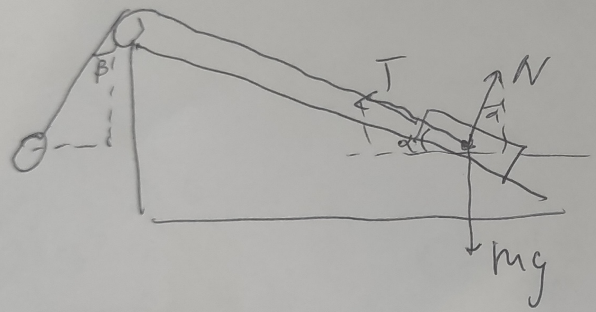
$a_k = a_g \cos\alpha$



$a_y \sin\alpha = A$

$a_g \cos\alpha = A$

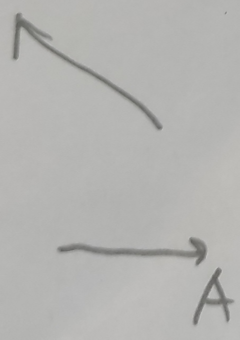
$\longrightarrow x \quad a = 0.$



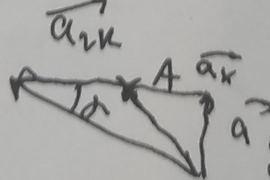
$N \sin\alpha = T\cos\alpha$

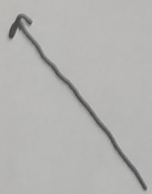
$a_{ab} = a_{ao} + a_{ob} = a_{ao} - a_{bo}$

$a_{2k} = a_{23} + a_{k3}.$



$\uparrow a_x \quad \uparrow a_y = A \sin\alpha$





$\tan\alpha = \frac{a_y}{a}$

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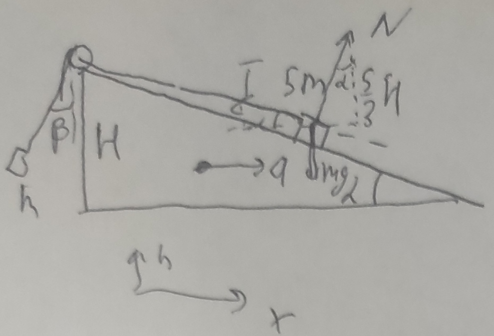
№1 Черновик

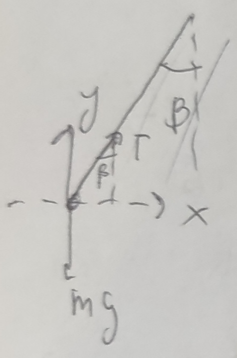


в ИСО:

$x)\quad 5ma = N\sin\alpha - T\cos\alpha$

$y)\quad T\sin\alpha = mg - N\cos\alpha.$

$$\begin{cases} 5ma = N\sin\alpha - T\cos\alpha \\ T\sin\alpha + N\cos\alpha = mg. \end{cases}$$



