Часть 1

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

Шифр: **21202453**

ID профиля: **312774**

Вариант 4

Чистовик, лист 2

№1 Дано:

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

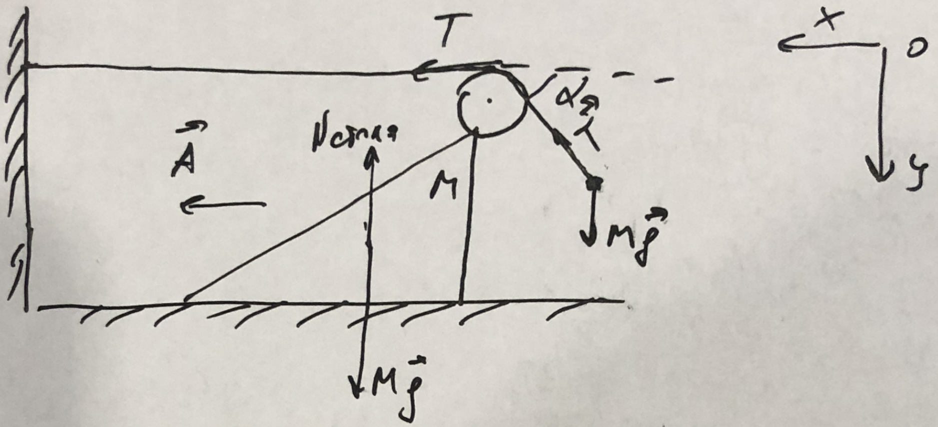
1. δ - ?

2. A - ?

3. $\frac{m}{M}$ - ?

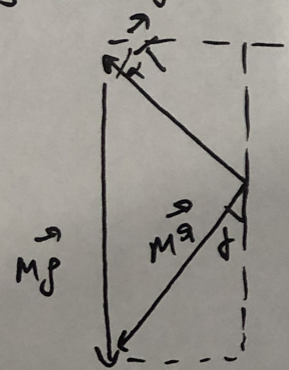
4. γ - ?

Решение:



1. 2ЗН для клина: x: $MA = T$

2. 2ЗН для шара:



$|a_x| = a\sin\alpha$, $|a_y| = a\cos\alpha$, где a - ускорение шара

Чистовик, лист 1

№2.

Дано:
ν, T_0
$c(T) = \frac{9}{5}R\frac{T}{T_0}$

1. Q_1 - ?
2. T^* - ?
3. A^* - ?

Решение:

1. $\delta Q = c(T)\nu\, dT$

$$\int_0^{Q_{получ}} dQ = \int_{T_0}^{\frac{3}{4}T_0} \frac{9}{5}R\nu\frac{T}{T_0}\, dT$$

$$Q_{получ} = \frac{9}{5}R\nu\frac{T^2}{2T_0}\Bigg|_{T_0}^{\frac{3}{4}T_0} = \frac{1}{2}\cdot\frac{9}{5}\frac{R\nu}{T_0}\left(\frac{9}{16}T_0^2 - T_0^2\right) =$$

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

$$Q_1 = -Q_{получ} \Rightarrow Q_1 = \frac{63R\nu T_0}{160}$$

2. 1-ое начало термодинамики:

$$Q = A + \Delta U \Rightarrow A = Q - \Delta U$$

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

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

$$= \frac{3}{2}\nu R\left(\frac{3}{5}\frac{T^2}{T_0} - T + \frac{8}{5}T_0\right)$$

$$(A)' = \left(\frac{3}{2}\nu R\left(\frac{3}{5}\frac{T^{*2}}{T_0} - T^* + \frac{8}{5}T_0\right)\right)' = \frac{3}{2}\nu R\left(\frac{3\cdot 2T^*}{5\cdot T_0} - 1\right) = 0 \Rightarrow$$

$$\Rightarrow \frac{6T^*}{5T_0} - 1 = 0 \Rightarrow T^* = \frac{5T_0}{6}$$

3. $A^* = A(T^*) = A\left(\frac{5}{6}T_0\right) = \frac{3}{2}\nu R\left(\frac{3}{5\cdot T_0}\cdot\frac{25}{36}T_0^2 - \frac{5}{6}T_0 + \frac{8}{5}T_0\right) =$

$$= \frac{3}{2}\nu R\left(\frac{5T_0}{12} - \frac{5}{6}T_0 + \frac{8}{5}T_0\right) = \frac{3}{2}\nu R\left(\frac{25T_0}{60} - \frac{50T_0}{60} + \frac{96T_0}{60}\right) =$$

$$= \frac{3}{2}\nu R\left(\frac{71}{60}T_0\right) = \frac{71\nu RT_0}{40}$$

Ответ: $\frac{63\nu RT_0}{160}$; $\frac{5T_0}{6}$; $\frac{71\nu RT_0}{40}$

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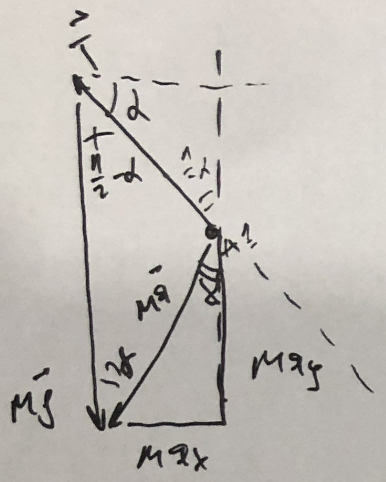
Черновик



$u = \frac{a_y t^2}{2}$

$\frac{m}{M} - ?$

$A - ?$

$a_y = a\cos\gamma$

$a_x = a\sin\gamma$

$$\frac{T}{\sin\gamma} = \frac{ma}{\cos\alpha} = \frac{mg}{\sin(\Pi - \alpha} = \frac{mg}{\cos(\gamma-\alpha)}$$

~~$A - (\frac{\pi}{2} - \alpha) - \gamma = \frac{\pi}{2} - \gamma + \alpha$~~

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

~~$\sin(\frac{\pi}{2} - (\gamma - \alpha)) = \cos(\gamma-\alpha)$~~

$\cos(\gamma-\alpha) = \cos\gamma \cdot \cos\alpha + \sin\gamma \sin\alpha$

$T\cos\alpha = ma\sin\gamma$

$T\sin\alpha + ma\cos\gamma = mg$

~~$T = \frac{mg\sin\gamma}{\cos\gamma \cdot \cos\alpha + \sin\gamma \cdot \sin\alpha}$~~

~~ma~~

$T\cos\alpha = ma\sin\gamma$

~~$T\sin\alpha =$~~

$mg - T\sin\alpha = ma\cos\gamma$

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

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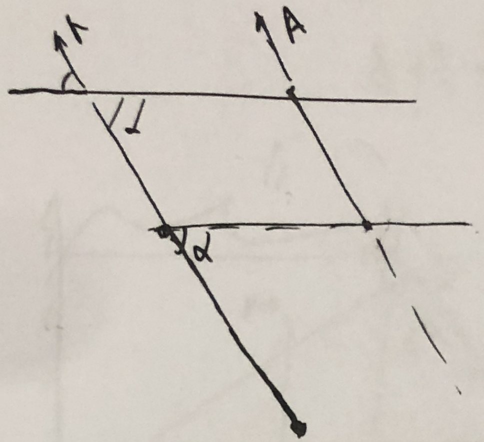

