Часть 1

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

Шифр: **21202603**

ID профиля: **218061**

Вариант 7

Черновик

$$C = \frac{dQ}{dT}$$

$$dQ = \delta A + dU = p \cdot dV \cdot \sin\varphi + \frac{3}{2} \nu R\, dT$$

$$\nu R dT = p \cdot dV + V \cdot dp$$

$$dQ = p \cdot dV \left(\frac{3}{2} + \sin\varphi\right) + \frac{3}{2} V \cdot dp$$

$$p = p_0 \cdot k \cdot \sin\varphi$$
$$V = V_0 \cdot k \cdot \cos\varphi$$

$$p_0 k \cdot \sin\varphi \cdot$$

$$\left(\frac{V}{V_0}\right)^2 = k^2 - \left(\frac{p}{p_0}\right)^2$$

$$\frac{V}{V_0} = \sqrt{k^2 - \frac{p^2}{p_0^2}}$$

$$V = V_0 \cdot \sqrt{k^2 - \frac{p^2}{p_0^2}} = \frac{V_0}{p_0} \cdot \sqrt{k^2 p_0^2 - p^2}$$

$$dV = \cancel{V_0}\ \frac{V_0}{p_0} \cdot \frac{1}{2\sqrt{k^2 p_0^2 - p^2}} \cdot (-2p) \cdot dp$$

$$p \cdot \frac{V_0}{p_0} \cdot \frac{1}{\cancel{2}\sqrt{k^2 p_0^2 - p^2}} \cdot 2p \cdot \cancel{dp} \left(\frac{3}{2} + \sin\varphi\right) = \frac{3}{\cancel{2}} \sqrt{k^2 - \frac{p^2}{p_0^2}} \cdot \cancel{dp}$$

$$2p^2 \cdot \frac{V_0}{\cancel{p_0}} \left(\frac{3}{2} + \sin\varphi\right) = 3 \cdot \sqrt{k^2 p_0^2 - p^2} \cdot \frac{\sqrt{k^2 p_0^2 - p^2}}{\cancel{p_0}}$$

$$2p^2 V_0 \left(\frac{3}{2} + \sin\varphi\right) = 3\left(k^2 p_0^2 - p^2\right)$$

$$\frac{3}{2} + \sin\varphi = \frac{3\left(k^2 p_0^2 - p_0^2 k^2 \cdot \sin^2\varphi\right)}{2 p_0^2 k^2 V_0 \cdot \sin^2\varphi} = \frac{3\left(1 - \sin^2\varphi\right)}{2 V_0 \cdot \sin^2\varphi} = \frac{3\,\cancel{t}}{2 V_0 \cdot}$$

Черновик

$$a_0 \cdot \sin^2\alpha - a\cdot\sin\alpha + g\cdot\cos\beta\,\sin\alpha = a_0 - a\cdot\sin\alpha$$

$$a_0\cdot\cos^2\alpha = g\cdot\cos\beta\cdot\sin\alpha$$

$$\frac{\cancel{13}}{29}\cdot\frac{25}{13^{\cancel{2}}}\left(3a - \frac{18}{65}g\right) = g\cdot\frac{3}{5}\cdot\frac{12}{13}$$

$$\frac{25}{29\cdot 13}\cdot 3a - \frac{18g\cdot 25}{29\cdot 13\cdot 65} = \frac{g\cdot 3\cdot 12}{5\cdot 13}$$

$$\frac{3\cdot 12}{65} + \frac{18\cdot 25}{29\cdot 13\cdot 65}$$

$$p = p_0\cdot k\cdot\sin\varphi$$
$$V = V_0\cdot k\cdot\cos\varphi$$

$$dQ = \delta A + dU$$

~~$\delta A = p\cdot dm$~~

$$\delta A = p\cdot dV$$
$$dU = \frac{3}{2}\nu R\,dT = \frac{3}{2}(p\cdot dV + V\cdot dp)$$

$$dQ = \frac{5}{2}p\cdot dV + \frac{3}{2}V\cdot dp$$

$$\left(\frac{V}{V_0}\right)^2 + \left(\frac{p}{p_0}\right)^2 = k^2$$

$$\sin^2\varphi = \frac{3}{13}$$
$$\sin\varphi = \sqrt{\frac{3}{13}}$$

$$\frac{V}{V_0} = \sqrt{k^2 - \left(\frac{p}{p_0}\right)^2} = \frac{\sqrt{k^2p_0^2 - p^2}}{p_0}$$

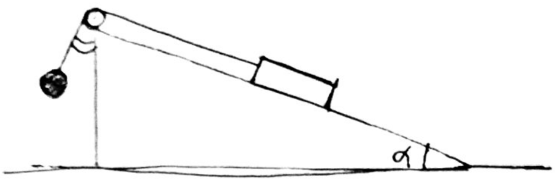
$$V = \frac{V_0}{p_0}\cdot\sqrt{k^2p_0^2 - p^2}$$

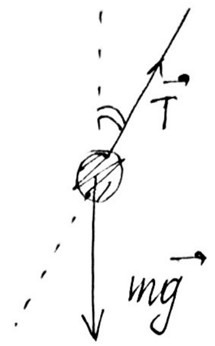
$$dV = \frac{V_0}{p_0}\cdot\frac{1}{\sqrt{k^2p_0^2-p^2}}\cdot(-2p)\cdot dp = -\frac{2V_0}{p_0\sqrt{k^2p_0^2-p^2}}\cdot p\,dp$$

