Часть 1

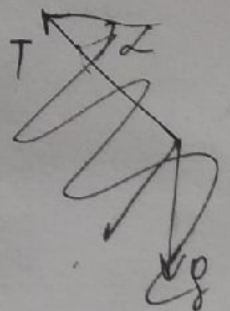
Олимпиада: **Физика, 11 класс (1 часть)**

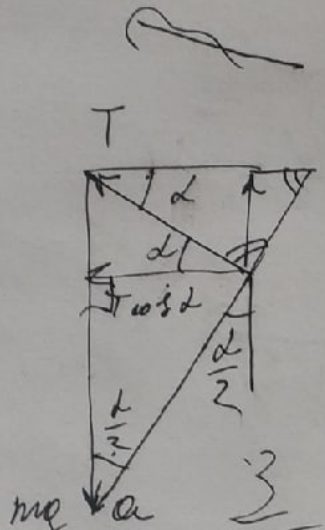
Шифр: **21201255**

ID профиля: **55972**

Вариант 4

$MA = T(1-\cos\alpha)$





$\frac{3}{5}$

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

$\frac{T\cos\alpha}{mg - T\sin\alpha} = \operatorname{tg}\frac{\alpha}{2}$

$\frac{T\cos\alpha}{mg - T\sin\alpha} = \frac{\sqrt{1-\cos^2\frac{\alpha}{2}}}{\cos\frac{\alpha}{2}}$

$\frac{34-25}{34}$

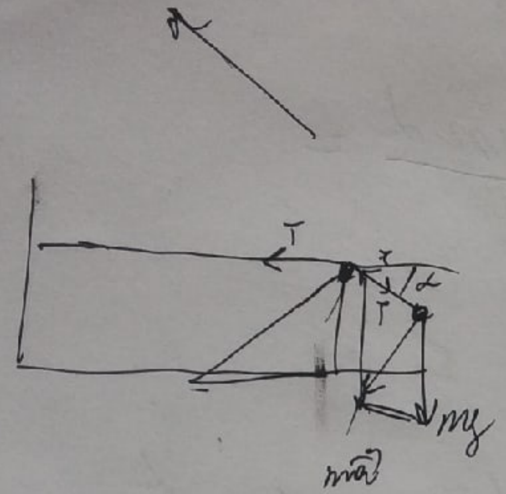
$\frac{\frac{9}{\sqrt{34}}}{5}$

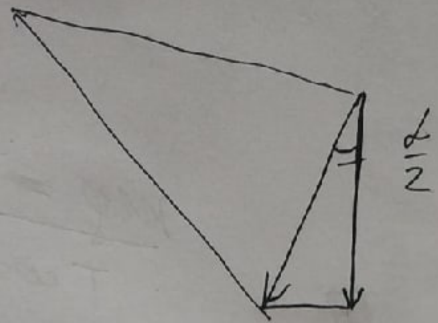
$\frac{9}{5}$

$\frac{34-25}{34}$

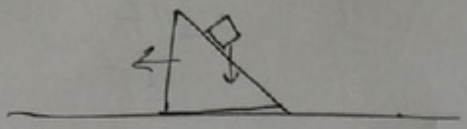
$T(\cos\alpha + \frac{3}{5}\sin\alpha) = \frac{3}{5}mg$

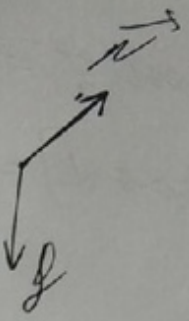
$T = \frac{1}{1}$



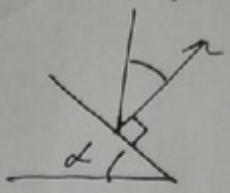


$V \cdot 2 \sin\frac{\alpha}{2} =$





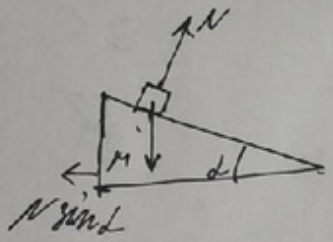
$$\begin{cases} m\vec{g} + \vec{N} = \vec{a}m \\ AM = N\sin\alpha \\ ma_2 = N\sin\alpha \end{cases}$$

