Часть 1

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

Шифр: **21200999**

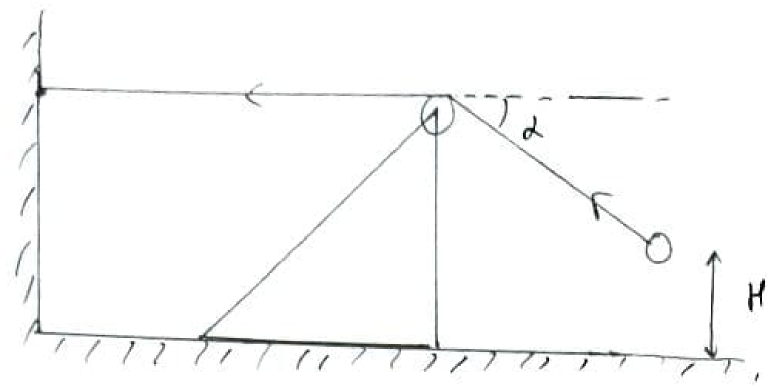
ID профиля: **74985**

Вариант 1

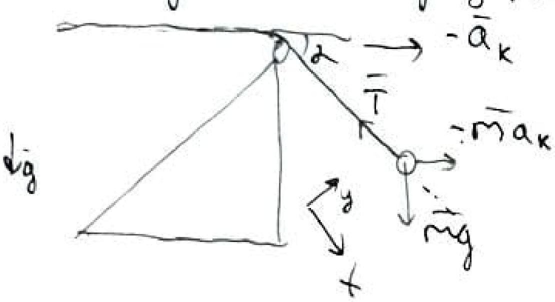
Чистовик. Вариант 11-01.

Задача №1

Дано:
$\cos\alpha = \frac{3}{5}$; H



Т.к. угол наклона нити остается постоянным, то на клин действует сила, вследствие чего он начинает двигаться горизонтально по поверхности. Перейдем в С.О. клина:



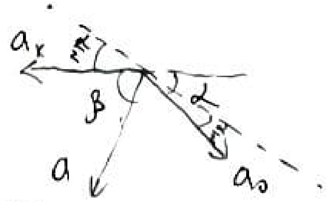
т.к. $\alpha = const$, то шарик в С.О. клина движется вдоль нити, ~~прямо~~:

$$\begin{cases} Ox: & mg\sin\alpha + ma_к\cos\alpha - T = ma_0 \\ Oy: & ma_к\sin\alpha - mg\cos\alpha = 0 \end{cases}$$

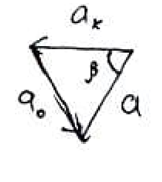
где $a_к$ − ускорение клина, a_0 − ускорение шарика в С.О. клина, m − масса шарика

Рассмотрим малое перемещение Δx нити с начала движения: $\Delta x = \frac{|a_к|T^2}{2} = \frac{|a_0|T^2}{2}$ (=)

$|a_к| = |a_0|$ (нить нерастяжима).



$|a| = 2|a_0|\cdot\sin\frac{\alpha}{2}$ Запишем т-му косинусов для тр-ка:



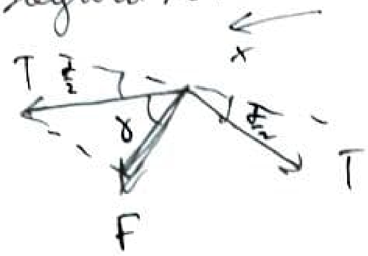
$$a_0^2 = a_к^2 + 4a_0^2\sin^2\frac{\alpha}{2} - 4a_0\sin\frac{\alpha}{2}\cdot\cos\beta \; (=) \; \boxed{\cos\beta = \sin\frac{\alpha}{2}}$$

Зная, что $\sin\alpha = \sqrt{1-\cos^2\alpha} = \frac{4}{5} = 2\cdot\sin\frac{\alpha}{2}\cdot\cos\frac{\alpha}{2}$, получаем $\boxed{\sin\frac{\alpha}{2} = \frac{1}{\sqrt{5}} \approx 0{,}45}$

$ma_к\sin\alpha - mg\cos\alpha = 0 \; (=) \; \boxed{a_к = a_0 = g\frac{\cos\alpha}{\sin\alpha} = \frac{3}{4}g}$

Чистовик

Задача №1



из т-мы косинусов:

$$T^2 = T^2 + 4T^2\sin^2\frac{\alpha}{2} - 4T^2\sin\frac{\alpha}{2}\cos\gamma \Leftrightarrow$$

$\cos\gamma = \sin\frac{\alpha}{2} \Rightarrow$ запишем II-ой з-н Нь-на для клина:

$$F = 2T\sin\frac{\alpha}{2}$$

ox: $M a_к = F\cos\gamma = 2T\sin^2\frac{\alpha}{2}$; $T = mg\sin\alpha + ma_к\cos\alpha - ma_0 =$

$$= mg\left(\sin\alpha + \frac{\cos^2\alpha}{\sin\alpha} - ctg\alpha\right) = mg\left(\frac{1}{\sin\alpha} - ctg\alpha\right) \Rightarrow$$

$$\boxed{\frac{m}{M} = \frac{g\,ctg\,\alpha}{g\left(\frac{1}{\sin\alpha} - ctg\alpha\right)2\sin^2\frac{\alpha}{2}} = \frac{ctg\,\alpha}{\left(\frac{1}{\sin\alpha} - ctg\alpha\right)\cdot 2\sin^2\frac{\alpha}{2}} = \frac{15}{4}}$$

4) $H = \frac{a_0\cdot\tau^2}{2}\sin\beta \Rightarrow$ $\boxed{\tau = \sqrt{\frac{2H}{a_0\sin\beta}} = \sqrt{\frac{2H}{g\,ctg\,\alpha\cdot\frac{2}{\sqrt5}}} = \sqrt{\frac{4\sqrt5 H}{3g}}}$