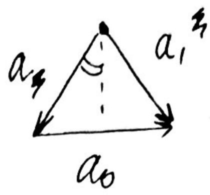
$$5p\cdot\frac{2\cancel{V_0}\,p\,\cancel{dp}}{\cancel{p_0}\sqrt{k^2p_0^2-p^2}} = 3\cdot\frac{\cancel{V_0}}{\cancel{p_0}}\sqrt{k^2p_0^2-p^2}\cdot\cancel{dp}$$

$$5\cdot 2p^2 = 3(kp_0^2 - p^2) \Rightarrow 10p^2 = 3k^2p_0^2 - 3p^2$$
$$13p_0^2k^2\cdot\sin^2\varphi = 3k^2p_0^2$$

Черновик



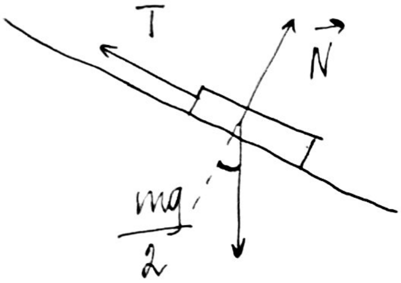


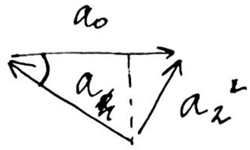


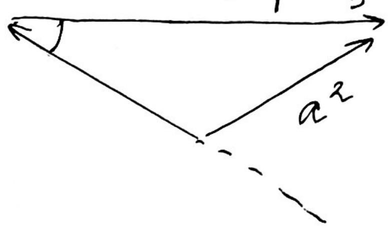
$169-25=144=12^2$

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

$\sin\beta=\frac{4}{5}$ $\cos\beta=\frac{3}{5}$







$$T-\frac{mg}{2}\cdot\sin\alpha=\frac{m}{2}\left(a_1-a_0\cdot\cos\alpha\right)$$

$$T-mg\cdot\cos\beta=m\left(a_0\cdot\sin\alpha-a_1\right)$$

$$T\cdot\sin\alpha=m(a_0-a_1\cdot\sin\alpha)$$

$$T=m\left(a_0\cdot\sin\alpha-a+g\cdot\cos\beta\right)$$

$$\left(a_0\cdot\sin\alpha-a+g\cdot\cos\beta\right)\cdot 2-g\cdot\sin\alpha=a-a_0\cdot\cos\alpha$$

$$\frac{12}{13}\cdot 2a_0-2a+\frac{2g\cdot 3}{5}-\frac{12g}{13}=a-\frac{a_0\cdot 5}{13}$$

$$\frac{12\cdot 5-6\cdot 13}{5\cdot 13}=$$

$$=\frac{60-78}{65}=-\frac{18}{65}$$

$$\frac{24a_0}{13}+\frac{5a_0}{13}=a+2a+\frac{12g}{13}-\frac{6g}{5}$$

$$\frac{29a_0}{13}=3a-\frac{18}{65}g$$

$$a_0=\frac{13}{29}\left(3a-\frac{18}{65}g\right)$$

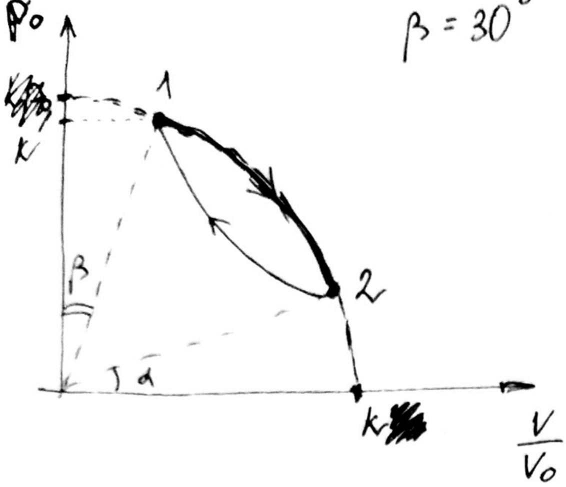
$$\left(a_0\cdot\sin\alpha-a+g\cdot\cos\beta\right)\sin\alpha=a_0-a\cdot\sin\alpha$$

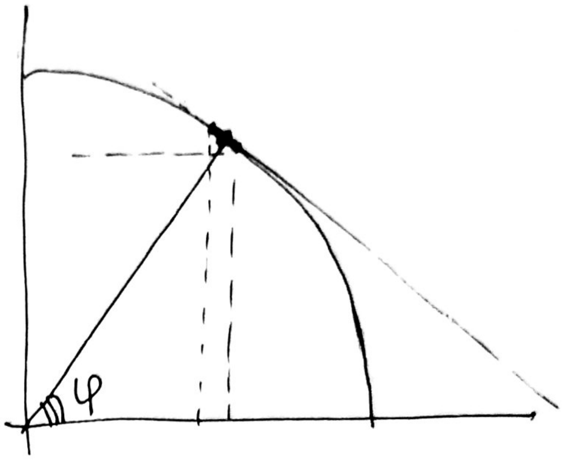
Черновик

$\alpha = 15^\circ$

$\beta = 30^\circ$

$\dfrac{T_1 - T_2}{T_2}$ — ?





$$\left(\frac{p}{p_0}\right)^2 + \left(\frac{V}{V_0}\right)^2 = k^2$$

$\dfrac{p_1}{p_0} = k \cdot \cos\beta$ $\qquad$ $\dfrac{V_1}{V_0} = k \cdot \sin\beta$

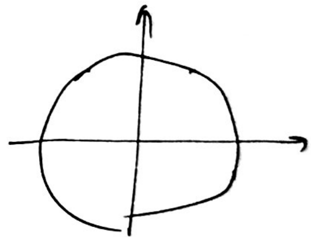
$\dfrac{p_2}{p_0} = k \cdot \sin\alpha$ $\qquad$ $\dfrac{V_2}{V_0} = k \cdot \cos\alpha$

