Часть 1

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

Шифр: **21200764**

ID профиля: **277206**

Вариант 6

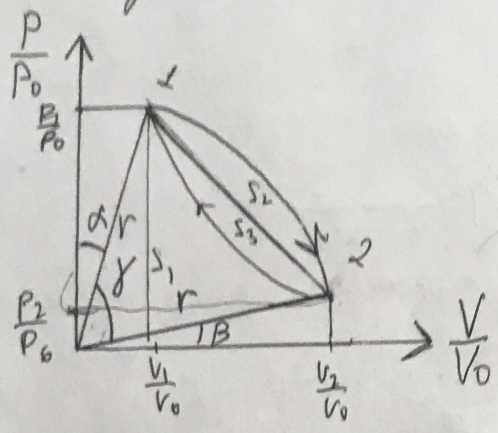
Чистовик

Задача №2

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

$\alpha = 2,5°$

$\beta = 15°$



Используем угол (тк. на окружности)

$\sin\alpha = \frac{\frac{P_1}{P_0}}{r} \Rightarrow P_1 = P_0 r \sin\alpha$

$\cos\alpha = \frac{\frac{P_2}{P_0}\frac{V_1}{V_0}}{r} \Rightarrow V_1 = V_0 r \cos\alpha$

$P_1V_1 = \nu R T_1 = P_0V_0 r^2 \sin\alpha\cos\alpha$

Для точки 2:

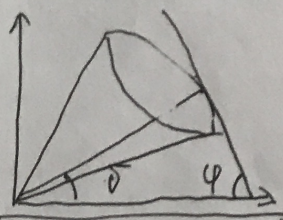
$P_2V_2 = P_0V_0 r^2 \sin\beta\cos\beta = \nu R T_2$

Из этого следует: $\frac{T_1}{T_2} = \frac{\sin\alpha\cos\alpha}{\sin\beta\cos\beta} = \frac{\sin 2\alpha}{\sin 2\beta} = \frac{\sqrt{2}}{2}\cdot\frac{1}{\frac{1}{2}} = \sqrt{2}$

$\delta A = d(PV)$, когда $Q = 0$ $\left|\delta A\right| = \left|dU\right| \Rightarrow d(PV) = \frac{5}{2}\nu R\Delta T$

$\nu R\Delta T = P_1V_1 - P_2V_2$

То есть касательная к точке образует с ОУ $\operatorname{tg}\varphi = \frac{5}{2}$



$\delta = \frac{\pi}{2} - \operatorname{arctg}\frac{5}{2}$

3) $\gamma = 90 - \alpha - \beta$ Вернёмся к исходному рисунку.

$S = S_1 + S_2 + S_3 = \frac{\gamma}{360°}\cdot P_0V_0\pi r^2 = |A_{21}| + A_{\text{цикла}}$

$|A_{21}| = \frac{5}{2}\nu R\Delta T_{12} = \frac{5}{2}\nu R T_2(\sqrt{2}-1) = \frac{5}{2}(\sqrt{2}-1)\cdot P_0V_0r^2\sin\beta\cos\beta$ радиус

Выразим через $P_0V_0r^2$

Теперь найдём работу $A_{12} = \frac{(P_1+P_2)}{2}(V_2 - V_1) = P_0V_0r^2(\sin\alpha + \sin\beta)(\cos\beta - \cos\alpha)$

$A_{\text{цикла}} = \frac{\gamma}{360°}P_0V_0\pi r^2 - \frac{5}{2}(\sqrt{2}-1)P_0V_0r^2\sin\beta\cos\beta$

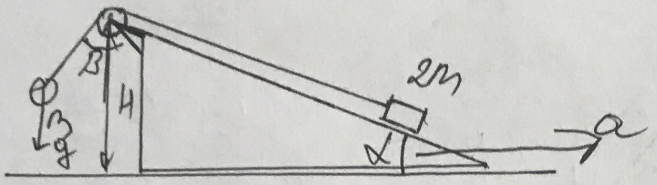
$X = \frac{A_{21}}{A_{12}} = \frac{\frac{\pi\gamma}{360°} - \frac{5}{2}(\sqrt{2}-1)\sin\beta\cos\beta}{(\sin\alpha+\sin\beta)(\cos\beta-\cos\alpha)} =$

$\approx$ 1,4

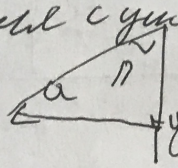
Задача №1 Условия

$\cos\beta = \frac{12}{13}$

$\sin\alpha \cos\alpha = 4\tau \frac{4}{5}$



Из-за того, что клин движется с ускорением, нить образовал угол B

1) 

