Часть 1

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

Шифр: **21201285**

ID профиля: **804597**

Вариант 7

Чистовик

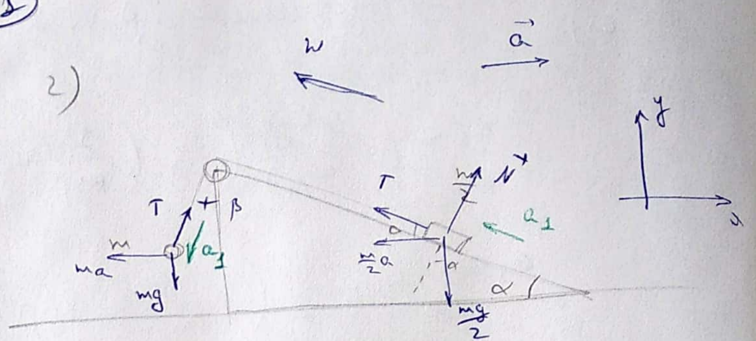
№1

(1)

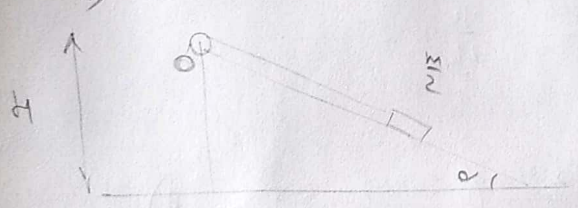
Дано: $\cos\alpha = 5/13$; m; $\cos\beta = 3/5$; g

1) a - ?
2) a_1 - ?
3) t_1 - ?

2)



1)



II Закон Ньютона на ось w для бруска:

$$T + \frac{ma}{2}\cos\alpha - \frac{mg}{2}\sin\alpha = \frac{m}{2}a_1 \quad (3)$$

Перейдём к НеИСО, связанную с клином:

II Закон Ньютона на ось y для шарика:

$$T\cos\beta - mg = -ma_1\cos\beta \quad (1)$$

на ось x:

$$T\sin\beta - ma = -ma_1\sin\beta \quad (2)$$

$$(1):\cos\beta - (2):\sin\beta \Rightarrow T - \frac{mg}{\cos\beta} - T + \frac{ma}{\sin\beta} = 0$$

$$\frac{mg}{\cos\beta} = \frac{ma}{\sin\beta} \Rightarrow \underline{a = g\,tg\,\beta} = \frac{4g}{3} \approx 13{,}067 \text{ м/с}^2$$

$$\cos\beta = \frac{3}{5} \quad \sin\beta = \sqrt{1 - \frac{9}{25}} = \frac{4}{5} \Rightarrow tg\,\beta = \frac{4/5}{3/5} = \frac{4}{3}$$

$$(1):\cos\beta + (2):\sin\beta \Rightarrow T - \frac{mg}{\cos\beta} + T - \frac{mg\,tg\,\beta}{\sin\beta} = -2ma_1$$

~~$2T = -2ma_1 \Rightarrow T = -ma_1$~~

$$2T - \frac{2mg}{\cos\beta} = -2ma_1 \Rightarrow T = \frac{mg}{\cos\beta} - ma_1$$

Подставляем в (3):

~~$-ma_1 + \frac{mg}{\cos\beta} + \frac{mg\,tg\,\beta}{2}\cos\alpha - \frac{mg}{2}\sin\alpha = \frac{m}{2}a_1$~~

$$\frac{mg}{\cos\beta} - ma_1 + \frac{mg}{2}tg\,\beta\cos\alpha - \frac{mg}{2}\sin\alpha = \frac{m}{2}a_1$$

Чистовик

(2)

$$\frac{mg}{\cos\beta} + \frac{mg}{2}\operatorname{tg}\beta\cos\alpha - \frac{mg}{2}\sin\alpha = \frac{3m}{2}a_1 \quad \Big|:m$$

$$\frac{3}{2}a_1 = \cancel{g\,\frac{\cos\alpha}{\cos\beta}}\; g\left(\frac{1}{\cos\beta} + \frac{\operatorname{tg}\beta\cos\alpha}{2} - \frac{\sin\alpha}{2}\right) \quad \Big|\cdot\frac{2}{3}$$

$$a_1 = \frac{g}{3}\left(\frac{2}{\cos\beta} + \operatorname{tg}\beta\cos\alpha - \sin\alpha\right) =$$

$$\cos\alpha = 5/13 \Rightarrow \sin\alpha = \sqrt{1 - \frac{25}{169}} = \sqrt{\frac{144}{169}} = \frac{12}{13}$$

$$\Downarrow$$

$$a_1 = \frac{g}{3}\left(\frac{2}{3}\cdot 5 + \frac{4}{3}\cdot\frac{5}{13} - \frac{12}{13}\right) = \frac{2g}{39}\left(\frac{5\cdot 13}{3} + \frac{2\cdot 5}{3} - 6\right) =$$

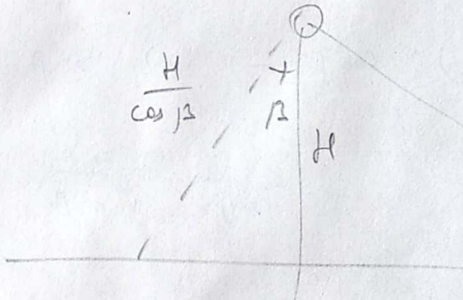
$$= \frac{2g}{39\cdot 3}\left(\overset{75}{65 + 10} - 18\right) = \frac{2g}{39\cdot\cancel{3}}\cdot\overset{19}{\cancel{57}} = \frac{38g}{39} \approx 9{,}549\ м/с^2$$

$$\frac{a_1 t^2}{2} = \frac{H}{\cos\beta}$$

$$\Downarrow$$

$$t^2 = \frac{\cancel{2}H}{\cos\beta}\cdot\frac{39}{\underset{19}{\cancel{38}}g} = \frac{39H}{19g\cos\beta} =$$

$$= \frac{\overset{13}{\cancel{39}}H}{19g\cdot\cancel{3}/5} = \frac{65H}{19g} \Rightarrow t = \sqrt{\frac{65H}{19g}}$$