$\gamma + (\frac{\pi}{2} - \alpha)$

$\cos(\frac{\pi}{2} - \alpha + \gamma) =$

$= \cos(\frac{\pi}{2} - (\alpha - \gamma)) = \sin(\alpha - \gamma)$

$\Delta l_1 = -A$

$MA\cos\alpha = ma\sin\gamma$

$\Delta l_2 = A\cos\alpha + a\sin(\alpha - \gamma)$

$A = A\cos\alpha + a\sin(\alpha - \gamma)$

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

$1 = \cos\alpha + \frac{a}{A} \cdot \sin(\alpha - \gamma)$

$a_y = a\cos\gamma$

$mgH = \frac{m v^2}{2} + \frac{M u^2}{2}$

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

$mgH = \frac{m}{2} a^2 t^2 + \frac{M}{2} A^2 t^2$

$mg \cdot \frac{a}{2}\cos\gamma \cdot t^2 = \frac{ma^2}{2} t^2 + \frac{M}{2} A^2 t^2$

$mg \cdot a\cos\gamma = ma^2 + MA^2$ $\quad | : ma$

$g\cos\gamma = a + \frac{MA^2}{ma}$

$\frac{MA^2}{ma} = \frac{\sin\gamma}{\cos\alpha} \cdot A$

$\frac{a}{A} = \frac{1 - \cos\alpha}{\sin(\alpha - \gamma)} \Rightarrow$

$\Rightarrow A = \frac{a \cdot \sin(\alpha - \gamma)}{1 - \cos\alpha}$

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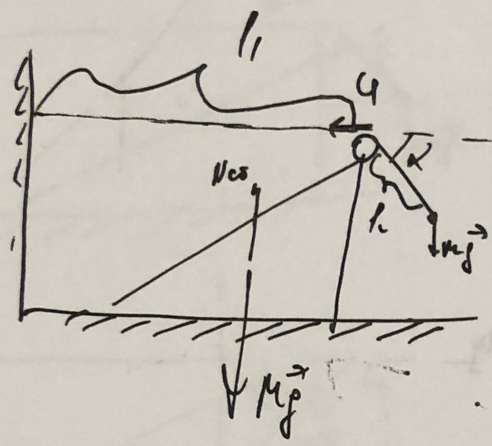
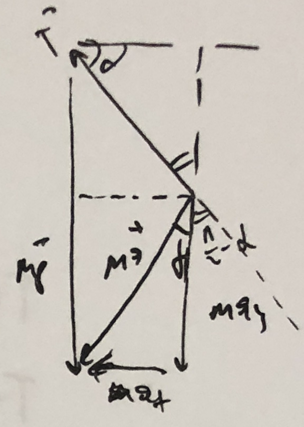
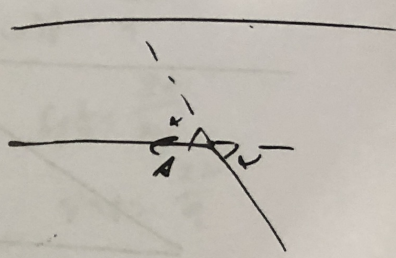
Черевик

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





$A = a_x$



$T\sin\alpha - mg = ma_y$

$MA = T$

$T\cos\alpha = ma_x$

$MA\cos\alpha = m a_x$

$M\cos\alpha = m \Rightarrow$

$\frac{m}{M} = \cos\alpha$

$T = MA$

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

$\operatorname{tg}\alpha = \operatorname{ctg}\gamma + \frac{g}{a_x}$

$A\frac{t^2}{2}$

$l_2 \uparrow \Rightarrow \Delta l_2 +$ $\quad \sin(\alpha-\gamma)$

$-A$

$\Delta l_2 = A\cos\alpha + a\cos(\frac{\pi}{2} + \gamma - \alpha)$

$l_1 + l_2 = const \Rightarrow$

$\Delta l_1 + \Delta l_2 = 0$

$-A + A\cos\alpha + a\sin(\alpha - \gamma)$

$-A + A\cos\alpha + a(\sin\alpha\cos\gamma - \cos\alpha\sin\gamma)$

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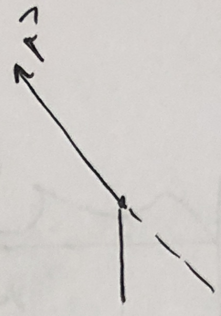
Черновик

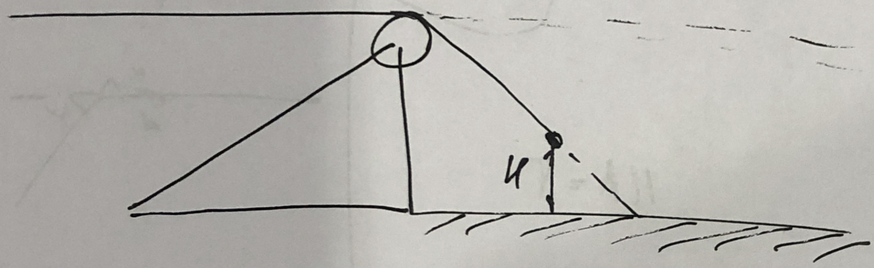
$$h = \frac{a_y t^2}{2}$$

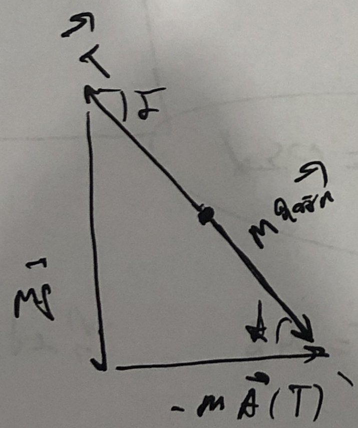


$$T\cos\alpha = ma_x$$

$$T = MA$$

$$T\sin\alpha - mg = ma_y$$





$$(mg)^2 + T^2 = (T + ma_{отн})^2$$

$$m^2g^2 + T^2 = T^2 + 2Tma_{отн} + m^2a_{отн}^2$$

$$m^2g^2 = m^2a_{отн}^2 + 2Tma_{отн}$$

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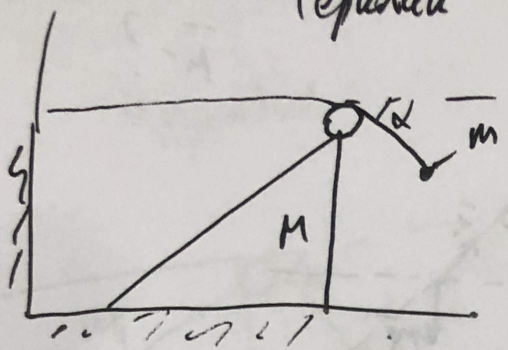
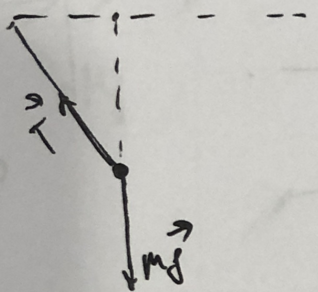
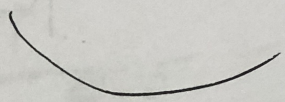
Черновик

