Часть 1

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

Шифр: **21200013**

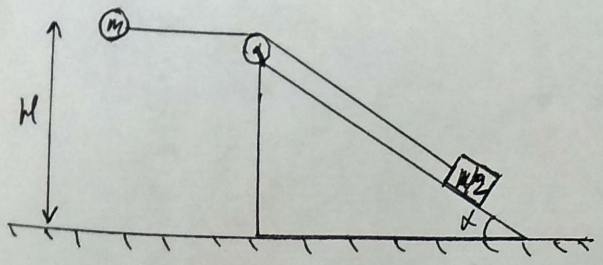
ID профиля: **900184**

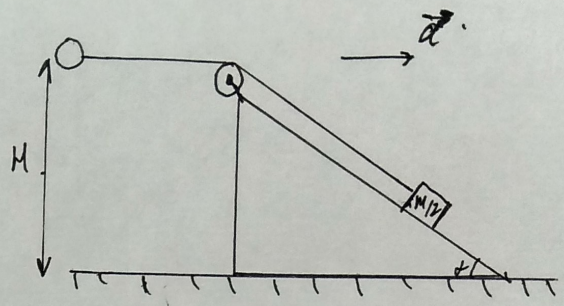
Вариант 7

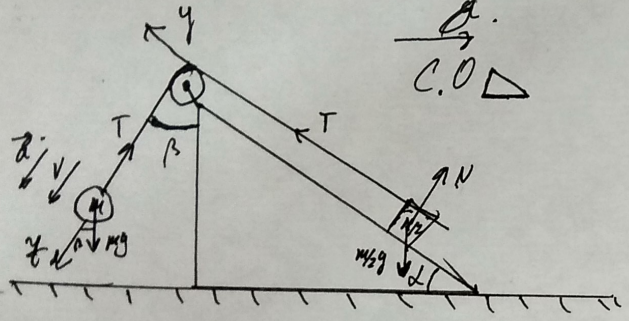
1) $a - ?$
2) $a_{m/2 \text{ отн}} - ?$
3) $t - ?$

Черновик №1

$\cos\alpha = 5/13$. $\cos\beta = 3/5$.







$\vec{a}$.

С.О

1) $mg\cdot\cos\beta - T_1 = ma_1$. (ОХ)
2) O_y: $T_2 - \frac{mg}{2}\sin\alpha = \frac{ma_2}{2}$ } +.

Т.к. нить нерастяжима, невесома:

$T_1 = T_2$; $a_1 = a_2$.

$mg\cos\beta - \cancel{T} + \cancel{T} - \frac{mg}{2}\sin\alpha = 1{,}5\,ma$.

$\cancel{m}g\left(\cos\beta - \frac{\sin\alpha}{2}\right) = 1{,}5\cancel{m}a$.

$g\left(\cos\beta - \frac{\sin\alpha}{2}\right) = 1{,}5\,a$.

$a = \frac{g\left(\cos\beta - \frac{\sin\alpha}{2}\right)}{1{,}5}$

$a = \frac{10\left(\frac{3}{5} - \frac{12}{2\cdot 13}\right)}{1{,}5} = \frac{10\left(\frac{39-30}{13\cdot 5}\right)}{1{,}5}$

$a = \frac{10\cdot\frac{9}{13\cdot 5}}{1{,}5} = \frac{\overset{30}{\cancel{90}}}{13\cdot 5}\cdot\frac{2}{\cancel{3}} = \frac{60}{13\cdot 5} =$

$= 0{,}92$ м/с.

10 · 3/5.

$\cos\alpha = \frac{5}{13}$.

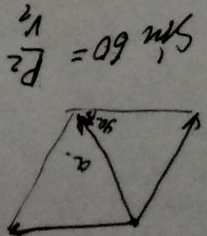
$\cos^2\alpha + \sin^2\alpha = 1$

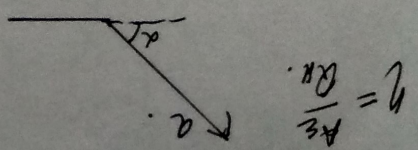
$\sin^2\alpha = 1 - \cos^2\alpha$

$\sin\alpha = \sqrt{1 - \frac{25}{169}}$.