Ответ:

1) $a = \frac{4g}{3} \approx 13{,}067\ м/с^2$ (при $g = 9{,}8\ м/с^2$)

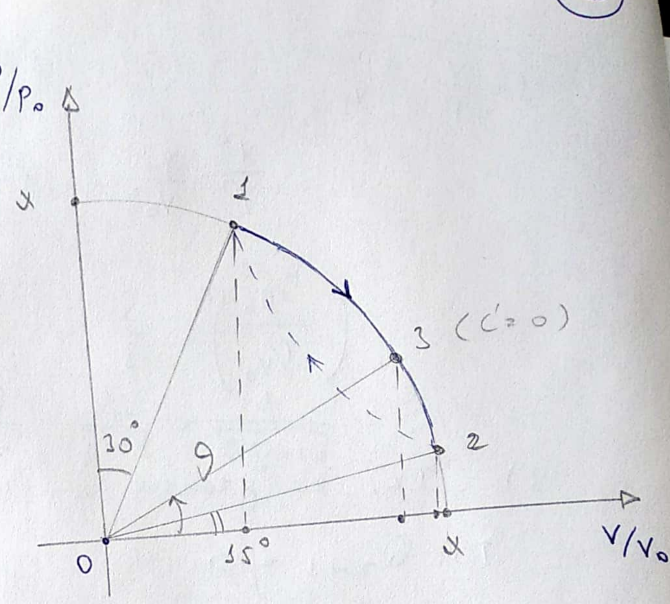
2) $a_1 = \frac{38g}{39} \approx 9{,}549\ м/с^2$ (при $g = 9{,}8\ м/с^2$)

3) $t = \sqrt{\frac{65H}{19g}}$

Чистовик

№2

Дано: одноатомный => $i=3$



1) Пусть радиус окружности x

В т.1:

$\frac{P_1}{P_0} = x\cos 30°$ $\frac{V_1}{V_0} = x\sin 30°$

В т.2:

$\frac{P_2}{P_0} = x\sin 15°$ $\frac{V_2}{V_0} = x\cos 15°$

Ур-ие Менделеева-Клапейрона:

$P_1V_1 = \nu RT_1$
$P_2V_2 = \nu RT_2$ $\Big\} -$ $\nu R(T_2 - T_1) = P_2V_2 - P_1V_1$ $|:(\nu RT_2)$

$$\frac{T_2-T_1}{T_2} = \frac{P_2V_2 - P_1V_1}{P_2V_2} = 1 - \frac{\frac{P_1}{P_0}\cdot\frac{V_1}{V_0}}{\frac{P_2}{P_0}\cdot\frac{V_2}{V_0}} =$$

$$= 1 - \frac{x\cos 30°\cdot x\sin 30°}{x\sin 15°\cdot x\cos 15°} = 1 - \frac{\sin 60°}{\sin 30°} = 1 - \frac{\sqrt{3}/2}{1/2} = 1 - \sqrt{3}$$

$$\frac{T_1-T_2}{T_2} = -\frac{T_2-T_1}{T_2} = \sqrt{3} - 1$$

2) Ур-ие процесса: $d\left[\left(\frac{P}{P_0}\right)^2 + \left(\frac{V}{V_0}\right)^2 = x^2\right]$

$$2\frac{P}{P_0}d\left(\frac{P}{P_0}\right) + 2\frac{V}{V_0}d\left(\frac{V}{V_0}\right) = 0$$

$$\frac{P}{P_0^2}dp = -\frac{V}{V_0^2}dV \Rightarrow \frac{dp}{dV} = -\frac{V}{P}\cdot\frac{P_0^2}{V_0^2}$$

$$~~C = \delta Q~~ \quad C = \frac{\delta Q}{\nu dT} = \frac{dU + dA}{\nu dT} = \frac{\frac{i}{2}\nu R\,dT + p\,dV}{\nu\,dT} =$$

$$= \frac{i}{2}R + \frac{p\,dV}{\nu dT} = \frac{i}{2}R + R\frac{p\,dV}{d(\nu RT)} = \frac{i}{2}R + R\frac{p\,dV}{d(pV)} =$$

$$= \frac{i}{2}R + R\frac{p\,dV}{p\,dV + V\,dp} = R\left(\frac{i}{2} + \frac{1}{1 + \frac{V}{p}\cdot\frac{dp}{dV}}\right) = 0$$

Чистовик

$$\frac{1}{1+\frac{V}{p}\cdot\frac{dp}{dV}} = -\frac{3}{2} \Rightarrow 1+\frac{V}{p}\left(-\frac{V}{p}\cdot\frac{p_0^2}{V_0^2}\right) = -\frac{2}{3}$$

$$\frac{V^2}{p^2}\cdot\frac{p_0^2}{V_0^2} = 1+\frac{2}{3} \Rightarrow \left(\frac{V/V_0}{p/p_0}\right)^2 = \frac{5}{3}$$

$\Leftarrow$ *(если что, то $\vartheta = 37^\circ > 15^\circ$ и $< 60^\circ \Rightarrow$ точка на дуге $1\to2$)