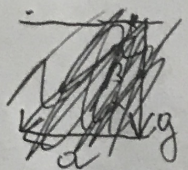
$tg\beta = \frac{a}{g}$

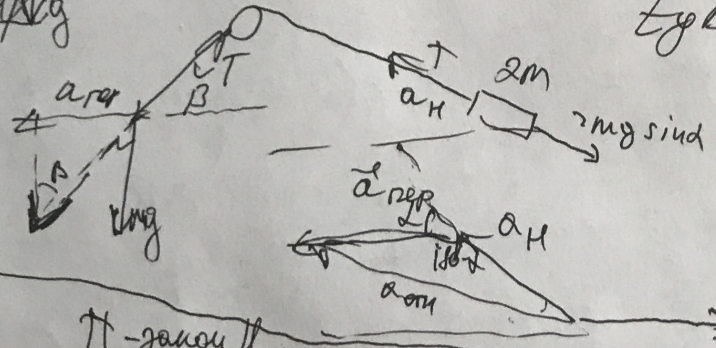
$a = tg\beta\, g$

$\sin\beta$ ~~$tg\beta = \frac{}{}$~~

$\sin\beta = (1-\cos^2\beta)^{\frac{1}{2}} = \frac{5}{13}$

$tg\beta = \frac{5}{12} \Rightarrow a = \frac{5}{12} g$



2) 

$a_{отн}^2 = a_н^2 + a_п^2 + 2a_н a_п \cos\alpha$

II-закон Ньютона для грузов

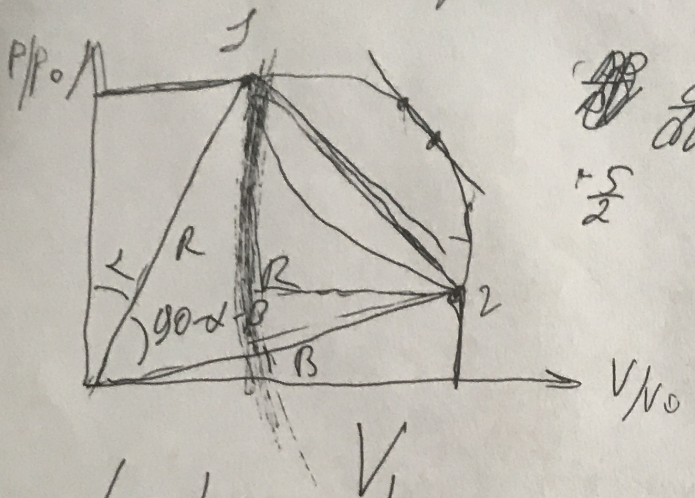
$$\begin{cases} 2ma_н = T - 2mg\sin\alpha \\ mg\cos\beta + mg\frac{a}{g\sin\beta} - T = ma_н \end{cases}$$

$a_н = \frac{629}{2340} g$ $a_{отн} = (a_н^2 + a^2 + 2a_н a\cos\alpha)^{\frac{1}{2}} \approx 0{,}65g$

$T = a_y\sqrt{\frac{2H}{a_y}}$ $a_y = a_н \cos\beta$ $T = \sqrt{\frac{2H}{\frac{629}{2340} g \cdot \frac{12}{13}}} =$

$= \varphi = \sqrt{\frac{H}{g}\frac{5070}{629}}$

Чертёж



$\frac{90-\alpha-\beta}{360} \cdot \pi R^2 = S$

$\frac{5}{2} \nu R (T_2 - T_1) = A_{12}$

$PV = \nu RT$ $(P_1V_1 - P_2V_2)$

$\sin\alpha = \frac{V_1}{R}$ $\cos\alpha = \frac{P_1}{R}$

$\sin\beta = \frac{P_2}{R}$

$tg\alpha = \frac{V_1}{P_1}$

$tg\beta = \frac{P_2}{V_2}$

$P_2V_2 = \nu RT_2$

$P_1V_1 = \nu RT_1$ $R^2 = \frac{2\nu RT_1}{\sin 2\alpha}$

~~$P_2 = V_2 tg\beta$~~

$\sin\alpha \cos\alpha R^2 = \nu RT_1$

$\sin\beta\cos\beta R^2 = \nu RT_2$

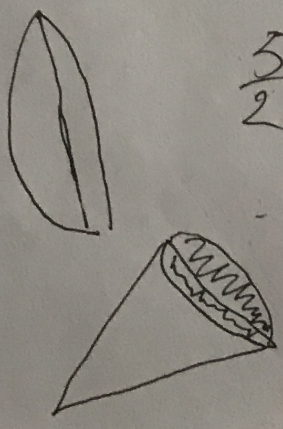
$\frac{\sin\alpha\cos\alpha}{\sin\beta\cos\beta} = \frac{\sin 2\alpha}{\sin 2\beta} = \frac{\sin 45^\circ}{\sin 30^\circ} = \frac{\sqrt{2}}{2 \cdot \frac{1}{2}} = \sqrt{2}$