$\sin\alpha = \sqrt{\frac{169-25}{169}} = \frac{\sqrt{144}}{13} = \frac{12}{13}$

13 × 13 = 169



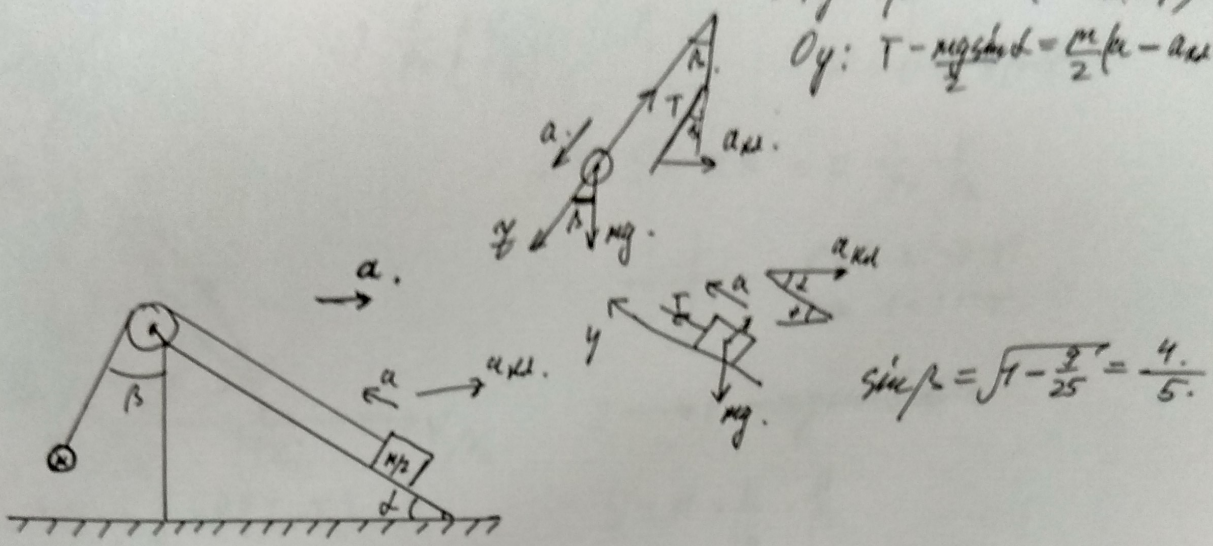


Черновик

$\cos\beta = 3/5 \quad \cos\alpha = 5/13$

Ox: $mg\cos\beta - T = m(a - a_{отн}\sin\beta)$

Oy: $T - \frac{mg\sin\alpha}{2} = \frac{m}{2}(a - a_{отн}\cos\alpha)$

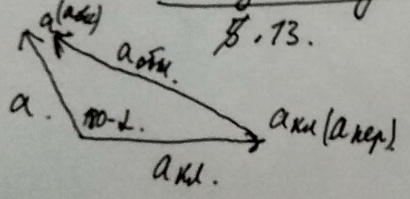


$\sin\beta = \sqrt{1 - \frac{9}{25}} = \frac{4}{5}$

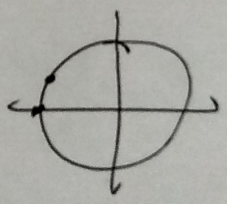
$$\begin{cases} \frac{3}{5}mg - T = ma - ma_{отн}\cdot\frac{4}{5} \\ T - \frac{mg}{2}\cdot\frac{12}{13} = \frac{m}{2}a - \frac{m}{2}a_{отн}\cdot\frac{5}{13} \end{cases} +$$

$$\frac{3}{5}mg - \frac{6}{13}mg = 1{,}5ma - ma_{отн}\cdot\frac{4}{5} - \frac{ma_{отн}\,5}{26}$$

$$\frac{39g - 30g}{5\cdot 13} = 5\cdot\frac{3}{2}a - \frac{26\cdot 4\,a_{отн} + 25\,a_{отн}}{26\cdot 5}$$



$\cos\alpha = \frac{5}{13} \qquad \cos(180-\alpha) = -\cos\alpha.$



Th cos: $a_{отн}^2 = a_{отн}^2 + a^2 + 2aa_{отн}\cdot\frac{5}{13}$

$$\frac{9}{13}g = \frac{15}{2}a - \frac{129a_{отн}}{26}$$

$$\frac{129a_{отн}}{26} = \frac{15a}{2} - \frac{90}{13} = \frac{195a - 180}{26}$$

$$129a_{отн} = 195a - 180.$$

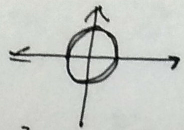
$mg\cos\beta - T = m(a - a_{отн}\sin\beta)$

$T - \frac{mg\sin\alpha}{2} = \frac{m}{2}(a - a_{отн}\cos\beta).$

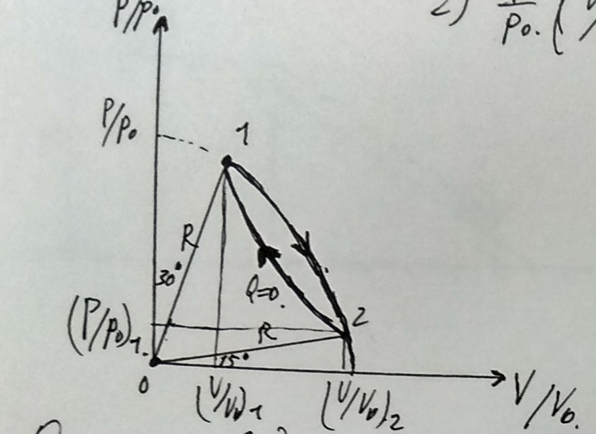
$i = 3.$ Черновик

1) $\frac{T_1 - T_2}{T_2}$ -? №2. 3) η -?

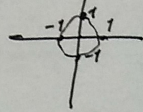
2) $\frac{p}{p_0}\left(\frac{V}{V_0}\right)$ p



~~$R^2 = (1-y)^2 + (1-x)^2$~~



$S = \pi R^2 = \pi \frac{p}{p_0} \cdot \frac{V}{V_0}$



$R^2 = (1-x)^2 + (1-y^2)$

$1 = 1 + 1 - y^2$

$2 \longrightarrow 1$ — адиабата.