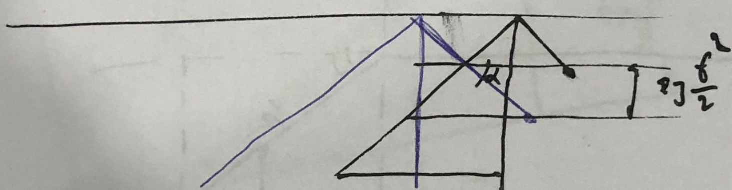


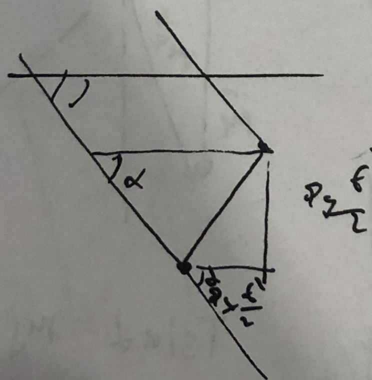
$T = MA$

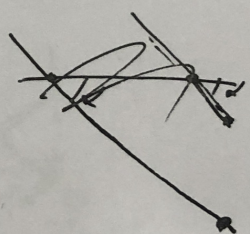
$\vec{T} + m\vec{g} = M\vec{a}$











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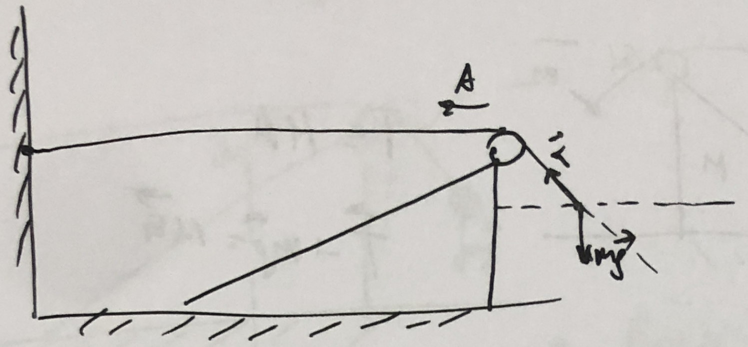
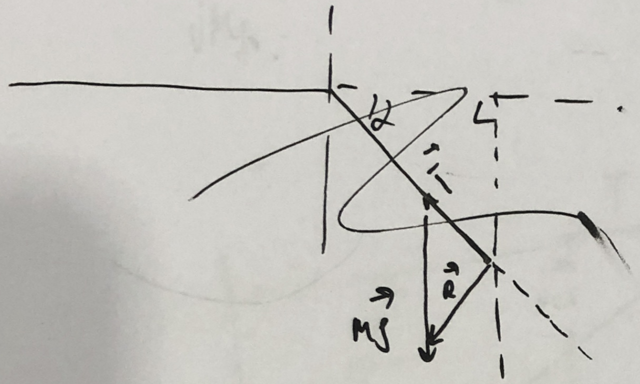
Черновик

$\frac{m}{M}$ - ?

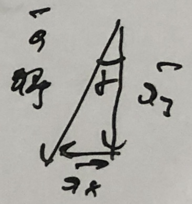


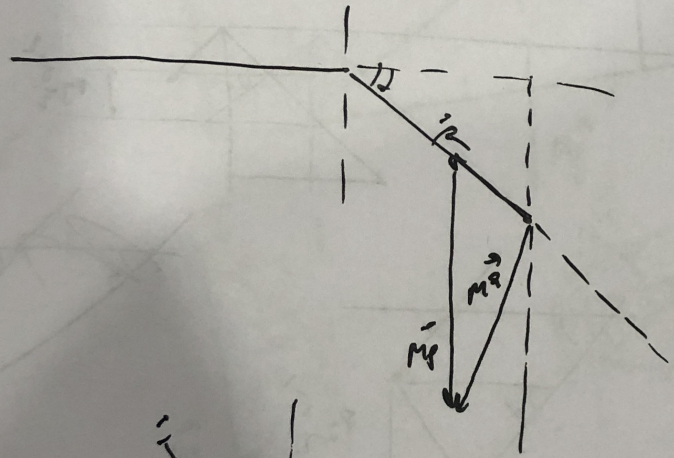


$\cos\gamma = \frac{a_y}{a}$

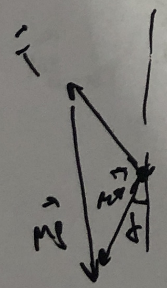
$tg\gamma = \frac{a_x}{a_y}$

$\sin\gamma = \frac{a_x}{a}$





$T\sin\alpha = ma_y + Mg$



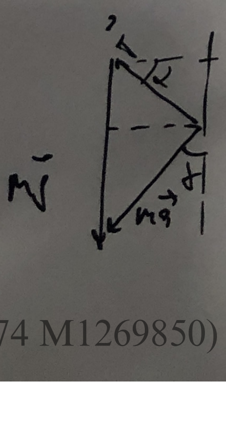
$T\sin\alpha - mg = ma_y$

$T\cos\alpha = ma_x$

$tg\alpha = \frac{ma_y + mg}{ma_x} =$

$= ctg\gamma + \frac{g}{a_x}$

$T = MA$



$\frac{1}{2}g \cdot T \cdot \cos\alpha = g \cdot ma\sin\gamma$

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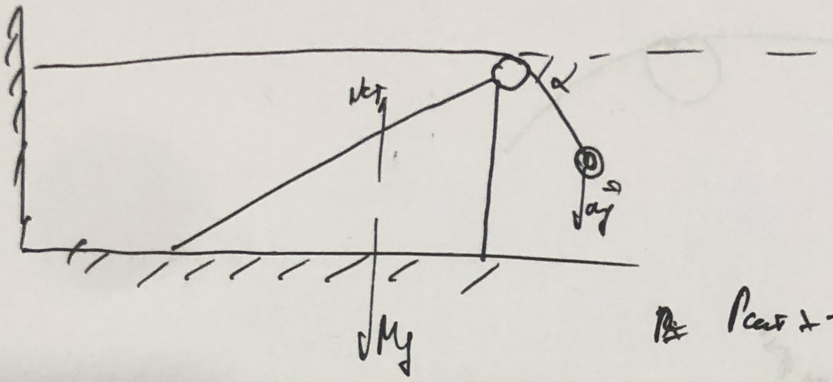
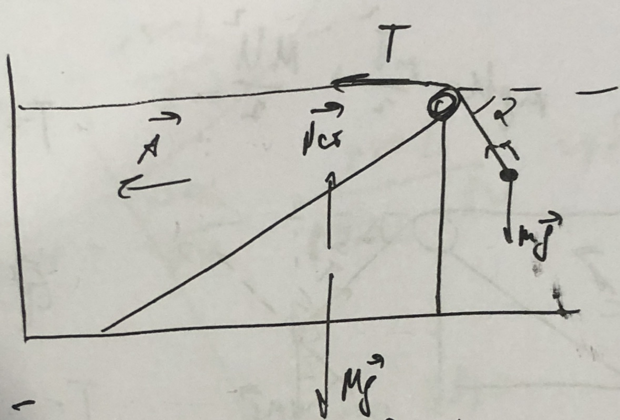
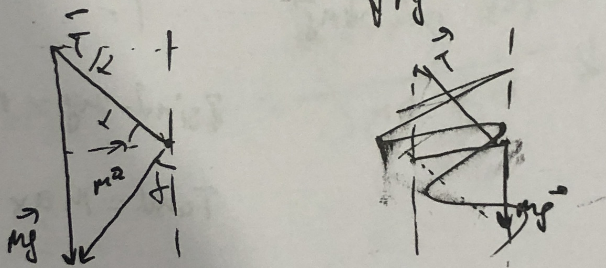
Черновик



