Часть 1

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

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Вариант 4

Чистовик

Задача № 2

1'

Количество теплоты, которую получает газ при нагреве от Тн до Тк:

$$Q = \int_{T_н}^{T_к} \nu c(T)\,dT = \frac{9\nu R}{5T_0}\int_{T_н}^{T_к} T\,dT = \frac{9\nu R}{5T_0}\,\frac{T^2}{2}\Big|_{T_н}^{T_к} = \frac{9\nu R}{10T_0}\left(T_к^2 - T_н^2\right)$$

1) $\cancel{Q = \frac{9\nu R}{10T_0}}$

$$Q_1 = -\frac{9\nu R}{10T_0}\left(\left(\frac{3}{4}T_0\right)^2 - T_0^2\right) = \frac{9\nu R}{10T_0}\left(T_0^2 - \frac{9}{16}T_0^2\right) = \frac{9\nu R}{10T_0}\cdot\frac{7}{16}T_0^2 = \frac{63\nu R T_0}{160}$$

2) 1-й закон термодинамики:

$$Q = A + \Delta U$$

$$\begin{cases} Q = \frac{9\nu R}{10T_0}\left(T^2 - T_0^2\right) \\ \Delta U = \frac{3}{2}\nu R(T - T_0) \end{cases}$$

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

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

$$T' = \frac{-b}{2a} = \frac{\frac{3}{2}\nu R}{\frac{9}{5}\frac{\nu R}{T_0}} = \frac{5}{6}T_0$$

~~3) $A_{min} = \frac{4ac - b^2}{4a} = c - \frac{b^2}{4a} = \frac{3\nu R T_0}{5} + \frac{9\nu^2 R^2}{4}$~~

$$3)\ A_{min} = \frac{9\nu R}{10T_0}\cdot\frac{25}{36}T_0^2 - \frac{3\nu R}{2}\cdot\frac{5}{6}T_0 + \frac{3\nu R T_0}{5} = -\frac{\nu R T_0}{40}$$

Ответ: 1) $\frac{63\nu R T_0}{160}$

2) $\frac{5}{6}T_0$

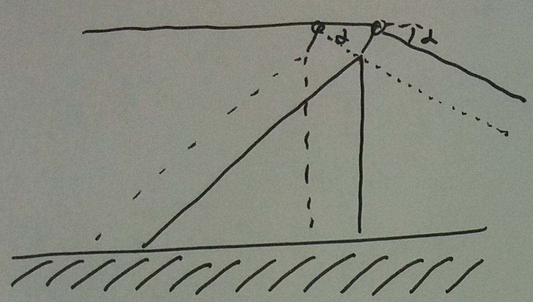
3) $-\frac{\nu R T_0}{40}$

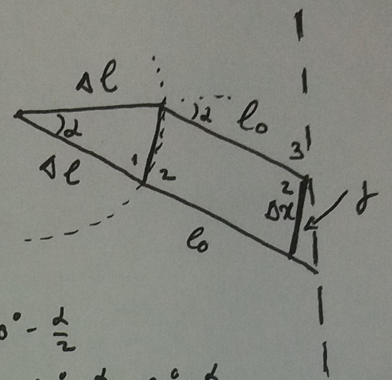
Чистовик

Задача № 1

2

1)





$\angle 1 = 90^\circ - \frac{\alpha}{2}$

$\angle 2 = 180 - 90^\circ + \frac{\alpha}{2} = 90^\circ + \frac{\alpha}{2}$

$\angle 3 = 90^\circ - \alpha$

$\gamma + \angle 2 + \angle 3 = 180^\circ$

$\gamma + 90^\circ + \frac{\alpha}{2} + 90^\circ - \alpha = 180^\circ$

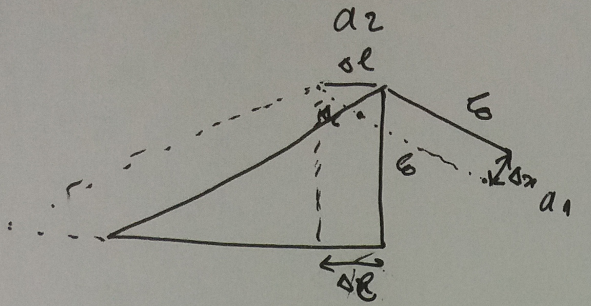
$\gamma = \frac{\alpha}{2}$

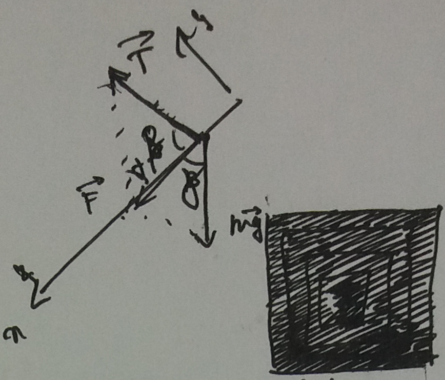
$$\cos\frac{\alpha}{2} = \sqrt{\frac{1+\cos\alpha}{2}} = \sqrt{\frac{1+\frac{8}{17}}{2}} = \frac{5}{\sqrt{34}}$$

$$\sin\frac{\alpha}{2} = \sqrt{1-\frac{25}{34}} = \frac{3}{\sqrt{34}}$$

$$\operatorname{tg}\gamma = \operatorname{tg}\frac{\alpha}{2} = \frac{3}{5}$$

Черновик



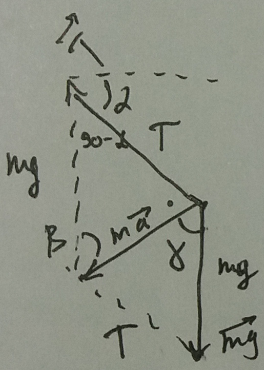


$T\cos\beta = mg\cos\gamma$

$T\sin\beta = mg\sin\gamma$

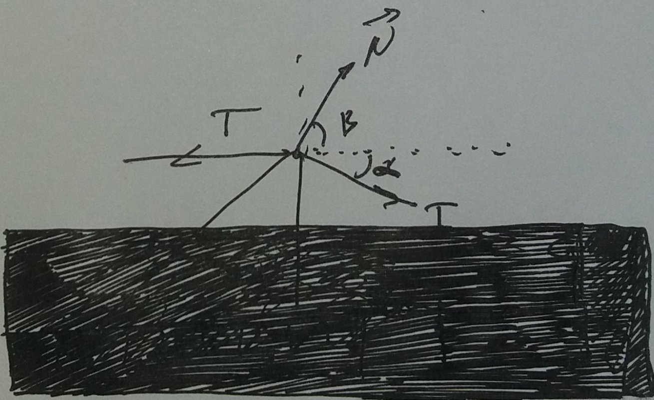
$ma = T\cos\beta + mg\cos\gamma$

[redacted]



$90-\alpha+\beta$

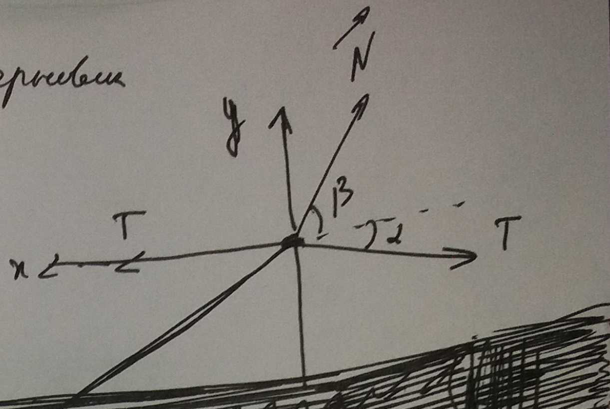
$$\frac{a_2}{a_1} = \frac{\Delta l}{\Delta x}$$