$T\sin\beta = ma.$

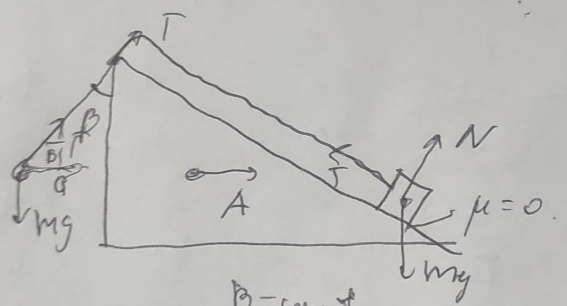
$T\cos\beta = mg.$

$a = g\,tg\beta$

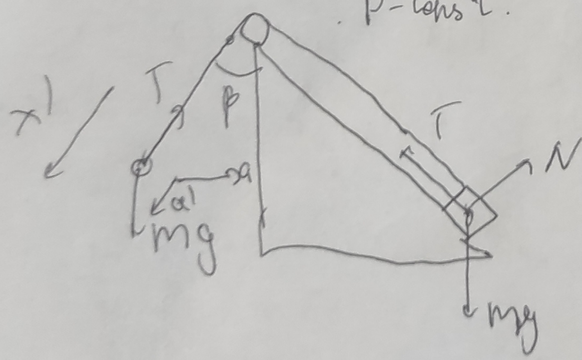
$T\sin\beta = ma.$

$T\cos\beta = mg.$

$tg\beta = \frac{a}{g} \quad a = g\,tg\beta.$

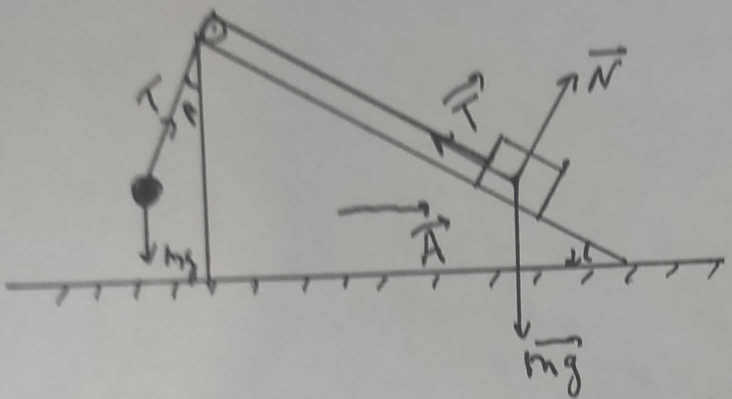


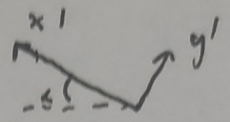
$\beta = \text{const}.$



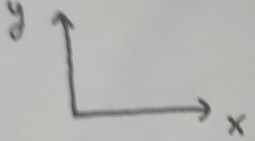
Циолковский 1 10

№1





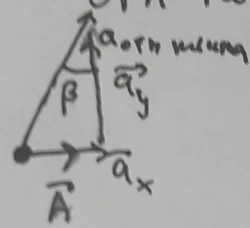
в ИСО: по 2-му зак-ну Ньютона (для шарика)



$y)\ ma_y = mg - T\cos\beta$

$x)\ ma_x = T\sin\beta$

Отн-но клина шарик двигается по прямой



$\vec a_{\text{отн клина}} = \vec a_{\text{отн земли}} - \vec A$ ← ускор. клина.

$tg\beta = \dfrac{A+a_x}{a_y}$.

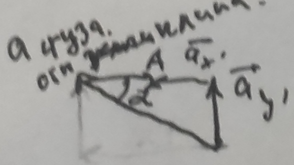
$a_{\text{отн клина шарик}} = a_{\text{отн клина груз}}$ (т.к. нить нерастяжима

$x')\ 5ma_{x'} = T - mg\sin\alpha$.

$5ma_{y'} = N - mg\cos\alpha$. , Заметим $\vec a_{y'\,\text{груза}} = \vec A_{y'\,\text{клина}}$

$A_{y'} = A\sin\alpha \Rightarrow a_{y'} = A\sin\alpha$.

Тогда



$tg\alpha = \dfrac{a_{y'}}{A+a_{x'}} = \dfrac{A\sin\alpha}{A+a_{x'}}$

$\dfrac{1}{\cos\alpha} = \dfrac{A}{A+a_{x'}}$

$\dfrac{A+a_{x'}}{\cos\alpha} = \dfrac{A+a_x}{\sin\beta} \Rightarrow A\sin\beta + a_{x'}\sin\beta = A\cos\alpha + a_x\cos\alpha$.

Часть 2

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

Шифр: **21202159**

ID профиля: **336267**

Вариант 8

Черновик (4)

По формуле линзы:

$D_{глаз} + D_1 = \frac{1}{f} + \frac{1}{d_1}$, $d_1 \to \infty \Rightarrow$

$D_{глаз} + D_2 = \frac{1}{f} + \frac{1}{d_2}$ $\quad D_2 - D_1 = \frac{1}{d_2} = \frac{1}{0{,}25} = 4.$

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

$D_2 = -1$

$D_1 = -5.$

Без очков:

$D_{глаз} = \frac{1}{f} + \frac{1}{d_{б.}}$, $\frac{1}{f} = D_{глаз} + D_1$

$\frac{1}{d_б} = -D_1 = 5. \Rightarrow d_{б.} = \frac{1}{5} = 0{,}2\ (м).$

1) Отв: $d_{б.} = 0{,}2\ (м)$

$D_{дальн} = -5\ (дптр)$

$D_{глаз} + D_{очки} = \frac{1}{f} + \frac{1}{0{,}5} = \frac{1}{f} + 2.$

$\frac{1}{f} = D_{глаз} + D_1$

$D_{очки} = D_1 + 2 = -5 + 2 = -3.$

2) Отв: $D_{очки} = -3$

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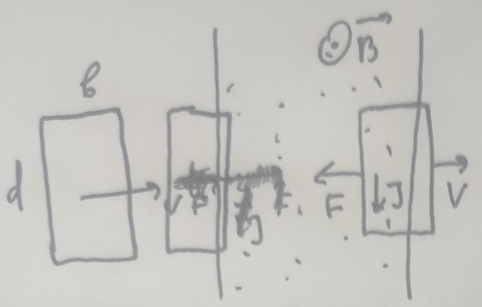
Инегавин

3

№4.