$P\cos\alpha = \cos\gamma = ?$





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

$$mg = T\sin\alpha + ma\cos\gamma$$

$$mg = ma\sin\gamma \cdot tg\alpha + ma\cos\gamma$$

$$g = a\sin\gamma \cdot tg\alpha + a\cos\gamma$$

$$g = a(\sin\gamma \cdot tg\alpha + \cos\gamma)$$

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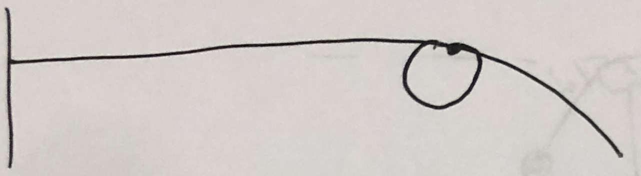
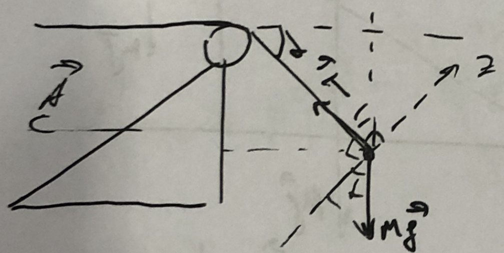
Черновик



$\frac{m\upsilon^2}{2}$

$$mgh = \frac{m\upsilon^2}{2} + \frac{MU^2}{2}$$

$T = MA$



$\vec{a} +$

$T -$

$T\sin\alpha - mg = ma_y$

$T\cos\alpha = ma_x$

$MA\sin\alpha - mg = ma_y$

$MA\cos\alpha = ma_x$

$mg\cos\alpha = ma_z$

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Черновик

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

$$\cos(\gamma-\alpha) = \cos\gamma\cdot\cos\alpha + \sin\gamma\cdot\sin\alpha =$$

$$= \sin\gamma\left(\frac{\cos\gamma}{\sin\gamma}\cdot\cos\alpha + \sin\alpha\right) =$$

$$= \sin\gamma\,(\operatorname{ctg}\gamma\cdot\cos\alpha + \sin\alpha)$$

$$\frac{T}{\sin\gamma} = \frac{mg}{\sin\gamma(\operatorname{ctg}\gamma\cdot\cos\alpha + \sin\alpha)}$$

$$T = \frac{mg}{\operatorname{ctg}\gamma\cdot\cos\alpha + \sin\alpha}$$

$$T\,\frac{mg\cdot\cos\alpha}{\operatorname{ctg}\gamma\cdot\cos\alpha + \sin\alpha} = m$$

$$\operatorname{ctg}\gamma\cdot\cos\alpha + \frac{\sin\alpha}{\operatorname{tg}\alpha} = \frac{mg}{T\cos}$$

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

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

$$\operatorname{ctg}\gamma = \operatorname{ctg}\gamma + \operatorname{tg}\alpha - \sin\alpha$$

Черновик

$Q = A' + \Delta U$ (T) $Q = \frac{9}{10} R \nu \frac{T^2}{T_0}$

$Q - \Delta U = A'$

$\frac{9}{10} R \nu \frac{T^2}{T_0} - \frac{3}{2} \nu R (T - T_0) = A' =$

$= \frac{9}{10} \nu R \frac{T^2}{T_0} - \frac{3}{2} \nu R T + \frac{3}{2} \nu R T_0 \quad | \cdot \frac{2}{3} : \nu R$

$\frac{9}{10} \cdot \frac{T^2}{T_0} - \frac{3}{2} T + \frac{3}{2} T_0 = A' \quad | \cdot 2$

$\frac{9}{5} \frac{T^2}{T_0} - 3T + 3T_0 = A' \quad | : 3$

$\frac{3T^2}{5T_0} - T + T_0 = A'$

$(A')' = \left(\frac{3T^2}{5T_0} - T + T_0\right)' = \frac{3}{5T_0} \cdot 2 \cdot T - 1 \Rightarrow$

$\frac{6T}{5T_0} = 1 \Rightarrow T = \frac{5T_0}{6}$

$\frac{9}{10} = \frac{3 \cdot 3}{5 \cdot 2} = \frac{3}{2} \cdot \frac{3}{5}$

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Черновик

$$\frac{T}{\sin\gamma} = \frac{mg}{\cos\alpha} = \frac{mg}{\sin\left(\frac{\pi}{2} - (\gamma-\alpha)\right)} = \frac{mg}{\cos(\gamma-\alpha)}$$

$$\pi - \gamma - \left(\frac{\pi}{2} - \alpha\right) = \frac{\pi}{2} - \gamma + \alpha = \frac{\pi}{2} - (\gamma - \alpha)$$

$$T = \frac{mg\sin\gamma}{\sin\gamma\left(\operatorname{ctg}\gamma\cdot\cos\alpha + \sin\alpha\right)}$$

$\cos(\alpha \cdot \gamma$

$$\cos(\gamma-\alpha) = \cos\gamma\cdot\cos\alpha + \sin\gamma\cdot\sin\alpha$$

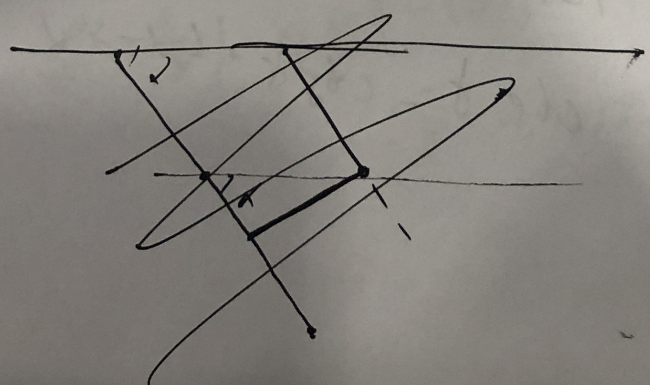
$$T = \frac{mg}{\operatorname{ctg}\gamma\cdot\cos\alpha + \sin\alpha} \Rightarrow \frac{mg}{\cos\alpha\cdot T} = \operatorname{ctg}\gamma\cdot + \operatorname{tg}\alpha$$

$$T\cos\alpha = mg\sin\gamma$$

$$mg - T\sin\alpha = mg\cos\gamma$$

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

$$\Rightarrow \operatorname{ctg}\gamma = \frac{mg}{T\cos\alpha} - \operatorname{tg}\alpha$$



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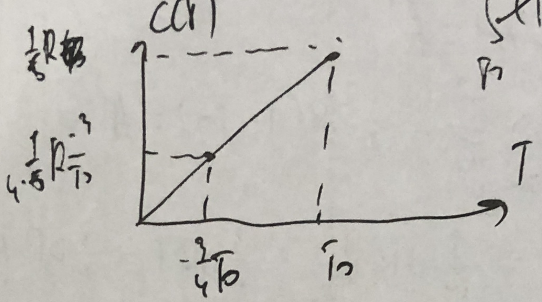
Черновик

$= const$

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

$Q = C(T) \nu \Delta T$

$\int_{T_0}^{\frac{3}{4}T_0} C(T) dT$



$\frac{9}{5}$

$C(T) \nu dT$

$dQ = \frac{9}{5} R \frac{T}{T_0} dT$

$\int_0^{Q_1} dQ = \int_{T_0}^{\frac{3}{4}T_0} \frac{9}{5} R \frac{T}{T_0} dT$

$Q_1 = \frac{9}{5} R \frac{\nu}{T_0} \frac{T^2}{2} \Big|_{T_0}^{\frac{3}{4}T_0} =$