$Q_{21} = 0 = \frac{3}{2}\nu R(T_1 - T_2) + A.$

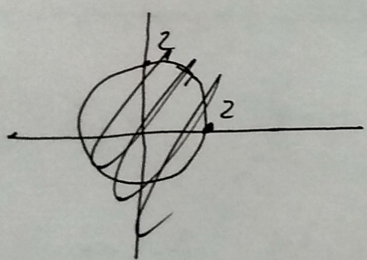
$S = \pi \cdot \frac{V}{V_0} \cdot \frac{p}{p_0}$

$\frac{\Delta p}{p} + \frac{\Delta V}{V} = \frac{\Delta T}{T}$

$(p + p_0)(V + V_0) = \nu R(T + T_0)$

$R^2 = (1 - x^2) + (1 - y^2)$ $R^2 = (1-x)^2 + (1-y)^2.$

~~$4 = 1 - 4 + 1 = 4$~~ $4 = (1-2)^2 + (1-2)^2.$



$4 = (1-x)^2 + (1+y^2)$

$4 = 1 + 1 - 2y + y^2$

$2 = -2y + y^2.$

$\frac{1}{4}\pi\frac{\nu RT}{V_0 p_0}$

$90 - 45.$

$Q_\Sigma =$ ~~Q~~ $\cdot Q_\Sigma =$

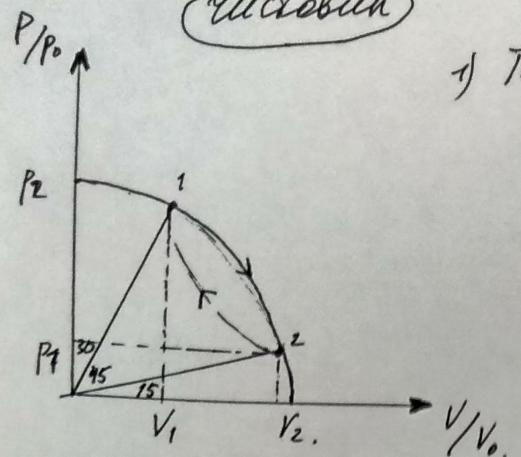
$Q = 0 = \frac{3}{2}\nu R(T_1 - T_2) + S_{тр}.$ $S = \pi R^2.$

$\frac{p(V)}{p_0} = \frac{\nu RT \cdot V_0}{V p_0} = \frac{\nu RT}{V} \cdot const.$

$\frac{p(V)}{p_0} = \frac{\nu RT V_0}{V p_0}.$ $p_0; V_0$ - const.

Чистовик

№2.



1) По усл. процесс 2→1 – адиабата. ($Q_{21}=0$)

$p(V)=\frac{\nu RT}{V}$, $\frac{p}{V_0}\left(\frac{V}{V_0}\right)=\frac{\nu RT}{VV_0}$

$\frac{p}{V_0}\left(\frac{V}{V_0}\right)=\frac{\nu RT}{V}$ const.

$Q_{21}=0=\frac{3}{2}\nu R(T_1-T_2)+A_{21}$.

$Q_\Sigma=\Delta U_\Sigma^{=0}+A_\Sigma$.

$pV^\gamma=$ const, $\gamma=\frac{3+2}{3}=\frac{5}{3}$

$pV^{5/3}=$ const.

$p_1V_2^{5/3}=p_2V_1^{5/3}$.

$\frac{p_1}{p_2}=\left(\frac{V_1}{V_2}\right)^{5/3}$.

$S_{уч}=\frac{1}{4}\cdot\pi\frac{V}{V_0}\cdot\frac{p}{p_0}$.

$tg\,15^\circ=\frac{p_2}{V_2}=0{,}27$.

$tg\,60^\circ=\frac{p_2}{V_1}=\sqrt{3}$.):

$\frac{p_1}{V_2}\cdot\frac{V_1}{p_2}=\frac{0{,}27}{\sqrt{3}}=0{,}16$.

$\frac{p_1}{p_2}=\frac{V_2}{V_1}\cdot 0{,}16$.

~~$A_{21}=$~~

Проведём бесконечно малый процесс:

2) $C_\mu=\frac{Q}{\nu\Delta T}$, $\delta Q=\Delta U+A=\frac{3}{2}\Delta(pV)+p\Delta V$

$\delta Q=\frac{3}{2}p\Delta V+\frac{3}{2}V\Delta p+p\Delta V=\frac{5}{2}p\Delta V+\frac{3}{2}V\Delta p$.

~~$(1-p)^2+(1-V)^2=$ const.^{2}~~

~~$0=(1-p)+1)$~~

$1-2p+p^2+1-2V+V^2=$ const^2.

$\sin 60^\circ=\frac{p_2}{p_1}$.

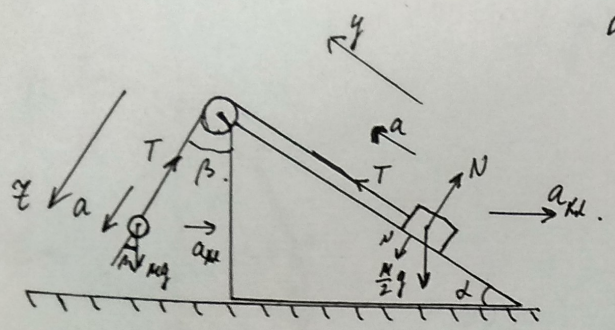
$p(V)=\sin 60^\circ$

$p(V)$

Чистовик

№1

г) Т.к. нить невесома, нерастяжима, то силы натяжения верёвки равны, ускорения грузов (a) равны.



По II з. Н:

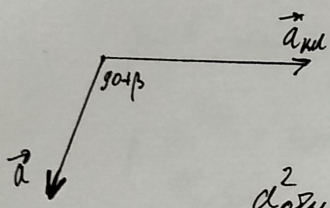
Oz: $mg\cos\beta - T = ma - ma_{кл}\cdot\sin\beta$.