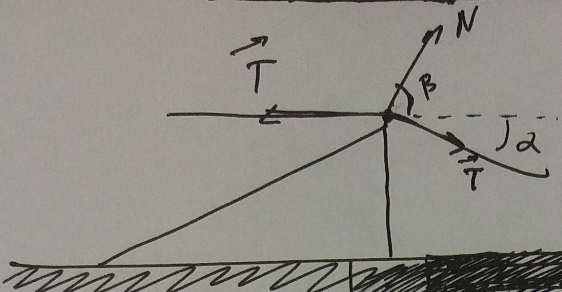


$N\sin\beta = T\sin\alpha$

[redacted]

черновик





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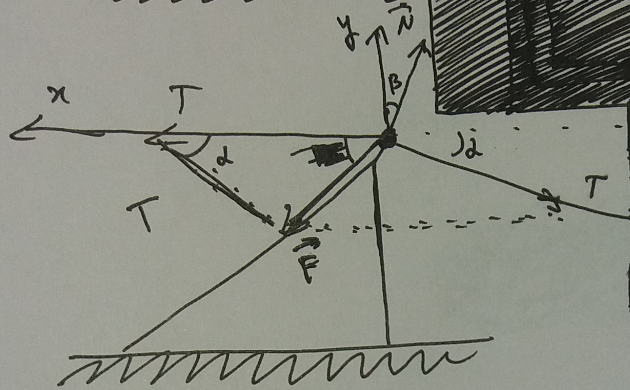
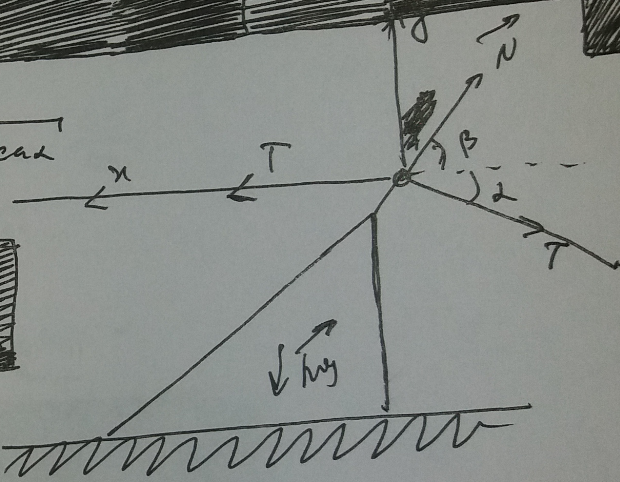




$$F = \sqrt{T^2 + T^2 - 2TT\cos\alpha} = \sqrt{2T^2 - 2T^2\cos\alpha}$$

[redacted]

$$\begin{cases} x: & Ma = T - T\cos\alpha - N\cos\beta \\ y: & 0 = N\sin\beta - T\sin\alpha - mg \end{cases}$$

$$N\sin\beta = T\sin\alpha + mg$$

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

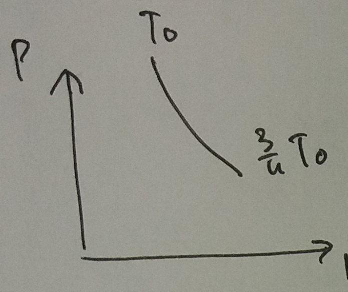
$$\cos\beta = \sqrt{1 - \frac{(T\sin\alpha + mg)^2}{N^2}}$$

[redacted]

$C(T) = \frac{9R}{5T_0} T$ Черновик

[redacted] $\int \nu C(T)\, dT = \cancel{\frac{9\nu R}{5T_0}} \frac{9\nu R}{5T_0}\int T\, dT = \frac{9\nu R}{5T_0}\frac{T^2}{2} = \frac{9\nu R}{10T_0} T^2$

$Q_1 = \int \nu C(T)\, dT = \frac{9\nu R}{10T_0}\left(T_0^2 - \frac{9}{16}T_0^2\right) = \frac{9\nu R}{10T_0}\frac{7}{16}T_0^2 = \frac{9\cdot 7}{160}\nu R T_0$



[redacted]

$Q = \int \nu \frac{9R}{5}\frac{T}{T_0}\, dT = \frac{9\nu R}{5T_0}\int T\, dT = \frac{9\nu R}{5T_0}\frac{T^2}{2}\Big|_{T_0}^{\frac{3}{4}T_0} =$

$= \frac{9\nu R}{10T_0}\left(T_0^2 - \frac{9}{16}T_0^2\right) = \frac{9\cdot 7}{160}\nu R T_0 = \frac{63}{160}\nu R T_0$ Дж

[redacted]

[redacted]

$Q_2 = \nu R(T - T_0) + A$

$A = Q_2 + \nu R(T_0 - T)$

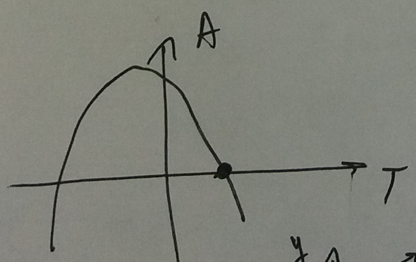
$Q_2 = \frac{9\nu R}{10T_0}\left(T_0^2 - T^2\right)$

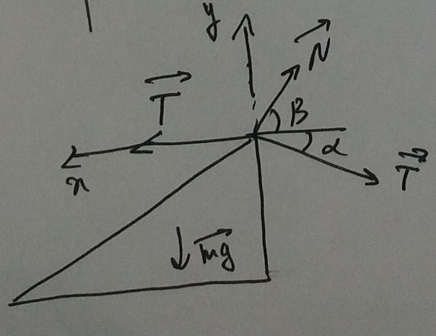
$A = \frac{9\nu R}{10T_0}\left(T_0^2 - T^2\right) + \nu R(T_0 - T) = \frac{9\nu R}{10}T_0 - \frac{9\nu R}{10T_0}T^2 + \nu R T_0 - \nu R T$

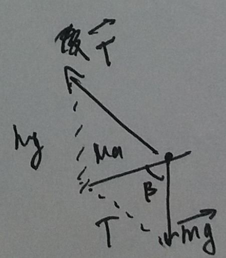
$A(T) =$ [redacted] $- \frac{9\nu R}{10T_0}T^2 - \nu R T + \frac{19\nu R}{10}T_0$

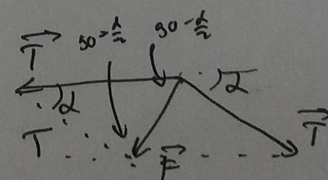
[redacted]

$T' = \frac{-b}{2a} = \frac{\nu R}{-\frac{9\nu R}{5T_0}} = -\nu R\frac{5T_0}{9\nu R} = -\frac{5}{9}T_0$









$F^2 = 2T^2(1 - \cos\alpha)$

$F = T\sqrt{2(1-\cos\alpha)} = Ma\cos\left(90 - \frac{\alpha}{2}\right)$

Черновик

$$\frac{9\nu R}{10T_0}\left(T^2-T_0^2\right)=A+\nu R(T-T_0)$$

$$\frac{9\cdot 10}{4\cdot 36}=\frac{9\cdot 5}{2\cdot 36}=\frac{5}{2\cdot 4}=\frac{5}{7}$$