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

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

$\frac{9}{5}$

$\frac{\frac{9}{5} R \cdot \frac{3}{4} T_0 + \frac{9}{5} R}{2} \cdot \frac{1}{4} T_0 =$

$= \frac{\frac{9}{5} R \left(\frac{7}{4} \right) T_0}{2} \cdot \frac{1}{4} T_0 =$

$= T_0^2 \cdot R \cdot \frac{63}{160}$

$=$

$Q = A' + \Delta U$

$\Delta U = \frac{3}{2} \nu R (T - T_0)$

$A' =$

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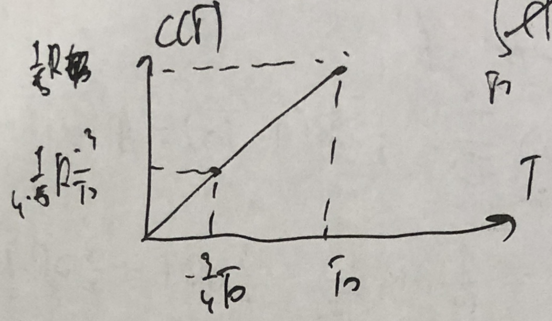
4 задача

$C(T) = \frac{8}{5} R \frac{T}{T_0}$ (= const)

~~$\delta Q = C(T)\,\nu\,\Delta T$~~

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



$\frac{8}{5}$

$\delta Q = C(T)\,\nu\,dT$

$\delta Q = \frac{8}{5} R \frac{T}{T_0}\,dT$

$\int_0^{Q_1} dQ = \int_{T_0}^{\frac{3}{4}T_0} \frac{8}{5} R \frac{T}{T_0}\,dT$

$Q_1 = \frac{8}{5} R \frac{\nu}{T_0} \frac{T^2}{2} \Big|_{T_0}^{\frac{3}{4}T_0} =$

$= \frac{8}{10} R \frac{\nu}{T_0} \left(\frac{9}{16} T_0^2 - T_0^2\right) =$

$= \frac{8}{10} R\nu \cdot -\frac{7}{16} T_0^2 = -\frac{63}{160} \nu R T_0^2$

$\frac{8}{5}$

$\frac{\frac{8}{5} R \cdot \frac{3}{4} T_0 + \frac{8}{5} R}{2} \cdot \frac{1}{4} T_0 =$

$= \frac{\frac{8}{5} R \left(\frac{7}{4}\right) T_0}{2} \cdot \frac{1}{4} T_0 =$

$= T_0^2 \cdot R \cdot \frac{63}{160}$

$=$

$Q = A' + \Delta U$

$\Delta U = \frac{3}{2} \nu R (T - T_0)$

$A' =$

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Часть 2

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

Шифр: **21202453**

ID профиля: **312774**

Вариант 4

Чистовик, лист №1.

№3. Дано:

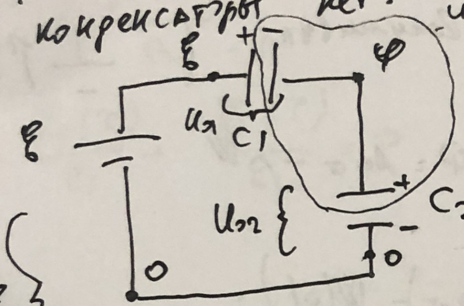
$C_2 = C$

$C_1 = 5C$

1. $I^* - ?$
2. $Q - ?$
3. $I^{**} - ?$

Решение:

1. Рассмотрим цепь до замыкания ключа, токов через конденсаторы нет:



метод потенциалов

Пусть полярности обкладок как на рисунке, тогда:

ЗСЗ:

$-C_1 \cdot U_{01} + C_2 U_{02} = 0$

$\Downarrow$

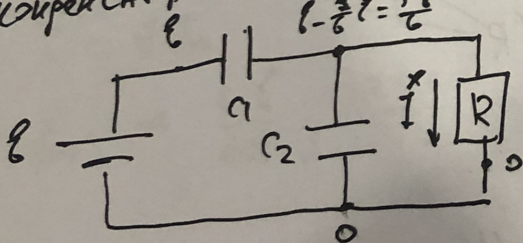
$5C U_{01} = C U_{02} \Rightarrow 5U_{01} = U_{02}$

2. $\begin{cases} U_{01} = \mathcal{E} - \varphi \\ U_{02} = \varphi \\ 5U_{01} = U_{02} \end{cases} \rightarrow 5(\mathcal{E} - \varphi) = \varphi \rightarrow 5\mathcal{E} - 5\varphi = \varphi \rightarrow 5\mathcal{E} = 6\varphi \rightarrow$

$\rightarrow \varphi = \frac{5\mathcal{E}}{6}$

3. $U_{01} = \frac{\mathcal{E}}{6}$; $U_{02} = \frac{5\mathcal{E}}{6}$

4. Рассмотрим цепь сразу после замыкания ключа (напряжения на конденсаторах скачком не изменятся): $t = 0$

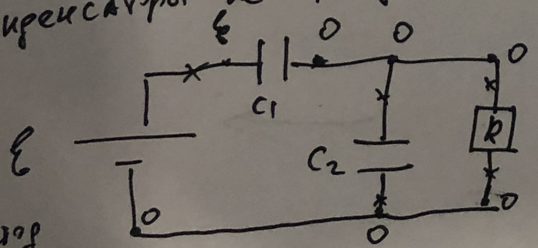


$\left(I^* = \frac{\frac{5\mathcal{E}}{6} - 0}{R} = \frac{5\mathcal{E}}{6R} \right)$

5. $W(0) = \frac{C_1 U_1^2}{2} + \frac{C_2 U_2^2}{2} = \frac{5C}{2} \cdot \frac{\mathcal{E}^2}{36} + \frac{C}{2} \frac{25\mathcal{E}^2}{36} = \frac{1}{2} C \left(\frac{5}{36}\mathcal{E}^2 + \frac{25}{36}\mathcal{E}^2 \right) =$

$= \frac{1}{2} C \cdot \frac{30}{36} \mathcal{E}^2$

6. Рассмотрим цепь в установившемся режиме ($t_{уст}$), токи через конденсаторы не текут:



метод потенциалов

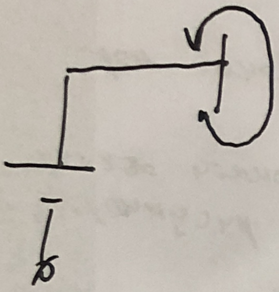
$U_2(t_{уст}) = 0$

$U_1(t_{уст}) = \mathcal{E}$

$W(t_{уст}) = \frac{C_1 \cdot U_1(t_{уст})^2}{2} = \frac{5C}{2} \cdot \mathcal{E}^2$

Чистовик, лист №2

1. Рассмотрим левую обкладку конденсатора C_1:



– было ~~[illegible]~~ $q_1(0) = +C_1 \cdot U_{01} = 5C \cdot \frac{\mathcal{E}}{6} = \frac{5}{6} C \mathcal{E}$

