Часть 1

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

Шифр: **21200586**

ID профиля: **236821**

Вариант 4

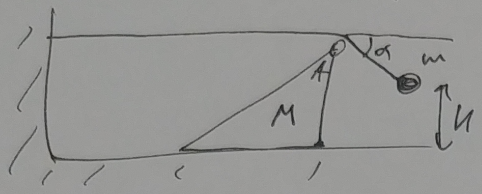
Черновик

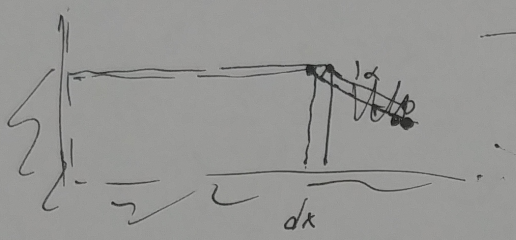
$ma_m \cos\beta = mg - T\sin\alpha$

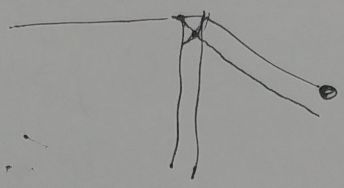
$T(1-\cos\alpha) = Ma_K = M\frac{a_m}{\cos\beta}$

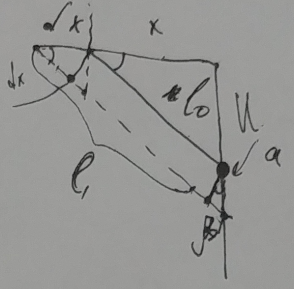
$\cos\alpha = \frac{8}{17}$

$\sin\alpha = \frac{15}{17}$



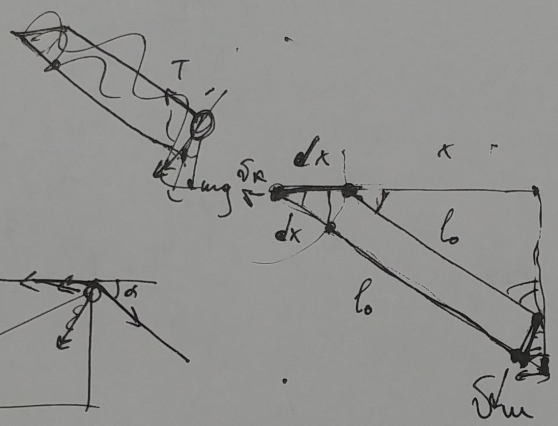


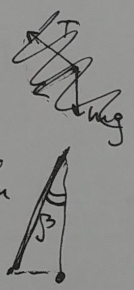




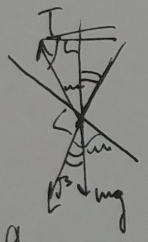
$dx + l_0 = l_1$

$\frac{x}{x+dx} = \frac{H}{H+dh}$





$T(1-\cos\alpha) = Ma_K$



$(dx+l_0)\cos\alpha$

$\vec{dl_m} = \vec{v}\,dt$

$\vec{v} = \vec{a}\,dt$

$\frac{dx_m}{dy_m} = tg\beta$

$mg\sin\beta = T\sin(\alpha+\beta)$.

$T = \frac{mg\sin\beta}{\sin(\alpha+\beta)}$

$ma_m\cos\beta = mg - T\sin\alpha$

$dx_m = dx(1-\cos\alpha)$.

$dy_m = dx\sin\alpha$

$\frac{dx_m}{dy_m} = \frac{1-\cos\alpha}{\sin\alpha} = tg\beta$

$\begin{cases} dx = v_K\,dt \\ dx(1-\cos\alpha) = v_m\sin\beta\,dt \end{cases}$

$1-\cos\alpha = \frac{v_m\sin\beta}{v_K}$

$a_m = a_K\frac{(1-\cos\alpha)\sin\alpha\sqrt{1+\frac{(1-\cos\alpha)^2}{\sin^2\alpha}}}{1-\cos^2\alpha}$

$v_K(1-\cos\alpha) = v_m\sin\beta$

$a_K(1-\cos\alpha) = a_m\sin\beta$

$\frac{tg\beta}{\cos\alpha}$

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

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

$1-\frac{1}{tg^2\alpha}$

$\sin\alpha = \frac{tg\alpha}{\sqrt{1+tg^2\alpha}}$

$a_m = a_K\frac{1-\cos\alpha}{\sin\beta} =$

$= a_K\frac{1-\cos\alpha\left(1+\frac{1-\cos\alpha}{\sin^2\alpha}\right)}{(1-\cos)^2}$.

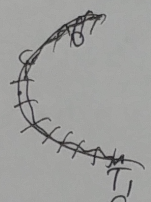
Не Черновик

ν

T_0

$C(T) = \frac{9}{5} R \frac{T}{T_0}$

$T_0 \to T$



$Q_2 = \Delta U + A$

$Q_2 = \int_{T_0}^{\frac{3}{4}T_0} C(T)\nu\, dT$

$Q_1 = \int_{T_0}^{\frac{3}{4}T_0} \frac{9}{5} R\nu \frac{T\,dT}{T_0} = \frac{9}{5}\frac{R\nu}{T_0} \int_{T_0}^{\frac{3}{4}T_0} T\,dT =$