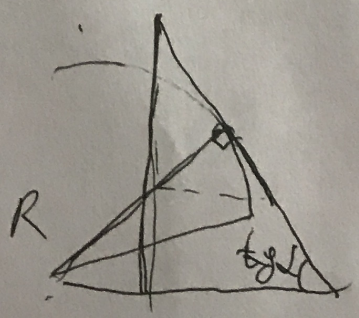
$\Delta Q = 0$

$\Delta U = -A$

PV $d(PV)$ – положительно

$\frac{5}{2}$



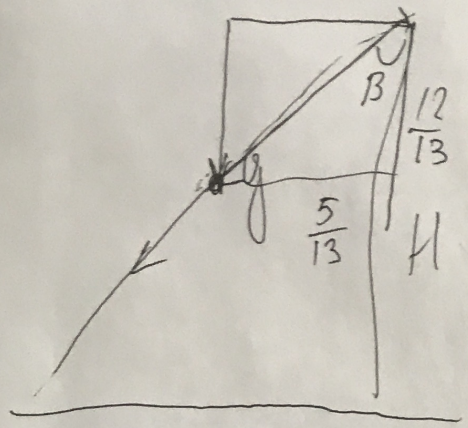


$tg\alpha = +\frac{5}{2}$

90° $\frac{\pi}{2} - arctg\frac{5}{2}$

Черновик

144 169



$\frac{5}{13}$

~~$5a = 12g$~~

$\frac{5}{12} = \frac{a}{g}$

$5g = 12a$

$a = \frac{5}{12}g$

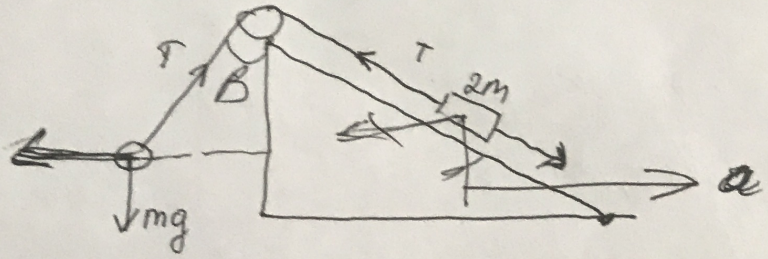
$\frac{13}{12}g$

$\frac{H}{\cos\beta} = \frac{\frac{13}{12}gt^2}{2}$

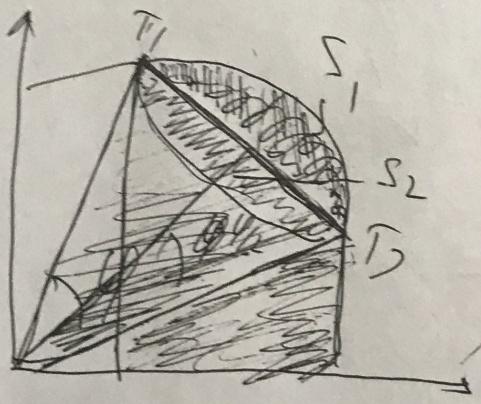
$\frac{H}{12}\cancel{13} = \frac{gt^2}{2}\cancel{\frac{13}{12}}$

~~$\frac{2H}{g} = t^2$~~

Черновик



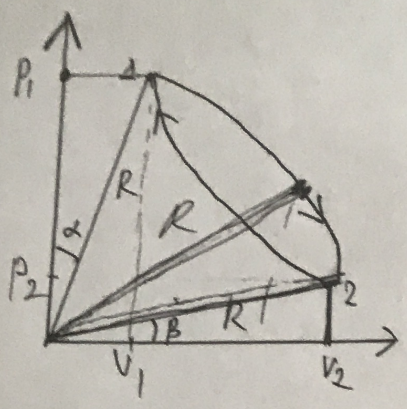
~~mg - Tcosβ = ma~~



$\varphi = 90 - \alpha + \beta \approx 26{,}25$

$\frac{\varphi}{360} \cdot \pi r^2 = A_2$

Черновик



1) $P_1V_1 = \nu RT_1$

$P_2V_2 = \nu RT_2$

$P_1 = R\sin\alpha$

$V_1 = R\cos\alpha$ $\Rightarrow P_1V_1 = R^2\frac{\sin 2\alpha}{2} = \nu RT_1$

$P_2 = R\sin\beta$

$V_2 = R\cos\beta$ $\Rightarrow P_2V_2 = R^2\frac{\sin 2\beta}{2} = \nu RT_2$

$$\frac{T_1}{T_2} = \frac{\sin 2\alpha}{\sin 2\beta} = \frac{1}{\sqrt{2}\cdot\frac{1}{2}\sqrt{2}} = \underline{\sqrt{2}}$$

2) $Q = 0$

~~до~~ $d\varphi R^2 = \delta A$ $\quad dU = \frac{5}{2}\nu R\Delta T$

$d\varphi R^2 = \frac{5}{2}\nu R\,dT$

$$\frac{5\nu R}{2r^2} = \frac{d\varphi}{dT}$$

$$\frac{5\nu R}{2r^2}(T - T_2) = \varphi \qquad \varphi R\sin\varphi\cos\varphi = \nu RT$$

$$T = \frac{R^2\sin\varphi\cos\varphi}{\nu R}$$

$T =$

$$\frac{5\nu R}{2\nu^2}\cdot\frac{R^2\sin\varphi\cos\varphi}{\nu R} - \frac{\nu^2\sin\beta\cos\beta}{\nu R}$$