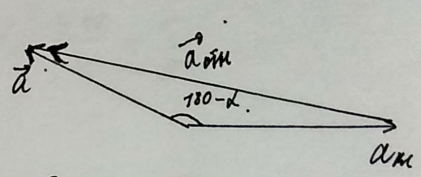
Oy: $T - \frac{mg}{2}\sin\alpha = \frac{m}{2}(a - a_{кл}\cdot\cos\alpha)$

~~$a\cos\alpha = a_{кл}$~~.

$\cos\alpha = 5/13$ $\sin\alpha = \frac{12}{13}$

$\cos\beta = 3/5$ $\sin\beta = 4/5$.





$$\begin{cases} mg\cdot\frac{3}{5} - T = ma - ma_{кл}\cdot\frac{4}{5} \\ T - \frac{mg}{2}\cdot\frac{12}{13} = \frac{m}{2}\left(a - a_{кл}\cdot\frac{5}{13}\right). \end{cases} +$$

$a^2_{отн} = a^2 + a^2_{кл} + 2aa_{кл}\cdot\cos\alpha$.

$a^2_{отн} = a^2 + a^2_{кл} + \frac{5\cdot 2}{13}aa_{кл}$.

$\frac{-12mg}{26} + \frac{3}{5}mg = 1{,}5ma - \frac{4}{5}ma_{кл} - \frac{5}{13}ma_{кл}$.

$g\left(\frac{3}{5} - \frac{12}{26}\right) = 1{,}5a - \left(\frac{4}{5} + \frac{5}{13}\right)a_{кл}$.

$g\left(\frac{26\cdot 3 - 12\cdot 5}{26\cdot 5}\right) = 1{,}5a - \frac{26\cdot 4 + 5\cdot 10}{26\cdot 5}\cdot a_{кл}$.

$g(26\cdot 3 - 12\cdot 5) = 26\cdot 3\cdot 1{,}5a - (26\cdot 4 + 5\cdot 10)a_{кл}$.

Часть 2

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

Шифр: **21200013**

ID профиля: **900184**

Вариант 7

2 линзы

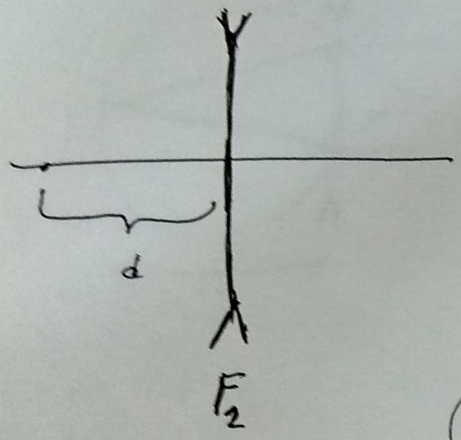
$\frac{D_1}{D_2} = 3$. $\frac{1}{F_1} \cdot \frac{F_2}{1} = 3$ $\frac{F_2}{F_1} = 3$

1) $X - ?$
$D_1 - ?$

Черновик

~~25 см~~

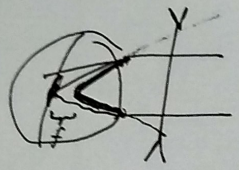
1 — дальн
2 — 25 см.



$d = 25$ см

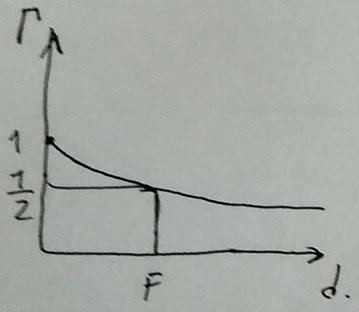
$\frac{1}{F} = +\frac{1}{d} - \frac{1}{f}$. $\frac{1}{f} = \frac{1}{d} + \frac{1}{F} = \frac{F+d}{dF}$.

$\frac{F_2+25}{25F_2} = \frac{1}{f}$ $f = \frac{25F_2}{F_2+25}$.



$f = \frac{25F_2}{F_2+25}$.

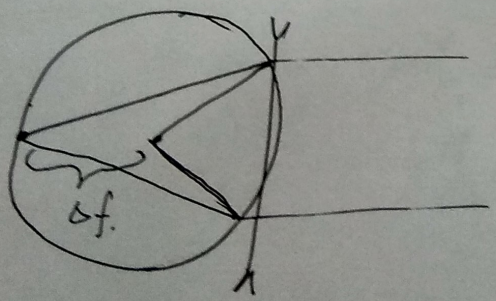
$X = 25 - \frac{25F_2}{F_2+25}$.



$\frac{1}{F} = \frac{1}{d} - \frac{1}{f}$ $d \to \infty$.

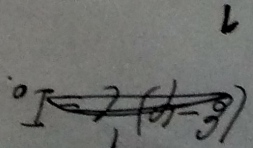
$\frac{1}{F_1} = -\frac{1}{f}$. $\frac{F_1 f}{f F_1} = 0$.