Как только рамка начинает входить в поле $\vec{B}$, 2/3 неё изменяется поток Φ_B.

$$F = J \cdot B \cdot l = JBd.$$

на стержень $l = d$.

(По правилу Ленца опр. направление тока в рамке, по правилу левой руки, находим F) при входе F действ. влево. и выходе.

$$J = \frac{\varepsilon}{R};$$ По зак-ну Эл.магн. индукции:

$$|\varepsilon| = \frac{d\Phi}{dt} = \frac{B \cdot dS}{dt}, \quad dS = v \cdot d \cdot dt.$$

Получим:

$$F = \frac{(Bd)^2}{R} \cdot v \qquad (1)$$

(Во время движения по области $\frac{d\Phi}{dt} = 0 \Rightarrow$ на рамку не действуют силы)

По 2му зак-ну Ньютона:

$$ma = \frac{(Bd)^2}{R} \cdot v \Rightarrow$$ Отв: 1) $$a = \frac{(Bd)^2}{mR} \cdot v_0.$$

Домножим (1) на dt.

$$\int F dt = \int \frac{(Bd)^2}{R} v dt$$

$$\Delta p = \Delta x \frac{(Bd)^2}{R}.$$

Когда рамка полностью войдет в область с $\vec{B}$, то $\Delta x = b$.

$$\Delta p_1 = \frac{b(Bd)^2}{R}$$

Отв:

$$\Delta v = \frac{b(Bd)^2}{mR} \Rightarrow 2)\ v_{кон_1} = v_0 - \frac{b(Bd)^2}{mR}.$$

Когда рамка начнет выходить из области $\vec{B}$, сила F совершит ту же работу $\Rightarrow$. Отв:

$$\Delta p_{на\ выходе} = \Delta p_{на\ входе} \Rightarrow 3)\ v_{k_2} = v_0 - \frac{2b(Bd)^2}{mR} = v_0 - \frac{4}{3}\frac{B^2 d^3}{mR}$$

Чистовик (1)

Получим:

$$\varepsilon^2 \frac{c_1 c_2 (c_1+c_2)}{2(c_1+c_2)^2} = -\varepsilon^2 \frac{c_1^2}{c_1+c_2} + \frac{c_1^2\varepsilon^2}{2c_1} + Q$$

$$\varepsilon^2 \frac{c_1 c_2}{2(c_1+c_2)} = \varepsilon^2 \left(\frac{-c_1^2}{c_1+c_2} + \frac{c_1}{2}\right) + Q$$

$$\cancel{\varepsilon^2 \frac{c_1 c_2}{2(c_1+c_2)} = \varepsilon^2 \frac{c_1 c_2}{c_1+c_2} + Q}$$

$$\cancel{Q = \varepsilon^2 \frac{c_1 c_2}{2(c_1+c_2)}}$$

$$\varepsilon^2 \frac{c_1 c_2}{2(c_1+c_2)} = \varepsilon^2 \frac{c_1^2 + c_1 c_2 - 2c_1^2}{2(c_1+c_2)} + Q$$

$$Q = \varepsilon^2 \frac{c_1^2}{2(c_1+c_2)} = \varepsilon^2 \frac{c^2}{2(c+5c)} = c\varepsilon^2 \frac{1}{12}.$$

3) $\frac{d}{dt}(\varepsilon R) = \frac{d}{dt}\left(\frac{q_1}{c_1} + \frac{q_2}{c_2}\right).$

$$0 = \frac{J_1}{c_1} + \frac{J_2}{c_2} \Rightarrow J_1 c_2 + J_2 c_1 = 0.$$

правило Кирхгофа!

$$\begin{cases} J = J_1 + J_2 \,|\cdot -c_2 \\ J_1 c_2 + J_2 c_1 = 0. \end{cases} \quad \begin{cases} -J c_2 = -J_1 c_2 + J_2 c_2 \\ 0 = J_1 c_2 + J_2 c_1. \end{cases}$$

$J = J_2 \frac{c_2 - c_1}{c_2}$, когда $J_2 = J_0$, $J = J_0 \frac{5c - c}{c} = 4J_0.$

Отв: $U_R = JR = 4J_0 R$

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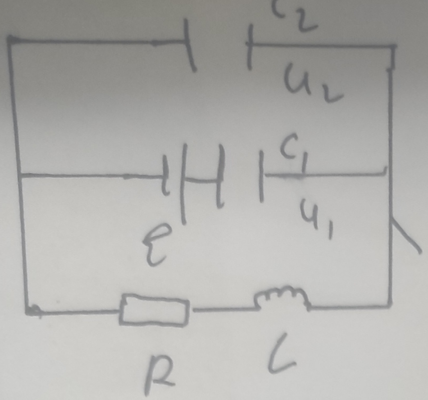
Чистовик ①



До замыкания.