~~$A=$~~

$$\cancel{A=\left(\frac{9\nu R}{10T_0}\right)T^2-(\nu R)T}$$

$$\cancel{A=\left(\frac{9\nu R}{10T_0}\right)T^2-(\nu R)T+\frac{\nu RT_0}{10}}$$

$$\cancel{A_{min}=\frac{4ac-b^2}{4a}=c-\frac{b^2}{4a}=\frac{\nu RT_0}{10}-\frac{\nu^2R^2}{\frac{36}{10}\frac{\nu R}{T_0}}=}$$

$$\cancel{=\frac{\nu RT_0}{10}-\nu R\frac{10T_0}{36\nu R}=\frac{\nu RT_0}{10}-\frac{10\nu RT_0}{36}=\frac{36\nu RT_0-100\nu RT_0}{360}}$$

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

$$\frac{3}{2}-\frac{9}{10}=\cancel{\frac{15}{}}$$
$$=\frac{15}{10}-\frac{9}{10}=\frac{6}{10}=\frac{3}{5}$$

$$A=\frac{9\nu R}{10T_0}T^2-\frac{9\nu RT_0}{10}-\frac{3\nu RT}{2}+\frac{3\nu RT_0}{2}$$

~~$9/10$~~

$$A=\left(\frac{9\nu R}{10T_0}\right)T^2-\left(\frac{3\nu R}{2}\right)T+\frac{3\nu RT_0}{5}$$

$$T'=\frac{-b}{2a}=\frac{\frac{3}{2}\nu R}{\frac{9}{5}\frac{\nu R}{T_0}}=\frac{3}{2}\cdot\frac{5T_0}{9}=\frac{1}{2}\cdot\frac{5T_0}{3}=\frac{5}{6}T_0$$

$$A_{min}=\frac{4ac-b^2}{4a}=c-\frac{b^2}{4a}=\frac{3\nu RT_0}{5}+\frac{\frac{9\nu^2R^2}{4}}{\frac{36\nu R}{10T_0}}=\frac{3\nu RT_0}{5}+\frac{9\nu^2R^2}{4}\cdot\frac{10T_0}{36\nu R}=$$

$$=\frac{3\nu RT_0}{5}+\frac{5\nu RT_0}{8}=\frac{(24+25)\nu RT_0}{40}=\frac{49}{40}\nu RT_0$$

$$A_{min}=\frac{4ac-b^2}{4a}=c-\frac{b^2}{4a}=\frac{3\nu RT_0}{5}-\frac{\frac{9}{4}\nu^2R^2}{\frac{36\nu R}{10T_0}}=$$

$$\cancel{=\frac{3}{5}\nu RT_0-}\quad\frac{3\nu RT_0}{5}+\frac{9\nu^2R^2}{4}\cdot\frac{10T_0}{36\nu R}$$

$$\frac{9}{4}\cdot\frac{10}{36}=\frac{9\cdot 5}{2\cdot 36}=\frac{3\cdot 5}{2\cdot 4}=\frac{15}{8}\qquad\frac{3}{5}-\frac{5}{8}=$$

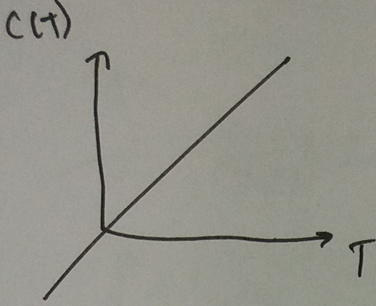
$$\frac{9}{4}\cdot\frac{10}{36}=\frac{\cancel{3\cdot3}\cdot2\cdot5}{2\cdot2\cdot\cancel{9}\cdot4}=\frac{5}{8}$$

$$c-\frac{b^2}{4a}$$

[redacted]

[redacted] Черновик

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

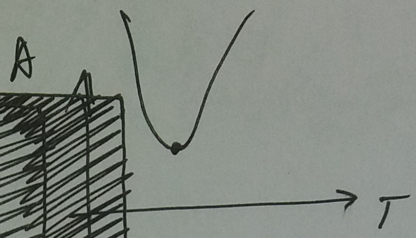


$$Q = \int_{T_н}^{T_к} \nu c(T)\,dT = \int_{T_н}^{T_к} \frac{9\nu R}{5T_0} T\,dT = \frac{9\nu R}{5T_0} \int_{T_н}^{T_к} T^2\,dT =$$

$$= \frac{9\nu R}{5T_0} \frac{T^2}{2}\Big|_{T_н}^{T_к} = \frac{9\nu R}{10T_0}\left(T_0^2 - \frac{9}{16}T_0^2\right) =$$

$$= \frac{9\nu R}{10T_0} \cdot \frac{7}{16} T_0^2 = \frac{63\nu R}{160}$$

$$Q_1 = \frac{63\nu R}{160}$$



[redacted]

16

$$A_2 = Q_2 - \Delta U_2 = \cancel{\frac{9\nu R}{5T_0}(T_0^2 - T^2)}$$

$$Q_2 = \frac{9\nu R}{10T_0}\left(T^2 - T_0^2\right) = A + \nu R(T - T_0) \quad \text{(нагрев)}$$

$$A = \frac{9\nu R}{10T_0} T^2 - \frac{9\nu R T_0}{10} - \nu R T + \nu R T_0 = \left(\frac{9\nu R}{10T_0}\right)T^2 - (\nu R)T \cancel{+ \frac{19\nu R T_0}{10}} + \frac{\nu R T_0}{10}$$

$$T' = \frac{-b}{2a} = \frac{\nu R}{\frac{9}{5}\frac{\nu R}{T_0}} = \nu R \frac{5T_0}{9\nu R} = \frac{5}{9}T_0$$

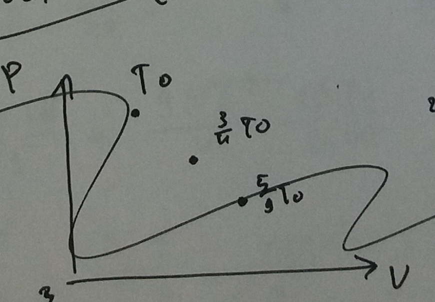
$$\cancel{A_{min} = \frac{4ac - b^2}{4a} = c - \frac{b^2}{4a} = -\frac{19\nu R T_0}{10} + \frac{\nu^2 R^2}{\frac{36\nu R}{10T_0}} =}$$

$$\cancel{= -\frac{19\nu R T_0}{10} + \nu^2 R^2 \frac{10T_0}{36\nu R} = \left(-\frac{19}{10}\nu R T_0 + \frac{10}{36}\nu R T_0\right) = \left(\frac{10}{36} - \frac{19}{10}\right)\nu R T_0}$$

$\frac{5}{9}$ vs $\frac{3}{4}$

20 vs 27

$-Q_x = \cancel{A + \Delta U}$



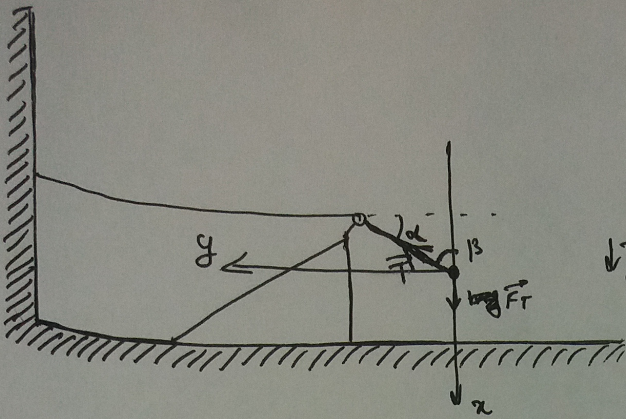
$$\frac{9\nu R T_0}{10} + \frac{3\nu R T_0}{2}$$

$$\frac{9}{10} \quad \frac{15}{10} - \frac{9}{10} = \frac{6}{10} = \frac{3}{5}$$

$$\frac{3}{2}$$

$$\frac{3}{2} \cdot \frac{5}{9} = \frac{1}{2} \cdot \frac{5}{3} = \frac{5}{6}T_0$$