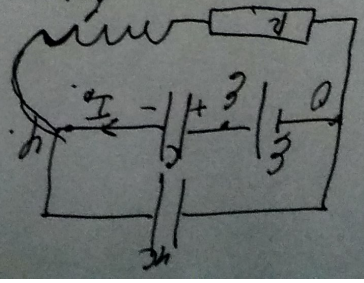
$F_1 + f = 0$



$\Delta f = \frac{25F_2}{F_2+25} = 25$

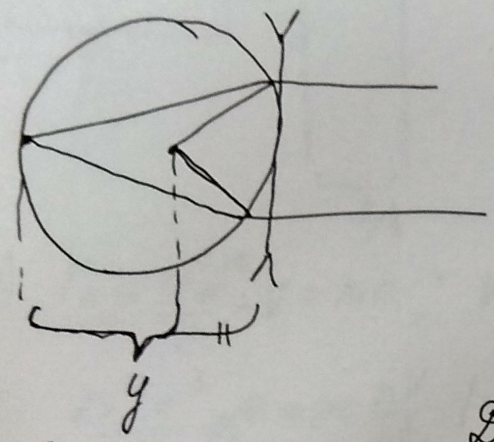
~~$F_2 \cdot 25 + 625 =$~~





Чистовик №5.

Т.к. человек близорукий, то он носит очки с рассеивающими линзами.



1 очки — дать. 2 очки — 25 см.

1) $\frac{-1}{F_2} = -\frac{1}{y} + \frac{1}{25}$.

$\frac{1}{25} = \frac{1}{y} - \frac{1}{F_2}$.

2) $\frac{-1}{F_1} = \frac{-1}{y} + \frac{1}{d}$, $d \to \infty \Rightarrow \frac{1}{d} \to 0$.

$\frac{1}{F_1} = \frac{1}{y} \Rightarrow \frac{1}{F_1} = \frac{1}{25} + \frac{1}{F_2}$.

$\frac{D_1}{D_2} = 3 = \frac{1}{F_1} \cdot \frac{F_2}{1} \Rightarrow 3 \cdot F_1 = F_2. \Rightarrow \frac{1}{F_1} = \frac{1}{25} + \frac{1}{3F_1}$.

Обозначения:
$y = X$

$\frac{1}{25} = \frac{1}{F_1} - \frac{1}{3F_1} = \frac{2}{3F_1} \Rightarrow 50 = 3F_1$

$F_1 = \frac{50}{3}$ см $= \frac{0{,}01 \cdot 50}{3} =$

$= \frac{0{,}5}{3} = \frac{5}{30} = \frac{1}{6}$.

$X = \frac{50}{3}$ см ≈ 16 см

~~$D_1 = \frac{3}{50}$ дптр.~~

$D_1 = 6$ дптр

3) $-\frac{1}{F} = \frac{1}{50} - \frac{1}{y}$

$-\frac{1}{F} = \frac{1}{50} - \frac{3}{50}$.

$-\frac{1}{F} = \frac{-2}{50} \Rightarrow 2F = 50 \Rightarrow F = 25$ см $= 0{,}25$ м.

$D = \frac{1}{0{,}25} = \frac{1}{1} \cdot \frac{4}{1} = 4$ дптр.

Ответ: 1) $D_1 = 6$ дптр 2) $D = 4$ дптр.
$X = 16$ см

3

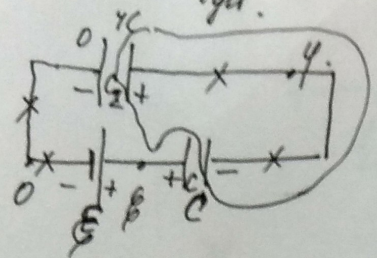
Черновик $C_1 = C$ $C_2 = 4C$. №3

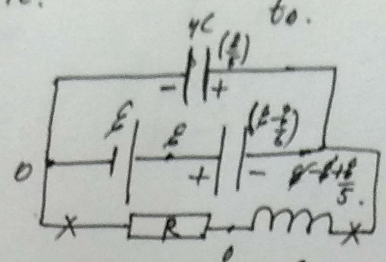
$0 = +4C\cdot(\varphi - 0) - C(\mathcal{E} - \varphi)$

$C\mathcal{E} - C\varphi = 4C\varphi$

$\mathcal{E} = 5\varphi$

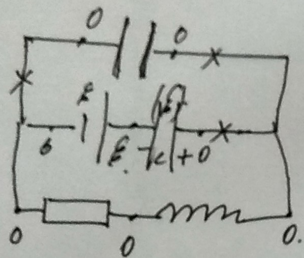
$\varphi = \frac{\mathcal{E}}{5} < \mathcal{E}$.





I' $u = LI'$ $I' = \frac{\mathcal{E}}{5L}$.

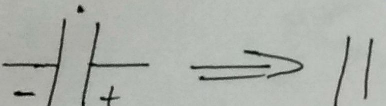
2)



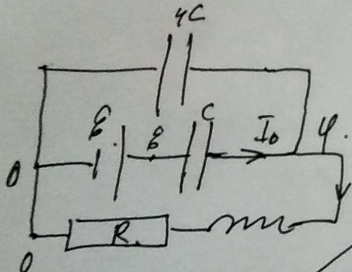
$W_1 = \frac{4C\cdot\frac{\mathcal{E}^2}{25}}{2} + \frac{C\cdot\frac{16}{25}\mathcal{E}^2}{2.} = \frac{\frac{20\mathcal{E}^2}{25}}{2.} = \frac{C4\mathcal{E}^2}{10}$

$W_1 = \frac{4C\mathcal{E}^2}{10.}$ $W_2 = \frac{C\cdot\mathcal{E}^2}{2.}$

$C = \frac{q}{u} \Rightarrow q = u\cdot C$.