$U_1 + U_2 = \mathcal{E}$

$\cancel{A \neq \frac{U_1}{C_1} \neq \frac{U_2}{C_2}}$

$q = C_1 U_1 = C_2 U_2$

$\frac{q}{C_1} + \frac{q}{C_2} = \mathcal{E}$. $\quad U_1 = \frac{C_2}{C_1 + C_2}\mathcal{E}$

$q = \frac{C_1 C_2}{C_1 + C_2}\mathcal{E}. \Rightarrow \quad U_2 = \frac{C_1}{C_1 + C_2}\mathcal{E}.$

1) $\mathcal{E} = U_1 + U_R + U_L$, в $t = 0$ $J_R = 0 \Rightarrow U_R = 0 \Rightarrow$

$U_L = \mathcal{E} - U_1 = U_2 = \frac{C_1}{C_1 + C_2}\mathcal{E}. \Rightarrow$

$\frac{dJ}{dt} = \frac{C_1}{C_1 + C_2}\frac{\mathcal{E}}{L} = \frac{\mathcal{E}}{6L}.$

2) По ЗСЭ

$W_{нач_1} + W_{нач_2} = -A_{бат} + W_{кон_1} + \underset{0.}{\underset{\shortparallel}{W_{кон_2}}} + Q$

$A_{бат} = \Delta q \cdot \mathcal{E}.$

$W_{нач_1} = \frac{C_1 U_1^2}{2} = \frac{C_1 C_2^2}{2(C_1 + C_2)^2}\mathcal{E}^2$

$W_{нач_2} = \frac{C_2 U_2^2}{2} = \frac{C_2 C_1^2}{2(C_1 + C_2)^2}\mathcal{E}^2.$

$\Delta q = q_{конеч} - q_{нач}$ (для конд C_1) $\quad q_{нач} = \frac{C_1 C_2}{C_1 + C_2}\mathcal{E} = \frac{6}{7}\mathcal{E}$

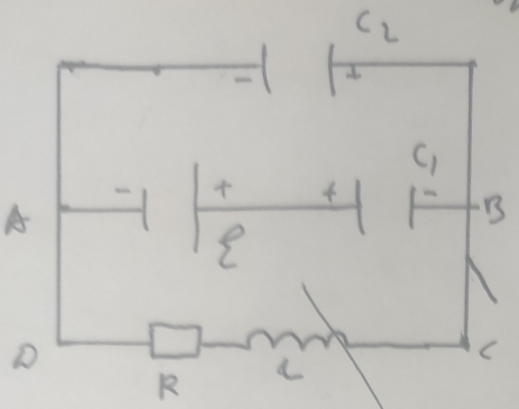
$U_{1\,конечн} = \mathcal{E} \Rightarrow \quad q_{конечн} = C_1\mathcal{E} \Rightarrow$

$\Delta q = \cancel{\mathcal{E}\left(\frac{C_1(C_1 + C_2) - C_1 C_2}{C_1 + C_2}\right) = \mathcal{E}\frac{C_1^2}{C_1 + C_2}} =$

$= \mathcal{E} \cdot C_1 - \mathcal{E}\frac{C_1 C_2}{C_1 + C_2} = \mathcal{E}\frac{C_1^2 + C_1 C_2 - C_1^2 C_2}{C_1(C_1 + C_2)} = \frac{C_1^2}{C_1 + C_2}\mathcal{E}.$

Черновик ①

№1



До замыкания

$q_I = q_{II}$

$U_1 + U_2 = \mathcal{E}$.

$C_1 q \quad C_2 q$

$q = \frac{\mathcal{E}}{C_1 + C_2}$. $\Rightarrow U_1 = \frac{C_1}{C_1 + C_2}\mathcal{E}$

$U_2 = \frac{C_2}{C_1 + C_2}\mathcal{E}$.

1) контур ABCDA

$\mathcal{E} = U_1 + U_R + U_L$, в нач. момент времени $J_R = 0 \Rightarrow U_R = 0$.

$\mathcal{E} = U_1 + U_L \quad U_L = \mathcal{E} - U_1 = U_2 = \frac{C_2}{C_1 + C_2}\mathcal{E}$.

$U_L = L\frac{dJ}{dt} \Rightarrow \frac{dJ}{dt} = \frac{C_2}{L(C_1 + C_2)}\mathcal{E} = \frac{5}{6L}\mathcal{E}$.