$A_T = Q - \Delta U$

$A_2 = \int_{T_0}^{T} C(T)\nu\,dT - \frac{3}{2}\nu R(T-T_0) =$

$= \frac{9R\nu}{5T_0} \int_{T_0}^{T} T\,dT - \frac{3}{2}\nu R(T-T_0) =$

$= \frac{9R\nu}{5T_0} \cdot \frac{T^2}{2}\Big|_{T_0}^{\frac{3}{4}T_0} =$

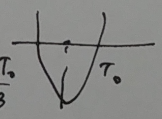
$= \frac{9R\nu}{5T_0} \cdot \frac{\frac{9}{16}T_0^2 - T_0^2}{2} =$

$= \frac{9R\nu}{5T_0} \cdot \frac{-\frac{7}{16}T_0^2}{2} = -\frac{9R\nu \cdot 7T_0}{5 \cdot 2 \cdot 16} = -\frac{63\nu R T_0}{160}$

$= \frac{9}{5}\frac{R\nu(T^2 - T_0^2)}{T_0 \cdot 2} - \frac{3}{2}\nu R(T-T_0) =$

$= \frac{3\nu R(T-T_0)}{2}\left(\frac{3(T+T_0)}{5T_0} - 1\right) =$

$= \frac{3\nu R(T-T_0)\cdot(3T-2T_0)}{2 \cdot 5 \cdot T_0} = \frac{3\nu R(T-T_0)(3T-2T_0)}{10T_0}$



$T = T_0 \quad T = \frac{2T_0}{3}$

$T = \frac{5}{6}T_0$

$A_{min} = \frac{3\nu R\left(-\frac{1}{6}T_0\right)\cdot\frac{1}{2}T_0}{10T_0} = -\frac{\nu R T_0}{40}$

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

№2. He → i = 3

ν; T_0

$c(T) = \frac{9}{5}R\frac{T}{T_0}$

1) $T_0 \xrightarrow{\frac{3}{4}T_0} \frac{3}{4}T_0$

$$Q = \int_{T_0}^{\frac{3}{4}T_0} c(T)\nu\,dT = \int_{T_0}^{\frac{3}{4}T_0} \frac{9\nu R}{5T_0} T\,dT =$$

$$= \frac{9\nu R}{5T_0}\cdot\left(\frac{\left(\frac{3}{4}T_0\right)^2}{2} - \frac{T_0^2}{2}\right) = \frac{9\nu R\left(\frac{9}{16}-1\right)T_0^2}{2\cdot 5T_0} =$$

$$= -\frac{9\cdot 7\nu R T_0}{10\cdot 16} = -\frac{63\nu R T_0}{160}$$

$$Q_{12} = -Q = \boxed{\frac{63\nu R T_0}{160}}$$

2) $A = \min$, T_x - ? $T_0 \to T_x$

$Q = \Delta U + A$

$A = Q - \Delta U$

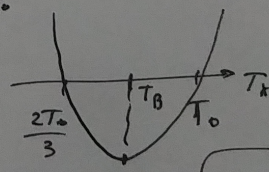
$$Q = \int_{T_0}^{T_x} c(T)\nu\,dT = \int_{T_0}^{T_x} \frac{9\nu R}{5T_0} T\,dT = \frac{9\nu R\left(T_x^2 - T_0^2\right)}{10T_0} = \frac{9\nu R(T_x - T_0)(T_x + T_0)}{10T_0}$$

$$\Delta U = \frac{3}{2}\nu R\left(T_x - T_0\right).$$

$$A = \frac{9\nu R(T_x - T_0)(T_x + T_0)}{10T_0} - \frac{3}{2}\nu R\left(T_x - T_0\right) = \frac{3}{2}\nu R(T_x - T_0)\left(\frac{3(T_x + T_0)}{5T_0} - 1\right)$$

$$A = \frac{3\nu R}{10T_0}(T_x - T_0)(3T_x - 2T_0).$$ - парабола, ветви вверх.

$T_x = T_0$, $T_x = \frac{2T_0}{3}$



$$T_B = \frac{T_0 + \frac{2T_0}{3}}{2} = \frac{5T_0}{6} \Rightarrow \text{при } A = \min \quad \boxed{T_x = \frac{5T_0}{6}}$$

3) $$A_{min} = \frac{3\nu R\left(\frac{5}{6}T_0 - T_0\right)\left(\frac{3\cdot 5T_0}{6} - 2T_0\right)}{10T_0} = \frac{3\nu R\left(-\frac{1}{6}T_0\right)\cdot\frac{1}{2}T_0}{10T_0} = \boxed{-\frac{\nu R T_0}{40}}$$

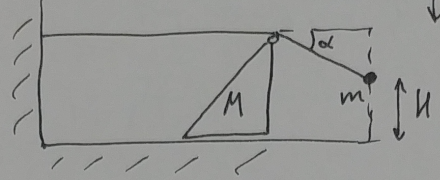
Ответы: 1) $\frac{63\nu R T_0}{160}$

2) $\frac{5T_0}{6}$ 3) $-\frac{\nu R T_0}{40}$.

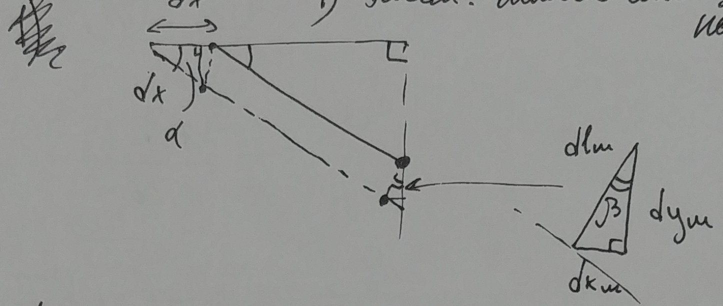
№1. $\cos\alpha = \frac{8}{17} \Rightarrow \sin\alpha = \frac{15}{17}$

H.