$57 = 9 \cdot$

$$\begin{array}{r|l} 57 & 3 \\ 19 & 19 \end{array}$$

$$\nu R T_1 = p_1 V_1 = p_0 V_0 \cdot k^2 \cdot \cos\beta \cdot \sin\beta = \frac{p_0 V_0 k^2 \cdot \sin 2\beta}{2}$$

$$\nu R T_2 = p_0 V_0 \cdot k^2 \cdot \frac{\sin 2\alpha}{2}$$



$$T_1 - T_2 = \frac{p_0 V_0 k^2}{2\nu R}\left(\sin 2\beta - \sin 2\alpha\right)$$

$$T_2 = \frac{p_0 V_0 k^2}{2\nu R} \cdot \sin 2\alpha$$

$$\frac{T_1 - T_2}{T_2} = \frac{\sin 2\beta - \sin 2\alpha}{\sin 2\alpha} = \frac{\sin 60^\circ - \sin 30^\circ}{\sin 30^\circ} = \frac{\frac{\sqrt{3}}{2} - \frac{1}{2}}{\frac{1}{2}} = \sqrt{3} - 1$$

$$\frac{\cancel{2} \cdot \overset{13}{\cancel{39}} \cdot 5}{\underset{19}{\cancel{38}} \cdot \cancel{3}} = \frac{65}{19}$$

Черновик

$$\left(\frac{2V_0}{3p_0}\left(k^2p_0^2-p^2\right)^{\frac{3}{2}}\right)' = \frac{2V_0}{3p_0}\cdot\frac{3}{2}\sqrt{k^2p_0^2-p^2}\cdot(-2p)$$

$$A_{21} = -\frac{3}{2}\nu R\Delta T = -\frac{3}{2}\nu R\cdot(T_1-T_2) = -\frac{3}{2}\frac{p_0V_0k^2}{2}(\sin 2\alpha-\sin 2\beta) =$$

$$= \frac{3p_0V_0k^2(\sin 2\beta-\sin 2\alpha)}{4}$$

$$Q_+ = \frac{3V_0\sqrt{k^2p_0^2-p^2}\cdot dp}{2p_0} - \frac{5V_0p^2\,dp}{2p_0\sqrt{k^2p_0^2-p^2}} =$$

$$= \frac{V_0}{2p_0}\left(3\sqrt{k^2p_0^2-p^2}-\frac{5p^2}{\sqrt{k^2p_0^2-p^2}}\right)$$

$$A_{0\varepsilon} = \frac{\frac{3}{4}p_0V_0k^2(\sin 2\beta-\sin 2\alpha)+\frac{p_0}{V_0}\int_{V_1}^{V_2}\sqrt{k^2V_0^2-V^2}\cdot dV}{\frac{p_0}{V_0}\int_{V_0'}^{V_2}\sqrt{k^2V_0^2-V^2}\cdot dV+\frac{3}{4}p_0V_0k^2(\sin 2\beta-\sin 2\varphi)}$$

$$\cancel{p = \frac{p_0}{V}}$$

$$\frac{p}{p_0} = \sqrt{k^2-\left(\frac{V}{V_0}\right)^2}$$

$$p = \frac{p_0}{V_0}\sqrt{k^2V_0^2-V^2}\cdot dV$$

Чистовик

№1.

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

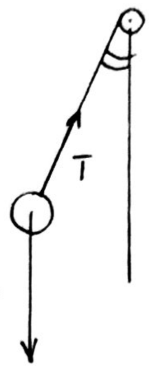
$\cos\beta = \frac{3}{5}$

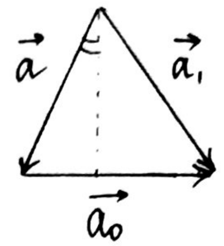
$\sin\alpha = \frac{12}{13}$

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

$H, m, \frac{m}{2}$

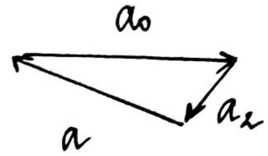
$a, a_0, t - ?$

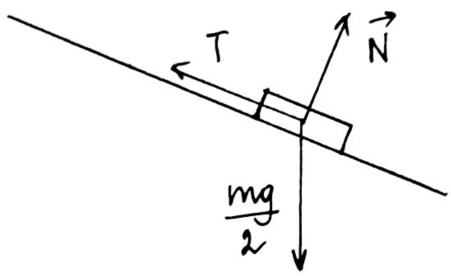




по II закону Ньютона:

$$\begin{cases} mg\cdot\cos\beta - T = m(a - a_0\cdot\sin\beta) \\ T\cdot\sin\beta = m(a_0 - a\cdot\sin\beta) \end{cases}$$





$$T - \frac{mg}{2}\cdot\sin\alpha = \frac{m}{2}(a - a_0\cdot\cos\alpha)$$

$$\begin{cases} T = \frac{m(a_0 - a\cdot\sin\beta)}{\sin\beta} \\ mg\cdot\cos\beta - \frac{m(a_0 - a\cdot\sin\beta)}{\sin\beta} = m(a - a_0\cdot\sin\beta) \\ \frac{m(a_0 - a\cdot\sin\beta)}{\sin\beta} - \frac{mg\cdot\sin\alpha}{2} = \frac{m(a - a_0\cdot\cos\alpha)}{2} \end{cases}$$

$$\begin{cases} g\cdot\cos\beta\cdot\sin\beta = \sin\beta(a - a_0\cdot\sin\beta) + a_0 - a\cdot\sin\beta \\ 2(a_0 - a\cdot\sin\beta) - g\cdot\sin\alpha\cdot\sin\beta = \sin\beta(a - a_0\cdot\cos\alpha) \end{cases}$$

$$g\cdot\cos\beta\cdot\sin\beta = a_0(1 - \sin^2\beta) = a_0\cdot\cos^2\beta \Rightarrow a_0 = \frac{g\cdot\sin\beta}{\cos\beta}$$

$$a_0 = g\cdot\frac{4\cdot 5}{5\cdot 3} = \frac{4g}{3}$$

$$2\left(\frac{4g}{3} - a\cdot\sin\beta\right) - g\cdot\sin\alpha\cdot\sin\beta = \sin\beta\left(a - \frac{4g\cdot\cos\alpha}{3}\right)$$