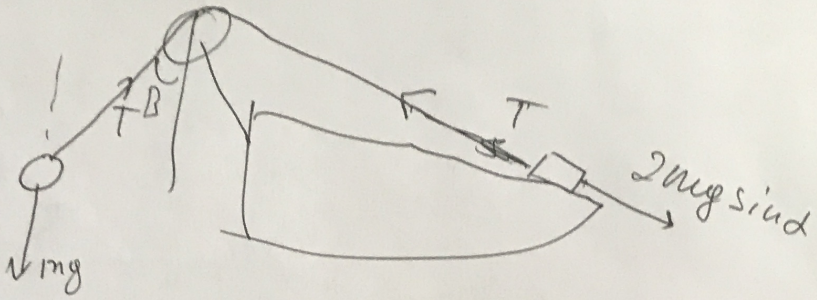
$$\frac{5}{2}(\sin\varphi\cos\varphi - \sin\beta\cos\beta) = \varphi$$

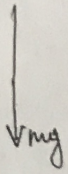
$$\frac{5}{2}\varphi - \frac{5}{4}\sin 2\beta = \varphi$$

$$\frac{3}{2}\varphi = \frac{5}{4}\sin 2\beta \qquad \varphi = \frac{5}{6}\sin 2\beta = \frac{5}{6}\cdot\frac{1}{2} =$$

$$= \frac{5}{12}\text{ рад}$$

Черновик





$ma = mg - T$

$2ma = T - 2\frac{6}{5}mg$

$ma = mg - 2ma + \frac{6}{5}mg$

$3ma = \frac{11}{5}mg$

$a = \frac{11}{15}g$

$\frac{25}{144} + \frac{144}{144} > \frac{13}{12}g$

$2ma = T - \frac{6}{5}mg$

~~AA~~ $\frac{12}{18}mg + \frac{13}{12}mg - T = ma$

$\frac{144+169}{12\cdot 13}mg - 2ma - \frac{6}{5}mg = ma$

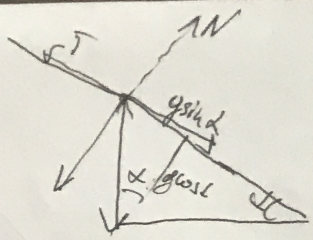
$\frac{2}{\frac{629}{195\cdot 13}}$ $3ma = mg\left(\frac{313}{156} - \frac{6}{5}\right) = \frac{1565-926}{780} = \frac{629}{780}$

~~0,269~~ $\frac{629}{2340}g$

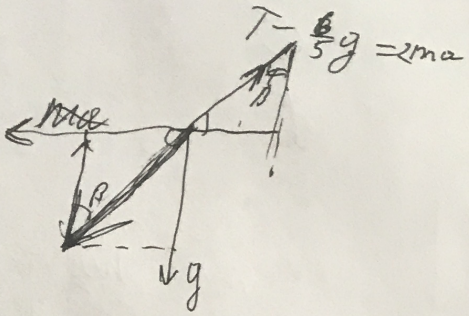
0,246 0,425

Черновик

Задача 1



$$P_2(V_2-V_1)+\frac{(P_1-P_2)(V_2-V_1)}{2}$$

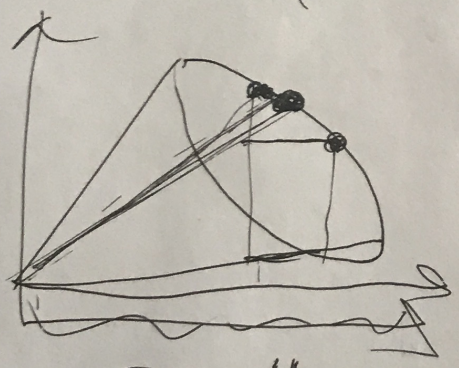


$$P_2V_2-P_2V_1+\frac{P_1V_2}{2}-\frac{P_1V_1}{2}-\frac{P_2V_2}{2}+\frac{P_2V_1}{2}$$

$$\frac{P_2V_2}{2}-\frac{P_2V_1}{2}+\frac{P_1V_2}{2}-\frac{P_1V_1}{2}$$

$$ma = T-\frac{mg}{\cos\beta} = 2ma+\frac{6}{5}mg-mg\frac{13}{12}$$

$$\frac{P_2}{2}(V_2-V_1)+\frac{P_1}{2}(V_2-V_1)\quad \frac{(P_1+P_2)}{2}(V_2-V_1)\quad a = \frac{13}{12}-\frac{6}{5}$$



$$\Delta T\cdot\frac{5}{2}=\Delta U \quad P\Delta V$$

$$R_1\quad P_2\Delta V+\frac{(P_1-P_2)\Delta V}{2}=$$

$$\Delta V$$

$$\frac{P_1\Delta V}{2}+\frac{P_2\Delta V}{2}=$$

$$=\frac{(P_1+P_2)}{2}\Delta V = P\Delta V$$

$$\delta A = d(PV)$$

$$VRT_2 = P_0 r^2 \sin\beta$$

$$T\sin\alpha \cdot P_0 r(\sin\alpha+\sin\beta)\cdot rV_0(\cos\beta-\cos\alpha) = P_0V_0r^2(\sin\alpha+\sin\beta)(\cos\beta-\cos\alpha)$$