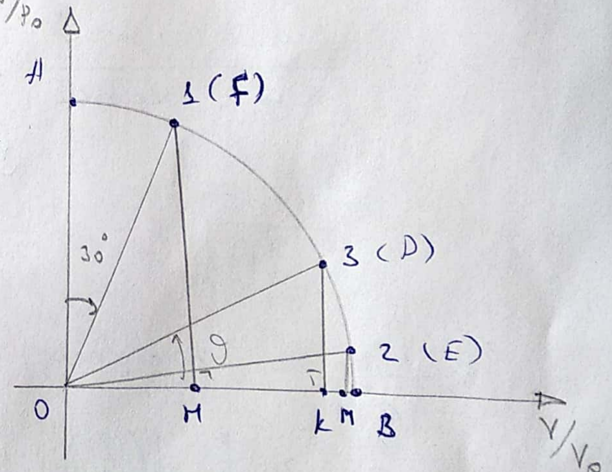
$$\left(\frac{p/p_0}{V/V_0}\right)^2 = \frac{3}{5} \Rightarrow \frac{p/p_0}{V/V_0} = \operatorname{tg}\vartheta = \frac{\sqrt{3}}{\sqrt{5}} \Rightarrow$$

$$\Rightarrow \cos\vartheta = \frac{1}{\sqrt{1+\operatorname{tg}^2\vartheta}} = \frac{1}{\sqrt{1+\frac{3}{5}}} = \frac{\sqrt{5}}{2\sqrt{2}} \Rightarrow \sin\vartheta = \operatorname{tg}\vartheta\cos\vartheta = \frac{\sqrt{3}}{2\sqrt{2}}$$

3) Т.к. на участке $2\to1$ теплообменом можно пренебречь, то $Q_{2\to1} = 0$ $\Rightarrow$ Подвод тепла участок $1\to3$, ~~будет~~ а отвод $\to$ $3\to2$

$$Q_{13} = \Delta U_{13} + A_{13} = \frac{i}{2}(p_3V_3 - p_1V_1) + A_{13}$$

$$p_3 = p_0\, x\sin\vartheta = \frac{\sqrt{3}}{2\sqrt{2}}\, x p_0 \qquad V_3 = V_0\, x\cos\vartheta = \frac{\sqrt{5}}{2\sqrt{2}}\, x p_0$$



$$S_{DBK} = S_{ODB} - S_{ODK} = \frac{\pi x^2}{2\pi}\arctan\left(\sqrt{\frac{3}{5}}\right) - \frac{1}{2}x\cos\vartheta\cdot x\sin\vartheta =$$

$$= \frac{x^2}{2}\left(\arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) - \frac{\sqrt{15}}{8}\right)$$

$$S_{FBM} = S'_{OFB} - S'_{OFM} = \frac{\pi x^2}{\cancel{360^\circ}_{6}}\cdot\cancel{60^\circ} - \frac{1}{2}x\cos 60^\circ\cdot x\sin 60^\circ) = \frac{x^2}{2}\left(\frac{\pi}{3} - \frac{\sqrt{3}}{2}\cdot\frac{1}{2}\right) = \frac{x^2}{2}\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4}\right)$$

$$S_{FDKM} = S_{FBM} - S_{DBK} = \frac{x^2}{2}\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) + \frac{\sqrt{15}}{8}\right)$$

$$A_{1\to3} = p_0V_0\, S_{FDKM} = \frac{x^2}{2}p_0V_0\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) + \frac{\sqrt{15}}{8}\right)$$

Чистовик

$$Q_{32} = -(\Delta U_{32} + A_{32}) = -\left[\frac{i}{2}\left(p_2V_2 - p_3V_3\right) + A_{32}\right]$$

$$S_{EBM} = S_{OEB} - S_{OEM} = \frac{\pi x^2}{360^\circ}\cdot 15^\circ - \frac{1}{2}\, x\cos 15^\circ \cdot x \sin 15^\circ =$$

$$= \frac{\pi x^2}{24} - \frac{x^2}{4}\cdot \sin 30^\circ = \frac{\pi x^2}{24} - \frac{x^2}{8} = \frac{x^2}{4}\left(\frac{\pi}{6} - \frac{1}{2}\right) = \frac{x^2}{2}\left(\frac{\pi}{12} - \frac{1}{4}\right)$$

$$S_{DEMK} = S_{DBK} - S_{EBM} = \frac{x^2}{2}\left(\arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) - \frac{\sqrt{15}}{8} - \frac{\pi}{12} + \frac{1}{4}\right)$$

$$\Downarrow$$

$$A_{32} = p_0V_0\, S_{DEMK} = \frac{x^2}{2}\, p_0V_0\left(\arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) - \frac{\sqrt{15}}{8} - \frac{\pi}{12} + \frac{1}{4}\right)$$

$$\cancel{\eta = \frac{Q_{13} - Q_{32}}{Q_{13}} = 1 - \frac{Q_{32}}{Q_{13}} = 1 - \frac{3}{2}p_0V_0x^2\left(\sin 15^\circ \cos 15^\circ - \right.}$$

$$\cancel{\left. - \frac{\sqrt{15}}{8}\right) + \frac{x^2}{2}p_0V_0\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) + \frac{\sqrt{15}}{8}\right)}$$

$3/4$

$$\eta = \frac{Q_{13} - Q_{32}}{Q_{13}} = 1 - \frac{Q_{32}}{Q_{13}} = 1 + \frac{\frac{3}{2}p_0V_0x^2\left(\sin 15^\circ \cos 15^\circ - \frac{\sqrt{15}}{8}\right) + \frac{x^2}{2}p_0V_0\left(\arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) - \frac{\sqrt{15}}{8} - \frac{\pi}{12} + \frac{1}{4}\right)}{\frac{3}{2}p_0V_0x^2\left(\frac{\sqrt{15}}{8} - \sin 30^\circ \cdot \cos 30^\circ\right) + \frac{x^2}{2}p_0V_0\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) + \frac{\sqrt{15}}{8}\right)} =$$