Чистовик

$$\frac{8g}{3} - 2a\cdot\sin\beta - g\cdot\sin\alpha\cdot\sin\beta = a\cdot\sin\beta - \frac{4g\cdot\cos\alpha\cdot\sin\beta}{3}$$

$$3a\cdot\sin\beta = \frac{4g}{3}(2+\cos\alpha\cdot\sin\beta) - g\cdot\sin\alpha\cdot\sin\beta$$

$$a = \frac{4g}{9}\left(\frac{2}{\sin\beta} + \cos\alpha\right) - \frac{g\cdot\sin\alpha}{3}$$

$$a = \frac{4g}{9}\left(\frac{2\cdot 5}{4} + \frac{5}{13}\right) - \frac{g\cdot 12}{3\cdot 13} = \frac{4g}{9}\left(\frac{5\cdot 13}{2\cdot 13} + \frac{5\cdot 2}{13\cdot 2}\right) -$$

$$- \frac{4g}{13} = \frac{4g}{9}\cdot\frac{75}{26} - \frac{4g\cdot 2\cdot 9}{26\cdot 9} = \frac{g}{26\cdot 9}(4\cdot 75 - 4\cdot 18) =$$

$$= \frac{2g}{13\cdot 9}\cdot 57 = \frac{2g\cdot 19}{13\cdot 3} = \frac{38g}{39}$$

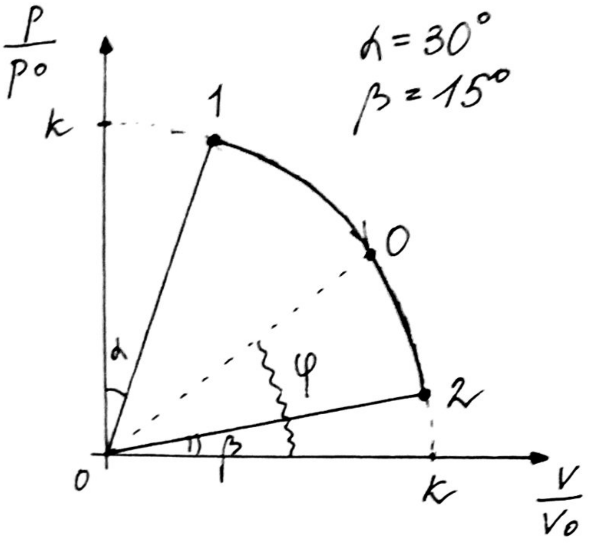
$$H = \frac{a\cdot\cos\beta\cdot t^2}{2}$$

$$t = \sqrt{\frac{2H}{a\cdot\cos\beta}} = \sqrt{\frac{2H\cdot 39\cdot 5}{38g\cdot 3}} = \sqrt{\frac{65H}{19g}}$$

Ответ: $a_0 = \frac{4g}{3}$; $a = \frac{38g}{39}$; $t = \sqrt{\frac{65H}{19g}}$.

Чистовик

№2.



$\alpha = 30^\circ$
$\beta = 15^\circ$

$$\left(\frac{V}{V_0}\right)^2 + \left(\frac{p}{p_0}\right)^2 = k^2$$

$p_1 = kp_0 \cdot \cos\alpha \qquad p_2 = kp_0 \cdot \sin\beta$

$V_1 = kV_0 \cdot \sin\alpha \qquad V_2 = kp_0 \cdot \cos\beta$

ур-ие идеального газа:

$$\begin{cases} p_1V_1 = \nu RT_1 \\ p_2V_2 = \nu RT_2 \end{cases}$$

$$T_1 = \frac{p_1V_1}{\nu R} = \frac{p_0V_0 \cdot k^2 \cdot \cos\alpha \cdot \sin\alpha}{\nu R} = \frac{p_0V_0k^2 \cdot \sin 2\alpha}{2\nu R}$$

$$T_2 = \frac{p_0V_0k^2 \cdot \sin 2\beta}{2\nu R}$$

$$\frac{T_1 - T_2}{T_2} = \frac{\sin 2\alpha - \sin 2\beta}{\sin 2\beta} = \frac{\frac{\sqrt{3}}{2} - \frac{1}{2}}{\frac{1}{2}} = \sqrt{3} - 1$$

$$C = \frac{dQ}{dT}$$

I закон термодинамики:

$$dQ = \delta A + dU = p \cdot dV + \frac{3}{2}\nu R dT$$

$$\nu RT = pV \Rightarrow \nu R dT = p \cdot dV + V \cdot dp$$

$$dQ = \frac{5}{2} p \cdot dV + V \cdot dp \cdot \frac{3}{2}$$

$$\frac{V}{V_0} = \sqrt{k^2 - \left(\frac{p}{p_0}\right)^2}$$

$$V = \frac{V_0}{p_0}\sqrt{k^2p_0^2 - p^2}$$

Чистовик

№

$$dV = \frac{V_0}{p_0} \cdot \frac{1}{2\sqrt{k^2p_0^2 - p^2}} \cdot (-2p) \cdot dp = -\frac{V_0 p \cdot dp}{p_0\sqrt{k^2p_0^2-p^2}}$$

$$dQ = -\frac{5}{2} \cdot p \cdot \frac{V_0 p \cdot dp}{p_0\sqrt{k^2p_0^2-p^2}} + \frac{V_0}{p_0}\sqrt{k^2p_0^2-p^2} \cdot dp \cdot \frac{3}{2}$$