0,2 0,966

0,383 0,642 $-0,255849$

0,042 0,6 0,027

Часть 2

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

Шифр: **21200764**

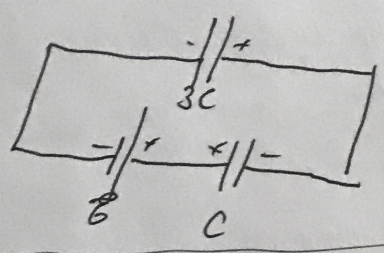
ID профиля: **277206**

Вариант 6

Чистовик

Задача №3

б) До замыкания:

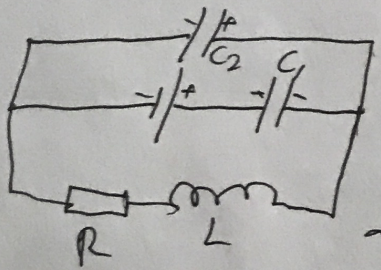


$$\mathcal{E} = \frac{q_0}{C} + \frac{q_0}{3C} = \frac{q_0}{C}\left(\frac{4}{3}\right)$$

$$q_0 = \frac{3}{4}C\mathcal{E}$$

После замыкания:

1)



$$Li = \frac{q_0}{3C} = \frac{3}{4}C\mathcal{E}\frac{1}{3C} = \frac{\mathcal{E}}{4}$$

$$i = \frac{\mathcal{E}}{4L}$$

2) Когда всё установится, то $U_L = 0$, $U_{C_2} = 0$ и $I_C = 0$, т.к. иначе на резисторе будет ноль ток.

$$\mathcal{E} = \frac{q_1}{C} \quad q_1 = C\mathcal{E}$$

ЗСЭ:

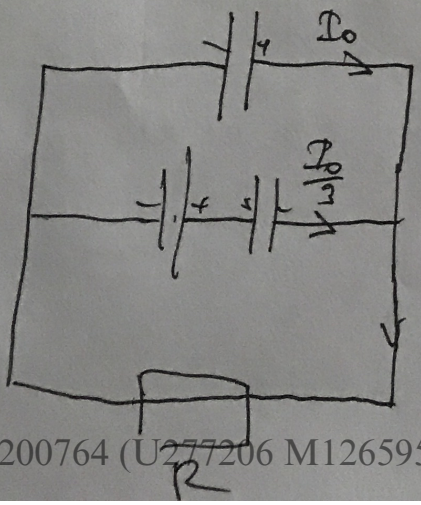
$$\frac{q_0^2}{2C} + \frac{q_0^2}{2\cdot 3C} + \mathcal{E}(C\mathcal{E} - q_0) = Q + \frac{q_0^2}{2C}$$

$$\frac{9}{32}C\mathcal{E}^2 + \frac{3}{32}C\mathcal{E}^2 + \frac{8C\mathcal{E}^2}{32} = Q + \frac{16}{32}C\mathcal{E}^2$$

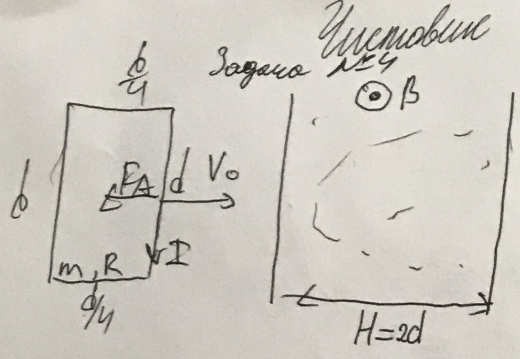
$$Q = \frac{4}{32}C\mathcal{E}^2 = \frac{1}{8}C\mathcal{E}^2$$

3) $I_0 = -\dot{q}_2$ $\quad \frac{\mathcal{E} + q_1}{C} = \mathcal{E} = \frac{q_1}{C} + \frac{q_2}{3C}$ $\quad \dot{\mathcal{E}} = -\frac{I_1}{C} + \frac{I_2}{3C} = 0$

$$I_1 = -\frac{I_0}{3}$$



$$U_R = \frac{4}{3}I_0 R$$



После того, как правая сторона рамки попадет в магнитное поле, на неё начинает действовать сила Ампера, вследствие чего появляется и сила Ампера, как. как появляется $\mathcal{E}_i = BVd$, $I = \frac{BVd}{R}$ на правую сторону рамки

Найдем силу Ампера $F_A = BId = \frac{(Bd)^2 V}{R}$, до того, как в поле не вошла левая сторона рамки, рамка двигается равно с ускорением.

$$m|a| = |F_A| \quad |a| = \frac{(Bd)^2 V_0}{mR}$$

F_A будет замедлять рамку

II-закон Ньютона:

$$\frac{dV}{dt} = -\frac{(Bd)^2}{mR} V$$

$$dV = -\frac{(Bd)^2}{mR} V dt$$

$$\int_{V_0}^{V_1} = -\frac{(Bd)^2}{mR} \int_0^{\frac{d}{4}} dl$$

$$V_1 = V_0 - \frac{B^2 d^3}{4mR}$$

$V_2 = V_0$, т.к. левая рамка будет двигаться с тем же ускорением

Читовник.