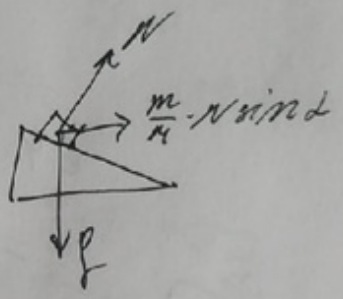


$$g - N\cos\alpha = ma_6$$

$$ma_2 = N\sin\alpha$$

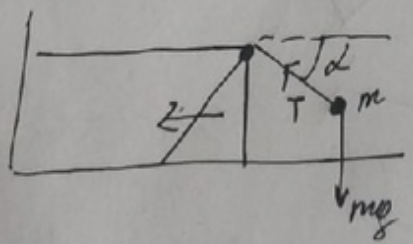
$$ma_6 = g - N\cos\alpha$$

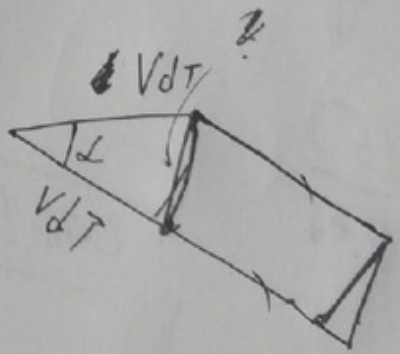


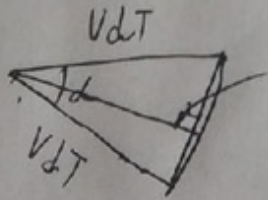


$$AM = N\sin\alpha$$

$$A = \qquad T(1-\cos\alpha) = AM$$







$$V2\sin\left(\frac{\alpha}{2}\right) = v$$

$$2\sin\left(\frac{\alpha}{2}\right)A = a$$

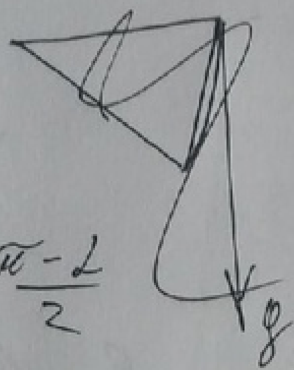
$A \cdot 2 \sin \frac{\alpha}{2} = a$

$\frac{I}{M}(1 - \cos \alpha) = A$

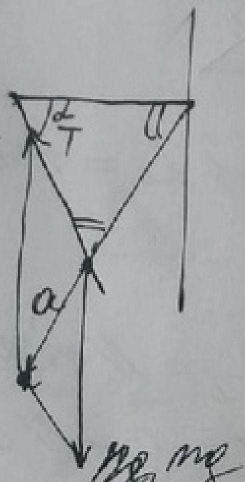
$8 + 17$

$\frac{25}{34}$

$\frac{5}{\sqrt{34}}$



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



$\frac{15}{17}$

$\frac{8}{17}$

~~289+64~~

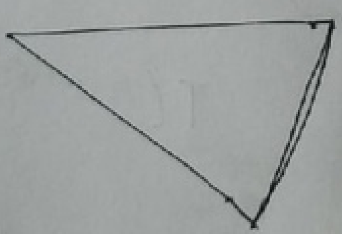
$\frac{64}{289}$

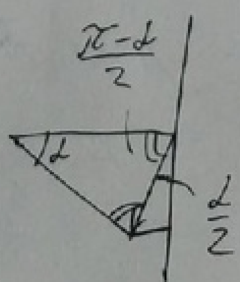
$\frac{15 + 17}{34}$

225

$64 + 289 =$
$= 353$

$\sqrt{\frac{353}{578}}$





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

$\frac{\pi}{2} - \frac{\pi}{2} + \frac{\alpha}{2}$

$\frac{\alpha}{2}$

$\frac{\alpha}{2}$

$\frac{353}{578}$

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

$\sqrt{\frac{\cos(2\alpha) + 1}{2}}$

$\sin(2\alpha) = 2\cos\alpha \cdot \sin\alpha$

~~$\sin(\alpha)$~~ $= 2\sqrt{1 - \sin}$

MA = I

21201255 (U55972 M1265679)

$$\frac{dA}{dt} = \left(\frac{9}{5}\frac{T}{T_0} - \frac{3}{2}\right) dT$$

$$\frac{15}{12} - \frac{9}{10}$$

$$\frac{3}{5} \quad \frac{63}{80}$$

$$\frac{27+36}{20 \cdot 2} = \frac{63}{40}$$

$$A = \frac{9}{10} \cdot \frac{T_1^2 - T_0^2}{T_0} - \frac{3}{2}(T_1 - T_0) =$$

$$dQ = C\,dT$$

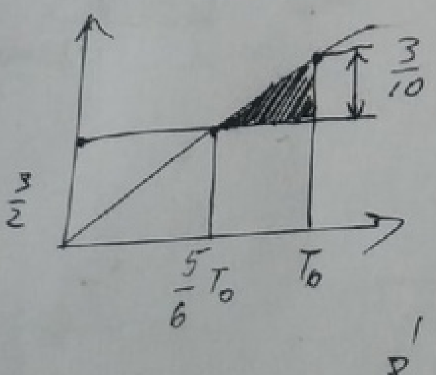
$$= \frac{9}{10} \cdot \frac{T_1^3}{T_0} - \frac{3}{2} T_1 + \frac{3}{5} T_0$$