Если $C=0$, то $dQ = 0 \cdot dT = 0$

$$\frac{5p^2 V_0\, dp}{p_0\sqrt{k^2p_0^2-p^2}} = \frac{3V_0\sqrt{k^2p_0^2-p^2} \cdot dp}{p_0}$$

$$5p^2 = 3(k^2p_0^2 - p^2)$$

$$5p^2 = 3k^2p_0^2 - 3p^2$$

$$p = p_0 k \cdot \sin\varphi$$

$$8p_0^2k^2 \cdot \sin^2\varphi = 3k^2p_0^2$$

$$\sin^2\varphi = \frac{3}{8}$$

$$\sin\varphi = \sqrt{\frac{3}{8}}$$

$15^\circ < \arcsin\sqrt{\frac{3}{8}} < 60^\circ \Rightarrow$ такая точка существует

$$\eta = \frac{A_{12} + A_{21}}{Q_+}$$

при $\sin\varphi < \sqrt{\frac{3}{8}}$ $dQ > 0 \Rightarrow$ тепло подводят $\Rightarrow Q_+ = Q_{0x}$

2-1 - адиабатический процесс $\Rightarrow A_{21} = -\Delta U_{21} =$

$$= \frac{3}{2}\nu R(T_2 - T_1) = \frac{3}{2} \cdot \nu R \cdot \frac{p_0V_0k^2}{2\nu R}(\sin 2\beta - \sin 2\alpha) =$$

$$= \frac{3p_0V_0k^2(\sin 2\beta - \sin 2\alpha)}{4}$$

Чистовик

$$A_{12} = \int_{p_1, V_1}^{p_2, V_2} p \cdot dV = \int_{V_1}^{V_2} \frac{p_0}{V_0} \sqrt{k^2 V_0^2 - V^2} \cdot dV$$

$$Q_{02} = A_{02} + \Delta U_{02}$$

$$A_{02} = \int_{V_0'}^{V_2} \frac{p_0}{V_0} \sqrt{k^2 V_0^2 - V^2} \cdot dV$$

$$V_0' = V_0 \cdot k \cdot \sqrt{\frac{3}{8}}$$

$$\Delta U_{02} = \frac{3}{2} \nu R (T_2 - T_0) = \frac{3}{2} \nu R \cdot \frac{p_0 V_0 k^2}{2 \nu R} (\sin 2\beta - \sin 2\varphi) =$$

$$= \frac{3}{4} p_0 V_0 k^2 (\sin 2\beta - \sin 2\varphi)$$

$$\eta = \frac{\frac{3}{4} p_0 V_0 k^2 (\sin 2\beta - \sin 2\alpha) + \frac{p_0}{V_0} \int_{V_1}^{V_2} \sqrt{k^2 V_0^2 - V^2} \cdot dV}{\left(\frac{p_0}{V_0} \int_{V_0'}^{V_2} \sqrt{k^2 V_0^2 - V^2} \cdot dV \right) + \frac{3}{4} p_0 V_0 k^2 (\sin 2\beta - \sin 2\varphi)}$$

$$\eta = \frac{3 V_0^2 k^2 (\sin 2\beta - \sin 2\alpha) + 4 \int_{V_1}^{V_2} \sqrt{k^2 V_0^2 - V^2} \cdot dV}{3 V_0^2 k^2 (\sin 2\beta - \sin 2\varphi) + 4 \int_{V_0'}^{V_2} \sqrt{k^2 V_0^2 - V^2} \cdot dV}$$

Ответ: 1) $\sqrt{3} - 1$;

2) $\sin \varphi = \sqrt{\frac{3}{8}}$.

Часть 2

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

Шифр: **21202603**

ID профиля: **218061**

Вариант 7

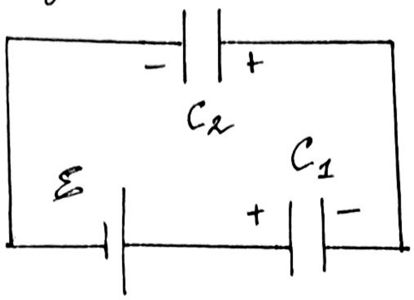
Чистовик В 11-07

№3.

$C_1 = C$
$C_2 = 4C$
$\mathcal{E}, C, L, R$

$I_0' - ?$
$Q - ?$
$I_R - ?$

до замыкания ключа:



закон сохранения заряда:

$q_1 = q_2 = q$

$\frac{q}{C_1} + \frac{q}{C_2} = \mathcal{E}$

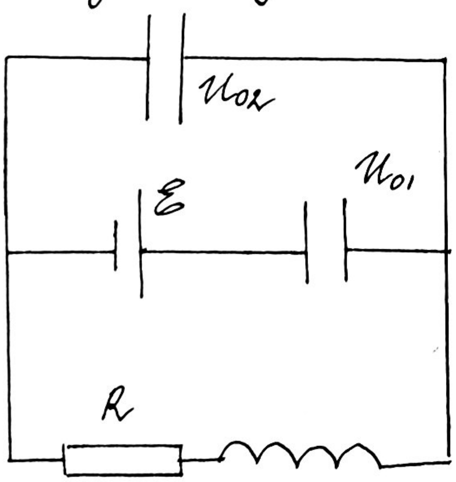
$\frac{q}{C}\left(1 + \frac{1}{4} = \mathcal{E}\right)$