$\downarrow g \quad \alpha = const.$



1) Рассм. малое смещ. клина на dx.:



$$dx - dx\cos\alpha = dx_ш$$

$$\begin{cases} dx(1-\cos\alpha) = dx_ш \\ dy_ш = dx\sin\alpha \end{cases} \qquad tg\,\beta = \frac{dx_ш}{dy_ш} = \frac{1-\cos\alpha}{\sin\alpha} = const$$

⇓ (*)

(*) $tg\,\beta = const$

⇓

$v_ш$ всегда напр под угл. β к верт.

⇓ (т.к. траект. шара диф. малое. смеще. отр.)

$a_ш$ всегда напр под угл. β к верт.

$$dl_ш = \sqrt{dy_ш^2 + dx_ш^2} = dx\sqrt{\sin^2\alpha + (1-\cos\alpha)^2} \Big| : dt$$

$$v_ш = v_к\sqrt{\sin^2\alpha + (1-\cos\alpha)^2}$$

ск. шара — ск. клина в нек. мом. вр.

$$\frac{dv_ш}{dt} = a_ш = \frac{dv_к}{dt}\sqrt{\sin^2\alpha + (1-\cos\alpha)^2} + v_к\frac{d\left(\sqrt{\sin^2\alpha + (1-\cos\alpha)^2}\right)}{dt}$$

$$\alpha = const \Rightarrow \frac{d(f(\alpha))}{dt} = 0$$

$$a_ш = a_к\sqrt{\sin^2\alpha + (1-\cos\alpha)^2}$$

$$tg\,\beta = \frac{dx_ш}{dy_ш} = \frac{1-\cos\alpha}{\sin\alpha}$$

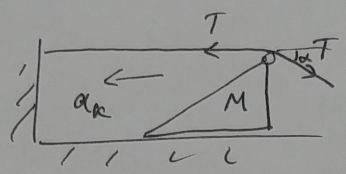
$$tg\,\beta = \frac{1-\frac{8}{17}}{\frac{15}{17}} = \frac{9}{15} = \boxed{\frac{3}{5}}$$

$$\sin\beta = \frac{tg\,\beta}{\sqrt{1+tg^2\beta}} = \frac{3}{5\cdot\sqrt{1+\frac{9}{25}}} = \frac{3}{\sqrt{34}}$$

$$\Rightarrow \cos\beta = \frac{1}{\sqrt{1+tg^2\beta}} = \frac{5}{\sqrt{34}}$$

№1 (прод.)

2) Рассм. клин. T – сила натяж. нити.

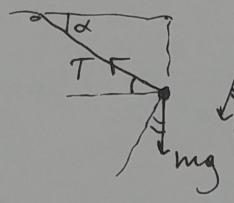


II з-н Ньютона:

$Ma_к = T - T\cos\alpha$

$Ma_к = T(1-\cos\alpha)$.

Рассм. шар:



$$\begin{cases} ma_ш\cos\beta = mg - T\sin\alpha \\ ma_ш\sin\beta = T\cos\alpha \end{cases} \qquad T\sin\alpha = m(g - a_ш\cos\beta)$$

$$\frac{Ma_к}{ma_ш\sin\beta} = \frac{T(1-\cos\alpha)}{T\cos\alpha}$$

$$\frac{Ma_к}{ma_к\sqrt{\sin^2\alpha + (1-\cos\alpha)^2}\,\sin\beta} = \frac{1-\cos\alpha}{\cos\alpha}$$

$$\sin\beta = \frac{tg\beta}{\sqrt{1+tg^2\beta}} = \frac{1-\cos\alpha}{\cos\alpha\sin\alpha\sqrt{1+\frac{(1-\cos\alpha)^2}{\sin^2\alpha}}} =$$

$$= \frac{1-\cos\alpha}{\sqrt{\sin^2\alpha + (1-\cos\alpha)^2}}$$

$$\frac{M}{m(1-\cos\alpha)} = \frac{1-\cos\alpha}{\cos\alpha}$$

$$\frac{m}{M} = \frac{\cos\alpha}{(1-\cos\alpha)^2} = \frac{8/17}{\left(1-\frac{8}{17}\right)^2} = \frac{8\cdot 17^2}{9^2} = \frac{8\cdot 17}{9^2} = \frac{136}{81} \approx \boxed{1{,}68}$$

№1 (прод.)

3) $T = \frac{m(g - a_m \cos\beta)}{\sin\alpha}$ $\quad tg\alpha = \frac{15}{8}$

$m a_m \sin\beta = \cos\alpha \cdot m (g - a_m \cos\beta)$ $\quad \sqrt{\sin^2\alpha + 1 + \cos^2\alpha - 2\cos\alpha} =$

$a_m \sin\beta \, tg\alpha = g - a_m \cos\beta$ $\quad = \sqrt{2 - 2\cos\alpha}$

$$a_m = \frac{g}{\sin\beta \, tg\alpha + \cos\beta} = const$$

$$a_к = \frac{a_m}{\sqrt{\sin^2\alpha + (1-\cos\alpha)^2}} = \frac{g}{(\sin\beta \, tg\alpha + \cos\beta)\sqrt{\sin^2\alpha + (1-\cos\alpha)^2}}$$

$$a_к = \frac{g}{\left(\frac{3}{\sqrt{34}} \cdot \frac{15}{8} + \frac{5}{\sqrt{34}}\right) \cdot \sqrt{2 - 2 \cdot \frac{8}{17}}} = \frac{g}{\left(\frac{3 \cdot 15 + 5 \cdot 8}{\sqrt{34}}\right)\sqrt{\frac{2 \cdot 9}{17}}} =$$

$$= \frac{g}{95 \cdot 3 \cdot \sqrt{\frac{2}{17 \cdot 34}}} = \frac{17g}{285} \approx 0{,}06g. = const$$