Ответ: 1) $\cos\beta = \frac{1}{\sqrt5}$

2) $a_к = \frac{3}{4}g$

3) $\frac{m}{M} = \frac{15}{4}$

4) $\sqrt{\frac{4\sqrt5 H}{3g}}$

Чистовик

Задача №2

~~$|Q_1| = |\Delta U + A_\Gamma|$~~ $|Q_1| = |\Delta U + A_\Gamma|$

$\Delta U = C\nu\Delta T \Leftrightarrow \Delta U = \frac{2\nu R}{T_0}\int_{T_0}^{\frac{5}{6}T_0} T\,dT = \frac{\nu R}{T_0}\cdot T^2\Big|_{T_0}^{\frac{5}{6}} = -\frac{11}{36}\nu R T_0$

$A_\Gamma = p_2V_2 - p_1V_1 = \nu R T_0\cdot\frac{5}{6} - \nu R T_0 = -\frac{\nu R T_0}{6} \Rightarrow$

$Q_1 = \left|-\frac{11}{36}\nu R T_0 - \frac{6\nu R T_0}{36}\right| = \frac{17}{36}\nu R T_0$

$\boxed{1)\ \text{Ответ: } Q_1 = \frac{17}{36}\nu R T_0}$

$\Delta U = \int_{T_0}^{T_м}\nu C\,dT = \frac{\nu R}{T_0}\cdot T^2\Big|_{T_0}^{T_м}$

~~$A_1 = Q_1 - \Delta U = Q_1 - \nu R T_0 + \frac{\nu R T_м^2}{T_0}$~~

$A_\Gamma = \nu R T_м - \nu R T_0$ = эта работа минимальна, при $T_м = 0 \Rightarrow$

$A_\Gamma = -\nu R T_0$

~~2) $T_м = 0$~~

~~3) $A_\Gamma = -\nu R T_0$~~

Ответ: 2) $T_м = 0$

3) $A_\Gamma = -\nu R T_0$

$$C_{1,2} = \begin{cases} \frac{4}{5} \\ \frac{1}{5} \end{cases}$$

$\sin^2 t = C$

$\sin^2 t = \frac{4}{5}$ $\quad \sin t = \frac{1}{\sqrt{5}}$

$A_\Gamma = Q_1 - \Delta U.$

$$\Delta U = \int \nu C \cdot dT = \frac{\nu R}{T_0} T^2 \Big|_{T_0}^{T_м} = \frac{\nu R T_м^2}{T_0} - \frac{\nu R \cancel{T_0^2}}{\cancel{T_0}} \nu R T_0.$$

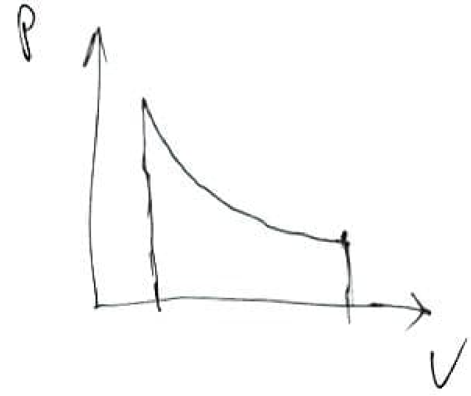
$$\cancel{A_\Gamma = Q_1 - \nu R T_0 + \frac{\nu R T_м^2}{T_0}}$$

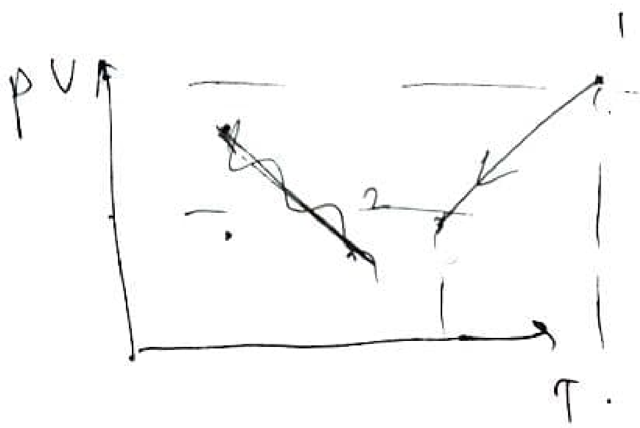
$$A_\Gamma = Q_1 - \frac{\nu R T_м^2}{T_0} + \nu R T_0$$

$$A_\Gamma = \cancel{p_2 V_{2m}} \cdot \nu R T_м - \nu R T_0$$

$$p\frac{V}{T} = \nu R.$$

$$p(V) = \frac{\nu R T}{V}.$$

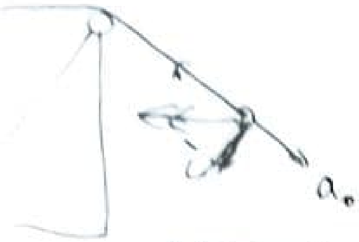




$$\frac{\frac{3}{4}}{\left(\frac{5}{4} - \frac{3}{4}\right) \cdot 2 \cdot \frac{1}{5}} = \frac{15}{4}$$

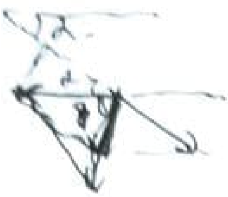
$$Ma_0 = \frac{mg}{\sin\alpha} - T \qquad \frac{a_0\tau^2}{2} = \frac{a_k\tau^2}{2} \qquad T = \frac{mg}{\sin\alpha} - ma_0$$

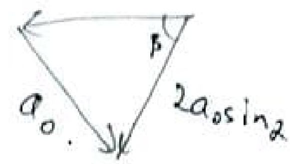
$$T = m\left(\frac{g}{\sin\alpha} - g\frac{\cos\alpha}{\sin\alpha}\right)$$



$$a_0 = a_k$$

$$\boxed{a_0 = g\cdot \mathrm{ctg}\,\alpha = g\cdot\frac{\cos\alpha}{\sin\alpha} = \frac{3}{4}g}$$