$\frac{5q}{4C} = \mathcal{E}$

$q = \frac{4C\mathcal{E}}{5}$

$U_{01} = \frac{4\mathcal{E}}{5}$; $U_{02} = \frac{\mathcal{E}}{5}$

ключ замкнули:



ток через катушку мгновенно измениться не может ⇒ сразу после замыкания ключа через резистор и катушку ток не течёт

закон Ома:

$\mathcal{E} - U_{01} = 0 \cdot R + L I_0'$

$I_0' = \frac{\mathcal{E} - U_{01}}{L} = \frac{\mathcal{E} - \frac{4\mathcal{E}}{5}}{L} = \frac{\mathcal{E}}{5L}$

$W_0 = \frac{C_1 U_{01}^2}{2} + \frac{C_2 U_{02}^2}{2} = \frac{C \cdot 16\mathcal{E}^2}{2 \cdot 25} + \frac{4C \cdot \mathcal{E}^2}{2 \cdot 25} = \frac{20C\mathcal{E}^2}{50} = \frac{2C\mathcal{E}^2}{5}$

в уст. режиме через конденсаторы ток не течёт

$\Rightarrow U_1 = \mathcal{E}$, $U_2 = 0$, $q_1 = C\mathcal{E}$, $\Delta q_1 = C\mathcal{E} - \frac{4C\mathcal{E}}{5} = \frac{C\mathcal{E}}{5}$

$A_{ист} = \mathcal{E} \cdot \Delta q_1 = \frac{C\mathcal{E}^2}{5}$

Чистовик

$W_к = \frac{C\mathcal{E}^2}{2}$

ЗСЭ: $W_0 + A_{ист} = W_к + Q$

$$Q = W_0 + A_{ист} - W_к = \frac{2C\mathcal{E}^2}{5} + \frac{C\mathcal{E}^2}{5} - \frac{C\mathcal{E}^2}{2} = \frac{C\mathcal{E}^2}{10}$$

в $\forall$ момент времени:

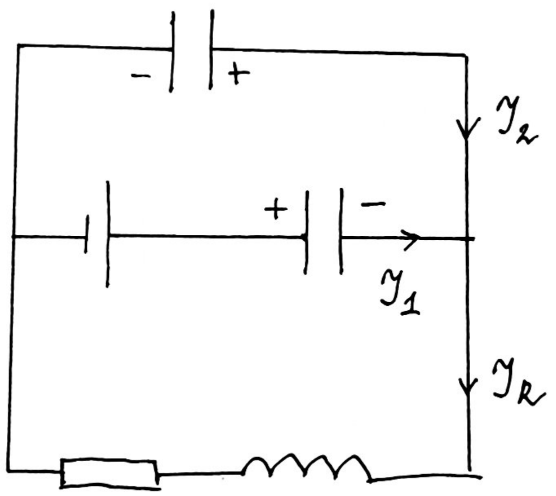
$$\mathcal{E} - \left(\frac{4\mathcal{E}}{5} + \frac{\Delta q_1}{C_1}\right) = \frac{\mathcal{E}}{5} - \frac{\Delta q_2}{C_2}$$

$$\frac{\Delta q_1}{C_1} = \frac{\Delta q_2}{C_2}$$

$$\frac{\Delta q_1}{C} = \frac{\Delta q_2}{4C}$$

$$\Delta q_2 = 4\Delta q_1$$

$$\frac{\Delta q_1}{\Delta q_2} = \frac{I_1}{I_2} = \frac{1}{4}$$



по I правилу Кирхгофа:

$I_R = I_1 + I_2$

$I_1 = I_0 \Rightarrow I_2 = 4I_0$

$I_R = 5I_0$

Ответ: 1) $I_0' = \frac{\mathcal{E}}{5R}$;

2) $Q = \frac{C\mathcal{E}^2}{10}$;

3) $I_R = 5I_0$.

Чистовик

№4.

m, d, v_0, R, B $b = 3d$ $H = \frac{d}{5}$ --- $a_0 - ?$ $v_1 - ?$ $v_2 - ?$	$\mathcal{E}_i = \left\lvert \frac{d\Phi}{dt} \right\rvert$ от момента, когда правая сторона вошла в поле, до момента, когда правая сторона из него вышла:

$$\mathcal{E}_i = \frac{B \cdot dS}{dt} = \frac{B \cdot d \cdot dx}{dt} = Bdv$$

в момент входа:

$$\mathcal{E}_i = Bdv_0$$

$$I_0 = \frac{\mathcal{E}_i}{R} = \frac{Bdv_0}{R}$$

$$F_{A0} = BI_0 d = \frac{B \cdot Bdv_0 \cdot d}{R} = \frac{B^2 d^2 v_0}{R}$$

$$ma_0 = F_{A0} = \frac{B^2 d^2 v_0}{R}$$

$$a_0 = \frac{B^2 d^2 v_0}{mR}$$

$$a = \frac{B^2 d^2 v}{mR}$$

$$-\frac{dv}{dt} = \frac{B^2 d^2}{Rm} \cdot \frac{dx}{dt}$$

$$-dv = \frac{B^2 d^2}{Rm} \cdot dx$$

$$-\Delta v = \frac{B^2 d^2}{Rm} \cdot \Delta x$$

$$v_0 - v_1 = \frac{B^2 d^2}{Rm} \cdot \frac{d}{5}$$

$$v_1 = v_0 - \frac{B^2 d^3}{5Rm}$$

Чистовик

после того, как правая сторона рамки покинула поле, и до того, как в него вошла её левая сторона, $\Phi = const \Rightarrow$ $v = const$. После этого:

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

$$-\frac{dv}{dt} = \frac{B^2 d^2}{Rm} \cdot \frac{dx}{dt}$$

$$-dv = \frac{B^2 d^2}{Rm} \cdot dx$$

$$v_1 - v_2 = \frac{B^2 d^2}{Rm} \cdot \frac{d}{5}$$

$$v_2 = v_1 - \frac{B^2 d^3}{5Rm} = v_0 - \frac{2B^2 d^3}{5Rm}$$

Ответ: 1) $\frac{B^2 d^2 v_0}{mR}$;

2) $v_1 = v_0 - \frac{B^2 d^3}{5Rm}$;

3) $v_2 = v_0 - \frac{2B^2 d^3}{5Rm}$.