стало $q_1(\text{уст}) = +C_1 \cdot U_1(\text{уст}) = 5C\mathcal{E}$

=> заряд увеличивался $(\perp \uparrow I)$ => $A_{ист} > 0$

2. ЗСЭ: $A_{ист} = \Delta W + Q \to Q = A_{ист} - \Delta W$

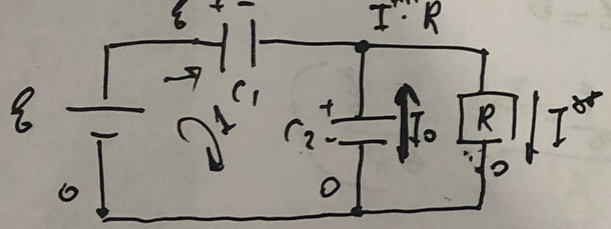
$$Q = \mathcal{E}\left(5C\mathcal{E} - \frac{5}{6}C\mathcal{E}\right) - \left(W(\text{уст}) - W(0)\right) =$$

$$= \mathcal{E}\left(\frac{30C\mathcal{E}}{6} - \frac{5C\mathcal{E}}{6}\right) - \left(\frac{5C\mathcal{E}^2}{2} - \frac{30C\mathcal{E}^2}{2\cdot 36}\right) = \frac{25}{6}C\mathcal{E}^2 -$$

$$- \left(\frac{30C\mathcal{E}^2}{2\cdot 6} - \frac{5C\mathcal{E}^2}{2\cdot 6}\right) = \frac{25C\mathcal{E}^2}{6} - \left(\frac{25C\mathcal{E}^2}{2\cdot 6}\right) =$$

$$= \frac{25C\mathcal{E}^2}{12} \qquad \left(Q = \frac{25C\mathcal{E}^2}{12}\right)$$

3. Рассмотрим цепь в момент времени $t = \tau$, когда ток через C_2 равен I_0:



~~$U_1(\tau) = \mathcal{E} - I^{**} \cdot R$~~ $\to$ ~~$U_1(\tau) = \mathcal{E} - U_2(\tau)$~~

$U_2(\tau) = I^* R$

~~момент прихода~~ ~~по~~ подключения

~~3. ЗСЗ: $-C_1 U_1(\tau) + C_2 U_2(\tau) = -C_1 U_{01} + C_2 U_{02}$~~

~~$-5C(\mathcal{E} - U_2(\tau)) + C \cdot U_2(\tau) = -5C \cdot \frac{\mathcal{E}}{6} + C \cdot \frac{5\mathcal{E}}{6}$~~

~~$-5C\mathcal{E} + 5C \cdot U_2(\tau) + C \cdot U_2(\tau) = -\frac{5C\mathcal{E}}{6} + \frac{5C\mathcal{E}}{6} = 0$~~

~~$-5\mathcal{E} + 5 \cdot U_2(\tau) + U_2(\tau) = 0$~~

~~$5\mathcal{E} = 6U_2(\tau) \Rightarrow U_2(\tau) = \frac{5\mathcal{E}}{6}$~~

→

Чистовик, лист №3

→ контур 1: $\varepsilon = U_1(\tau) + U_2(\tau)$

$\varepsilon = \frac{q_1(\tau)}{C_1} + \frac{q_2(\tau)}{C_2}$

$\varepsilon' = 0 \rightarrow \frac{I_1(\tau)}{C_1} + \frac{I_2(\tau)}{C_2} = 0$

9. ~~$I_1(\tau)$~~

$$\begin{cases} I_1(\tau) + I_0 = I^{\text{ко}} \\ \frac{I_1(\tau)}{C_1} + \frac{I_2(\tau)}{C_2} = 0 \\ I_2(\tau) = -I_0 \end{cases} \rightarrow \quad I_1(\tau) = I^{\text{ко}} - I_0 \rightarrow \quad \frac{I^{\text{ко}} - I_0}{5C} = + \frac{I_0}{C}$$

$\rightarrow + 5I_0 = I^{\text{ко}} - I_0 \rightarrow I^{\text{ко}} = 6I_0$ ~~(по направлению к конденсатору)~~

10. $I^{\text{ко}} = 6I_0$

Ответ: $\frac{5\varepsilon}{6R}$; $\frac{25C\varepsilon^2}{12}$; $6I_0$

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Чистовик, лист №5

Чистовик, лист №4

№5

Дано:

$F = 24$ см

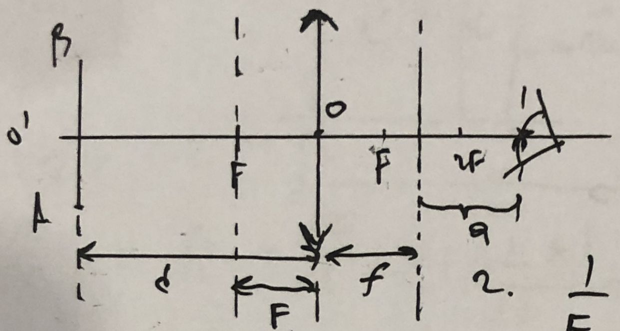
$H = 9$ см

$d = 36$ см

$a = 24$ см

1. x - ?
2. $D_м$ - ?
3. y - ?

Решение



1. $d > 2F$, линза ↕, AB - действ. источник => A'B' - изображение AB (действ., перевернутое, уменьшенное)

2. $\frac{1}{F} = \frac{1}{d} + \frac{1}{f} \rightarrow f = \frac{Fd}{d-F}$

3. $f = \frac{24 см \cdot 36 см}{36 см - 24 см} = 32$ см $\rightarrow F < f < 2F$

4. ($x = f + a \rightarrow x = 32 см + 24 см = 56 см$)

5. Г - увеличение AB (поперечное)

$Г = \frac{f}{d} = \frac{F}{d-F}$; $Г = \frac{32 см}{96 см} = \frac{1}{3} < 1$

6. т.к. $AB \perp OO'$, то $A'B' \perp OO' \rightarrow h' = ГH$; $h' = \frac{H}{3} = \frac{9 см}{3} = 3 см$ (h' - поперечный размер изображения)

7. Чтобы было видно весь циферблат; $h' = D_м$ ($D_м = 3$ см) - минимальный случай

8.

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Чистовик, лист №5

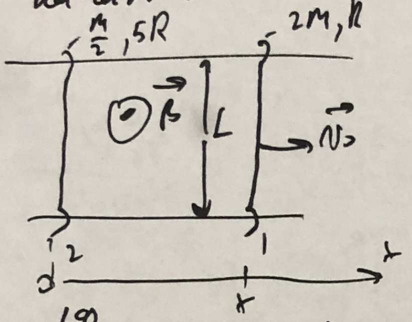
№4.

Дано: $B, L, 2m, \frac{m}{2}$, $R, 5R, v_0$

1. a_0 - ?
2. u - ? v - ?
3. Δ - ?