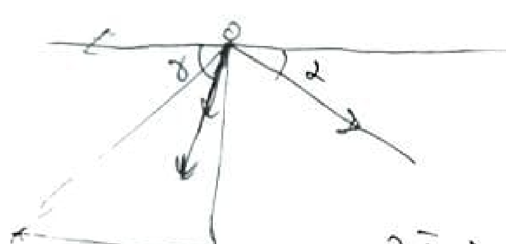
$$\cancel{a = 2a_0\sin\alpha}$$

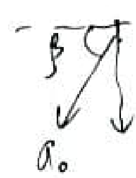
$$\cancel{\frac{a_0}{\sin\beta} = \frac{2a_0\sin\alpha}{\sin\beta} \Rightarrow \sin\beta = \frac{1}{2}.}$$

$$\tau = \sqrt{\frac{2H}{g\cdot\frac{3}{4}\cdot\cos\alpha}} = \tau = \sqrt{\frac{40H}{9g}} = \frac{\sqrt{\frac{40H}{g}}}{3}$$

$$a_0^2 = \cancel{a_0^2} + 4a_0^2\sin^2\alpha - 4a_0^2\sin\alpha\cdot\cos\beta$$

$$4a_0^2\sin^2\alpha = 4a_0^2\sin\alpha\cdot\cos\beta \Rightarrow \cos\beta = \sin\alpha = \sqrt{1-\frac{9}{25}} = \boxed{\frac{4}{5}}$$

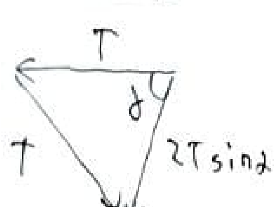




$$\frac{a_0\sin\beta\,\tau^2}{2} = H.$$

$$\sin\beta = \sqrt{1-\frac{1}{5}} = \frac{2}{\sqrt{5}}$$

$$2T\sin\alpha < F.$$



$$T^2 = T^2 + 4T^2\sin^2\alpha - 4T\sin\alpha\cdot\cos\gamma \Rightarrow$$

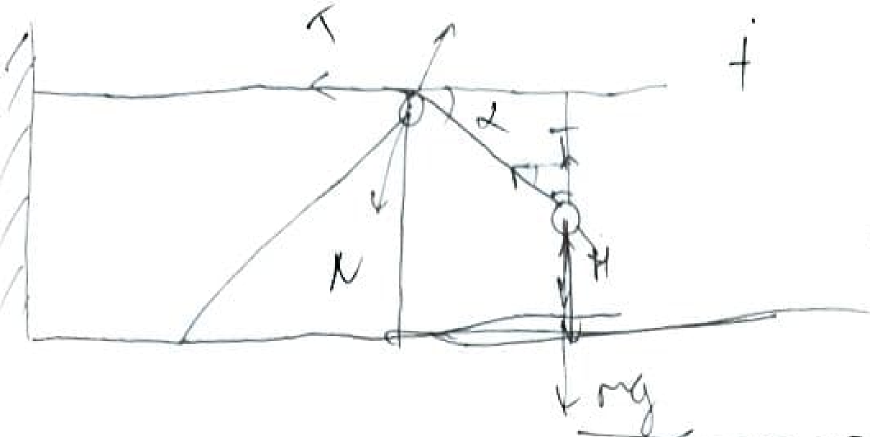
$$\cos\gamma = \sin\alpha = \frac{4}{5}.$$

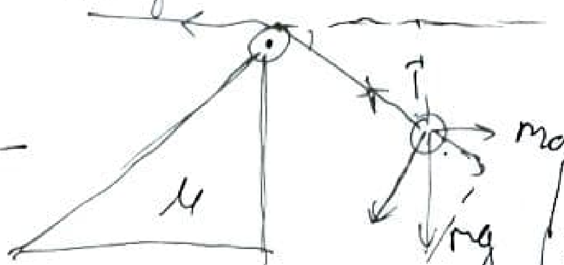
$$2T\sin\alpha\cdot\cos\gamma = Ma_k.$$

$$2\sin^2\alpha\cdot m\cancel{g}\left(\frac{1}{\sin\alpha} - \mathrm{ctg}\,\alpha\right) = M\cancel{g}\,\mathrm{ctg}\,\alpha.$$

$$\frac{M}{m} = \frac{\cancel{g}\,\mathrm{ctg}\,\alpha}{2\sin^2\alpha\left(\frac{1}{\sin\alpha} - \mathrm{ctg}\,\alpha\right)} = \frac{\frac{3}{4}}{2\cdot\frac{16}{25}\left(\frac{5}{4}-\frac{3}{4}\right)} = \frac{\frac{3}{4}}{\frac{16}{25}\cdot\cancel{2\left(\frac{1}{2}\right)}} = \frac{3\cdot 25}{4\cdot 16} = \boxed{\frac{75}{64}}$$

$\sin^4\frac{\alpha}{2} = t^2$

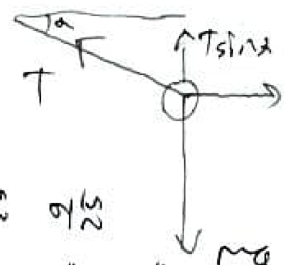




$\cancel{T\sin\alpha = mg}$

$T = mg\sin\alpha$

$\boxed{\cancel{mg\sin\alpha = T}}$



$ma = mg\cos\alpha$

$mg = T\sin\alpha$

$ma_0 = T\cos\alpha - ma_k$

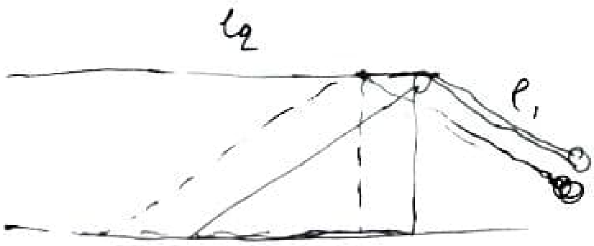
$t^2 - t + \frac{4}{25} = 0$

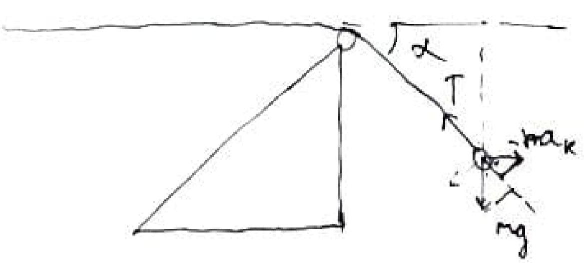
$t_{1,2} = \frac{1 \pm 3/5}{2}$

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

$\Delta X = \frac{a_k \tau^2}{2}$

$\Delta X = \frac{a_0 \tau^2}{2}$





$\cancel{ma_k \; mg\sin\alpha - T = ma_0}$

$$\begin{cases} ma_k\cos\alpha + mg\sin\alpha - T = ma_0 \\ mg\cos\alpha - ma_k\sin\alpha = 0 \end{cases}$$