Чистовик

$d_1 = 25$ см
$d_2 \to \infty$
$d_3 = 50$ см
$\frac{D_1}{D_2} = (3)^{\pm 1}$

$x - ?$
$D_2 - ?$
$D_3 - ?$

D_0 - оптическая сила глаза ($D_0 > 0$)

Человек близорукий $\Rightarrow D_1, D_2 < 0$

Оптические силы вплотную сложенных линз складываются:

$D_0 + D_1 = \frac{1}{f} + \frac{1}{d_1}$, где f - расстояние от линзы до дна глаза

$D_0 + D_2 = \frac{1}{f}$

$D_1 > D_2 \Rightarrow D_2 = 3D_1$

$$D_0 + D_1 = D_0 + 3D_1 + \frac{1}{d_1}$$

$$-2D_1 = \frac{1}{d_1}$$

$$D_1 = -\frac{1}{2d_1} = -\frac{1}{2 \cdot 0{,}25} = -2 \text{ дптр}$$

$$D_2 = -2 \cdot 3 = -6 \text{ дптр}$$

$$D_0 = \frac{1}{f} + \frac{1}{x}$$

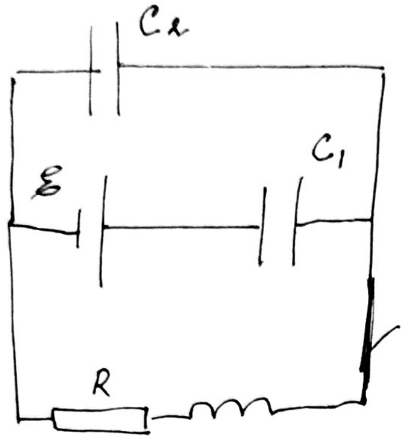
$$\frac{1}{x} = D_0 - \frac{1}{f} = -D_2 \Rightarrow x = -\frac{1}{D_2} = -\frac{1}{-6} = \frac{1}{6} \text{ м} \approx 16{,}7 \text{ см}$$

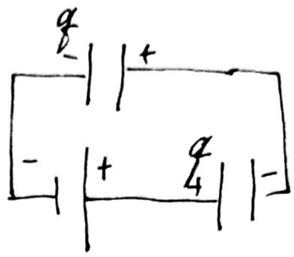
$$D_0 + D_3 = \frac{1}{f} + \frac{1}{d_3}$$

$$D_3 = \frac{1}{f} - D_0 + \frac{1}{d_3} = D_2 + \frac{1}{d_3} = -6 + \frac{1}{0{,}5} = -4 \text{ дптр}$$

Ответ: 1) $x = 16{,}7$ см; $D_2 = -6$ дптр;
2) $D_3 = -4$ дптр.

Черновик





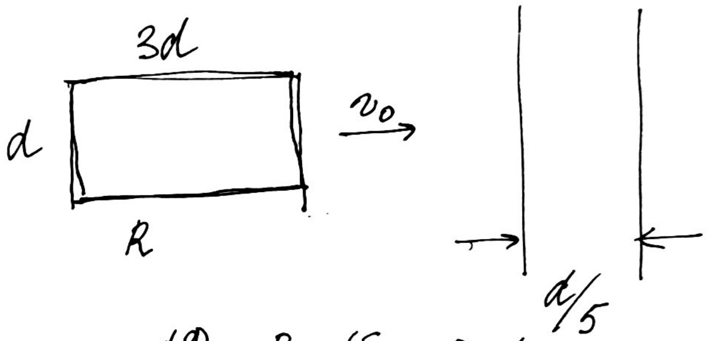
$$\frac{q}{C} + \frac{q}{4C} = \mathcal{E}$$

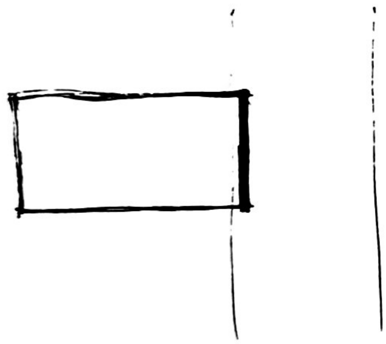
$$\frac{q}{C} \cdot \frac{5}{4} = \mathcal{E}$$

$$q = \cancel{\frac{4\mathcal{E}}{5}} \quad \frac{4\mathcal{E}C}{5}$$

$$\mathcal{E} - \frac{4\mathcal{E}}{5} = LI'$$

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





$$\mathcal{E}_i = \frac{d\Phi}{dt} = \frac{B \cdot dS}{dt} = \frac{B \cdot d \cdot dx}{dt} = Bdv_0$$