$W_1 = \frac{4C\varphi^2}{2} + \frac{(\mathcal{E}-\varphi)^2\cdot C}{2} + \frac{Li_0^2}{2.}$

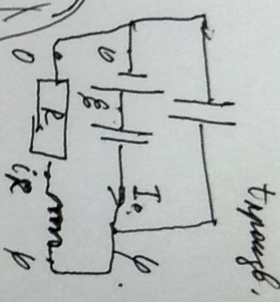


$I_0 = C\cdot\frac{\Delta u}{\Delta t}$

$I_0\tau = C(\mathcal{E} - \frac{4}{5}\mathcal{E})$

$I_0\tau = C\frac{1}{5}\mathcal{E}$

$\tau = \frac{C\mathcal{E}}{5I_0}$.



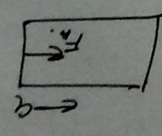
$(\varphi - iR) = L\frac{\Delta I}{\Delta t}$

$\tau(\varphi - iR) = L(i - 0)$

$\tau\varphi - \tau iR = Li$

№5

$a = \frac{\frac{BV_0 d}{R}\cdot B\cdot d}{m} = \frac{B^2 V_0 d}{R\,m}$



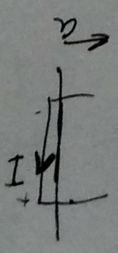
$F_A = m\cdot a$.

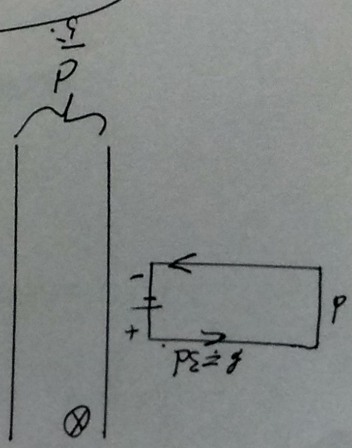
$I = \frac{\mathcal{E}_i}{R} = \frac{BV_0 d}{R}$

$\mathcal{E}_i = B\cdot V_0\cdot d$.

$a_0 - ?$

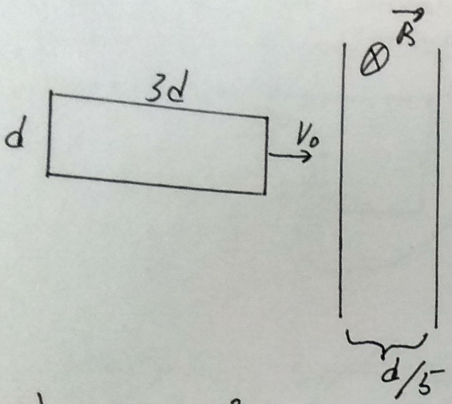
$\ell = 2d$ V_0 R B $\mu = \frac{\ell}{3}$ M.

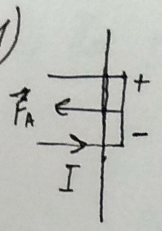




Условие

№4.



1) 

$\mathcal{E}_i = BV_0 d$; $I = \frac{\mathcal{E}_i}{R} = \frac{BV_0 d}{R}$

$F_A = IBd = \frac{B^2 V_0 d^2}{R}$

По II з. Н.: $F_A = ma$

$$\frac{B^2 d^2 V_0}{Rm} = a$$

2) $F_A = \frac{B^2 d^2}{R} \cdot V = ma$; $V \neq const \Rightarrow a \neq const$.

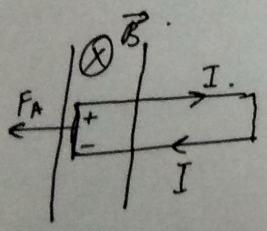
$\frac{B^2 d^2}{R} \Delta V = m \frac{\Delta V}{\Delta t} \mid \cdot \Delta t \Rightarrow \frac{B^2 d^2}{R} \Delta x = m \Delta V$, $\Delta x = \frac{d}{5}$.

Просуммируем соотношение

$\frac{B^2 d^3}{5R} = m(V_1 - V_0) \Rightarrow mV_1 - mV_0 = \frac{B^2 d^3}{5R} \Rightarrow V_1 = \frac{\frac{B^2 d^3}{R \cdot 5} + mV_0}{m}$.

$$V_1 = \frac{B^2 d^3}{5Rm} + V_0$$

3) $F_A = \frac{B^2 d^2}{R} V = m \frac{\Delta V}{\Delta t} \Rightarrow \frac{B^2 d^2}{R} \Delta x = m \Delta V \Rightarrow \frac{B^2 d^2}{R} \Sigma \Delta x = m \Sigma \Delta V$



$\frac{B^2 d^2}{R} \frac{d}{5} = m(V_2 - V_1) \Rightarrow \frac{B^2 d^3}{5R} = mV_2 - mV_1$

$V_2 = \frac{B^2 d^3}{5Rm} + V_1 = \frac{B^2 d^3}{5Rm} + \frac{B^2 d^3}{5Rm} + V_0$

$$V_2 = \frac{2B^2 d^3}{5Rm} + V_0$$

Ответ: 1) $a = \frac{B^2 d^2 V_0}{Rm}$ 3) $V_2 = \frac{2B^2 d^3}{5Rm} + V_0$.