4) $a_m = const \Rightarrow H = \frac{a_m t^2}{2} \cos\beta$ $\quad (т.к.\ v_{m0} = 0)$

$$t = \sqrt{\frac{2H}{a_m \cos\beta}} = \sqrt{\frac{2H(\sin\beta \, tg\alpha + \cos\beta)}{g \cos\beta}} =$$

$$= \sqrt{\frac{2H\left(\frac{3 \cdot 15}{\sqrt{34} \cdot 8} + \frac{5}{\sqrt{34}}\right)}{g \cdot \frac{5}{\sqrt{34}}}} = \sqrt{\frac{95H}{4\sqrt{34} \cdot g}} = \sqrt{\frac{19}{4} \frac{H}{g}}$$

$t \approx 2{,}18\sqrt{\frac{H}{g}}$

$$t = \sqrt{\frac{95H\sqrt{34}}{4\sqrt{34}\, g 5}} =$$

$$= \sqrt{2\frac{H}{g}}$$

Ответы: 1) $tg\beta = \frac{3}{5}$

2) $a_к = 0{,}06g$

3) $\frac{m}{M} = 1{,}68$

4) $t = 2{,}18\sqrt{\frac{H}{g}}$

4

Часть 2

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

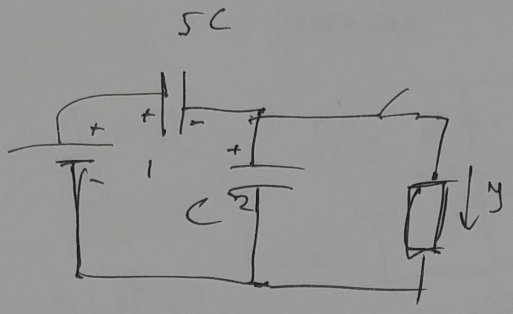
Шифр: **21200586**

ID профиля: **236821**

Вариант 4

Черновик.

$C_2 = C$, $C_1 = 5C$



$\frac{q}{5C} + \frac{q}{C} = \mathcal{E}$

$U_1 = \frac{q}{5C} = \frac{\mathcal{E}C}{6}$

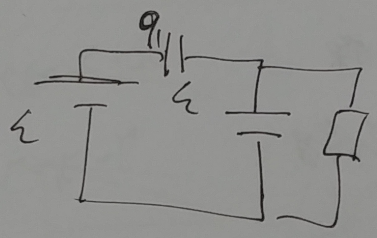
$\frac{6q}{5C} = \mathcal{E}$

$U_2 = \frac{5C\mathcal{E}}{6}$

1) $J = \frac{5C\mathcal{E}}{6R}$

$q_0 = \frac{5C\mathcal{E}}{6}$

В уст. реж.:



$q_1 = 5C\mathcal{E}$

$W_0 = \frac{5C\mathcal{E}^2}{6 \cdot 2} = \frac{5C\mathcal{E}^2}{12}$

$W_1 = \frac{5C\mathcal{E}^2}{2}$

$A = (q_1 - q_0)\mathcal{E}$

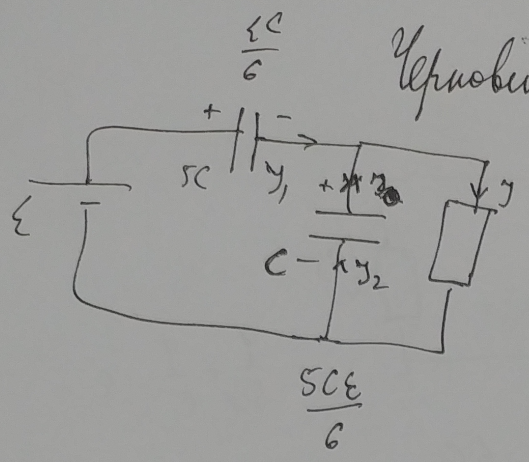
$A = W_1 - W_0 + Q$

$\left(5C\mathcal{E} - \frac{5C\mathcal{E}}{6}\right)\mathcal{E} = \frac{5C\mathcal{E}^2}{2} - \frac{5C\mathcal{E}^2}{12} + Q$

$\frac{25C\mathcal{E}^2}{6} = \frac{25C\mathcal{E}^2}{12} + Q$

$Q = \frac{25C\mathcal{E}^2}{12}$.

Черновик.