$\sqrt{3}/4$

$$= 1 + \frac{+\frac{3}{4} - \frac{3\sqrt{15}}{8} + \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) - \frac{\sqrt{15}}{8} - \frac{\pi}{12} + \frac{1}{4}}{\frac{3\sqrt{15}}{8} - \frac{3\sqrt{3}}{4} + \frac{\pi}{3} - \frac{\sqrt{3}}{4} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) + \frac{\sqrt{15}}{8}} =$$

$$= 1 + \frac{1 - \frac{\sqrt{15}}{2} - \frac{\pi}{12} + \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right)}{\frac{\sqrt{15}}{2} - \sqrt{3} + \frac{\pi}{3} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right)}$$

Числовеек

$$\frac{\sqrt{15}}{2} - \sqrt{3} + \frac{\pi}{3} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) - 1 + \frac{\sqrt{15}}{2} + \frac{\pi}{12} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right)$$

$$\frac{\sqrt{15}}{2} - \sqrt{3} + \frac{\pi}{3} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) =$$

$$= \sqrt{15} - \sqrt{3} - 1 + \frac{5\pi}{12} - 2\arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) =$$

$$\frac{\sqrt{15}}{2} - \sqrt{3} + \frac{\pi}{3} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right)$$

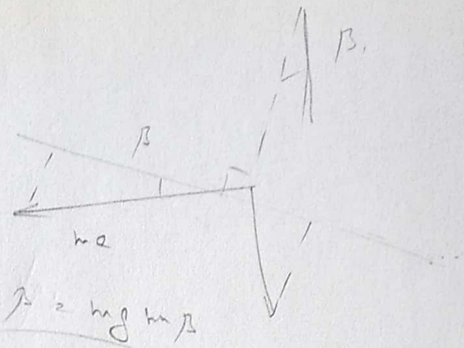
Ответ: 1) $\frac{T_1 - T_2}{T_2} = \sqrt{3} - 1$

2) $\operatorname{tg}\vartheta = \frac{\sqrt{3}}{\sqrt{5}} \Rightarrow \vartheta = \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right)$

3) $$\eta = 1 + \frac{1 - \frac{\sqrt{15}}{2} - \frac{\pi}{12} + \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right)}{\frac{\sqrt{15}}{2} - \sqrt{3} + \frac{\pi}{3} - \arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right)}$$

$$\frac{\cancel{38}^{19} g t^2}{\cancel{35 \cdot 2}_{13}} = \frac{H}{\cancel{3}} \cdot 5$$

$$t^2 = \frac{65H}{19g}$$



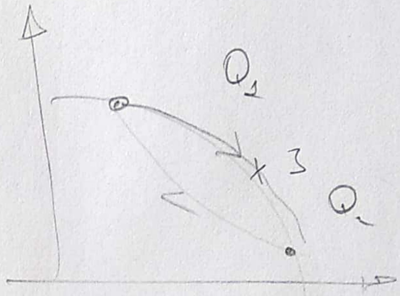
$ma \cos\beta = mg \sin\beta$

$a = g\,tg\,\beta$ ✓.

$Q_1 = \Delta U_{12} + A_{12} =$

$Q_2 = 0$

$\eta = \frac{A}{Q_1} = \frac{Q_1 - Q_2}{Q_1} = 1$?



$\arctan\left(\frac{\sqrt{3}}{\sqrt{5}}\right) \approx 0,6590580336 \approx$

$\approx 0,65906.$

$\frac{\sqrt{15}}{2} \approx 1,9364516731 \approx$

$\approx 1,9365$

$\sqrt{3} \approx 1,732051$

$-1,1982299 3833$ $\to 0,66 = -0,5\ldots$

$1 - 1,9365$ $\sqrt{\frac{5}{8}}$ $\sqrt{\frac{3}{8}}$ $\Rightarrow \frac{\sqrt{5}}{8} \cdot 4$

$0,2 + 1 - 0,6 = 0,6$

Часть 2

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

Шифр: **21201285**

ID профиля: **804597**

Вариант 7

Чистовик

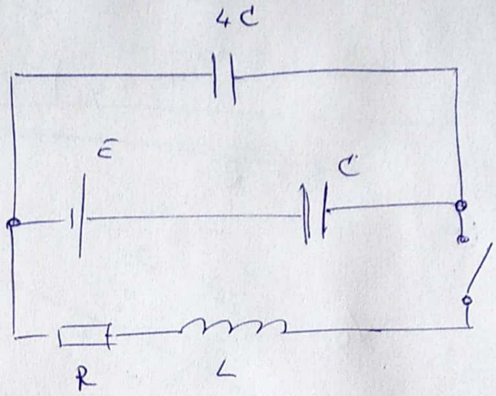
Вариант 11-07 (1)

№3

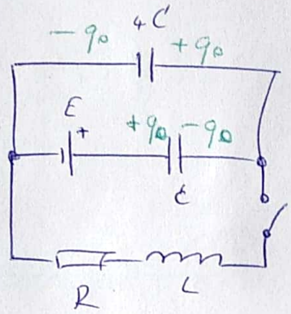
1) $\frac{dI_L}{dt}(0) = ?$

2) Q – ?