2) $V_1 = \frac{B^2 d^3}{5Rm} + V_0$

25 см. 1-долб. 2-25 мм $\frac{D_1}{D_2} = 3$. $\frac{F_2}{F_1} = 3$

Черновик

долб: $d \to \infty \Rightarrow \Gamma \to 0$. —

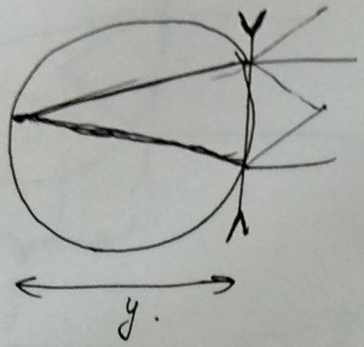
$\frac{1}{F_1} = -\frac{1}{y} + \left(\frac{1}{d}\right) \to 0.$

$\frac{1}{F_2} = -\frac{1}{y} + \frac{1}{d}.$

$\frac{1}{F_2} = -\frac{1}{y} + \frac{1}{25}.$

$\frac{1}{F_1} = -\frac{1}{y} = \frac{1}{F_2} - \frac{1}{25}$

$\frac{1}{F_1} = \frac{1}{F_2} - \frac{1}{25}.$



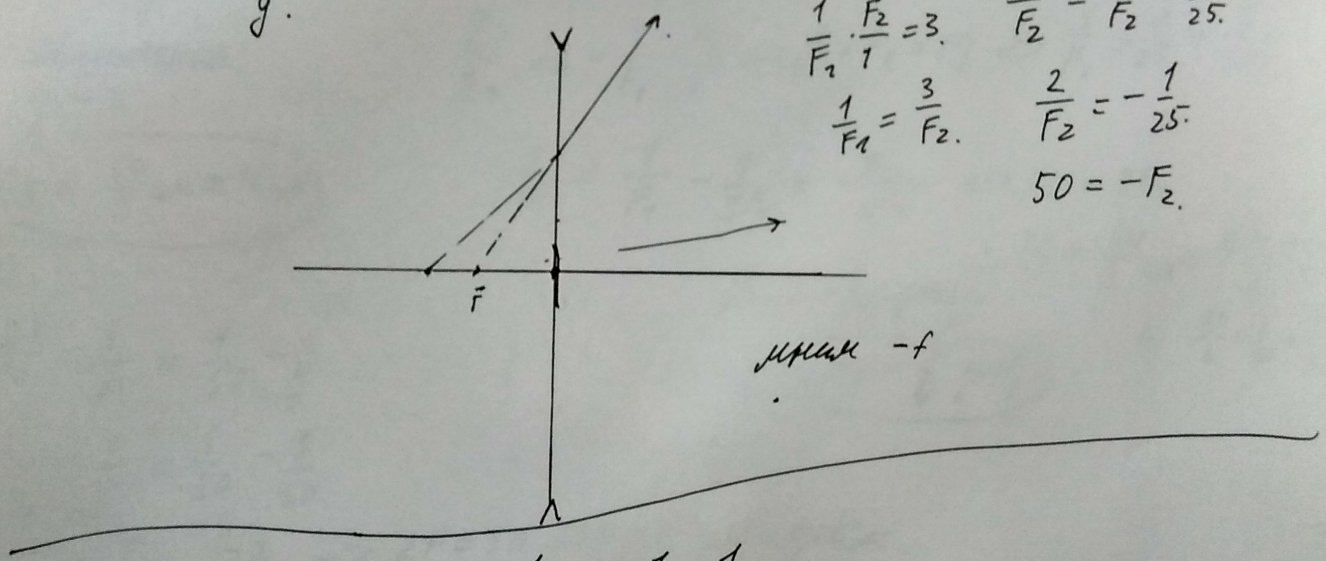
$\frac{1}{F_1} \cdot \frac{F_2}{1} = 3.$

$\frac{1}{F_1} = \frac{3}{F_2}.$

$\frac{3}{F_2} = \frac{1}{F_2} - \frac{1}{25}.$

$\frac{2}{F_2} = -\frac{1}{25}.$

$50 = -F_2.$



1-долб. $-\frac{1}{F_2} = -\frac{1}{y} + \frac{1}{d}.$

2-25 см. $-\frac{1}{F_2} = -\frac{1}{y} + \frac{1}{25}.$

$\frac{1}{n}.$

$y = \frac{50}{3}$ см $= 16$ см.

$-\frac{3}{50} = -\frac{1}{y}.$

$\varphi\left(\frac{\varepsilon}{5} + c_i R\right) = L i_0 I.$

$c\frac{\varepsilon}{5} \cdot \varphi + c\varphi i_0 R = L i_0 I_0.$

$\frac{\varphi - i_0 R}{I_0} = \frac{L i_0}{c\left(\frac{\varepsilon}{5} - \varphi\right)}$

$I = -4I_0.$

$\frac{(\varphi - i_0 R) \cdot 4c\left(\varphi - \frac{\varepsilon}{5}\right)}{I} = L i_0$

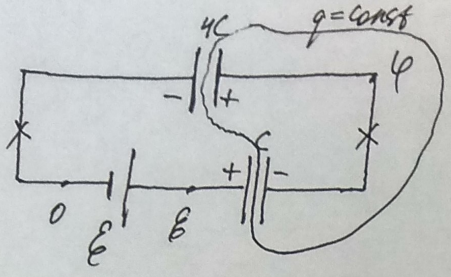
$\tau = \frac{4c\left(\varphi - \frac{\varepsilon}{5}\right)}{I}.$

$\varphi = \frac{I_0 \cdot 4L\left(\varphi - \frac{\varepsilon}{5}\right)}{I}.$

Чистовик

№3

нач. состояние.