2) По ЗСЭ:

$W_{нач_1} + W_{нач_2} = A_{бат} + W_{кон_1} + W_{кон_2} + Q$

$W_{кон_1} = \frac{q_{конеч}^2}{2C_1}$, $W_{кон_2} = 0$

$A_{бат} = \Delta q \cdot \mathcal{E}$.

$W_{нач_1} = \frac{C_1 U_1^2}{2} = \frac{C_1^3}{2(C_1 + C_2)^2}\mathcal{E}^2$

$W_{нач_2} = \frac{C_2 U_2^2}{2} = \frac{C_2^3}{2(C_1 + C_2)^2}\mathcal{E}^2$

в конечный момент времени все заряды скопились на C_1 (ток ч/з катушку не течет) (ч/з катушку) и C_2

$\mathcal{E} = U_{1\,конеч} \Rightarrow q_{конеч} = \frac{\mathcal{E}}{C_1}$

$F = qBv = JBl$.

$q_{нач} = \frac{C_1}{C_1 + C_2}\mathcal{E} \Rightarrow \Delta q = \frac{C_1 + C_2 - C_1^2}{(C_1 + C_2)C_1}\mathcal{E}^2$

$= \frac{C_2}{(C_1 + C_2)C_1}\mathcal{E}$

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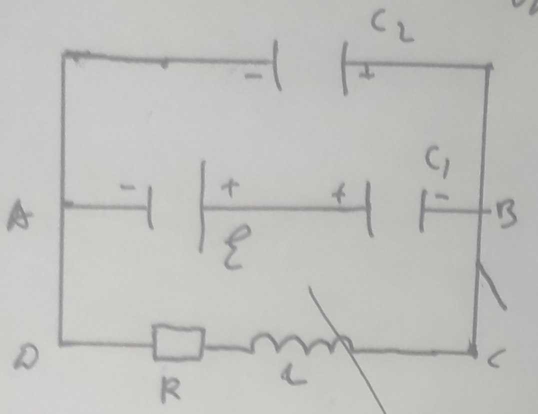
№1



До замыкания

$q_{I} = q_{II}$

$U_1 + U_2 = \mathcal{E}$.

$\frac{q}{C_1}$ $\frac{q}{C_2}$

$q = \frac{\mathcal{E}}{C_1 + C_2}$. $\Rightarrow U_1 = \frac{C_1}{C_1+C_2}\mathcal{E}$

$U_2 = \frac{C_2}{C_1+C_2}\mathcal{E}$.

1) контур ABCDA

$\mathcal{E} = U_1 + U_R + U_L$, в нач. момент времени $J_R = 0 \Rightarrow U_R = 0$.

$\mathcal{E} = U_1 + U_L$ $U_L = \mathcal{E} - U_1 = U_2 = \frac{C_2}{C_1+C_2}\mathcal{E}$.

$U_L = L\frac{dJ}{dt} \Rightarrow \frac{dJ}{dt} = \frac{C_2}{L(C_1+C_2)}\mathcal{E} = \frac{5}{6L}\mathcal{E}$.

2) По ЗСЭ:

$W_{нач_1} + W_{нач_2} = A_{бат} + W_{кон_1} + W_{кон_2} + Q$

$W_{кон_1} = \frac{q_{конечн}^2}{2C_1}$, $W_{кон_2} = 0$

$A_{бат} = \Delta q \cdot \mathcal{E}$.

$W_{нач_1} = \frac{C_1 U_1^2}{2} = \frac{C_1^3}{2(C_1+C_2)^2}\mathcal{E}^2$

$W_{нач_2} = \frac{C_2 U_2^2}{2} = \frac{C_2^3}{2(C_1+C_2)^2}\mathcal{E}^2$

в конечный момент времени все заряды скопились на C_1 (ток через катушку не течёт)
(2/3 катушку и C_2)

$\mathcal{E} = U_{1\,конечн} \Rightarrow q_{конечн} = \frac{\mathcal{E}}{C_1}$

$F = qBv = JBl$.