$ma_k = mg\,\mathrm{ctg}\,\alpha \qquad \cancel{ma_k}\; mg\,\mathrm{ctg}\,\alpha\cdot\cos\alpha + mg\sin\alpha - T = ma_0$

$mg\left(\frac{\cos^2}{\sin\alpha} + \sin\alpha\right) = mg\frac{1}{\sin\alpha} - T = ma_0 \Rightarrow \frac{mg}{\sin\alpha} - T = ma_0$

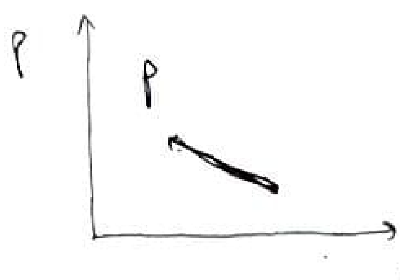
$\nu \quad T_0 \quad C(T) = 2R\frac{T}{T_0}$ $\qquad p_1 V_1 = \nu R T_1$

$Q = \Delta U + A_r$ $\qquad \Delta U = \int_{T_0}^{\frac{5}{6}T_0} C(T)\,dT = \frac{2R}{T_0}\int_{T_0}^{\frac{5}{6}} T\,dT =$

$A_r = Q_1 - \Delta U$ $\qquad = \frac{2R}{T_0}\left.\frac{T^2}{2}\right|_{T_0}^{\frac{5}{6}T_0} = T_0 R - \frac{25}{36}T_0^2 \cdot \frac{1}{2}\cdot\frac{2R}{T_0} =$

$A_r =$

$= \frac{11}{36}\nu R T_0$



$\frac{pV}{T} = const.$

$\Delta U = \nu C \Delta T$

$A_r = p_2 V_2 - p_1 V_1$ $\qquad \Delta U = \nu\frac{2R}{T_0}\int_{T_0}^{\frac{5}{6}T_0} T\,dT = \frac{2\nu R}{T_0}\cdot\left.\frac{T^2}{2}\right|_{T_0}^{\frac{5}{6}T_0} =$

$p_2 V_2 = \nu R \frac{5}{6} T_0$ $\qquad = \frac{\nu R}{T_0}\left(T_0^2 - \frac{25}{36}T_0^2\right) =$

$p_1 V_1 = \nu R T_0 \Rightarrow \boxed{A_r = \frac{\nu R T_0}{6}}$ $\qquad = \frac{\nu R T_0 \cdot 11}{36}$

$Q = \frac{17\nu R T_0}{36}$

$\frac{4}{5} = 2\sin t \cdot \cos t$ $\qquad C_{12} = \frac{1 \pm \frac{3}{5}}{2} = \frac{1}{5}$ $\quad \frac{4}{5}$

$A_r = \Delta(p \cdot V) =$

$\frac{2}{5} = \sin t \cdot \sqrt{1 - \sin^2 t}$

$\frac{4}{25} = c^2 - c^4 \Rightarrow c^2 - c + \frac{4}{25} = 0.$

$D = 1 - \frac{16}{25} = \left(\frac{3}{5}\right)^2$

Часть 2

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

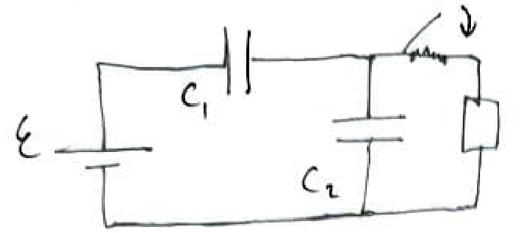
Шифр: **21200999**

ID профиля: **74985**

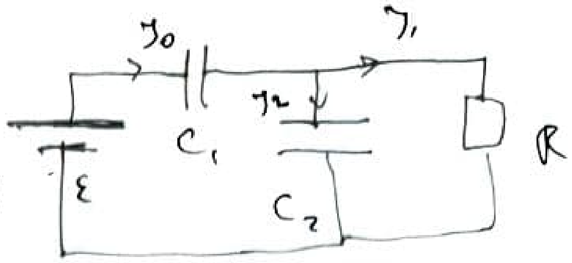
Вариант 1

Вариант 11-01. Чистовик.

Задача № 3



$\Rightarrow$



$C_1 = 2C$

$C_2 = C$

Когда режим установился:

$\mathcal{E} = \frac{q}{C_1} + \frac{q}{C_2}$ (заряды на конденсаторах равны, т.к. последовательное подключение) $\Rightarrow$ $q = \frac{2\mathcal{E}C}{3}$ $\Rightarrow$ Сразу после замыкания ключа напряжение на конденсаторе C_2 не изменится скачком и будет равно $U_{C_2} = \frac{q}{C_2} = \frac{2\mathcal{E}}{3} = U_R$ (параллельное подключение) $\Rightarrow$

$$\boxed{I_1 = \frac{2\mathcal{E}}{3R}}$$

$$\begin{cases} I_0 = I_1 + I_2 \\ q_0 = q_1 + q_2 \\ \frac{q_0}{C_1} + \frac{q_2}{C_2} = \mathcal{E} \\ \frac{q_2}{C_2} - I_1 R = 0 \end{cases} \Rightarrow \begin{cases} q_2 = \left(\mathcal{E} - \frac{q_0}{C_1}\right) C_2 \\ q_1 + \left(\mathcal{E} - \frac{q_0}{C_1}\right) C_2 = q_0 \end{cases}$$

$$\Downarrow$$

$$\boxed{q_1 = q_0 - C_2\mathcal{E} + q_0\frac{C_2}{C_1} = \frac{3}{2}q_0 - C_2\mathcal{E}}$$