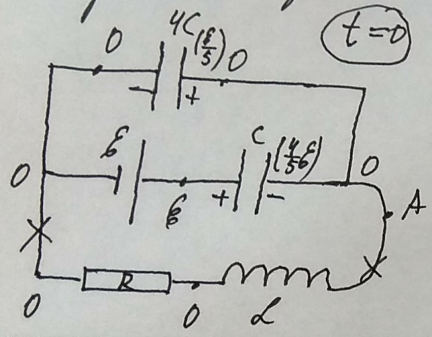
1) По З.С.З: $0 = +4C\cdot(\varphi-0) - C\cdot(\mathcal{E}-\varphi)$

$\mathcal{E}-\varphi = 4\varphi$

$\mathcal{E} = 5\varphi \Rightarrow \varphi = \frac{\mathcal{E}}{5}$ ~~$\cdot\mathcal{E}$~~

$$W_1 = \frac{4C\cdot\frac{\mathcal{E}^2}{25}}{2} + \frac{C\cdot\frac{16}{25}\mathcal{E}^2}{2} = \frac{\frac{20C\mathcal{E}^2}{25}}{2} = \frac{4}{10}C\mathcal{E}^2 = \frac{2}{5}C\mathcal{E}^2$$

Скорость изменения: $I' = \frac{\Delta q}{\Delta t} = \frac{u}{L}$

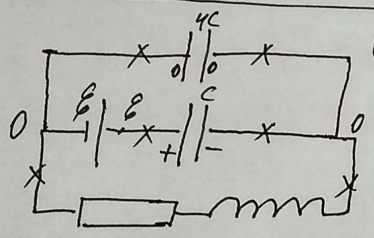


Сразу после замыкания ток скачком не изменился: $I_0 = 0$

~~на~~ потенциал в (.) A: $\mathcal{E} - \frac{4}{5}\mathcal{E} = \frac{\mathcal{E}}{5}$.

$u_L = \frac{\mathcal{E}}{5} \Rightarrow \boxed{I' = \frac{\mathcal{E}}{5L}}$

2) ~~$W_2 = \frac{C\cdot\mathcal{E}^2}{\frac{25}{2}}$~~

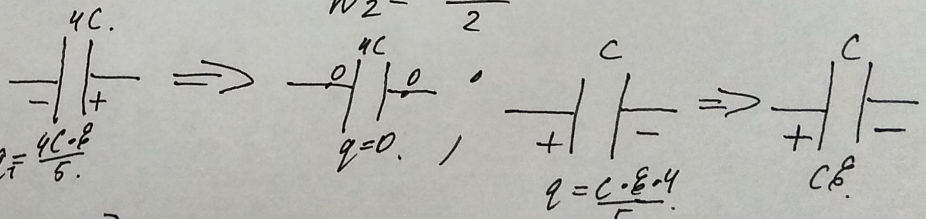


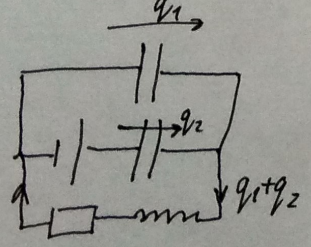
тут Установившееся состояние ток через конденсаторы не течет

$W_2 = \frac{C\cdot\mathcal{E}^2}{2}$

По З.С.Э:

$A_{ист} = W_2 - W_1 + Q$





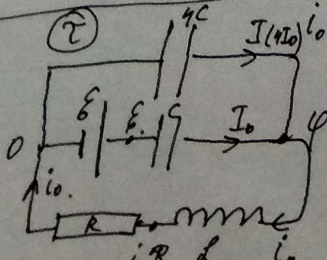
$q_2 = \frac{C\mathcal{E}}{5}$

$A_{ист} = +\mathcal{E}\cdot q_2 = +\frac{C\mathcal{E}^2}{5}$

$\frac{C\mathcal{E}^2}{5} = \frac{C\mathcal{E}^2}{2} - \frac{2}{5}C\mathcal{E}^2 + Q \Rightarrow Q = \frac{3C\mathcal{E}^2}{5} - \frac{C\mathcal{E}^2}{2} = \frac{C\mathcal{E}^2}{10}$.

~~$Q = 6C\mathcal{E}$~~ $\boxed{Q = \frac{C\mathcal{E}^2}{10}}$

3)



$i_0 = I + I_0$; ~~З.С.Э: $W_1 =$~~ $(\varphi - i_0R) = L\frac{\Delta I}{\Delta t} \mid \cdot\Delta t$

$(\varphi - i_0R)\cdot\tau = L(i_0 - 0)$; $I_0 = C\frac{\Delta u}{\Delta t} \Rightarrow I_0\tau = C(\mathcal{E}-\varphi-\frac{4}{5}\mathcal{E})$

$(\frac{\mathcal{E}}{5} - \varphi)C = I_0\tau$; $I = \frac{4C}{\Delta t}\Delta u \Rightarrow I\tau = 4C(\varphi - \frac{\mathcal{E}}{5})$.

$I = 4I_0 \Rightarrow i_0 = 5I_0$

$I' = \mathcal{E}/5L$

1

Ответ: 1) $I' = \mathcal{E}/5L$ 2) $Q = \frac{C\mathcal{E}^2}{10}$ 3) $i_0 = 5I_0$