$q_{нач} = \frac{C_1}{C_1+C_2}\mathcal{E}$ $\Rightarrow \Delta q = \frac{C_1 + C_2 - C_1^2}{(C_1+C_2)C_1}\mathcal{E}^2$

$= \frac{C_2}{(C_1+C_2)C_1}\mathcal{E}$

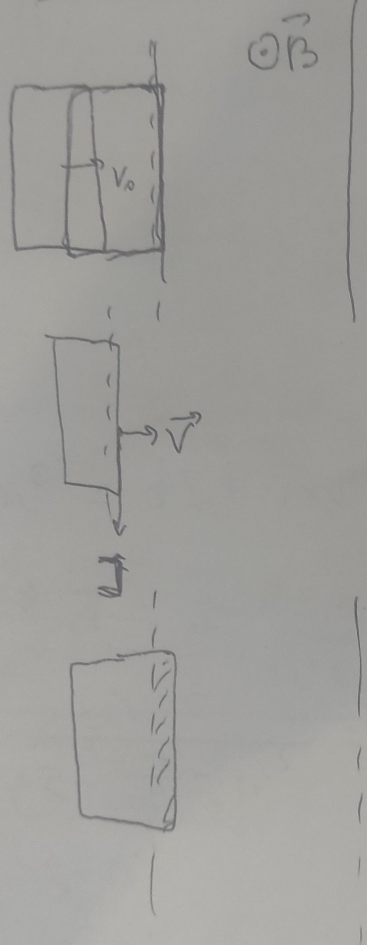
$\frac{D_1}{D_2} = 5.$

$\frac{1}{F} = \frac{1}{d} + \frac{1}{f}$

$D = \frac{1}{d} + \frac{1}{f}$

$x - ?$

$$\begin{cases} D_2 + D_1 = \frac{1}{d_1} + \frac{1}{f_1} \\ D_2 + D_2 = \frac{1}{d_2} + \frac{1}{f_2} \\ D_1 = 5D_2. \end{cases}$$



$\frac{d\Phi}{dt} = \varepsilon.$

$F = qBv = IBl.$

$l = const$

$I = \frac{\varepsilon}{R}$

$F = \varepsilon \frac{Bl}{R} = \frac{d\Phi}{dt} \frac{Bl}{R}.$

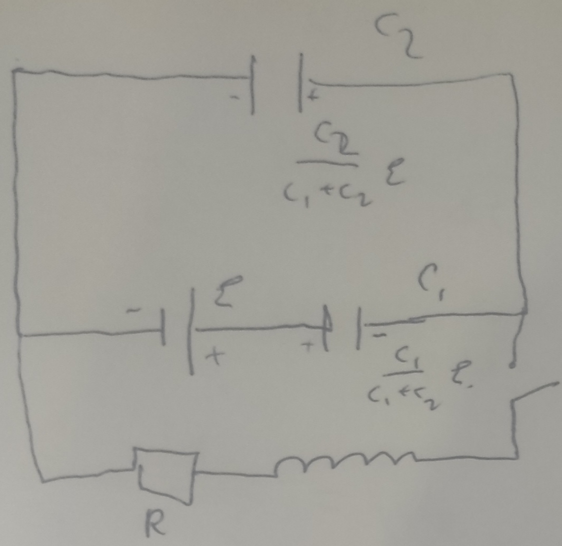
$\frac{d\Phi}{dt} = \frac{dS \cdot B}{dt} =$ $\quad dS = v \cdot l \cdot dt.$

$F = \frac{B^2 dS}{dt} \frac{l}{R} =$

$= (Bl)^2 \frac{v}{R}.$

$a = \frac{(Bl)^2}{mR} v.$

$v = v_0 e^{\frac{(Bl)^2}{mR} t}.$



$u_1 + u_2 = \mathcal{E}$

$q C_1 + q C_2 = \mathcal{E}$

$q = \frac{\mathcal{E}}{C_1 + C_2}$

$u_1 = \frac{C_1}{C_1+C_2}\mathcal{E}$

$u_2 = \frac{C_2}{C_1+C_2}\mathcal{E}$

$D_{глаз} + D_1 = \frac{1}{f}$

$D_{глаз} + D_2 = \frac{1}{f} + \frac{1}{x}$

$U_{кат} + U_{C_1} = \mathcal{E}$

$L\frac{dJ}{dt} = \mathcal{E} - U_{C_1}$

1) $\frac{dJ}{dt} = \frac{\mathcal{E} - \frac{C_1}{C_1+C_2} = U_{C_2}}{L} = \frac{C_2 \mathcal{E}}{(C_1+C_2)L}$

$$\begin{cases} q_2 C_2 = U_R + \frac{dJ}{dt} \\ \mathcal{E} + q_1 C_1 = U_R + \frac{dJ}{dt} \\ J_1 + J_2 = J \end{cases}$$

$q_1 + q_2 = q$

$\cancel{\mathcal{E} C_2 + q C_1 C_2 = (U_R + \frac{dJ}{dt})(C_1+C_2)}$

$J_1 + J_2 = J$

$\frac{dJ_1}{dt} + \frac{dJ_2}{dt} = \frac{dJ}{dt}$

$\mathcal{E} C_2 + C_1 C_2 \underbrace{(q_1 + q_2)}_{q} = (U_R + \frac{dJ}{dt})(C_1+C_2)$