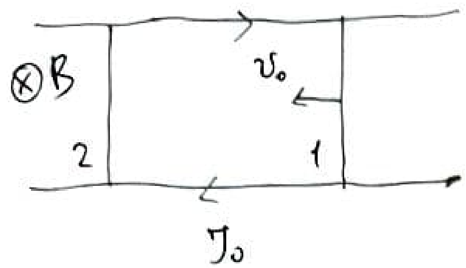
$q_0\mathcal{E} = \frac{q_1^2}{2C_1} + \frac{q_2^2}{2C_2} + Q$. В какой-то момент конденсатор C_2 разрядится полностью $\Rightarrow$ $q_2 = 0$ $\Rightarrow$ $q_1 = q_0$ $\Rightarrow$ $\boxed{Q = q_0\mathcal{E} - \frac{q_0^2}{2C_1} = C\mathcal{E}^2}$

Ответ: 1) $I_1 = \frac{2\mathcal{E}}{3R}$ 2) $Q = C\mathcal{E}^2$

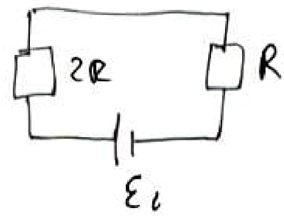
Чистовик

Задача №4

$$\mathcal{E}_i = -\frac{d\Phi}{dt} = -\frac{BdS}{dt} = -Bv_0L \Rightarrow$$



$\Leftrightarrow$



$$\Rightarrow |I_0| = \frac{|\mathcal{E}_i|}{3R} = \frac{v_0BL}{3R}.$$

на перемычку 2 будет действовать сила Ампера: $F = 2m \cdot a = F_A = I_0BL = \frac{v_0(BL)^2}{3R} \Rightarrow \boxed{a = \frac{v_0(BL)^2}{6mR}}$

Запишем З.С.И:

$$mv_0 = 3mv_y \Rightarrow \boxed{v_y = \frac{v_0}{3}}$$

Запишем З.С.Э.

$$-\frac{G2m\cdot m}{S_0} + \frac{mv_0^2}{2} = \frac{3mv_y^2}{2} - \frac{GMm}{S_1}$$

Решая это уравнение получим, что:

$$\boxed{S_1 = \frac{2mG}{G\cdot\frac{2m}{S_0} - \frac{v_0^2}{3}}}$$

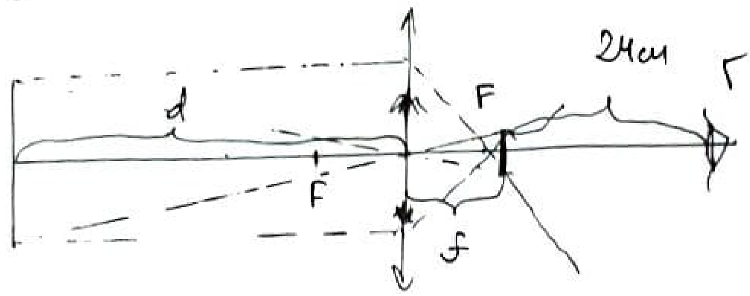
Ответ: 1) $a = \frac{v_0(BL)^2}{6mR}$

2) $v = \frac{v_0}{3}$

3) $S_1 = \frac{2mG}{G\frac{2m}{S_0} - \frac{v_0^2}{3}}$

Чистовик.

Задача № 5



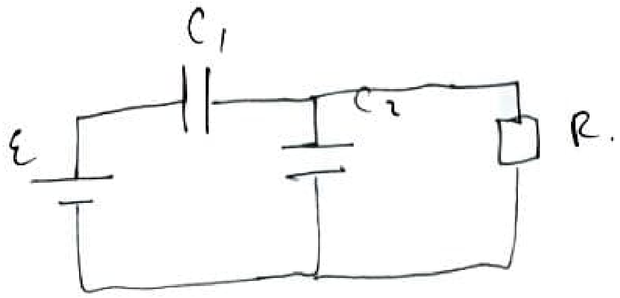
$$\frac{1}{d} + \frac{1}{f} = \frac{1}{F} \Rightarrow \frac{1}{f} = \frac{1}{F} - \frac{1}{d} \Rightarrow f = \frac{Fd}{d-F} = 12\text{см.} \Rightarrow$$

$$\boxed{X = 24\text{см.} + 12\text{см} = 36\text{см.}}$$

$$\boxed{\Gamma = \frac{f}{d} = \frac{1}{3}} \Rightarrow \boxed{D_м = \Gamma \cdot H = 3\text{см.}}$$

Ответ: 1) $X = 36$см

2) $D_м = 3$см.



$q_0 = q_1 \rightarrow$

$$q_0\varepsilon = \frac{q_1^2}{2C_1} + \cancel{\frac{q_2^2}{2C_2}} + Q.$$

$$q_0\varepsilon = \frac{q_0^2}{2C_1} + Q \Rightarrow \quad Q = q_0\varepsilon - \frac{q_0^2}{4C} = C\varepsilon^2$$

$$q_0 = C_1\varepsilon = 2C\varepsilon.$$

$$q_0\varepsilon = 2C\varepsilon^2 \qquad \frac{q_0^2}{4C} = \frac{4C^2\varepsilon^2}{4C} = C\varepsilon^2$$

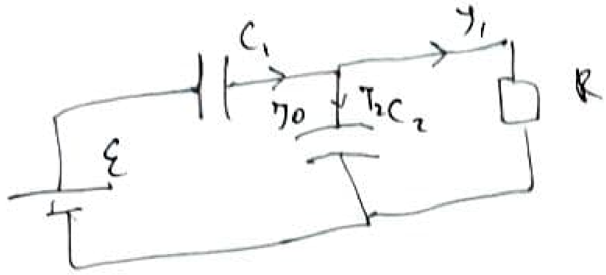
$$-\frac{GMm}{S_0}+\frac{mv_0^2}{2}=\frac{3mv_0^2}{2}-\frac{GMm}{S_1}$$

$$-G\frac{2m^2}{S_0}+\frac{3mv_0^2}{\cancel{6}}=\frac{mv_0^2}{6}-G\frac{2m^2}{S_1}$$