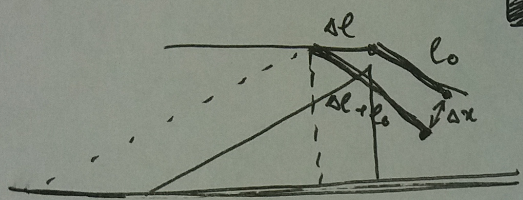
Черновик



$ma_y = T\cos\alpha$

$ma_x = mg - T\sin\alpha$

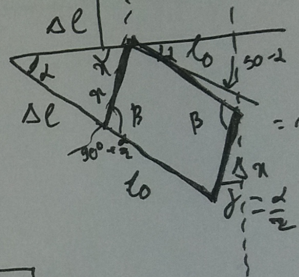
$\operatorname{tg}\beta = \frac{a_x}{a_y} = \frac{mg - T\sin\alpha}{T\cos\alpha}$



$\alpha + 2x = 180$

$2x = 180 - \alpha$

$x = 90 - \frac{\alpha}{2}$



$\beta = 180 - x =$

$= 180 - 90 + \frac{\alpha}{2} = 90 + \frac{\alpha}{2}$

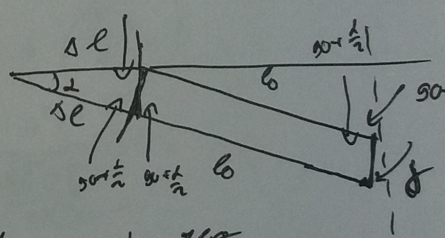
$\gamma = 180 - (90 - \alpha) - (90 + \frac{\alpha}{2}) = 180 - 90 + \alpha - 90 - \frac{\alpha}{2} = \frac{\alpha}{2}$

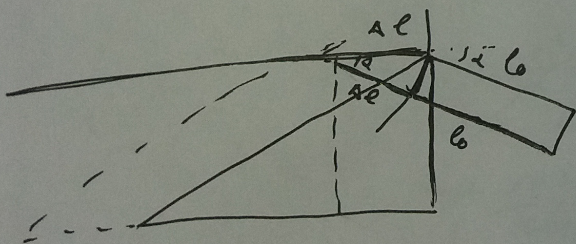
$\cos\alpha = 2\cos^2\frac{\alpha}{2} - 1$

$\cos\alpha + 1 = 2\cos^2\frac{\alpha}{2} \Rightarrow \cos\frac{\alpha}{2} = \sqrt{\frac{1+\cos\alpha}{2}} = \sqrt{\frac{1+\frac{8}{17}}{2}} = \sqrt{\frac{35}{34}}$

$+\frac{17}{8}$ / 25

$1 + \frac{8}{17}$





$\gamma + \cancel{90 + \frac{\alpha}{2}} + \cancel{90 - \alpha} = \cancel{180}$

$\gamma = \frac{\alpha}{2}$

$\cos\alpha = 2\cos^2\frac{\alpha}{2} - 1$

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

$\cos\frac{\alpha}{2} = \sqrt{\frac{1+\cos\alpha}{2}} = \sqrt{\frac{1+\frac{8}{17}}{2}} = \cancel{25}\sqrt{\frac{25}{34}}$

$\cancel{\sin\frac{\alpha}{2} = \sqrt{1 - \left(\frac{25}{34}\right)^2} = \sqrt{\frac{1156 - 625}{34}}}$

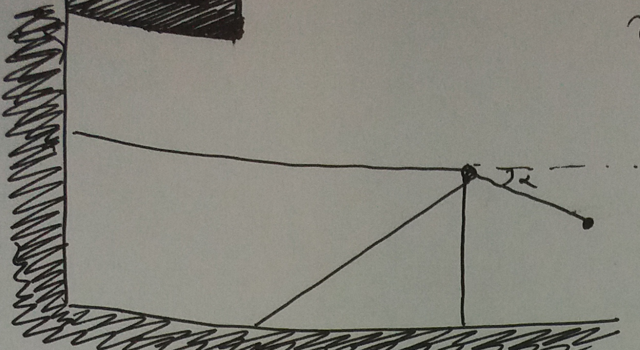
$\sin\frac{\alpha}{2} = \sqrt{1 - \frac{25}{34}} = \sqrt{\frac{34-25}{34}} = \sqrt{\frac{9}{34}}$

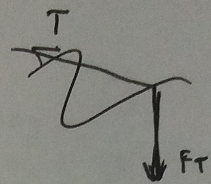
$\operatorname{tg}\frac{\alpha}{2} = \frac{3}{\sqrt{34}} \cdot \frac{\sqrt{34}}{5} = \frac{3}{5}$

$\operatorname{tg}\gamma = \frac{3}{5}$

[redacted]

Черосвец





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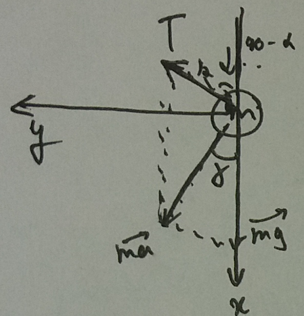


$\cos\gamma = \frac{5}{\sqrt{34}}$; $\sin\gamma = \frac{3}{\sqrt{34}}$

$$\begin{cases} ma\cos\gamma = mg - T\sin\alpha \\ ma\sin\gamma = T\cos\alpha \end{cases}$$

$$ma = \frac{T\cos\alpha}{\sin\gamma}$$

[redacted]

$$\frac{T\cos\alpha}{\sin\gamma}\cos\gamma = mg - T\sin\alpha$$

[redacted]

$$T\cos\alpha\,\mathrm{ctg}\gamma = mg - T\sin\alpha$$

$$T(\sin\alpha + \cos\alpha\,\mathrm{ctg}\gamma) = mg$$

$M\Delta U = m\Delta v$

$$T = \frac{mg}{\sin\alpha + \cos\alpha\,\mathrm{ctg}\gamma}$$

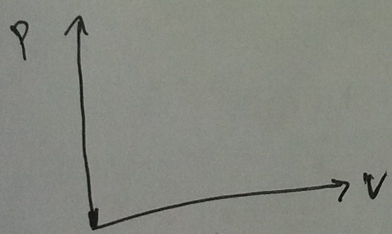
[redacted]

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

$$Q_н = \int_{T_н}^{T_к} \nu C(T)\,dT$$

$$\int_a^b f(x)\,dx = F(b) - F(a)$$

$$1 - \frac{9}{16} = \frac{16-9}{16} = \frac{7}{16}$$



$$dQ = \nu c(T)\,dT$$

$$Q = \int \nu c(t)\,dT = \nu\int c(T)\,dT =$$

[redacted]

$$= \nu\int \frac{9}{5}R\frac{T}{T_0} = \frac{\nu\frac{9}{5}R}{T_0}\int T\,dT = \frac{\frac{9}{5}\nu R}{T_0}\frac{T^2}{2}$$

$$Q_1 = \text{[redacted]}\ \frac{9\nu R}{10T_0}T^2\Big|_{T_к}^{T_н} = \frac{9\nu R}{T_0}(T_н^2 - T_к^2) =$$

$$\frac{9\nu R}{T_0}\left(T_0^2 - \frac{9}{16}T_0^2\right) = \frac{9\nu R}{10T_0}\frac{7}{16}T_0^2$$

Черновик

$$A = \frac{3JR}{10T_0}\cdot\frac{25}{36}T_0^2 - \frac{3JR}{2}\cdot\frac{5}{6}T_0 + \frac{3JRT_0}{5} =$$