Задача №5

$F_1 = 25$ см

$\frac{D_1}{D_2} = \frac{7}{3}$

2) $D_{o_1} = \frac{1}{F_1} = 4$ дптр

У нормального человека $D = 18$ дптр $\Rightarrow$

$D_{линз} = D - D_{o_1} = -3$ дптр, тогда $D_{дальнозр} = -4$ дптр

$X < 25$ см

г) $F_2 = 50$ см $D_{o_2} = 2$ дптр нужны очки $D'_{линз} = D_{o_2} - D_{o_1}$

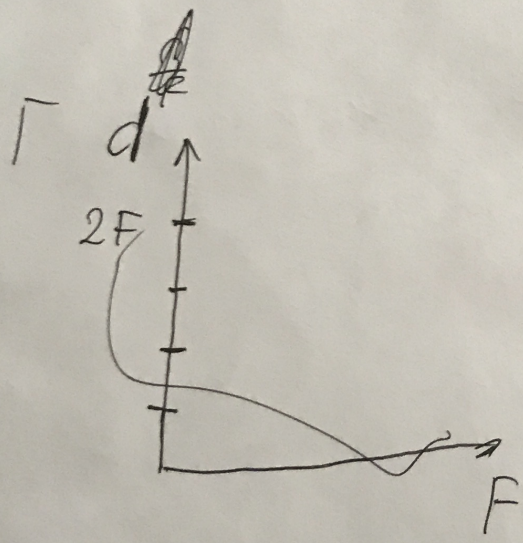
~~$D_{o_1} - D_{o_2}$~~ $= 2$ дптр

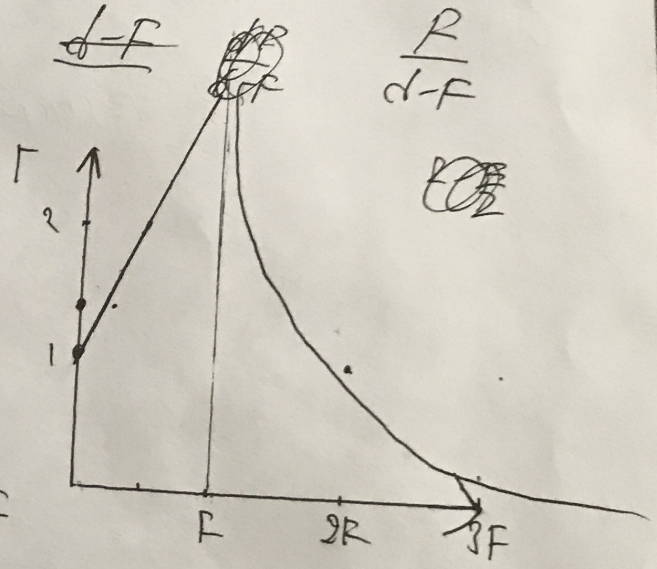
Черновик

~~F = 50~~

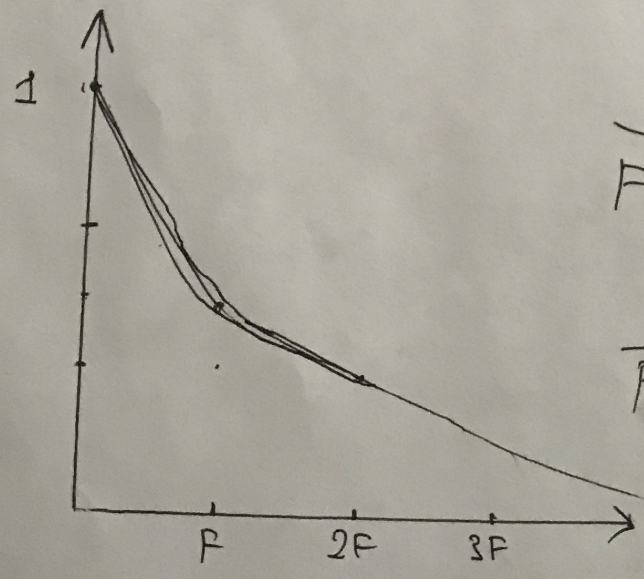
4 дптр

D = 2 − 2 дптр





$\frac{F}{d-F}$



$$\frac{1}{F} = \frac{1}{\frac{F}{2}} + \frac{1}{f}$$

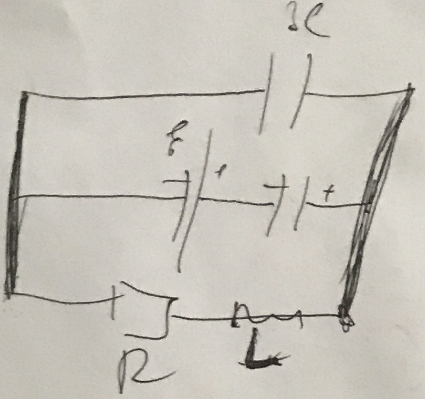
$$\frac{1}{F} = \frac{2}{F} + \frac{1}{f} \qquad \frac{1}{F} = -\frac{1}{F}$$

F > F

$$-\frac{1}{F} = \frac{1}{d} + \frac{1}{f} \qquad -\left(\frac{dF}{d+F}\right)$$

$$\frac{dF}{d+F} = F$$

Черновик



$LI = \mathcal{E}$

$\dot{I} = \frac{\mathcal{E}}{L}$

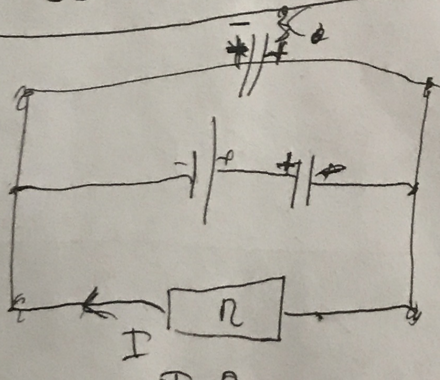
$\frac{q}{C} = \mathcal{E}$ $\mathcal{E} = \frac{q_0}{3C}$

$q_0 = 3C\mathcal{E}$

~~$C\mathcal{E} \cdot \mathcal{E}(C\mathcal{E} - 0) = Q + \frac{C\mathcal{E}^2}{2} + \frac{LI^2}{2}$~~