$$\frac{mv_0^2}{3}-G\frac{2m^2}{S_0}=-G\frac{2m^2}{S_1}\Rightarrow$$

$$G\frac{2m}{S_1}=G\frac{2m}{S_0}-\frac{v_0^2}{3}$$

$$S_1=\frac{2mG}{G\frac{2m}{S_0}-\frac{v_0^2}{3}}$$



$$\begin{cases} \mathcal{J}_0 = \mathcal{J}_1 + \mathcal{J}_2 \\ \frac{q_0}{C_1} + \frac{q_2}{C_2} = \mathcal{E} \\ q_1 + q_2 = q_0 \\ \mathcal{J}_1 R = \frac{q_2}{C_2} \end{cases} \Rightarrow \begin{cases} q_2 = \left(\mathcal{E} - \frac{q_0}{C_1}\right) C_2 \\ q_1 + \left(\mathcal{E} - \frac{q_0}{C_1}\right) C_2 = q_0 \\ \boxed{q_1 = q_0 - C_2\mathcal{E} + \frac{C_2}{C_1} q_0 = \frac{3q_0}{2} - C_2\mathcal{E}} = \frac{3q_0}{2} - \frac{q_0}{2} + q_2 \Rightarrow \end{cases}$$

$$q_1 = q_0 + q_2.$$

$$\mathcal{J}_1 = \frac{3\mathcal{J}_0}{2} - C_2\mathcal{E} = \cancel{\frac{3\mathcal{J}_0 - 2C\mathcal{E}}{2}}$$

$$\cancel{q_1 + q_2\, q}$$

$$\mathcal{J}_1 R C_2 = \left(\mathcal{E} - \frac{q_0}{C_1}\right) C_2$$

$$\mathcal{J}_1 R = \mathcal{E} - \frac{q_0}{C_1} = \frac{q_2}{C_2}$$

$$q_1 + C_2\mathcal{E} - \frac{C_2}{C_1} q_0 = q_0 \Rightarrow$$

$$\frac{3q_0}{2} - C_2\mathcal{E} + q_2 = q_0 \qquad C_2\mathcal{E} = \frac{q_0}{2} + q_2 = \frac{q_0}{2} + q_2.$$

$$\frac{dq_1}{dt} R = \frac{q_2}{C_2} \Rightarrow \int dq_1 = \int \frac{q_2\,dt}{C_2 R}$$

$J_0 = J_1 + J_2$ $\quad J_0 = J_1 + J_2.$ $\quad \mathcal{E} = \frac{q_0}{C_1} + \frac{q_2}{C_2} \Rightarrow$

$U_{C_1} + U_{C_2} = \mathcal{E}.$

$U_{C_2} = U_R.$

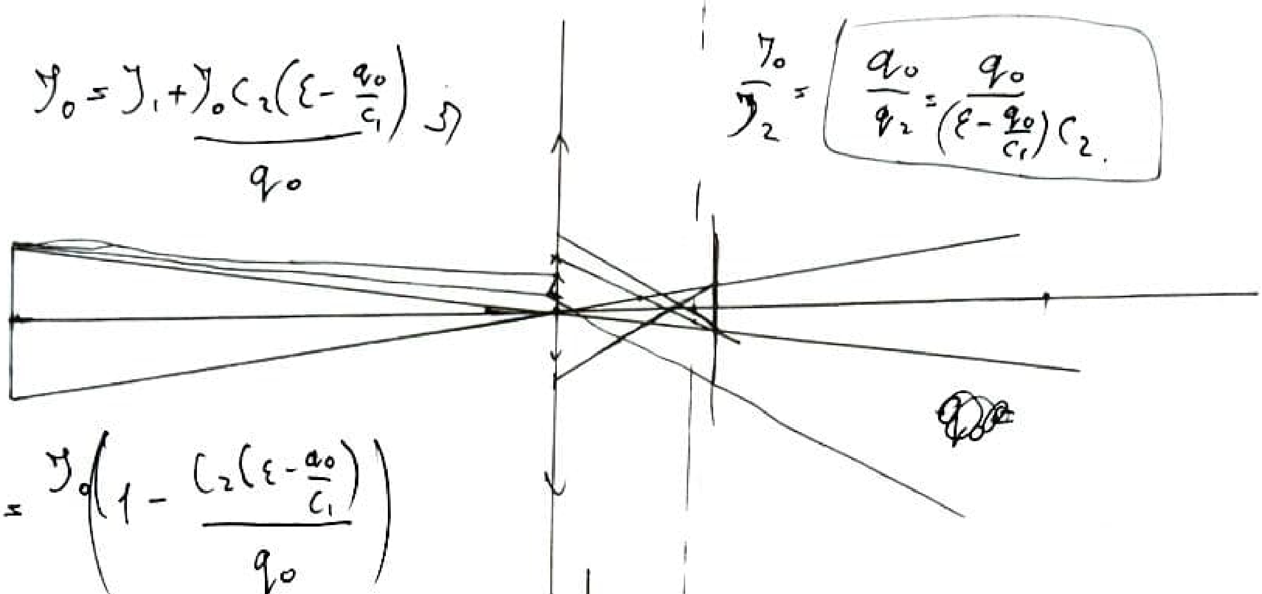
$\frac{1}{d} + \frac{1}{f} = \frac{1}{F}$