Решение:

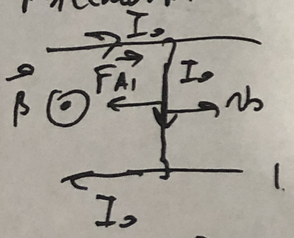
1. В начальный момент времени:



2. $\mathcal{E}_i = -\frac{d\Phi}{dt} = -\frac{d(BLx)}{dt} = -BLv_0 \Rightarrow |\mathcal{E}_i| = BLv_0$

3. $|\mathcal{E}_i| = I_0 R^*$, где $R^* = 6R \Rightarrow BLv_0 = 6I_0R \Rightarrow I_0 = \frac{BLv_0}{6R}$

4. Рассмотрим перемычку 1:



$x: -F_{A1} = 2ma_{0x}$

$F_{A1} = BLI_0 = \frac{B^2L^2v_0}{6R}$

$\Rightarrow a_0 = \left|-\frac{B^2L^2v_0}{12Rm}\right| = \frac{B^2L^2v_0}{12Rm}$

5. Пусть $\vec{R}$ - равнодействующая всех сил, действующих на систему перемычек, тогда $R_x = 0 \Rightarrow p_{сист\,x} = 0 = const$

6. Рассмотрим систему перемычек через продолжительный промежуток времени: пусть v_x - скорость 1-ой перемычки, u_x - скорость второй перемычки

ЗСИ: $x: 2mv_0 = 2mv_x + \frac{m}{2}u_x \Rightarrow 2mv_0 - 2mv_x = \frac{m}{2}u_x$

ЗСЭ: $\frac{2mv_0^2}{2} = \frac{2mv_x^2}{2} + \frac{mu_x^2}{2\cdot 2} \Rightarrow \frac{2m}{2}v_0^2 - \frac{2m}{2}v_x^2 = \frac{mu_x^2}{2\cdot 2}$

7. $\frac{2m}{2}(v_0 - v_x)(v_0 + v_x) = \frac{mu_x^2}{2\cdot 2}$

$2m(v_0 - v_x) = \frac{mu_x}{2}$

$(\div) \Rightarrow \frac{v_0 + v_x}{2} = \frac{mu_x^2 \cdot 2}{2\cdot 2 \cdot mu_x} = \frac{u_x}{2} \Rightarrow$

$\Rightarrow v_0 + v_x = u_x \Rightarrow v_x = u_x - v_0$

8. $2v_0 - 2(u_x - v_0) = \frac{u_x}{2} \Rightarrow 2v_0 - 2u_x + 2v_0 = \frac{u_x}{2} \Rightarrow 4v_0 = \frac{5}{2}u_x \Rightarrow u_x = \frac{8v_0}{5}$

$\longrightarrow$

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Чистовик, лист №6

9. $u_x = u = \frac{8v_0}{5} \Rightarrow v_x = \frac{8v_0}{5} - v_0 = \frac{3v_0}{5} = v$

10. $\left(u = \frac{8v_0}{5}\right)$; $\left(v = \frac{3v_0}{5}\right)$

11. $$\begin{cases} S_1 = \dfrac{v^2 - v_0^2}{-2a_0} \\ S_2 = \dfrac{u^2}{2a_0} \\ \Delta = |S_1 - S_2| \end{cases} \rightarrow \begin{cases} S_1 = \dfrac{\frac{9v_0^2}{25} - \frac{25}{25}v_0^2}{-2a_0} = \dfrac{\frac{16}{25}v_0^2}{2a_0} \\ S_2 = \dfrac{\frac{64}{25}v_0^2}{2a_0} \\ \Delta = |S_1 - S_2| \end{cases} \rightarrow$$

$$\rightarrow \begin{cases} S_1 = \dfrac{8v_0^2}{25a_0} \\ S_2 = \dfrac{32v_0^2}{25a_0} \\ \Delta = |S_1 - S_2| \end{cases} \rightarrow \Delta = \left|\frac{8v_0^2}{25a_0} - \frac{32v_0^2}{25a_0}\right| = \frac{24v_0^2}{25a_0} \rightarrow ~~\Delta = \frac{24v_0^2}{25}~~$$

$$\rightarrow \Delta = \frac{24v_0^2}{25} \cdot \frac{12Rm}{B^2L^2v_0} = \frac{288v_0Rm}{25B^2L^2}$$

Ответ: $a_0 = \frac{B^2L^2v_0}{12Rm}$; $v = \frac{3v_0}{5}$, $u = \frac{8v_0}{5}$; $\Delta = \frac{288v_0 \cdot Rm}{25B^2L^2}$

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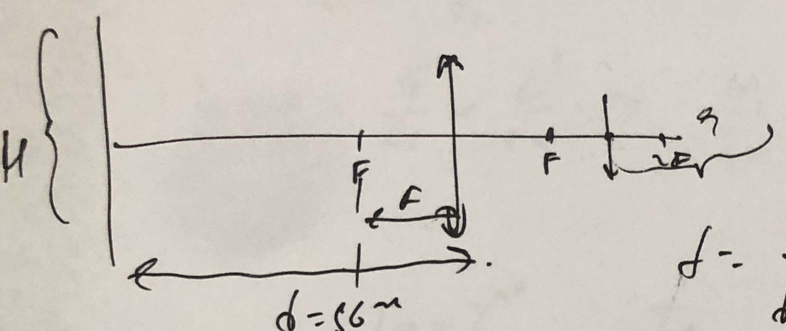
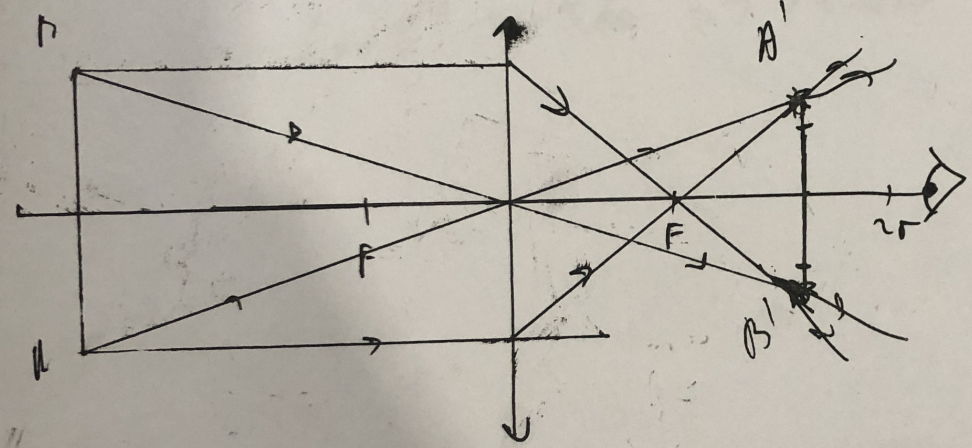
Механика



$$f = \frac{Fd}{d-F} = $$

$$f = \frac{24 \cdot 96}{96 - 24} = \frac{\quad}{72} = 32 \text{ см}$$



ΔS_1

$\Delta S_1 - \Delta S_2$

$$x_c = \frac{l_1 \cdot 2m + }{\quad} \cdot \frac{2}{5} \Rightarrow l_2 = \quad x_c = \frac{4}{5} l_1$$

$$4\Delta S_1 = -\Delta S_2$$

$$x_{01} = l_1 + \Delta S_1 \qquad 2\Delta S_1 + \frac{\Delta S_2}{2} = 0$$

$$x_{02} = \Delta S_2$$

$$x_c = \frac{2m \cdot l_1 + \Delta S_1 + \frac{m}{2} \Delta S_2}{\frac{5}{2} m} = \frac{4}{5} l_1$$

$$\frac{2 l_1 + 2\Delta S_1 + \frac{\Delta S_2}{2}}{\quad} = 2 l_1$$

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$$I_1 = I_0 + I^{\text{dt}}$$

$$q = \frac{q_1}{c_1} + \frac{q_2}{c_2} -$$

$$q' = 0 = \frac{q_1'}{c_1} + \frac{q_2'}{c_2} \Rightarrow \frac{I_1}{c_1} + \frac{I_2}{c_2} = 0$$

$$\frac{I_0 + I^{\text{dt}}}{c_1} = -\frac{I_0}{c_2}$$

$$\frac{I_0 + I^{\text{d}}}{5} = -I_0$$

$$I_0 + I^{\text{dt}} = -5 I_0 \Rightarrow I^{\text{dt}} = -6 I_0$$

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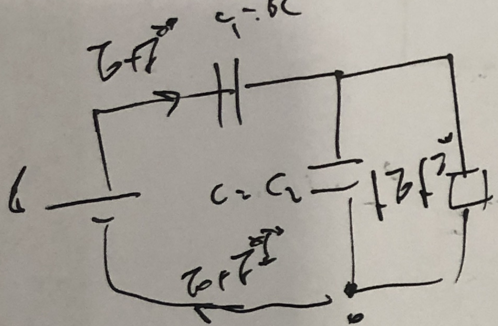
Черновик