3) I_{R1}, когда через C_1 I_0



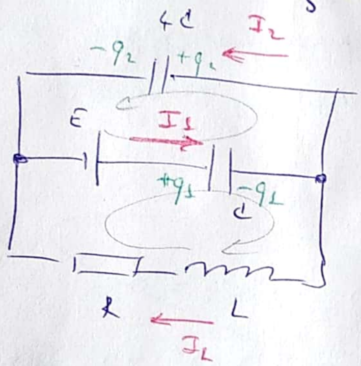
I



$$C_0 = \frac{1}{\frac{1}{4C} + \frac{1}{C}} = \frac{1}{\frac{5}{4C}} = \frac{4}{5}C$$

$$q_0 = C_0 E = \frac{4}{5} C E$$

II



Законы Кирхгофа:

$$\begin{cases} I_1 = I_2 + I_L \\ E - E_i = \frac{q_1}{C} + I_L R \\ E = \frac{q_1}{C} + \frac{q_2}{4C} \end{cases}$$

$\Updownarrow$

$$\begin{cases} \dot q_1 = \dot q_2 + I_L & (1) \\ E - L \dot I_L = \frac{q_1}{C} + I_L R & (2) \\ E = \frac{q_1}{C} + \frac{q_2}{4C} \,\Big|\cdot 4C & (3) \end{cases}$$

В начальный момент (момент замыкания ключа) ток через катушку = 0, т.к. поток не может мгновенно изм. =>

$$E - L \dot I_L(0) = \frac{q_0}{C} \Rightarrow L \dot I_L(0) = E - \frac{q_0}{C} = E - \frac{4}{5}E = \frac{E}{5}$$

$$\dot I_L(0) = \frac{E}{5L}$$

$$\cancel{dQ = I_L^2 R\, dt = I_L R\, dq_L} = \cancel{\left(E - L\dot I_L - \frac{q_1}{C}\right)} (\dot q_1 - \dot q_2) R\, dq_L =$$

$$\cancel{= (\dot q_1 - \dot q_2) R (dq_1 - dq_2)} \text{ и}$$

Из $\cancel{(3)}$: $\cancel{4CE = 4q_1 + q_2 \Rightarrow q_2 = 4(CE - q_1)}$ =>

Подставим

из (3): $\frac{d}{dt}\{4CE = 4q_1 + q_2\} \Rightarrow 0 = 4\dot{q}_1 + \dot{q}_2 \Rightarrow$

$\Rightarrow \dot{q}_2 = -4\dot{q}_1 \Rightarrow$ Подставляя в (1):

$\dot{q}_1 + 4\dot{q}_1 = \cancel{q_2}\, J_L \Rightarrow J_L = 5\dot{q}_1$

$J_{R1} = J_L = 5 J_0$

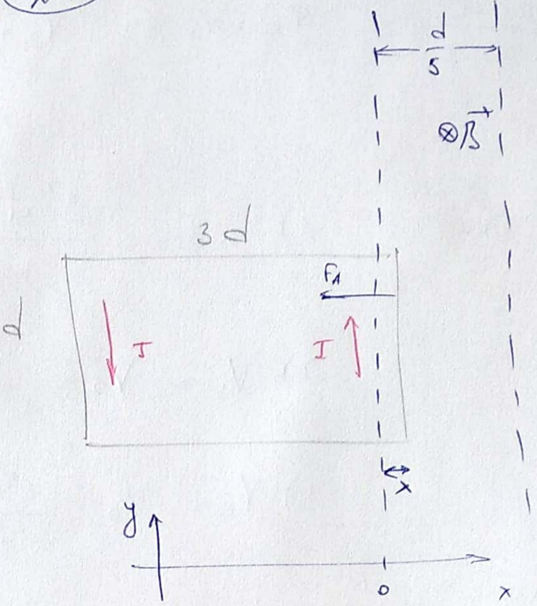
$W_0 = \frac{q_0^2}{C} + \frac{q_0^2}{4C} = \frac{4}{5} CE^2$

$$\boxed{\text{Ответ: } 1)\ \dot{J}_L(0) = \frac{E}{5L} \qquad 3)\ J_{R1} = 5J_0}$$

Чистовик

№4

Дано: m; d; V_0; R; B



$|\varepsilon_i| = IR$

$$B\frac{d \cdot dx}{dt} = IR$$

$$I = \frac{Bd}{R}\frac{dx}{dt}$$

II закон Ньютона на ось x:

$$-BId = m\frac{dv_x}{dt}$$

$$-Bd \cdot \frac{Bd}{R}\frac{dx}{dt} = m\frac{dv_x}{dt} \Rightarrow$$

В начальный момент $x = 0 \Rightarrow$

$$\Rightarrow a_x(0) = \frac{dv_x}{dt} = -\frac{(Bd)^2}{mR}\frac{dx}{dt} = -\frac{(Bd)^2}{mR}V_0$$

* Силы действующие вдоль границы (на ось y) уравновешивают друг друга $\Rightarrow a_y = 0$

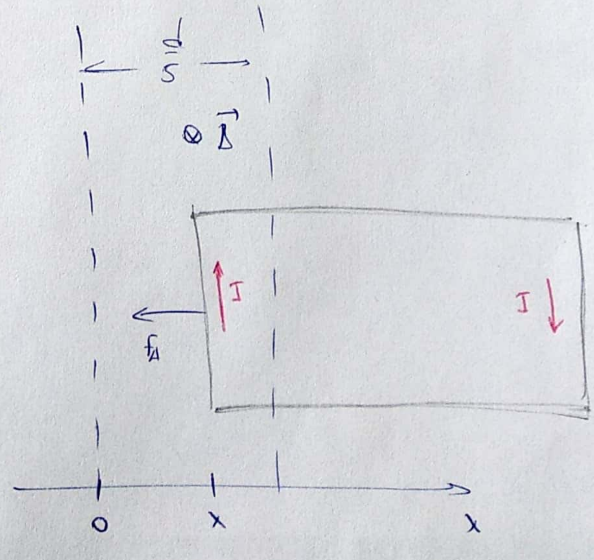
$$a = -a_x = \frac{(Bd)^2}{mR}V_0$$

$$\int_0^{d/5} -\frac{(Bd)^2}{mR}\,dx = \int_{V_0}^{V_1} \cancel{m}\,dv_x \Rightarrow -\frac{(Bd)^2}{mR}\cdot\frac{d}{5} = \cancel{m}\, V_1 - V_0$$

$$V_1 = V_0 - \frac{B^2 d^3}{5mR}$$

После того, как правая сторона покинет поле, но до того, как левая войдёт в него:

$\Phi = const = B\frac{d}{5}\cdot d = \frac{Bd^2}{5} \Rightarrow \varepsilon_i = 0 \Rightarrow I = 0$, а потом:



$$\left|-Bd\cdot\frac{dx}{dt}\right| = IR \Rightarrow I = \frac{Bd}{R}\frac{dx}{dt}$$

II закон Ньютона на ось x:

$$-BId = m\frac{dv_x}{dt}$$

$$Bd\cdot\frac{Bd}{R}\frac{dx}{dt} = m\frac{dv_x}{dt}$$

$$\int_0^{d/5} -\frac{(Bd)^2}{mR}\,dx = \int_{V_1}^{V_2} dv_x$$

Чистовик

$$-\frac{B^2 d^3}{5mR} = V_2 - V_3 \Rightarrow V_2 = V_1 - \frac{B^2 d^3}{5mR} = V_0 - \frac{2B^2 d^3}{5mR}$$

4

Ответ: 1) $a = \frac{B^2 d^2 V_0}{mR}$

2) $V_3 = V_0 - \frac{B^2 d^3}{5mR}$

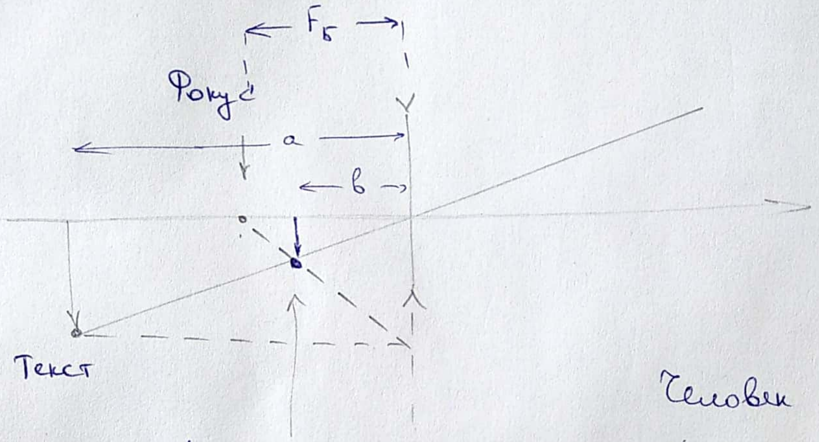
3) $V_2 = V_0 - \frac{2B^2 d^3}{5mR}$

Чистовик

№5

Дано: $a = 25$ см; $\frac{\Phi_Д}{\Phi_Б} = 3$

1) С 25 см:



По формуле тонкой линзы:

$$-\frac{1}{F_Б} = \frac{1}{a} - \frac{1}{b},$$

т.к. изображение мнимое

(т.к. линза рассеивающая

$$\Downarrow$$

$$\frac{1}{F_Б} = \frac{1}{b} - \frac{1}{a}$$

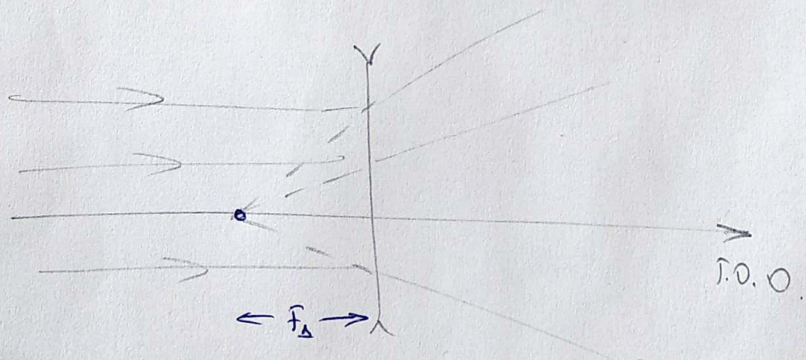
Г.О.О. ~~На пределе~~

~~$b = x_M$~~

$$b = x_M$$

Человек может разглядеть объекты с расстояния x_M и ближе, вплоть до предела аккомодации

2) Удалённые => лучи почти $\parallel$:



$$F_Д = x_M$$

$$\Downarrow$$

$$\frac{\Phi_Д}{\Phi_Б} = 3 \Rightarrow \frac{F_Д}{F_Б} = \frac{1}{3}$$

$$x\left(\frac{1}{b} - \frac{1}{a}\right) = \frac{1}{3}$$

$$x_M\left(\frac{1}{x_M} - \frac{1}{a}\right) = \frac{1}{3}$$

$$1 - \frac{x_M}{a} = \frac{1}{3} \Rightarrow \frac{x_M}{a} = \frac{2}{3} \Rightarrow x_M = \frac{2}{3}a = \frac{50}{3}\text{ см} = 16{,}67\text{ см}$$

$$\Phi_Д = \frac{1}{F_Д} = \cancel{\frac{3}{0{,}5}\text{ Диоп}}\ \frac{3}{0{,}5}\text{ м}^{-1} = 6\text{ м}^{-1} = 6\text{ Диоптрий}$$

3)

$$-\frac{1}{F} = \frac{1}{50\text{ см}} - \frac{1}{x} \Rightarrow F = \frac{1}{\frac{3}{50\text{ см}} - \frac{1}{50\text{ см}}} = \frac{1}{\frac{2}{50\text{ см}}} =$$

$$= 25\text{ см} \Rightarrow \Phi = \frac{1}{F} = \frac{1}{0{,}25}\text{ м}^{-1} = 4\text{ Диоптрий}$$