$\frac{\varepsilon C}{6}$ $\quad$ $\frac{5C\varepsilon}{6}$

$\gamma R = \frac{q_2}{C}$ $\quad$ $\frac{\dot{q}_2}{C} = \gamma R$

$\varepsilon = \frac{q_1}{5C} + \gamma R$

$\varepsilon = \frac{q_1}{C} + \frac{q_2}{C}$

$0 = \frac{\dot{q}_1}{5} + \dot{q}_2$

$R \Delta q = \Delta\Phi$

$\varepsilon = \frac{d\Phi}{dt}$ $\quad$ $W = d\Phi\gamma$

$\gamma R = \frac{d\Phi}{dt}$

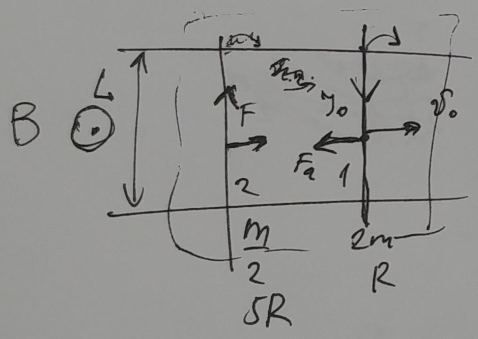
$\gamma R dt = d\Phi\gamma$

$dqR = d\Phi$

$\frac{\gamma_1}{5} = \gamma_2$

$\gamma_2 = \gamma_0 \Rightarrow \gamma_1 = 5\gamma_0$

$\gamma = \gamma_1 + \gamma_2 = 6\gamma_0$



$\varepsilon = \frac{d\Phi}{dt} = \frac{BLv_0}{dt} = \frac{BLv_0 dt}{dt} =$

$\varepsilon = BLv_0$

$\gamma_0 = \frac{BLv_0}{6R} = \frac{\varepsilon}{6R}$

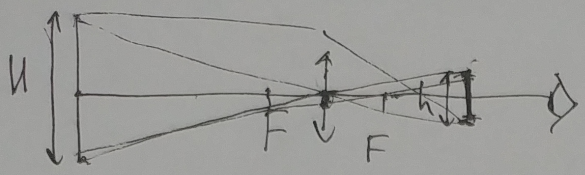
$F_a = \gamma_0 BL = \frac{B^2L^2v_0}{6R}$

$2ma = \frac{B^2L^2v_0}{6R}$

$a = \frac{B^2L^2v_0}{12mR}$

$v_c = \frac{2mv_0}{\frac{5m}{2}} = \frac{4v_0}{5}$

$v_c = \frac{2mv_0}{5m} = \frac{2v_0}{5}$



Черновик

$F = 24$ см.

$H = 9$ см.

$b = 96$ см.

в

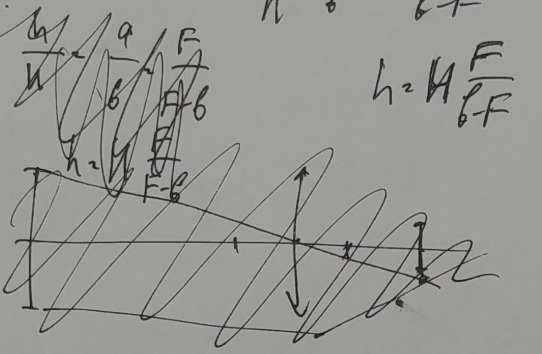
$\frac{1}{F} = \frac{1}{a} + \frac{1}{b}$

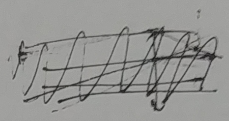
$l = 24$ см.

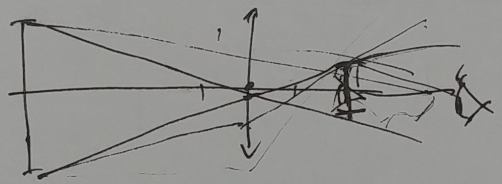
$\frac{H}{a} = \frac{b}{a} = \frac{bFb}{Fb - F}$

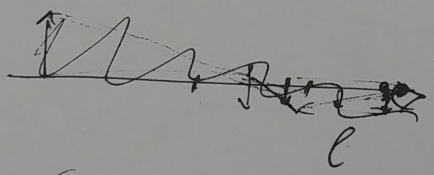
$\frac{h}{H} = \frac{a}{b} = \frac{F}{b-F}$

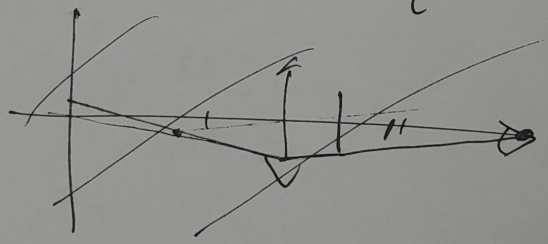
$h = H\frac{F}{b-F}$

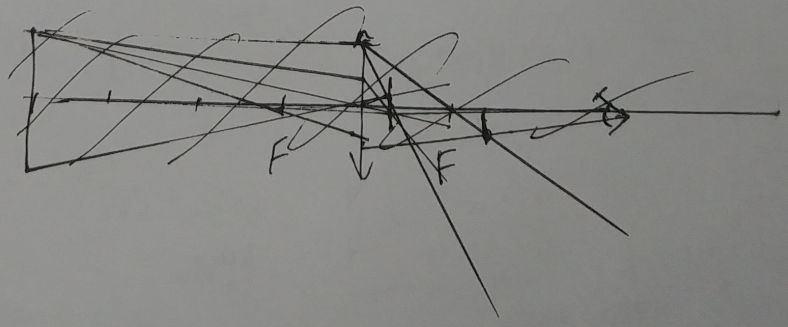










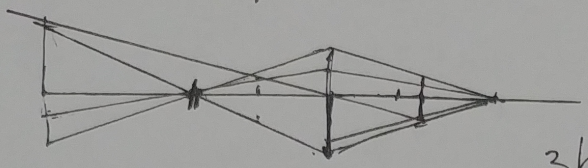


Черновик

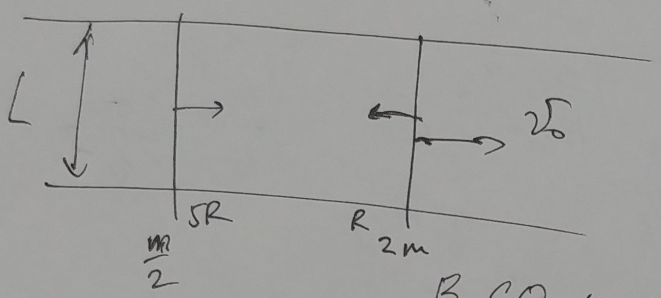
$\frac{1}{F} = \frac{1}{a} + \frac{1}{b}$