$\mathcal{E} C_2 + C_1 C_2 q = (U_R +$

2) ЗСЭ

$W_{C_1} + W_{C_2} = q\mathcal{E} + W_{1кон} + \underset{0}{\underset{\shortparallel}{W_{2кон}}} + Q$

$q = \frac{\mathcal{E}}{C_1}$

$\frac{C_1 \cdot C_1^2}{2(C_1+C_2)}\mathcal{E}^2$ . . . . - - - -

3)

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$$U_2 = U_R + L\frac{dJ}{dt}. \qquad J_1 + J_2 = J.$$

$$\begin{cases} \frac{q_2}{C_2} = U_R + L\frac{dJ}{dt} \;\Big|: C_1 \\ \mathcal{E} + \frac{q_1}{C_1} = U_R + L\frac{dJ}{dt}. \;\Big|: C_2. \end{cases}$$

$$U_C = U_R + L\frac{dJ}{dt}.$$

$$\frac{q_2}{C_2} = U_R + L\frac{dJ}{dt}.$$

=-4

$$\begin{cases} \frac{\mathcal{E}}{C_2} + \frac{q}{C_1C_2} = \left(U_R + L\frac{dJ}{dt}\right)\left(\frac{1}{C_1} + \frac{1}{C_2}\right) \end{cases}$$

$$\frac{q_2}{C_2} = JR + L\frac{dJ}{dt}.$$

$$\frac{q}{C_1C_2} + \frac{\mathcal{E}}{C_2} = JR\frac{C_1C_2}{C_1+C_2} + L\frac{dJ}{dt}\frac{C_1C_2}{C_1+C_2}.$$

$$\frac{J_0}{C_2} = R\frac{dJ}{dt} + L\frac{dJ^2}{d^2t}.$$

$$\frac{q}{C_1C_2} + L\frac{dJ}{dt}\frac{C_1C_2}{C_1+C_2} = J\frac{RC_1C_2}{C_1+C_2} - \frac{\mathcal{E}}{C_2}$$

$$q = q_1 e^{\lambda} + q_2.$$

$$q_2 = \frac{\mathcal{E}}{C_2}.$$

$$\frac{e^{\lambda}}{C_1C_2} + e^{\lambda}\frac{LC_1C_2}{C_1+C_2}\lambda^2 = \lambda\frac{RC_1C_2}{C_1+C_2}e^{\lambda}.$$

$$q = q_{max}\, e^{-\lambda}\cos\omega t.$$

$$J =$$

$$\sqrt{5}$$

$$\frac{1}{f} = D_1$$

$$D = D_1 + 2 = -3$$

$$D_2 = \frac{1}{f} + \frac{1}{d_1} \to \infty$$

$$\begin{cases} D_1 = \frac{1}{f}. \\ D_2 = \frac{1}{f} + \frac{1}{0{,}25} \end{cases}$$

$$D_2 = D_1 + \frac{1}{0{,}25}. \quad \frac{25}{100}$$

$$\Delta D = 4.$$

$$\frac{D_1}{D_2} = 5. \quad D_1 - D_2 = 4.$$

$$D_1 = 5D_2$$

$$4D_2 = 4 \quad D_2 = 1.$$

$$D_1 = -5.$$

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$D_2 - D_1 = \pm 4.$

$D_2 = 4D_1$

$3D_1 = \pm 4$ $\quad D_1 = -\frac{4}{3}$

$D_2 = -\frac{16}{3}.$

$D = \frac{1}{f} + \frac{1}{x}$

$\frac{4}{3}.$

$D = \frac{4}{3} + \frac{1}{x}$

$\frac{1}{f} = D_{2\text{л}} \cancel{+} D_1 = D_{\text{сч}} - \frac{4}{3}.$

$D_{\text{сч}} = D_{\text{сч}} - \frac{4}{3} + \frac{1}{x}$

$x = \frac{3}{4}$

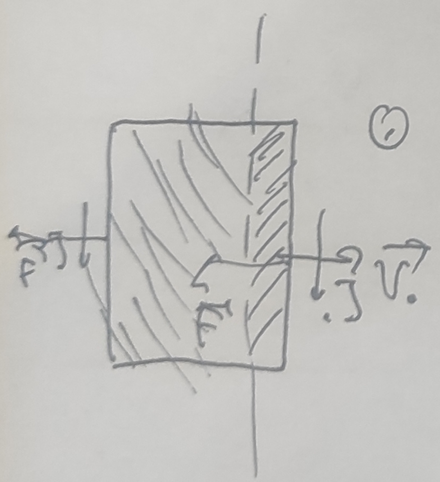
$D' =$

$D' = \frac{1}{f}$

$D_2' = D_1' + 4$

$D_2' - D_1' = 4.$ $\quad \cancel{3}D_1 = 4$

$\frac{D_2}{D_1} = 4$ $\quad D_1 = \frac{4}{3}$ $\quad D_2 = \frac{16}{3}.$



$\cancel{D} + D_1 = \frac{1}{f} + \frac{1}{x}.$ $\quad \frac{1}{f} = D_1 + \cancel{D}.$