$J_2 \cdot Z_2 + J_1 \cdot Z_1 = \mathcal{E}.$

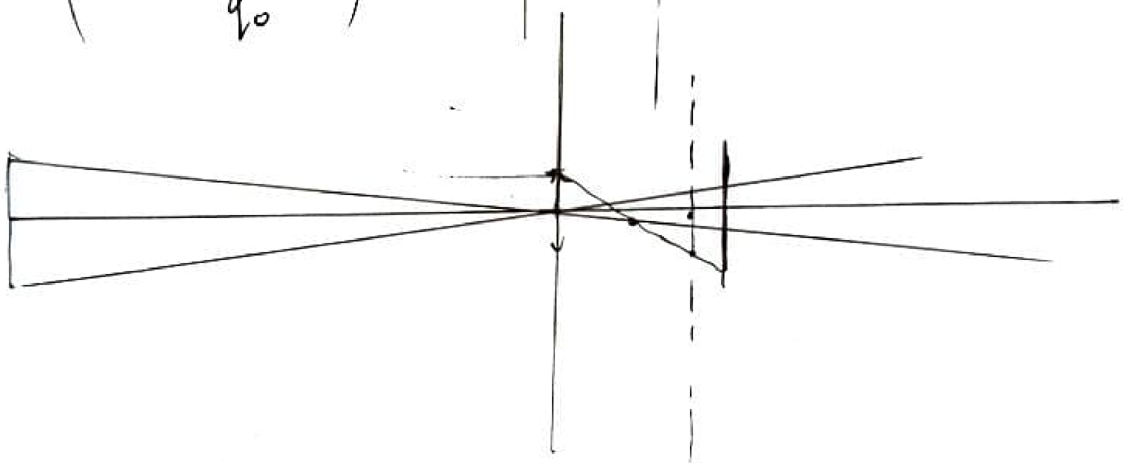
$q_2 = \left(\mathcal{E} - \frac{q_0}{C_1}\right) C_2.$

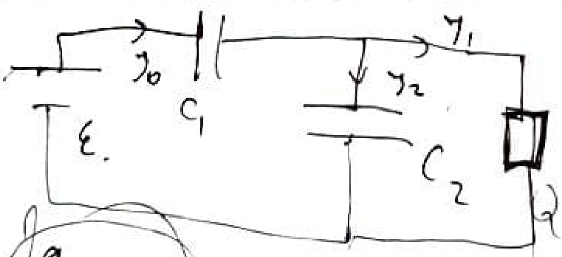
$J_0 = J_1 + \frac{J_0 C_2 \left(\mathcal{E} - \frac{q_0}{C_1}\right)}{q_0} \Rightarrow$

$\frac{J_0}{J_2} = \boxed{\frac{q_0}{q_2} = \frac{q_0}{\left(\mathcal{E} - \frac{q_0}{C_1}\right) C_2}.}$



$J_1 = J_0 \left(1 - \frac{C_2\left(\mathcal{E} - \frac{q_0}{C_1}\right)}{q_0}\right)$





$Q + q\mathcal{E} + \frac{q^2}{2C_1} = q\mathcal{E} + \frac{q_1^2}{2C_1} + \frac{q_2^2}{2C_2} + \ldots$

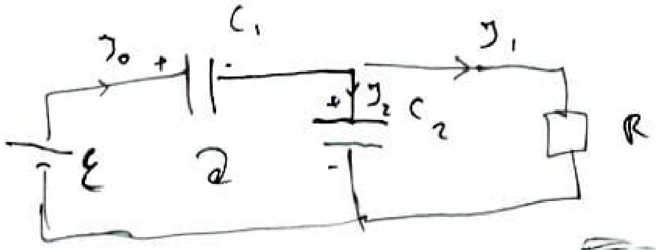
$\frac{q}{C_1} = \mathcal{E}.$

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

$q = C_1\mathcal{E} = 2C \cdot \mathcal{E}.$

$Q + q\mathcal{E} + \frac{q^2}{4C_1} = \frac{2}{3}C\mathcal{E}^2 + \frac{2}{18}C\mathcal{E}^2 + \frac{2C\mathcal{E}^2}{9} \ldots$

$= \frac{12+2+4}{18} = C\mathcal{E}^2$



$U_{C2} = \boxed{\frac{2\mathcal{E}}{3}}$ $U_{C1} = \frac{\mathcal{E}}{3}$

~~$\mathcal{E} = U_{C1} + U_{C2}$~~

$$\begin{cases} q_1 + q_2 = q_0 \\ \mathcal{E} = \frac{q_1}{C_1} + \frac{q_2}{C_2} \\ I_1 R = \frac{q_2}{C_2} \end{cases}$$

$q\mathcal{E} + \frac{C_1 U_{C1}^2}{2} + \frac{C_2 U_{C2}^2}{2} = Q.$

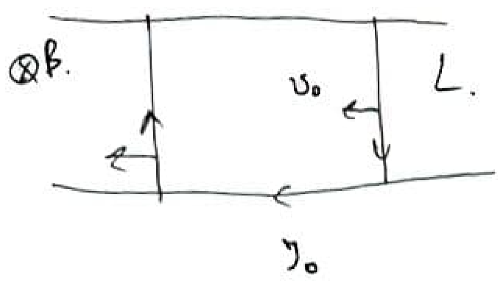
$$\boxed{q\mathcal{E} + \frac{q_1^2}{2C_1} + \frac{q_2^2}{2C_2} = Q.}$$

$\mathcal{E} = \frac{q_0}{C_1} + I_1 R \Rightarrow I_1 = \frac{\mathcal{E} - \frac{q_0}{C_1}}{R} =$

~~$I_1 + I_2 = I_0$~~. $I_1 + I_2 = I_0$

~~$I_1 = I_0 - I_2$~~ $q_1 + q_2 = q_0$. $\mathcal{E}_0$

$\frac{q_0}{C_1} = \frac{I_0 \tau}{C_1}$



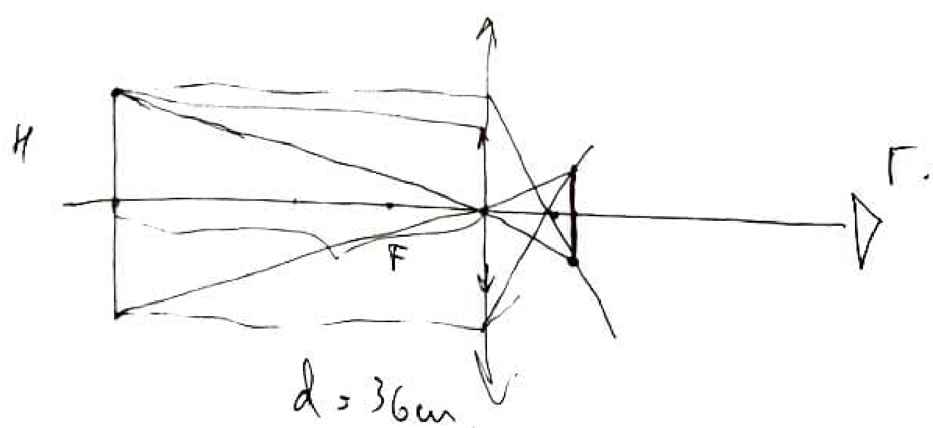
$$\mathcal{E} = -\frac{d\Phi}{dt} = \frac{B\,dS}{dt} = \frac{B\cdot L\cdot v_0\,dt}{dt} = B v_0 L.$$