$b = 4F$

$a = \frac{Fb}{b-F} = \frac{F\,4F}{3F} = \frac{4}{3}F$

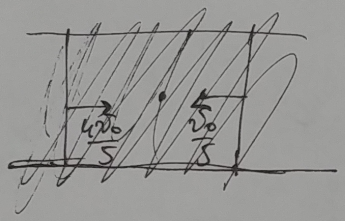


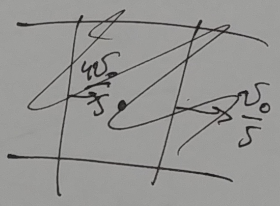
$\frac{2h}{D} = \frac{l}{l+a}$

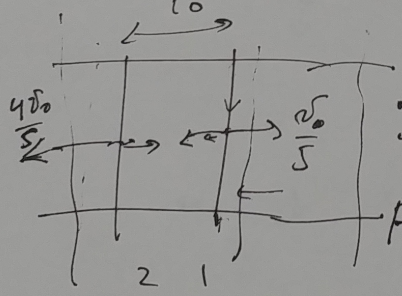


$\mathcal{E} = BLv_0$

В СО ц.м. $\frac{4v_0}{5}$ $v_c = \frac{4v_0}{5}$







$\mathcal{E} = \frac{BLv_0}{6R}$

$F_a = \mathcal{E}BL = \frac{B^2L^2v_0}{6R}$

$a_1 = \frac{B^2L^2(v_1+v_2)}{6R \cdot 2 \cdot m}$

$a_2 = \frac{B^2L^2(v_1+v_2)}{3Rm}$

$dv_1 = a_1 dt$

$dv_2 = a_2 dt$

$\frac{dv_1}{dv_2} = \frac{a_1}{a_2} = \frac{1}{4}$ $4dv_1 = dv_2$

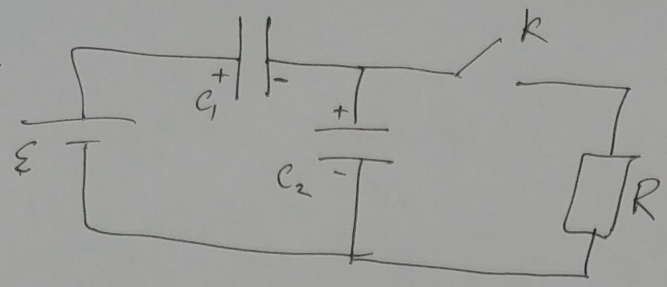
$dv_1 = \frac{B^2L^2}{12Rm}(v_1+2v_2)dt =$

$= \frac{B^2L^2}{12Rm}dx$

$\frac{v_0}{5} =$

$\Delta x = \frac{12Rm\,v_0}{5B^2L^2}$

№3.



$C_2 = C$

$C_1 = 5C$

1) До замык. K:

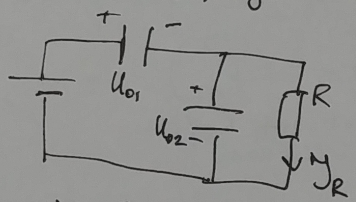
$q_1 = q_2 = q_0$.

$$\mathcal{E} = U_{01} + U_{02} = \frac{q_1}{C_1} + \frac{q_2}{C_2} = \frac{q_0}{5C} + \frac{q_0}{C} = \frac{6q_0}{5C}$$

$$q_0 = \frac{5C\mathcal{E}}{6} \Rightarrow U_{01} = \frac{q_0}{5C} = \frac{5C\mathcal{E}}{6 \cdot 5C} = \frac{\mathcal{E}}{6}$$

$$U_{02} = \frac{q_0}{C} = \frac{5C\mathcal{E}}{6C} = \frac{5\mathcal{E}}{6}$$

2) Сразу ~~после~~ после замык. K: заряды конд. не успели изм:

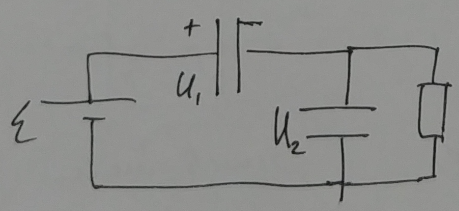


$$\mathcal{Y}_R R = U_{02}$$

$$\boxed{\mathcal{Y}_R = \frac{5\mathcal{E}}{6R}}$$

$$W_0 = \frac{5CU_{01}^2}{2} + \frac{CU_{02}^2}{2} = \frac{5C\mathcal{E}^2}{6^2 \cdot 2} + \frac{C5^2\mathcal{E}^2}{6^2 \cdot 2} = \frac{5C\mathcal{E}^2 \cdot 6}{6^2 \cdot 2} = \frac{5C\mathcal{E}^2}{12}$$

3) В уст. реж. после замык K: тока в цепи нет.