$I^{**} = \frac{U_2(\tau)}{R}$

$\varepsilon = cU$

$I = cU'$



$I_0 +$

$U_1 = \varepsilon - I^{*}R$

$\varepsilon(I_0 + I^{**}) = P_{ист} = U_2(\tau) I_0 + I^{**2} R + U_1(\tau)(I_0 + I^{**})$

$\varepsilon(I_0 + I^{**}) = I^{**} R \cdot I_0 + I^{**2} R + (\varepsilon - I^{**} R)(I_0 + I^{**})$

$\varepsilon = U_1 + U_2$

$\varepsilon I_0 + \varepsilon I^{**} = I^{**} R (I_0 + I^{**}) + \varepsilon I_0 + \varepsilon I^{**} - I^{**} R I_0$

$I_0 = C_2 \cdot U_2' \Rightarrow U_2' = \frac{I_0}{C_2}$

$I_0 + I^{**} = C_1 U_1' \to U_1' = \frac{I_0 + I^{**}}{C_1}$

$\varepsilon = U_1 + U_2$

$0 = U_1' + U_2' \Rightarrow U_1' = -U_2'$

$\frac{I_0 + I^{**}}{5C_2} = -\frac{I_0}{C_2}$

$I_0 + I^{**} = -5I_0$

$I^{**} = -5I + I_0 = -4I$

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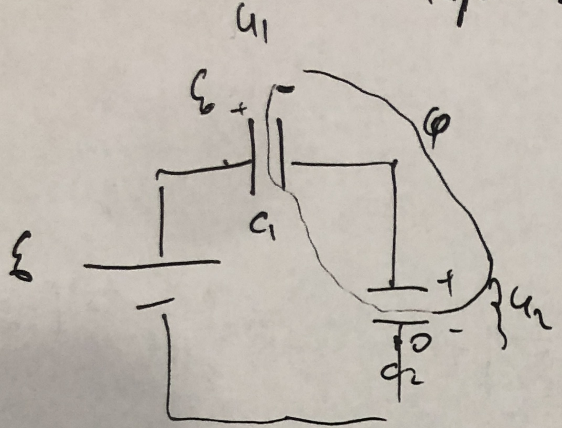
Чордик

$C_2 = C$

$C_1 = 5C$



$-C_1U_1 + C_2U_2 = 0$

$5CU_1 = CU_2 \Rightarrow$

$5U_1 = U_2$

~~$U_1 = \frac{\mathcal{E}-\varphi}{}$~~

$U_1 = \mathcal{E} - \varphi$

$U_2 = \varphi = 5U_1 \Rightarrow U_1 = \frac{\varphi}{5}$

$\frac{\varphi}{5} = \mathcal{E} - \varphi \Rightarrow$

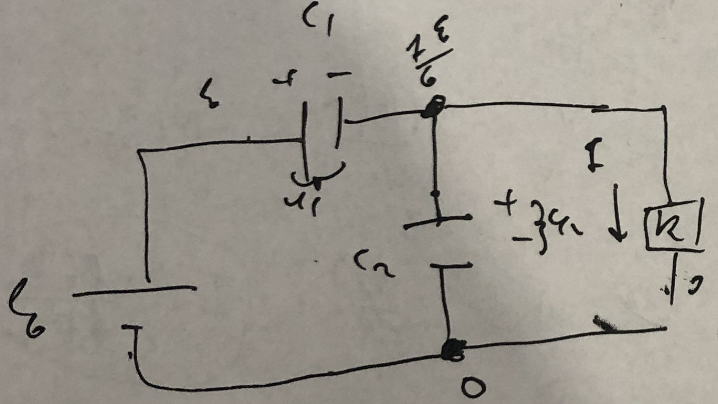
$\frac{6}{5}\varphi = \mathcal{E} \Rightarrow \varphi = \frac{5\mathcal{E}}{6}$

⇓

~~U_1~~ $U_2 = \frac{\mathcal{E}}{6}$

$U_1 = \frac{\mathcal{E}}{6}$

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



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

$W(0) = \frac{C_1U_1^2}{2} + \frac{C_2U_2^2}{2}$

$\mathcal{E} - \frac{\mathcal{E}}{6} = \frac{5\mathcal{E}}{6}$

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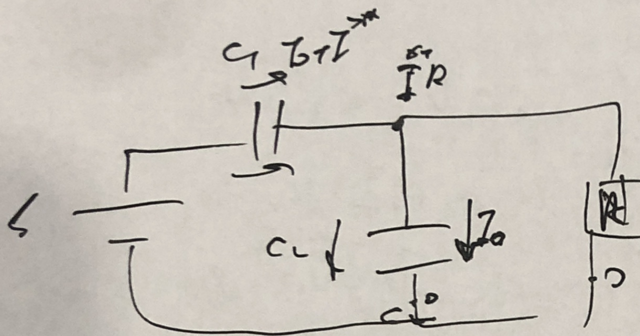
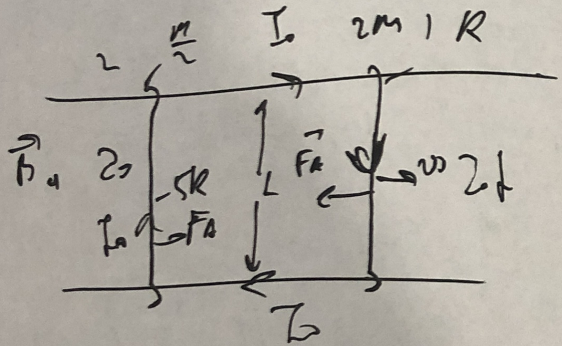
Мерфиц



$\mathcal{E}_i = BL\frac{dx}{dt} = I\cdot 6R$



$r' = \frac{5R}{6}$

$\mathcal{E}_i = -\frac{d\Phi}{dt} = -\frac{d(BL\,dx)}{dt} = -BLv_0 = I r'$

$I \cdot 6R$

$BLv_0 = \ldots \Rightarrow I_0 = \frac{BLv_0}{6R}$

$F_A = BI_0L = 2m a_0$

~~$a_0 = \frac{BI_0L}{2m} = \frac{BL}{2m}\cdot\frac{BLv_0}{6R} = \frac{B^2L^2v_0}{12mR}$~~

$a_0 = \frac{B^2L^2v_0}{12mR}$

$\frac{2mv_0^2}{2} = \frac{2mv^2}{2} + \frac{m}{2\cdot 2}u^2$

mv

(v_x)

(u_x)

$2mv_0 = 2mv_x + \frac{m}{2}u_x$

$2v_0 = 2v_x + \frac{u_x}{2}$

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