$$I_* = \frac{\mathcal{E}_i}{R} = \frac{Bdv_0}{R}$$

$$F_A = BId = \frac{B^2d^2v_0}{R} = ma_0$$

$$a_0 = \frac{B^2d^2v_0}{mR}$$

$$\frac{mv_0^2}{2} = \frac{mv_1^2}{2} + F_A \cdot \frac{d}{5}$$

$$F = \frac{B^2d^2v}{R}$$

$$dA = -\frac{B^2d^2v^2}{R} \cdot dt$$

$$A = -\frac{B^2d^2}{R} \int_{v_0}^{v_1} v^2 \cdot dt = -\frac{B^2d^2}{R} \cdot \left(\frac{v^3}{3}\right.$$

$$\frac{dv}{dt} = \frac{B^2d^2v}{R} = \frac{B^2d^2\,dx}{R \cdot dt}$$

$$dv = \frac{B^2d^2}{R} \cdot dx$$

$$\Delta v =$$

$d_1 = 25$ см

$D_0 + D_1 = \frac{1}{x} + \frac{1}{d_1}$

$D_0 + D_2 = \frac{1}{x}$

$D_0 + D_1$

$\cancel{D_0 = \frac{1}{d} + \frac{1}{f_0}}$

$\cancel{D_0 + 3D_2 = D_0 + D_2 + \frac{1}{d_1}}$

$\cancel{2D_2 = \frac{1}{d_1}}$ $\qquad D_0 =$

$\cancel{D_2 = \frac{1}{2d_1} = \frac{1}{2\cdot 0{,}25} = \frac{1}{0{,}5} = 2}$ дптр

$\cancel{D_0 + D_3}$

$D_0 + D_1 = \frac{1}{d} + \frac{1}{f_1}$

$D_0 + 3D_1 = \frac{1}{d}$

$D_0 + D_1 = D_0 + 3D_1 + \frac{1}{f_1}$

$-2D_1 = \frac{1}{f_1}$

$D_1 = -\frac{1}{2f_1} = -2$ дптр

$D_0 = \frac{1}{d} + \frac{1}{x}$

$\frac{1}{x} = D_0 - \frac{1}{d} = \frac{1}{f_1} - D_1$

$\frac{1}{x} = \frac{1}{0{,}25} - (-2) = 4 + 2 = 6$

$x = \frac{1}{6}$ см $\approx 0{,}167$ см

$D_0 + D_1 = \frac{1}{d} + \frac{1}{f_1}$

$D_0 + D_2 = \frac{1}{d}$ $\quad \Rightarrow D_2 = 2$ дптр

$D_0 = \frac{1}{d} + \frac{1}{f_0}$

$\frac{1}{f_0} = D_0 - \frac{1}{d} = -D_2$

$$\begin{array}{r|l} -1{,}000 & 6 \\ \underline{6} & 0{,}16(6) \\ -40 & \\ \underline{36} & \\ 40 & \end{array}$$

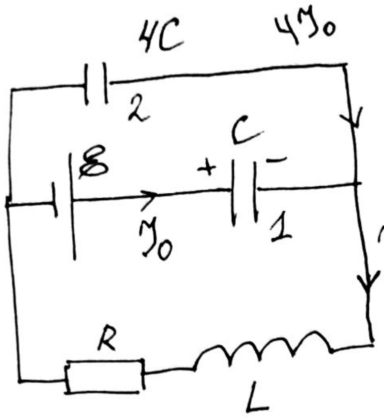
$\boxed{-6 \text{ дптр}}$

$D_0 + D_3 = \frac{1}{d} + \frac{1}{f_3}$

$D_3 = \frac{1}{d} - D_0 + \frac{1}{f_3} = D_1 - \frac{1}{f_1} + \frac{1}{f_3} = -2 - \frac{1}{0{,}25} + \frac{1}{0{,}5} = -2 - 4 + 2 =$

$= -4$ дптр

Черновик



$U_1 = \mathcal{E}$ $\qquad + \mathcal{E}\Delta \cdot$

$W_0 = \frac{q^2}{2C} + \frac{q^2}{8C} = \frac{C\mathcal{E}^2}{2} + Q$

$Q = \cancel{\frac{q^2}{2C}\left(1+\frac{1}{4}\right)} - \frac{C\mathcal{E}^2}{2}$

$A_{ист} = \mathcal{E}(q' - q) = \frac{C\mathcal{E}^2}{5}$

$q' = C\mathcal{E}$

$q = \frac{4C\mathcal{E}}{5}$ $\qquad \frac{5}{4}\cdot\frac{1}{2C}\cdot\left(\frac{4C\mathcal{E}}{5}\right)^2 = \frac{\cancel{5}\cdot \cancel{16}^{2} C^{\cancel{2}}\mathcal{E}^2}{\cancel{4}\cdot 2\cancel{C}\cdot \cancel{25}_{5}} = \frac{2C\mathcal{E}^2}{5}$

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

$Q = \frac{3C\mathcal{E}^2}{5} - \frac{C\mathcal{E}^2}{2} = \frac{6C\mathcal{E}^2}{10} - \frac{5C\mathcal{E}^2}{2\cdot 5} = \frac{C\mathcal{E}^2}{10}$

$\mathcal{E} - U_1 = I_R \cdot R + LI' = U_2$

$\mathcal{E} - Cq''$

$\mathcal{E} - U_1 = U_2$

$\mathcal{E} - \frac{4\mathcal{E}}{5} = \frac{\mathcal{E}}{5}$ $\qquad$ потери

пусть C_1 ~~потерял~~ Δq_1, а C_2 $- \Delta q_2$

$\mathcal{E} - \frac{\frac{4\mathcal{E}C}{5} + \Delta q_1}{C} = \frac{\mathcal{E}}{5} - \frac{\Delta q_2}{4C}$

$\frac{\mathcal{E}}{5} - \frac{\Delta q_1}{C} = \frac{\mathcal{E}}{5} - \frac{\Delta q_2}{4C}$

$4\Delta q_1 = \Delta q_2$