$U_2 = 0$

$U_1 = \mathcal{E}$

$q_1 = 5C\mathcal{E}$

$$W_K = \frac{5C\mathcal{E}^2}{2}$$

ЗСЭ: $A_{ист} = W_K - W_0 + Q$, где $A_{ист} = q_{ист} \cdot \mathcal{E} = (q_1 - q_0)\mathcal{E}$

$$\left(5C\mathcal{E} - \frac{5C\mathcal{E}}{6}\right)\mathcal{E} = \frac{5C\mathcal{E}^2}{2} - \frac{5C\mathcal{E}^2}{12} + Q$$

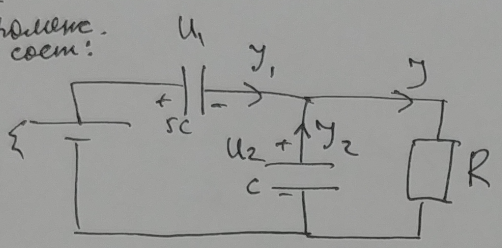
1

№3 (прод.).

$$5C\mathcal{E}^2\left(1-\frac{1}{6}\right) = \frac{5C\mathcal{E}^2}{2}\left(1-\frac{1}{6}\right) + Q$$

$$Q = \frac{5C\mathcal{E}^2 \cdot 5}{2 \cdot 6} = \boxed{\frac{25C\mathcal{E}^2}{12}}$$

4) Промежут. сост.:



γ_1 не меняет своего напр.

$$\mathcal{E} = U_1 + U_2 = \frac{q_1}{5C} + \frac{q_2}{C}$$

$$\dot{\mathcal{E}} = 0 = \frac{\dot{q}_1}{5C} + \frac{\dot{q}_2}{C}$$

$$\dot{q}_1 = -5\dot{q}_2$$

$\dot{q}_1 = \gamma_1$

$-\dot{q}_2 = \gamma_2$ (из расст. токов на рис.)

$\gamma_1 = 5\gamma_2$

$$\gamma = \gamma_1 + \gamma_2 = 6\gamma_2$$

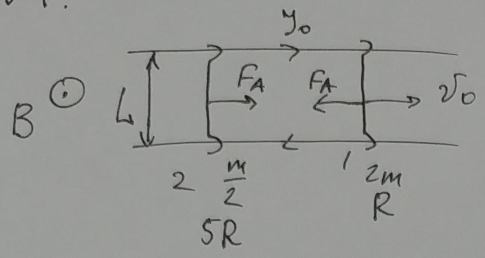
Если $\gamma_2 = \gamma_0$, то $\boxed{\gamma = 6\gamma_0}$

Ответ: 1) $\frac{5\mathcal{E}}{6R}$

2) $\frac{25C\mathcal{E}^2}{12}$

3) $6\gamma_0$.

№4.



1) В нач. мом:

$$\mathcal{E} = \frac{d\Phi}{dt} = \frac{B \cdot dS}{dt} = \frac{BL \cdot v_0 dt}{dt}$$

$$\mathcal{E} = BLv_0$$

$$F_A = y_0 BL = \frac{B^2L^2 v_0}{6R}$$

$$y_0 = \frac{\mathcal{E}}{6R} = \frac{BLv_0}{6R}$$

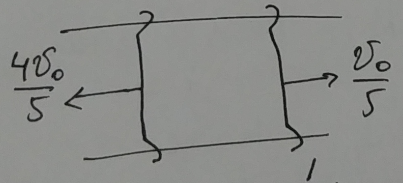
$$2m a_{1_0} = \frac{B^2L^2 v_0}{6R}$$

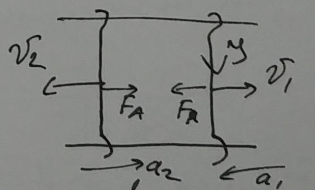
$$\boxed{a_{1_0} = \frac{B^2L^2 v_0}{12mR}}$$

2) На ц. м. системы из 2х перемычек не действ внеш сил. $\left(\vec{F}_{A1} = -\vec{F}_{A2}\right)$ т.к. ток в перем. одинаков. $\Rightarrow v_c = const$

в нач мом: $v_c = \frac{2m \cdot v_0}{\frac{m}{2} + 2m} = \frac{4mv_0}{5m} = \frac{4}{5}v_0$

3) Перейдем в СО ц.м.:





$$\begin{cases} 2ma_1 = F_A \\ \frac{m}{2}a_2 = F_A \end{cases}$$

$$4\frac{a_1}{a_2} = 1 \qquad \frac{a_1}{a_2} = const \Rightarrow \frac{v_1}{v_2} = const$$

$a_2 = 4a_1$ = const

т.к. $\frac{v_0 \cdot 5}{5 \cdot 4v_0} = \frac{1}{4}$

$$\mathcal{E} = \frac{d\Phi}{dt} = \frac{BL(v_1+v_2)dt}{dt}$$

$$y = \frac{BL(v_1+v_2)}{6R}$$

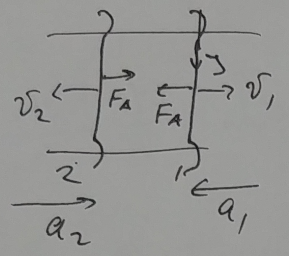
№4 (прод.) ④

Через продолж. промеж. времени в СО ц.м. перемычки остановятся.

④

в исходной СО $v_1 = v_2 = v_c = \boxed{\frac{4}{5}v_0}$

4)



$2ma_1 = F_A = \mathcal{E}BL = \frac{\mathcal{E}BL}{6R}$

$\mathcal{E} = \frac{d\Phi}{dt} = \frac{BL(v_1+v_2)\Delta t}{\Delta t}$

$2ma_1 = \frac{B^2L^2(v_1+v_2)}{6R}$

$a_1 = \frac{B^2L^2(v_1+v_2)}{12mR} = \frac{dv_1}{dt}$

$-dv_1 = \frac{B^2L^2}{12mR}\underbrace{(v_1+v_2)dt}$

dx - увелич. расст. между перемычками за dt.