Чистовик

Ответ: 1) $x \leq \frac{50}{3}$ см $\approx 16,67$ см

$\Phi_Д = 6$ Диоптрий

2) $\Phi = 4$ Диоптрий

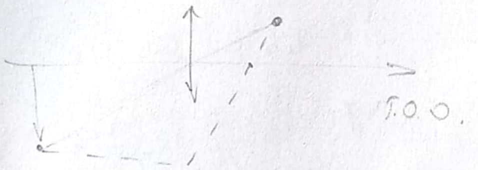
$\dot q_1 R(dq_1 - dq_2) - \dot q_2 R(dq_1 - dq_2) =$

$= \quad \dot q_1 = \frac{dq_1}{dt} \cdot dq_1 = \left(\frac{dq_1}{dt}\right)^2 \cdot dt \Rightarrow \dot q_1^{\,2} dt$

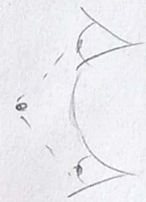
$E - L \dot I_L = \frac{q_1}{C} + I_L R$

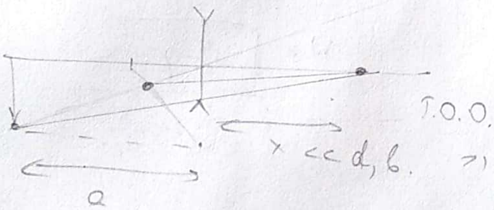
$I_L R dq_2 \left(E - L\dot I_L - \frac{q_1}{C}\right) dq_2 = \frac{dq_2}{dt} L \dot I_2$

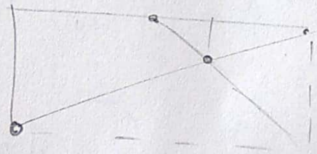
~~№4~~

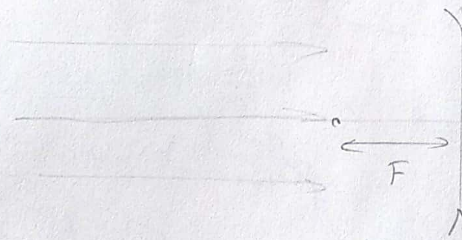


$-\frac{1}{F_Б} = -\frac{1}{a} + \frac{1}{b}$









$\frac{\Phi_Д}{\Phi_Б} = 3 \Rightarrow \frac{F_Б}{F_Д} = 3$

Т.О.О. a = 25 см

~~F = 25 см~~ $F_Д = l$ $\quad b = l$

$F_Д = l$

$l\left(\frac{1}{l} - \frac{1}{25}\right) = 3;\ \frac{1}{3}$ $\quad \frac{F_Д}{F_Б} = \frac{1}{3} = \left[\, l\left(\frac{1}{a} - \frac{1}{b}\right) = \frac{1}{3}\right.$

$1 - \frac{l}{25} = 3 \Rightarrow \frac{l}{25} = 1 - 3 = -2$ ⊗

$\frac{l}{25} = 1 - \frac{1}{3} = \frac{2}{3}$

$l\left(\frac{1}{25} - \frac{1}{25}\right) = 3;\ \frac{1}{3}$ $\quad l < 25$ см

$1 - \frac{2}{3} \cdot 25 =$

$\frac{l}{25} - 1 = 3 \Rightarrow \frac{l}{25} = 4 \Rightarrow l = 100$ ⊗ $= \frac{50}{3}$

$\Phi_Д = 0{,}5\frac{3}{2} = \cancel{0{,}06}\ 6Д$ $\quad F_Д = \frac{50}{3}$ см.

$\frac{d}{dt}\left[E - L\dot{J}_L = \frac{q_1}{C} + J_L R \right]$

$dq_2 = -4dq_1$

$0 - L\ddot{J}_L = \frac{1}{C}\dot{q}_1 + \dot{J}_L R$

$\Delta q_2 = -4\Delta q_1$

$\dot{q}_2 = -4\dot{q}_1 \Rightarrow \quad J_L = \dot{q}_1 - \dot{q}_2 = 5\dot{q}_1 \Rightarrow$

$\Rightarrow \dot{q}_1 = \frac{J_L}{5}$

$-L\ddot{J}_L = \frac{1}{C}\frac{J_L}{5} + \dot{J}_L R \quad \Rightarrow \quad \ddot{J}_L + \frac{R}{L}\dot{J}_L + \frac{1}{5LC}J_L = 0$

$dq_1 \quad dq_2 = -4dq_1$

$J_L = J_{L0}e^{-\gamma t}\cos wt$

$E = \frac{q_{1k}}{C} + \frac{q_{2k}}{4C} \; dq_1 \quad -dq_2 = dq_L$

$2\gamma = \frac{R}{L} \Rightarrow \gamma = \frac{R}{2L}$

$dq_L = 5dq_1$

$w_0 = \frac{1}{\sqrt{5LC}}$

$q_{1k} - q_{2k} =$

$\dot{q}_1 = \frac{dq_L}{5}$

$= q_{1k} - q_{2k}$

$w = \sqrt{w_0^2 - \gamma^2} =$

$q_L = \int_0^\infty J_{L0}e^{-\gamma t}\cos wt\, dt =$

$= \sqrt{\frac{1}{5LC} - \frac{R^2}{4L^2}} =$

$=$

$dq_L = 5dq_1 \Rightarrow \Delta Q_1 =$

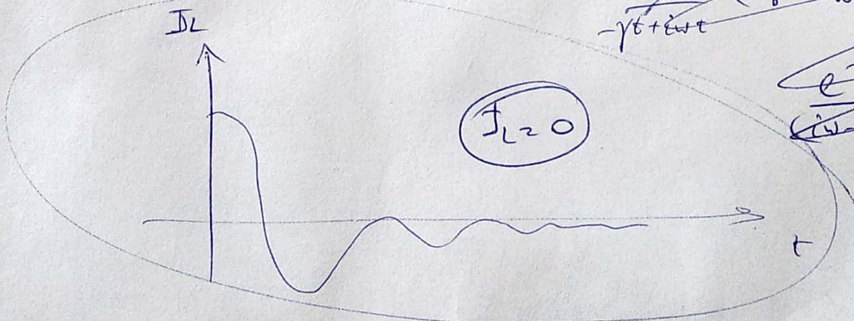
$E - L\dot{J}_L = \frac{q_1}{C} + J_L R$