$D_1 = -\frac{1}{x} = \frac{4}{3}$

$x = \frac{3}{4} = 0{,}75\ldots$

$J = J_2 + J_1.$

$\mathcal{E}R = \frac{q_1}{C_1} + \frac{q_2}{C_1}$

$0 = \frac{J_1}{C_1} + \frac{J_2}{C_2}$

$J_1 C_2 + J_2 C_1 = 0.$

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Формула тонкой линзы.

$-D_1' = \frac{1}{f} + \frac{1}{d_1}$, $d_1 \to \infty \Rightarrow -D_1' = \frac{1}{f}$

$-D_2' = \frac{1}{f} + \frac{1}{d_2}$, $d_2 = \frac{1}{4} \Rightarrow -D_2' = \frac{1}{f} + 4$.

$\begin{cases} D_2 - D_1 = -4. \\ \frac{D_2}{D_1} = 4 \end{cases} \Rightarrow 3D_1 = -4$ $D_1 = -\frac{4}{3}$

$D_2 = -\frac{16}{3}$.

1) Ответ: $D_1 = -\frac{4}{3}$ (дптр)

[illegible]

№8.

Формула линзы.

$$-D_1 = \frac{1}{f} + \frac{1}{d_1}; \quad -D_2 = \frac{1}{f} + \frac{1}{d_2}.$$

$$d_1 \Rightarrow \infty \Rightarrow$$

$$-D_1 = \frac{1}{f} \Rightarrow -D_2 = -D_1 + \frac{1}{d_2} \Rightarrow \Delta D = \frac{1}{d_2} = \frac{1}{0{,}25} = -4.$$

$$\begin{cases} D_1 - D_2 = -4 \\ \dfrac{D_1}{D_2} = 5 \end{cases} \Rightarrow \quad D_1 = 5D_2$$

$$4D_2 = -4; \quad D_2 = -1.$$

$$D_1 = -5.$$

Формула линзы.

$-D = 1$.

~~Чистовик~~

$D_2 - D_1 = \pm 4.$

$D_2 = 4D_1$

$3D_1 = \pm 4$ $\quad D_1 = -\frac{4}{3}$

$D_2 = -\frac{16}{3}.$

$D = \frac{1}{f} + \frac{1}{x}$

$\frac{4}{3}.$

$D = \frac{4}{3} + \frac{1}{x}$

$\frac{1}{f} = D_{глаз} + D_1 = D_{гл} + \frac{4}{3}.$

$D_{гл} = D_{гл} + \frac{4}{3} + \frac{1}{x}$

$x = \frac{3}{4}$

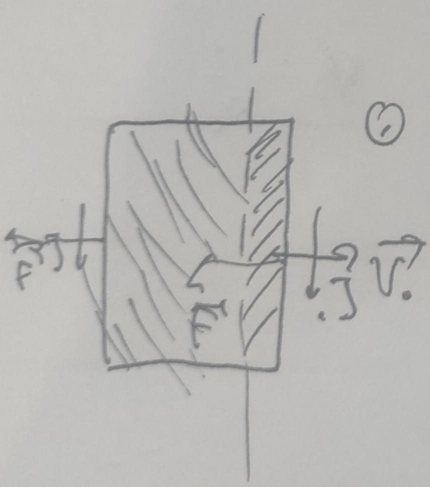
$D' =$

$D' = \frac{1}{f}$

$D_2' = D_1' + 4$

$D_2' - D_1' = 4.$ $\quad 3D_1 = 4$

$\frac{D_2}{D_1} = 4$ $\quad D_1 = \frac{4}{3}$ $\quad D_2 = \frac{16}{3}.$



$D + D_1 = \frac{1}{f} + \frac{1}{x}$ $\quad \frac{1}{f} = D_1 + D.$

$D_1 = -\frac{1}{x} = \frac{4}{3}$

$x = \frac{3}{4} = 0,75\ldots$

$J = J_2 + J_1.$ $\quad \Sigma R = \frac{q_1}{c_1} + \frac{q_2}{c_1}$

$0 = \frac{J_1}{c_1} + \frac{J_2}{c_2}$

$J_1 c_2 + J_2 c_1 = 0.$