$\frac{\mathcal{E}}{L} = \dot{I}$

$\frac{q_1}{3C} = IR$



$IR = \frac{q_2}{3C}$

$IR = \frac{q_1}{C} + \mathcal{E}$

$I_0 R = \frac{q_2}{3C}$

$\mathcal{E}\left(\frac{3}{2}C\mathcal{E} - \ldots\right)$

$\frac{3}{2}C\mathcal{E}$

$\frac{q}{3C} = \frac{3q}{3C} + \mathcal{E}$

$\frac{C\mathcal{E}^2}{2} - \frac{3}{2}C\mathcal{E} = \ldots$

$\frac{4q}{3C} = \mathcal{E}$

$IR = \frac{q}{3C} = \frac{3}{4}C\mathcal{E} \cdot \frac{1}{3C}$

$q = \frac{3}{4}C\mathcal{E}$

$I = \frac{\mathcal{E}}{4R}$

$\frac{2?}{16}C\mathcal{E}^2 = \frac{L}{2}\frac{\mathcal{E}^2}{16R^2} + \frac{\frac{9}{16}C\mathcal{E}^2}{2} +$

$q = \frac{3}{4}C\mathcal{E}$

$\frac{3}{16}C\mathcal{E}^2 - \frac{L}{2}\frac{\mathcal{E}^2}{16R^2}$ $\frac{3}{16}\frac{C\mathcal{E}^2}{2}$

$\mathcal{E}^2\left(\frac{3}{4}C - \frac{L}{32R^2}\right)$

$2q\mathcal{E} = A_{\mathcal{E}} = \frac{3}{2}C\mathcal{E}^2$

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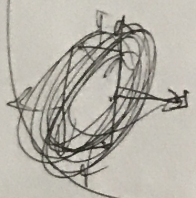
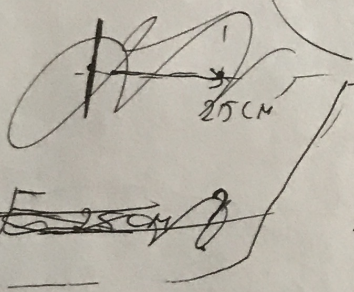
Чертежик