~~В конце:~~

$\cancel{e^{-\gamma t}\left(\sin wt + i\cos wt\right)\Big|_0^\infty}$

$-\gamma t + iwt$

$\cancel{\frac{e^{-\gamma t}}{(iw-\gamma)t}}$



$e^{-\gamma t}\cdot\frac{e^{iwt}+e^{-iwt}}{2} = \int_0^\infty \frac{1}{2}\left[e^{-\gamma t + iwt} + e^{-\gamma t - iwt}\right]dt =$

$t(iw-\gamma) \quad -t(iw+\gamma)$

$= \frac{1}{2}\left[\frac{1}{-\gamma t + iwt}e^{-\gamma t + iwt} + \frac{1}{-\gamma t - iwt}e^{-\gamma t - iwt}\right]\Big|_0^\infty$

$=$

Сканировано с CamScanner

$4EC = 4q_{1k} + q_{2k}$

$4EC = 4(q_0 + \Delta q_1) + q_0 - 4\Delta q_1$

$4EC = 4q_0 + \cancel{4\Delta q_1} + q_0 - \cancel{4\Delta q_1}$

$$\frac{dq_L}{dt} = 5\frac{dq_1}{dt}$$

$dQ = 5\dot{q}_1 \cdot 5R\, dq_1 = 25R\left(\frac{dq_1}{dt}\right)^2 dt =$

$= 25 R\left(\frac{dq_L}{dt}\right)^2 dt \qquad dq_L = 5dq_1$

$\ddot{J}_L + \cancel{\frac{R}{L}}$ $\qquad \left(E - L\dot{J}_L - \frac{q_1}{C}\right)R\, dq_L =$

$= R\left(E\,dq_L - \underbrace{L\dot{J}_L\, dq_L}_{} - \frac{q_1}{C}dq_L\right) =$

$\dot{J}_L = \frac{d^2q_L}{dt^2}dq_L \Rightarrow \ddot{J}_L\, dt$

$J_{L0}R = \frac{q_2}{4C} \Rightarrow q_2 = 4CRJ_{L0} =$

~~$dq_2 = -4dq_1 \Rightarrow \dot q_2 = -4\dot q_1$~~

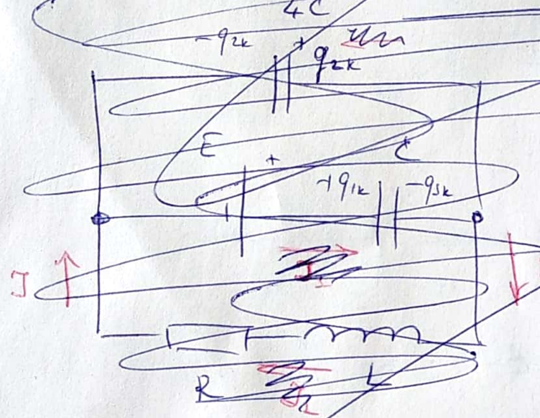
~~$dQ_2 = (\dot q_1 + 4\dot q_1) R (dq_1 + 4dq_1) = 5\dot q_1 \cdot R \cdot 5\, dq_1 =$~~

~~$= 25R$~~

$$W_0 = \frac{q_0^2}{4C} + \frac{q_0^2}{C} = \frac{5q_0^2}{4C} = \frac{5}{4} \cdot \frac{4^2}{5^2} CE^2 = \frac{4}{5} CE^2$$

~~II В конце: $I_L = const \Rightarrow \dot I_L = 0 \Rightarrow \mathcal{E}_i = 0$~~

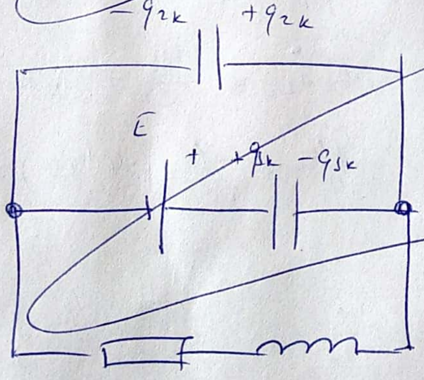
~~и $q_2 = const \Rightarrow I_2 = \dot q_2 = 0$~~



Далее будут затухающие колебания, копорую когда-то затухнут, тогда:

III В конце: $I_L = const \Rightarrow \dot I_L = 0 \Rightarrow \mathcal{E}_i = 0$

$q_2 = const$ и $q_1 = const \Rightarrow \dot q_1 = \dot q_2 = 0 \Rightarrow I_L = 0$



$$E = \frac{q_{1k}}{C} + \frac{q_{2k}}{4C}$$

$-q_{1k} + q_{2k} = 0 \Rightarrow q_{2k} = q_{1k} = q_k$

Иначе бы потёк ток

$$E = \frac{q_k}{C} + \frac{q_k}{4C} \quad \Big| \cdot 4C$$

$4CE = 5q_k \Rightarrow q_k = \frac{4CE}{5}$

$$W_k = \frac{q_k^2}{4C} + \frac{q_k^2}{C} = \frac{4}{5} CE^2$$