$$x_6 = \frac{3}{24 \cdot \frac{3}{5}} = \frac{5}{6}$$

$$\frac{25}{36} \cdot \frac{9}{10} = \frac{5}{8}$$

$$-\frac{5}{8} + \frac{3}{5} = \frac{25+24}{40} = \frac{1}{40}$$

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



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

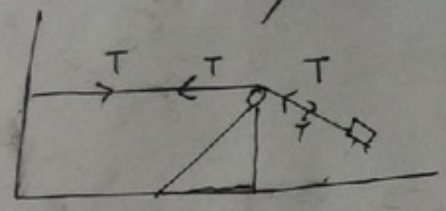
$$\frac{18-15}{10} = \frac{3}{10}$$

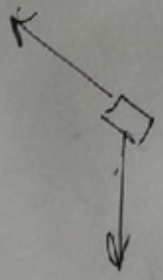
$$\frac{3}{10} \cdot \frac{1}{6} \cdot \frac{1}{2}$$

$$\frac{1}{120}$$

$$\frac{24}{5}$$

мировым



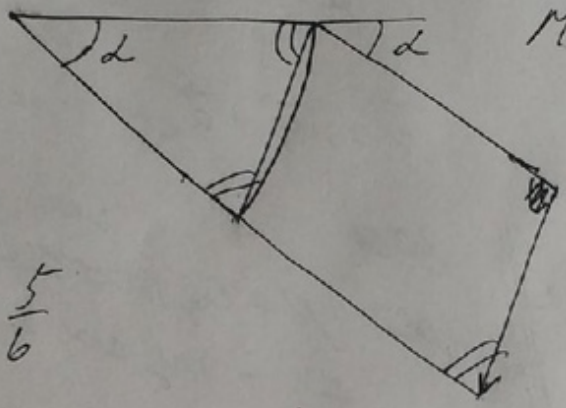


$M a_x = (1 - \cos\alpha) T$

$ma =$

$$\frac{M v_x^2}{2} + \frac{m v^2}{2} + mgH = \text{const}$$

$$M v_x \cdot a_x + m v \cdot a + mgH = 0$$



$\frac{5}{6}$

$$x_B = -\frac{b}{2a}$$

$$\frac{3}{10} \cdot \frac{25}{36} - \frac{3}{2} \cdot \frac{5}{6} + \frac{6}{10} \cdot \frac{3}{5}$$

$$C = C_V + \frac{dA}{dT} = \frac{3}{2}R + \frac{dA}{dT} = \frac{8}{5}R \frac{T}{T_0} \cdot \frac{25}{40} - \frac{50}{40} + \frac{24}{40} =$$

$$\left(\frac{8}{10} \cdot \frac{T_1^2}{T_0} - \frac{3}{2}T_1 + \frac{6}{10}T_0\right)R \qquad \frac{dA}{dT} = \left(\frac{8}{5}\frac{T}{T_0} - \frac{3}{2}\right)R =$$

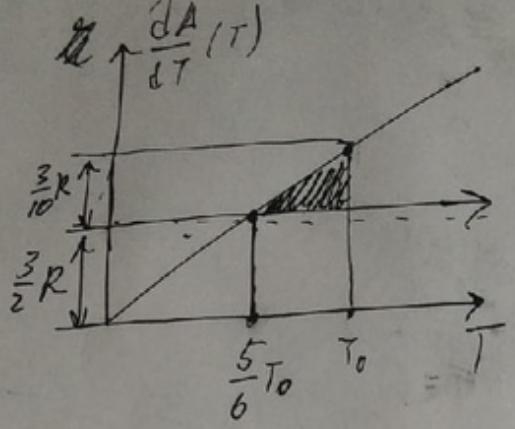
$$\frac{\frac{3}{2}}{2 \cdot \frac{8}{10}} = \frac{10}{12} = \frac{5}{6}$$

$$dA = \int_{T_0}^{T_1} \left(\frac{8}{5}\frac{T}{T_0} - \frac{3}{2}\right)R \, dT =$$

$T_1 = T_0 \Rightarrow$

$$= \left(\frac{8}{10}\frac{T_1^2 - T_0^2}{T_0} - \frac{3}{2}(T_1 - T_0)\right)R =$$

$$= \left(\frac{8}{10} \cdot \frac{T_1^2}{T_0} - \frac{3}{2}T_1 + \frac{6}{10}T_0\right)R$$