360 | 12, 30

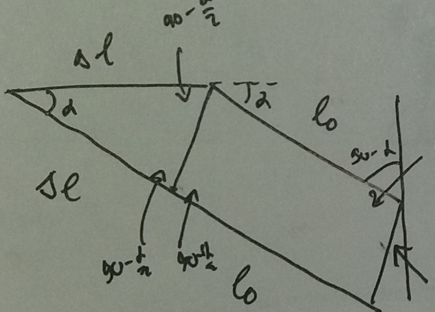
$$= JRT_0\left(\frac{9}{10}\cdot\frac{25}{36} - \frac{3}{2}\cdot\frac{5}{6} + \frac{3}{5}\right) =$$

[redacted]

$$= \frac{9}{10}\cdot\frac{25}{36} - \frac{3}{2}\cdot\frac{5}{6} + \frac{3}{5} = \frac{9\cdot 25}{360} - \frac{15}{12} + \frac{3}{5} =$$

$$= \frac{9\cdot25 - 15\cdot30 + 3\cdot72}{36} = \frac{225-450+216}{360} = \frac{-9}{360} =$$

$$= -\frac{1}{40}JRT_0$$



$\cancel{\gamma + 90 - \alpha + 90 + \frac{\alpha}{2} = 180}$

$\gamma = \alpha - \frac{\alpha}{2} = \frac{\alpha}{2}$

$\cos\gamma = \cos\frac{\alpha}{2} = \frac{5}{\sqrt{34}}$

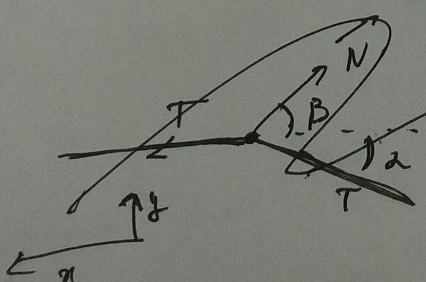
$\sin\gamma = \sin\frac{\alpha}{2} = \frac{3}{\sqrt{34}}$

$\mathrm{tg}\,\gamma = \frac{3}{5}$

$Ma = T - T\cos\alpha - N\cos\beta$

$0 = N\sin\beta - T\sin\alpha$

$N\sin\beta = T\sin\alpha$



21201493 (U314643 M1266596)

Часть 2

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

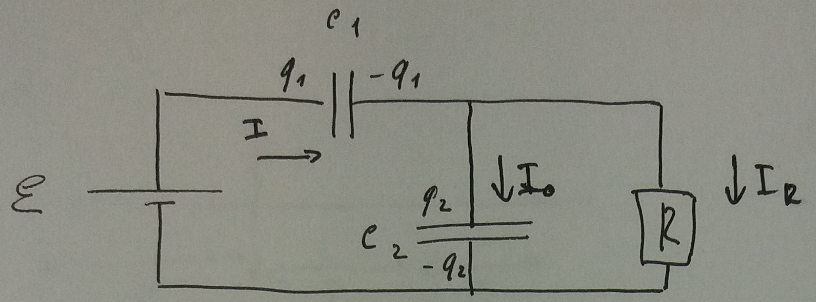
Шифр: **21201493**

ID профиля: **314643**

Вариант 4

Задача № 3

1



1) В начальный момент времени конденсатора обладают нулевым сопротивлением. Весь ток пойдет через C_1 и C_2. => $I_{R0} = 0$ A

2) В стационарном режиме ток через резистор равен нулю.

$$\begin{cases} \mathcal{E} = \dfrac{q_1}{C_1} + \dfrac{q_2}{C_2} \Rightarrow q_1 = \mathcal{E} C_1 \\ 0 = \dfrac{q_2}{C_2} + 0 \Rightarrow q_2 = 0 \end{cases}$$

Изменение энергии конденсаторов: $\Delta W = \frac{q_1^2}{2C_1} + 0 - 0 - 0 = \frac{C_1 \mathcal{E}^2}{2}$

Через ЭДС протёк заряд $q_1 = \mathcal{E} C_1 = \Delta q$

$$\mathcal{E} \Delta q = \Delta W + Q \Rightarrow Q = C_1 \mathcal{E}^2 - \frac{C_1 \mathcal{E}^2}{2} = \frac{C_1 \mathcal{E}^2}{2} = \frac{5C\mathcal{E}^2}{2} = Q$$

3) $(\mathcal{E})' = \left(\frac{q_1}{C_1} + \frac{q_2}{C_2}\right)'$

$$0 = \frac{I_1}{C_1} + \frac{I_2}{C_2}$$

$I_1 = -\frac{C_1}{C_2} I_2$ Исходя из граничных условий: $I = \frac{C_1}{C_2} I_0$

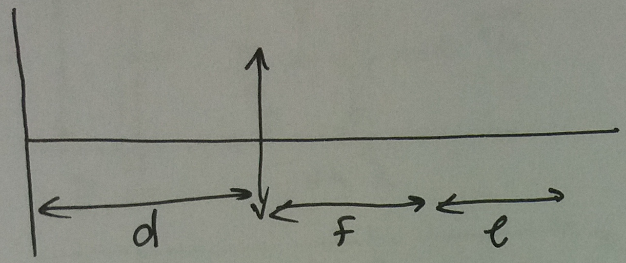
$$I = I_0 + I_R \Rightarrow I_R = I - I_0 = \left(\frac{C_1}{C_2} - 1\right) I_0 = \frac{5C - C}{C} I_0 = 4I_0$$

Ответ:
1) 0
2) $\frac{5C\mathcal{E}^2}{2}$
3) $4I_0$

чистовик

Задача № 5

(2)



1) $\frac{1}{d}+\frac{1}{f}=\frac{1}{F} \Rightarrow f=\frac{dF}{d-F}=\frac{96\cdot 24}{96-24}=32$ см

На расстоянии 32 см от линзы справа находится действительное изображение часов.

$x=f+l=32+24=56$ см

2) $D_m=H=9$ см

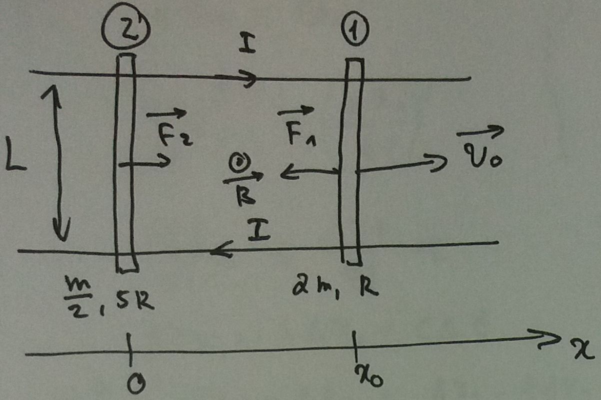
3) В её фокальной плоскости
(24 см справа от линзы)

Ответ: 1) 56 см
2) 9 см
3) 24 см справа от линзы

21201493 (U314643 M1266597)

Задача №4 Чистовик

3



1) В начальный момент времени:

$$\mathcal{E}_0 = \left|-\frac{d\Phi}{dt}\right| = BLv_0$$

$$I_0 = \frac{\mathcal{E}_0}{R+5R} = \frac{BLv_0}{6R}$$

$$F_1 = I_0BL = \frac{B^2L^2v_0}{6R} \quad \text{(сила Ампера)}$$

II з-н Ньютона:

$$2ma_0 = -\frac{B^2L^2v_0}{6R} \Rightarrow a_0 = -\frac{B^2L^2v_0}{12mR}$$

$$a_{01} = \frac{B^2L^2v_0}{12mR} \text{ влево}$$

2) В произвольный момент времени:

$$|2ma_1| = \left|\frac{m}{2}a_2\right| = IBL$$

$$4|a_1| = |a_2| \Rightarrow 4\Delta v_1 = \Delta v_2 \quad (\Delta v_1 > 0 \text{ и } \Delta v_2 > 0)$$