$$I_0 = \frac{B v_0 L}{3R}.$$

$$I_0 B L = 2ma \Rightarrow$$

$$a = \frac{I_0 B L}{2m} = \frac{\frac{B v_0 L}{3R}\cdot B\cdot L}{2m} = \frac{v_0 (BL)^2}{6mR}.$$

$$m v_0 = 3m v' \Rightarrow \boxed{v' = \frac{v_0}{3}}$$



$d = 36cm.$

$$\frac{1}{d} + \frac{1}{f} = \frac{1}{F} \Rightarrow \frac{1}{f} = \frac{1}{F} - \frac{1}{d} = \frac{1}{9} - \frac{1}{36} = \frac{3}{36} \Rightarrow$$

$$f = 12. \Rightarrow$$

$x = 24cm + 12cm = 36cm.$

$$\cancel{Q}\ \cancel{q}\ \frac{\cancel{1}C_2\cdot\varepsilon^2}{9\cdot 2} + \frac{C_1\cdot\varepsilon^2}{2\cdot 9} = \frac{C_1\varepsilon^2}{2} + Q \Rightarrow$$

$$\cancel{\#}\frac{6C\cdot\varepsilon^2}{18} = \frac{C\varepsilon^2}{3} - .$$

$$J_1R = J_0R\left(1-\frac{C_2\left(\varepsilon-\frac{q_0}{C_1}\right)}{q_0}\right) = \frac{q_2}{C_2} = \varepsilon-\frac{q_0}{C_1} = a.$$

$$J_0R - J_0RC_2\cdot\frac{a}{q_0} = a \Rightarrow$$

$$\cancel{a\ = \ J_0R}$$

$$J_0R - \frac{J_0RC_2\varepsilon}{q_0} + \frac{J_0RC_2}{\cancel{q_0}}\cdot\frac{\cancel{q_0}}{C_1} = \varepsilon-\frac{q_0}{C_1} \Rightarrow$$

$$J_0R - \frac{J_0RC_2\varepsilon}{q_0} + 2J_0R = \varepsilon - \frac{q_0}{C_1} \Rightarrow$$

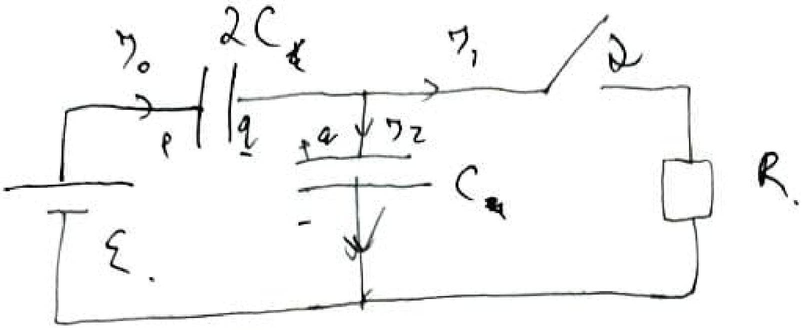
$$\cancel{\frac{q_0}{C}}\quad 3J_0R - \frac{J_0RC_2\varepsilon}{q_0} = \varepsilon-\frac{q_0}{C_1}$$

$$\frac{3J_0Rq_0 - J_0RC_2\varepsilon - \varepsilon q_0 + \frac{q_0^2}{C_1}}{q_0} = 0.$$

$$q_0^2 + q_0\overbrace{\left(3J_0RC_1 - C_1\varepsilon\right)}^{B} - \overbrace{J_0RC_2\varepsilon C_1}^{C} = 0.$$

$$D = B^2 + 4\cancel{a}C$$

$$q_0 = \frac{-B\pm\sqrt{B^2+4ac}}{2} = \frac{C_1\varepsilon - 3J_0R\cdot C_1 + \sqrt{}}{}$$



1) $\cancel{Q\ I_R = 0}$

$I_1 R = U_c$

$$\frac{q}{2C} + \frac{q}{C} = \mathcal{E} \Rightarrow \frac{3q}{2C} = \mathcal{E} \Rightarrow$$

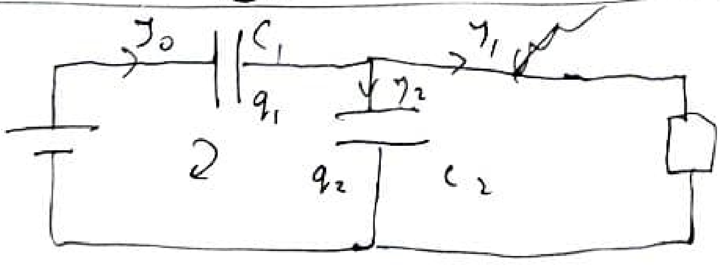
$$q = \frac{2C\mathcal{E}}{3} \Rightarrow \frac{q}{C} = \boxed{\frac{2\mathcal{E}}{3}} = I_1 R \overset{1)}{\Rightarrow} \boxed{I_1 = \frac{2\mathcal{E}}{3R}}$$

$$q^2 = \frac{4}{9}(C\mathcal{E})^2$$

$$q\mathcal{E} = \frac{q^2}{4C} + \frac{q^2}{2C} + Q$$

$$q\mathcal{E} = \frac{3q^2}{4C} + Q \Rightarrow Q = q\mathcal{E} - \frac{3q^2}{4C} = q\mathcal{E} - \frac{3}{4C}\cdot\frac{4}{9}C\mathcal{E}^2 = q\mathcal{E} - \frac{C\mathcal{E}^2}{3} =$$

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



$$\mathcal{E} = \frac{q_1}{C_1} + \frac{q_2}{C_2}.$$

$$\frac{q_2}{C_2} - I_1 R = 0.$$

$I_0 = I_1 + I_2$.

$q_0 = q_1 + q_2 \Rightarrow q$