D = 1 дптр $F_н$ = 1 м

$F_{л.п}$





$\frac{D_1}{D_2} = \frac{7}{3}$

$D_л$ = 4 дптр D_1 = −7 дптр

−3 дптр =

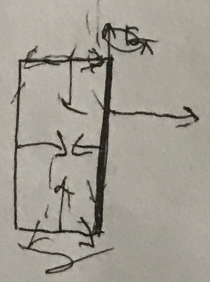
$BVd = \mathcal{E}_i$

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

$(V_2 - V_1) = \frac{(Bd)^2}{mR} \frac{B^2 d^2}{4mR}$

$V_2 = V_1 + \frac{B^2 d^3}{4mR} = V_0$

$BIL = F_A$



$F_{A_1} = \frac{Bd \cdot BdV}{R} = \frac{(Bd)^2 V}{R}$

$F_{A_2} = \frac{B^2 d^2 V}{R} = \frac{(Bd)^2 V}{4R} = \frac{F_{A_1}}{4}$

$\frac{(Bd)^2 V_0}{mR} =$

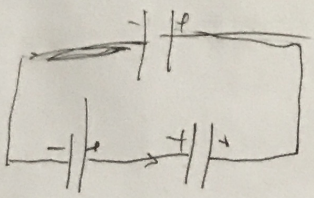
$m \frac{dV}{dt} = -\frac{(Bd)^2}{R} V$

$m\, dV = -\frac{(Bd)^2}{mR} V dt =$

$V_1 - V_0 = -\frac{(Bd)^2}{mR} \frac{d}{4}$

$V_1 = V_0 - \frac{B^2 d^2}{4mR}$

Черновик



$\frac{12}{32} + \frac{8}{32} - \frac{16}{32} =$

$= \frac{4}{32} = \frac{1}{8} C\mathcal{E}^2$

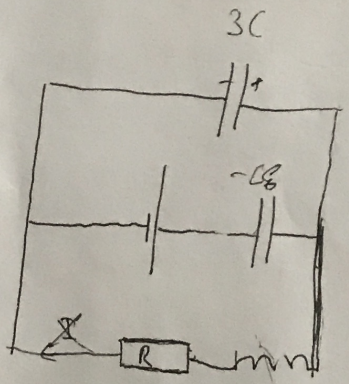
$\mathcal{E} = \frac{q}{C} + \frac{q}{3C}$

$\frac{q}{C} \left| 1 + \frac{1}{3} = \frac{4}{3} \frac{q_0}{C} \right.$

$q_0 = \frac{3}{4} C\mathcal{E}$

$\frac{q_0}{3C} = Li$

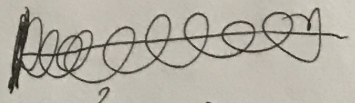
$I = \frac{q_0}{3LC} = \frac{3C\mathcal{E}}{8LC} = \frac{\mathcal{E}}{4L}$



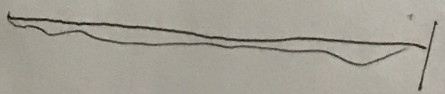
$\frac{q_к}{3C} = \mathcal{E} = IR$

$I = \frac{\mathcal{E}}{R}$

$q_к = 3C\mathcal{E} + C\mathcal{E}$



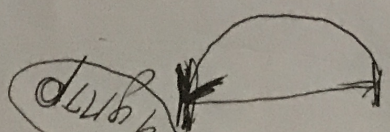
$\left(C\mathcal{E} - \frac{3}{4}C\mathcal{E}\right)\mathcal{E}^2 + \frac{q_0^2}{2C} + \frac{q_0^2}{2 \cdot 3C} = Q + \frac{q_к^2}{2C}$



$\frac{C\mathcal{E}^2}{4} + \frac{9C\mathcal{E}^2}{32} + \frac{3C\mathcal{E}^2}{16} = Q + \frac{C\mathcal{E}^2}{2}$

$\frac{12}{32} + \frac{1}{4}$

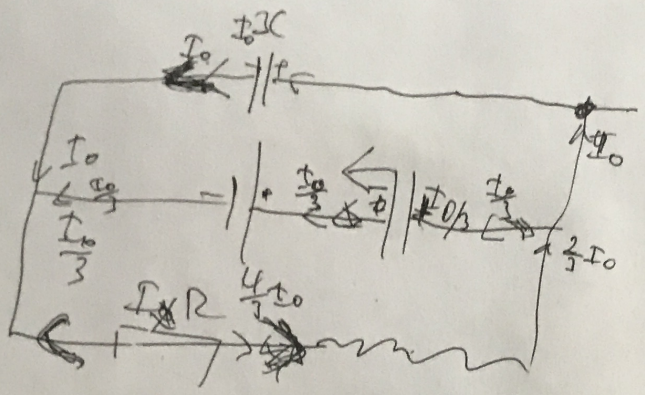
$\left(\frac{12}{32} + \frac{1}{4}\right) \frac{3}{2} C\mathcal{E}^2 = Q + \frac{1}{2} C\mathcal{E}^2$



Черновик

А) $U_L = 0$

$I_L > 0$



$$\mathcal{E} + \frac{q_1}{C} = IR + L\dot{I} = \frac{q_2}{3C}$$

$$\mathcal{E} + \frac{I_1}{C} = \frac{I_0}{3C}$$

$$I_1 = \frac{I_0}{3}$$

$\frac{2}{3}\mathcal{E}$ или $\frac{4}{3}\mathcal{E}$

$$150^4 + 50^4 = \frac{2^4 30^4}{3} = \frac{150^4}{3} = 50^4$$ на 1 ход.

$$\frac{q_2}{3C} + \mathcal{E} + \frac{q_1}{C} = 0$$

$$\frac{I_2}{3} = -\frac{I_1}{3}$$