В установившемся режиме:

$$\mathcal{E} = BL(v_1 - v_2) = 0 \Rightarrow v_1 = v_2$$

$$\begin{cases} v_2 = \Delta v_2 \\ v_1 = v_0 - \Delta v_1 \end{cases} \Rightarrow \begin{aligned} &\Delta v_2 = v_0 - \Delta v_1 \\ &4\Delta v_1 = v_0 - \Delta v_1 \\ &\Delta v_1 = \frac{v_0}{5} \end{aligned}$$

$$u = v_1 = v_2 = \frac{4v_0}{5}$$

Чистовик

(4)

3) $4\dot{v}_1 = \dot{v}_2$

$$\begin{cases} 2m\,\dot{v}_1 = \frac{B^2L^2}{6R}(v_2 - v_1) \\ \frac{m}{2}\dot{v}_2 = \frac{B^2L^2}{6R}(v_1 - v_2) \end{cases}$$

$$\left(\frac{\Delta x_2}{\Delta t}\right)' = 4\left(\frac{\Delta x_1}{\Delta t}\right)'$$

$$\frac{\Delta x_2}{\Delta t} = 4\,\frac{\Delta x_1}{\Delta t} + C$$

$$\Delta x_2 = 4\Delta x_1 + C\Delta t$$

$$\Delta l = \Delta x_1 - \Delta x_2 = \Delta x_1 - 4\Delta x_1 - C\Delta t = -3\Delta x_1 - C\Delta t$$

Ответ: 1) $\frac{B^2L^2v_0}{6R}$ влево

2) $\frac{4v_0}{5}$

Чернови

[redacted]

$2ma_1 = 0$

$2m\ddot{x}_1 = 0$

$\ddot{x}_1 = \ddot{x}_2$

$\cancel{\frac{d}{dt}\frac{\Delta x_1}{\Delta t} = \frac{d}{dt}\frac{\Delta x_2}{\Delta t}}$

$\Delta x_1 = \Delta x_2$

$\frac{d}{dt}\frac{\Delta x_1}{\Delta t} = \frac{d}{dt}\frac{\Delta x_2}{\Delta t}$

$\frac{\Delta x_1}{\Delta t} = \frac{\Delta x_2}{\Delta t} + C$

[redacted]

$\Delta x_1 = \Delta x_2 + C\Delta t$

$\Delta x_1 - \Delta x_2 = C\Delta t = X$

[redacted]

$2m\dot{v}_1 = \frac{m}{2}\dot{v}_2$

$4\dot{v}_1 = \dot{v}_2$

$\cancel{\frac{4\Delta x_1}{\Delta t} = \frac{\Delta x_2}{\Delta t}}$

$4\Delta x_1 = \Delta x_2$

[redacted]

$\frac{d}{dt}v_1 = \frac{d}{dt}v_2$

$v_1 = v_2 + C$

$\ddot{x}_1 = \ddot{x}_2$

$\frac{d}{dt}v_1 = \frac{d}{dt}v_2$

$v_1 = v_2 + C$

$C = 0$

$\frac{\Delta x_1}{\Delta t} = \frac{\Delta x_2}{\Delta t}$

$\Delta x_1 = \Delta x_2$

$\Delta l = 0$

$\frac{m}{2}a_2 = \frac{B^2L^2(v_1 - v_2)}{6R}$

$\frac{m}{2}\ddot{x}_2 = \frac{B^2L^2(v_1 - v_2)}{6R}$

$\Delta l = \Delta x_1 - \Delta x_2 =$

$= -3\Delta x_1 - C\Delta t$

$\frac{m}{2}\dot{v}_2 = \frac{B^2L^2}{6R}(v_1 - v_2)$

$2m\dot{v}_1 = \frac{B^2L^2}{6R}(v_2 - v_1)$

[redacted]

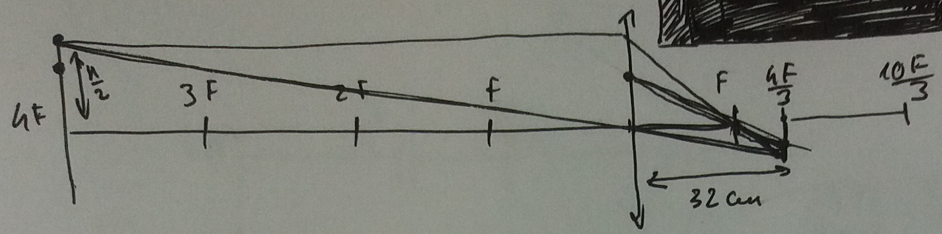
$\Delta x_2 = 4\Delta x_1 + C\Delta t$

$\dot{v}_2 = 4\dot{v}_1$

$\left(\frac{\Delta x_2}{\Delta t}\right)' = 4\left(\frac{\Delta x_1}{\Delta t}\right)'$

$\frac{\Delta x_2}{\Delta t} = 4\frac{\Delta x_1}{\Delta t} + C$

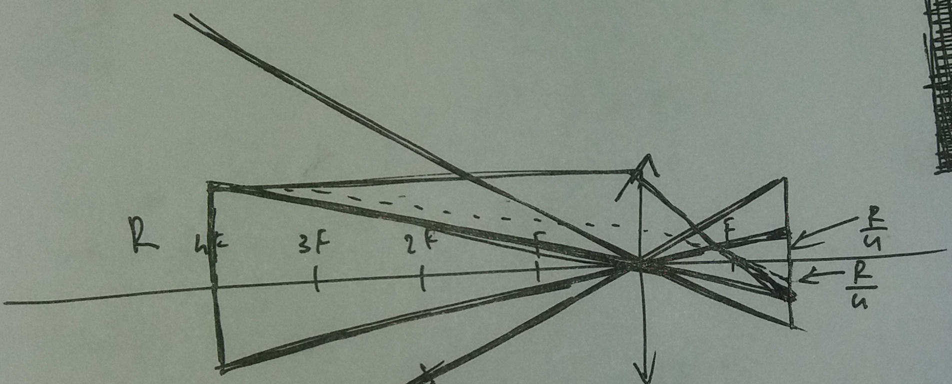
$2 = \frac{4}{3} =$ Черновик [redacted]



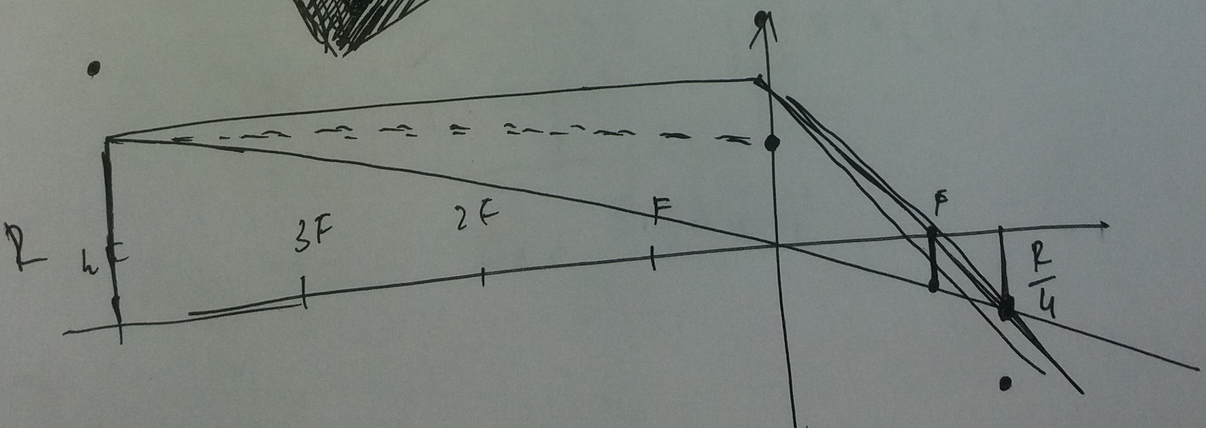
2) Dш = H = 9 см

3) 24 см между линзой и изображением (фокальная плоскость)