$-dv_1 = \frac{B^2L^2}{12mR}dx$

④

$-\Delta v_1 = \frac{B^2L^2}{12mR}\cdot\Delta x$

$-\left(0-\frac{v_0}{5}\right) = \frac{B^2L^2}{12mR}\Delta x$

$\boxed{\Delta x = \frac{12mRv_0}{5B^2L^2}}$

Ответ: 1) $\frac{B^2L^2v_0}{12mR}$

2) $\frac{4}{5}v_0$ (у обоих)

3) $\frac{12mRv_0}{5B^2L^2}$

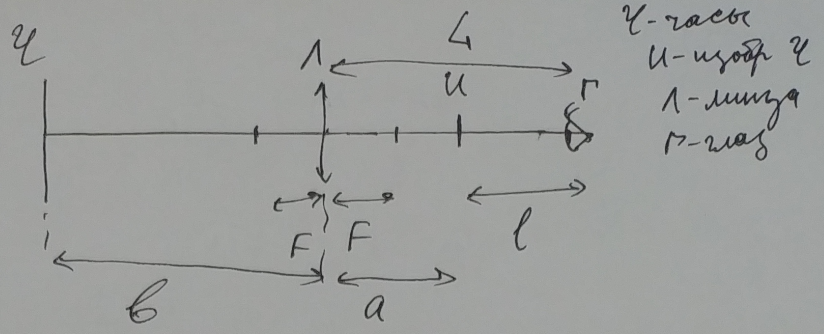
(4)

№5. $И = 9$см

$F = 24$см

$b = 96$см $= 4F$

$l = 24$см $= F$



Ч - часы
И - изобр Ч
Л - линза
Г - глаз

a - расст. от л. до изобр. часов

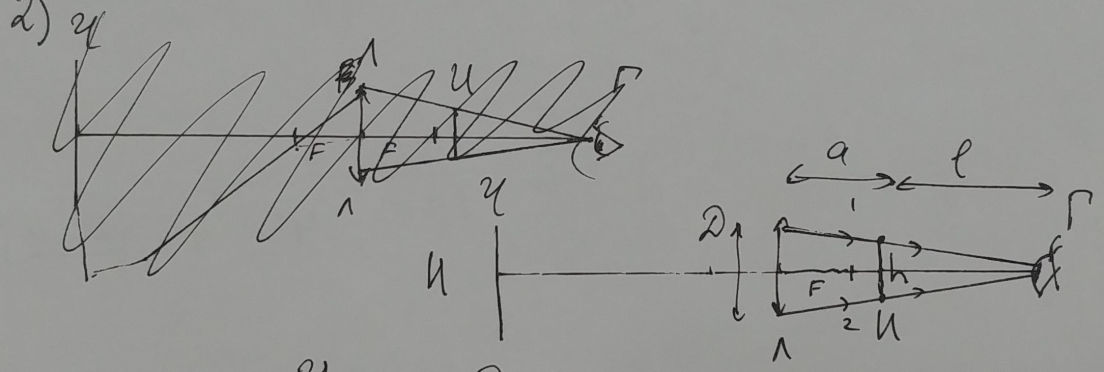
1) $\frac{1}{F} = \frac{1}{a} + \frac{1}{b}$

$$a = \frac{Fb}{b-F} = \frac{4F \cdot 3F}{3F} = \frac{4}{3}F$$

$$L = a + l = \frac{4}{3}F + F = \frac{7}{3}F$$

$$L = \frac{7}{3} \cdot 24^{8} = 56\text{см}.$$

2)



Усл. min D: лучи 1 и 2, идущие через края изобр. в Г, должны проходить через края Л.

h - диаметр изобр. Ч.

$$\frac{h}{И} = \frac{a}{b} = \frac{Fb}{(b-F)b} = \frac{F}{3F} = \frac{1}{3}$$

$$h = \frac{И}{3}.$$

$$Ч_1 \sim \Delta \Rightarrow \frac{h}{D_{min}} = \frac{l}{a+l}$$

$$D_{min} = \frac{(a+l)h}{l}$$

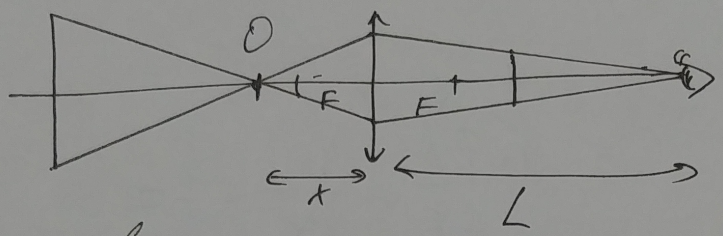
(5)

№5 (проф.)

$$D_{min} = \frac{(\frac{4}{3}F + F)4}{F\ 3} = \frac{7F4}{3 \cdot 3F} = \frac{7 \cdot 4}{9}.$$

2) $D_{min} = \frac{7 \cdot 9}{9} = \boxed{7\text{см}}$

3)



Если расп. в (.) O экран, то Г не увидит изобр.

O - изобр Г в Л.

$$\frac{1}{F} = \frac{1}{L} + \frac{1}{x}$$

$$x = \frac{LF}{L-F} = \frac{\frac{7}{3}F \cdot F}{\frac{7}{3}F - F} = \frac{7F}{4} = \frac{7 \cdot 24}{4} = \boxed{42\text{см}}$$

Ответы: 1) 56см
2) 7см.
3) 42см.