[redacted]



[redacted]

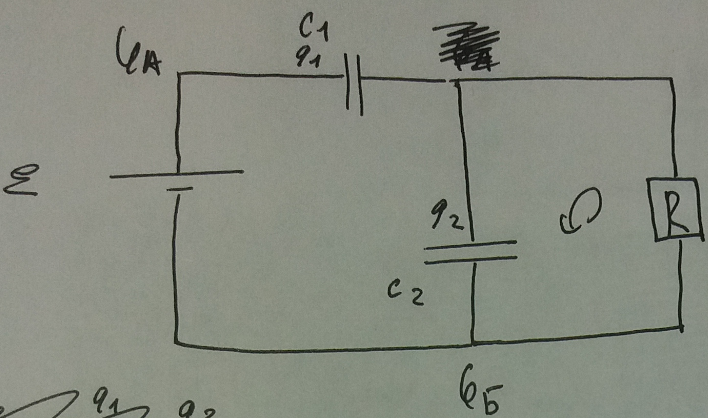


№ 3

Черновик

1) 0

2)



[redacted]

[redacted] $\cancel{\frac{q_1}{C_1}+\frac{q_2}{C_2}}$

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

$$0 = \frac{q_2}{C_2} \Rightarrow q_2 = 0$$

$$W_k = 0$$

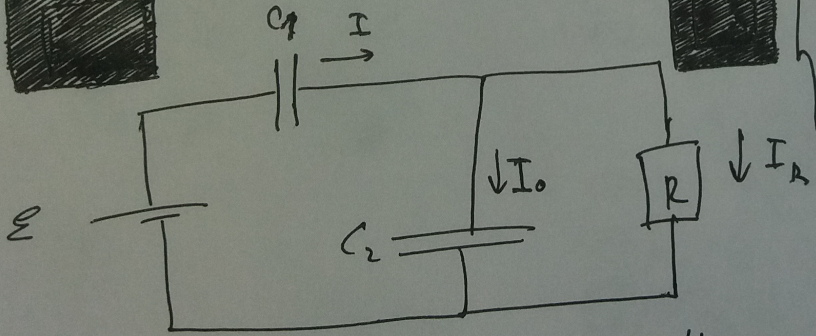
$$W_k = \frac{q_1^2}{2C_1} = \frac{\mathcal{E}^2 C_1^2}{2C_1} = \frac{C_1\mathcal{E}^2}{2}$$

$$\mathcal{E}\Delta q = \frac{C_1\mathcal{E}^2}{2} + Q$$

$$Q = C_1\mathcal{E}^2 - \frac{C_1\mathcal{E}^2}{2} = \frac{C_1\mathcal{E}^2}{2} = \frac{5C\mathcal{E}^2}{2}$$

[redacted]

3)

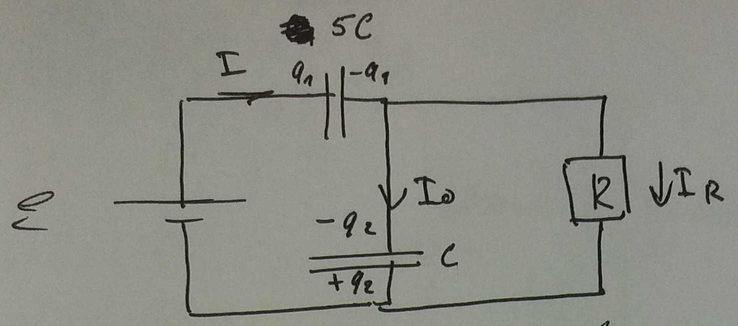


[redacted]

$$\begin{cases} \mathcal{E} = U_1 + I_R R \\ U_2 = I_R R \\ I = I_0 + I_R \end{cases}$$

$$\mathcal{E} - U_1 = I_R R \Rightarrow I_R = \frac{\mathcal{E} - U_1}{R} = \frac{U_2}{R}$$

Черновик



$\frac{I_0}{C_2}$

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

$$I = \frac{C_1}{C_2} I_0$$

$$0 = \frac{I}{5C} - \frac{I_0}{C}$$

$$5I_0 = I_0 + I_R$$

$$0 = \frac{I}{5} - I_0 \Rightarrow I = 5I_0$$

$$I_R = 4I_0$$

$$I = \frac{\Delta q}{\Delta t}$$

$$U_1 = \frac{q_1}{5C} = \frac{I\Delta t}{5C}$$

$$u_2 = \frac{q_2}{C} = \frac{I_0\Delta t}{C}$$

$$\mathcal{E} = \frac{I\Delta t}{5C} + \frac{I_0\Delta t}{C}$$

$$5C\mathcal{E} = I\Delta t + 5I_0\Delta t$$

$$5C\mathcal{E} = (I + 5I_0)\Delta t$$

$$\cancel{+5I_0 = \frac{5C\mathcal{E}}{\Delta t}}$$

$$\mathcal{E} = \frac{q_1}{5C}$$

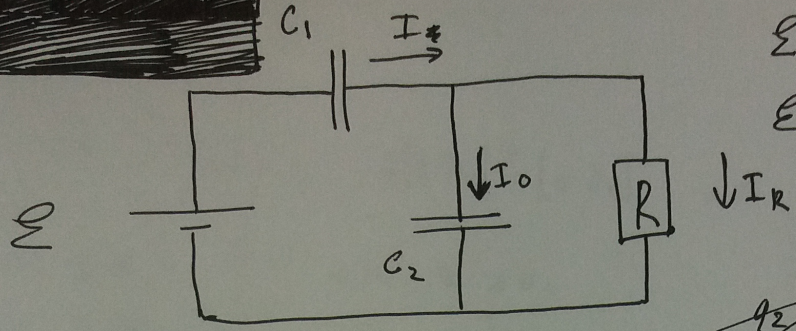
$$\frac{q_2}{C} = I_R R$$

I_1

[redacted]

№3

Черновик



$$\mathcal{E} = \frac{q_1}{C_1} + I_R R$$

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

$$\cancel{\frac{q_2}{C_2} = \mathcal{E} - \frac{q_1}{C_1}}$$

$$\cancel{q_2 = \mathcal{E} C_2 - q_1 \frac{C_2}{C_1}}$$

$$\cancel{I_0 = \dot{q}_2 = \dot{q}_1 \frac{C_2}{C_1}}$$

$$I_0 = \frac{\Delta q_0}{\Delta t}$$

$$I = \frac{\Delta q}{\Delta t}$$

$$I_R = \frac{\Delta q_R}{\Delta t}$$

[redacted]

$$\Delta q = \Delta q_0 + \Delta q_R$$

$$\mathcal{E} = \frac{q_1}{C_1} + \frac{q_2}{C_2} \Rightarrow$$ [redacted]

$$\cancel{0 = \frac{I_1}{C_1} + \frac{I_2}{C_2} \Rightarrow}$$

$$\cancel{0 = \frac{I}{C_1} + \frac{I_0}{C_2}}$$

$$\cancel{C_2 I + C_1 I_0 = 0}$$

$$\cancel{I = + \frac{C_2}{C_1} I_0}$$

$$I = I_0 + I_R$$

[redacted] $\cancel{\frac{C_2}{C_1} I_0 = I_0 + I_R}$

$$\cancel{I_R = \left(\frac{C_2}{C_1} - 1\right) I_0 = \frac{C_2 - C_1}{C_2} = \frac{C - 5C}{5C}}$$

$$0 = \frac{I}{C_1} + \frac{I_0}{C_2}$$

$$C_2 I + C_1 I_0 \Rightarrow I = -\frac{C_1}{C_2} I_0$$

$$-\frac{C_1}{C_2} I_0 = I_0 + I_R$$

$$I_R = -I_0 \left(1 + \frac{C_1}{C_2}\right) =$$

2) $\mathcal{E} = BL(v_2 - v_1) = 0 \Rightarrow v_2 = v_1$ черновик

$$\begin{cases} 2m a_2 = - IBL \\ \frac{m}{2} a_1 = IBL \end{cases}$$

$4|a_2| = |a_1| \Rightarrow 4|\Delta v_2| = |\Delta v_1| \Rightarrow$ [redacted] $\boxed{4\Delta x_2 = \Delta x_1}$

$$\begin{cases} v_1 = |\Delta v_1| \\ v_2 = v - |\Delta v_2| \end{cases}$$

$\Delta v_1 = v - \Delta v_2$

[redacted] $4\Delta v_2 = v - \Delta v_2$

[redacted]

$5\Delta v_2 = v$

$\Delta v_2 = \frac{v}{5}$

$\Delta v_1 = \frac{4v}{5}$

$u = \frac{4v}{5}$

[redacted]

3) [redacted]

$4v = v_0 - v$

$5v = v_0 \Rightarrow v = \frac{v_0}{5}$

[redacted]

~~$x_{20} - x_{10}$~~

[redacted] ~~$= x_0 + \Delta x_1$~~

[redacted] $-\begin{cases} x_2 = x_0 + \Delta x_2 \\ x_1 = x_0 + \Delta x_1 = x_0 + 4\Delta x_2 \end{cases}$

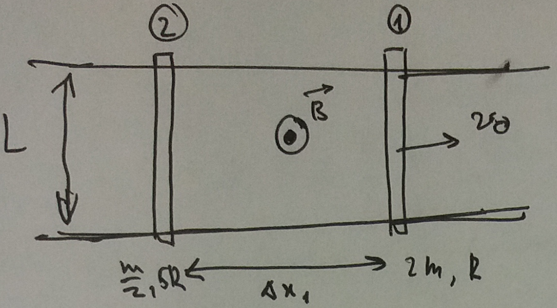
$x_2 - x_1 = x_0 + \Delta x_2 - x_0 - 4\Delta x_2 = -3\Delta x_2$

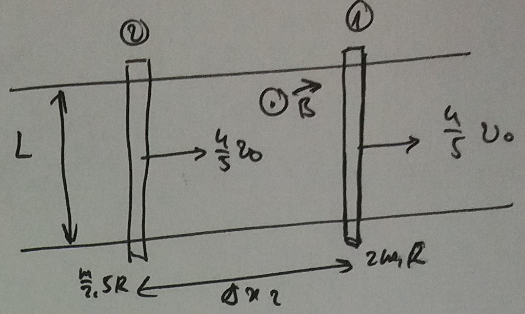
[redacted]

$4\Delta v_1 = v - \Delta v_1$

[redacted]

Черновик





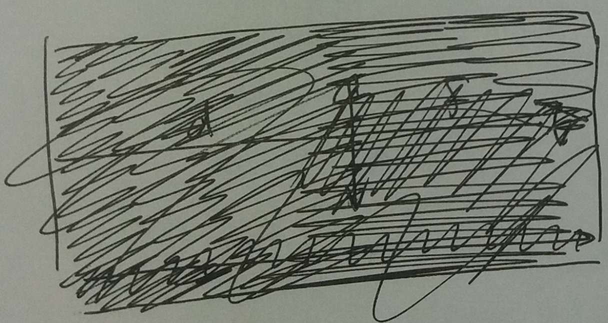
$$2m\frac{\Delta v_1}{\Delta t} = IBL = \frac{m}{2}\frac{\Delta v_2}{\Delta t}$$

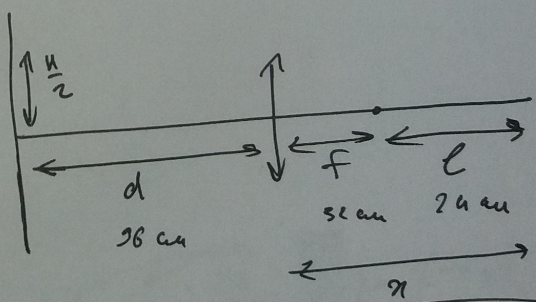
$$2m\Delta v_1 = \frac{m}{2}\Delta v_2 \Rightarrow \boxed{4\Delta v_1 = \Delta v_2}$$

[redacted]

3)

[redacted]





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

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

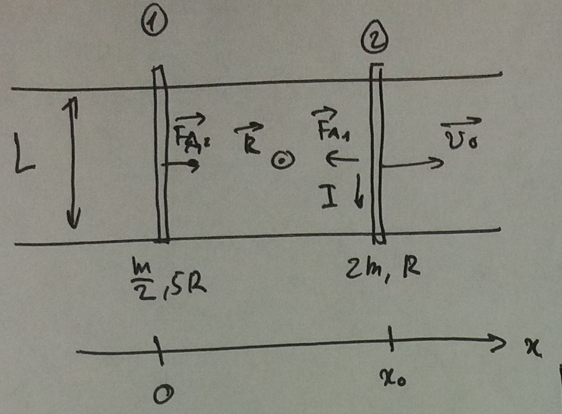
$$f = \frac{96 \cdot 24}{96-24} = \frac{2304}{72}$$ ~~32 см~~ 32 см

$x = \cancel{f + l = 32 + 24} = 56$ см

21201493 (U314643 M1266597)

№4 Черновик

[redacted]



1) $\mathcal{E}_0 = \frac{d\varphi}{dt} = BLv_0$

$I = \frac{\mathcal{E}_0}{R+5R} = \frac{\mathcal{E}_0}{6R} = \frac{BLv_0}{6R}$

[redacted]

$2ma = -F_A$

$F_A = IBL = \frac{BLv_0}{6R}BL = \frac{B^2L^2v_0}{6R}$

$a = \frac{1}{2m}\frac{B^2L^2v_0}{6R} = \frac{B^2L^2v_0}{12mR}$

2) $\mathcal{E}_1 = BL(v_2 - v_1)$

$I = \frac{BL(v_2 - v_1)}{6R} = \frac{\Delta q}{\Delta t}$

$F_A = IBL = \frac{B^2L^2(v_2 - v_1)}{6R} = 0 \Rightarrow v_2 = v_1$ [redacted] при $t \to \infty$

[redacted]

$m\frac{\Delta v}{\Delta t} = \frac{\Delta q}{\Delta t}BL$

$\Delta v = \frac{\Delta q BL}{m}$

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

$2ma_1 = -\frac{m}{2}a_2$

$4a_1 = -a_2$

Ускорение 1 в 4 раза больше 2

$4\Delta v_1 = \Delta v_2$

$v - \frac{v}{5}$

$v_2 = \Delta v_1$

$v_1 = v - \Delta v_2$

$\Delta v_1 = v - \Delta v_2$

$\Delta v_1 = v - 4\Delta v_1$

$5\Delta v_1 = v$

$\Rightarrow \Delta v_1 = \frac{v}{5}$

$\Delta v_2 = \frac{4v}{5}$