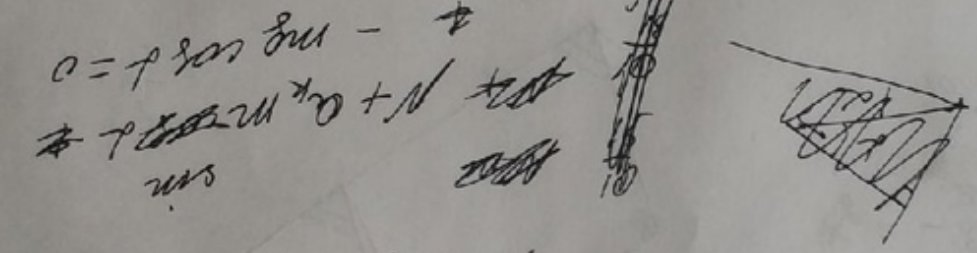
$$\frac{3}{10}R \cdot \frac{1}{6}T_0 \cdot \frac{1}{2} = \frac{3}{120}R$$

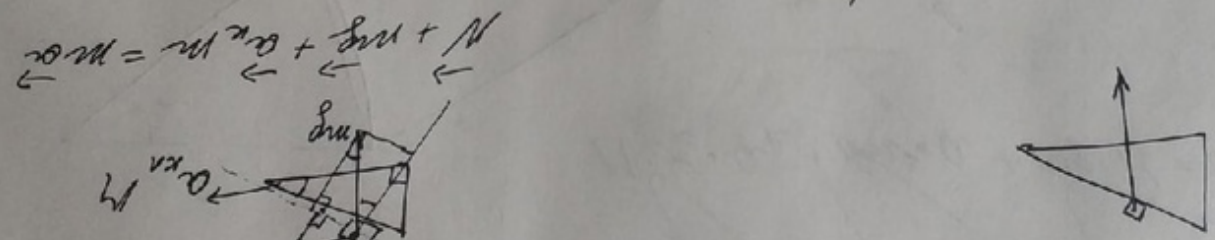
$$\frac{dA}{dT} = 0 \Rightarrow \frac{3}{5}\frac{T}{T_0} = \frac{3}{2} \Rightarrow T = \frac{5}{6}T_0$$

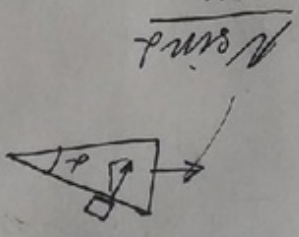
$$C(T) = \frac{3}{2}R\frac{T}{T_0}$$

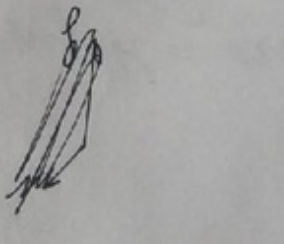
$$C(T) = \frac{3}{2}R + \frac{dA}{dT}(T)$$

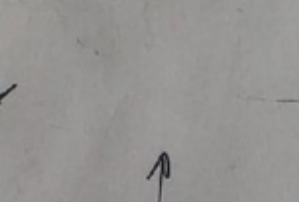
$$\frac{18}{10} - \frac{15}{10} = \frac{3}{10}$$

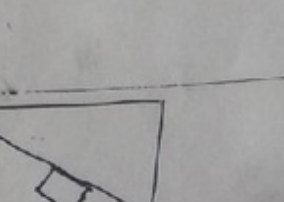












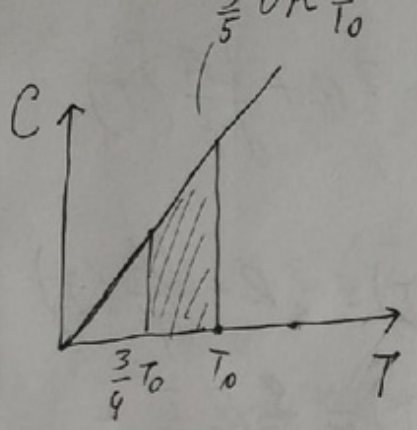
1 м.т.

$$dQ = C(T)\,dT$$

$$Q = \int_{T_0}^{\frac{3}{4}T_0} \frac{9}{5} R \cdot \frac{T}{T_0}\,dT = \frac{9}{10} R \cdot \frac{\frac{9}{16}T_0^2 - T_0^2}{T_0} =$$

$$= \frac{9}{10} \cdot \frac{-7}{16} \cdot R T_0 =$$

$$= -\frac{63}{160} R T_0$$



$$C = C_V + \frac{dA}{dT}$$

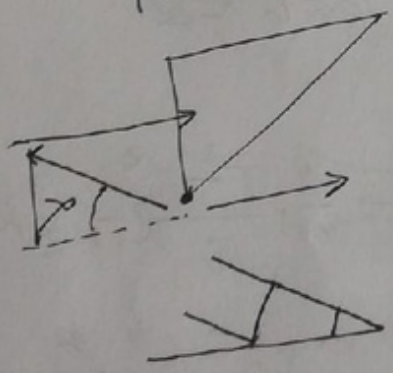
$$\frac{1}{4} \cdot \frac{9}{5} R \cdot \frac{\left(T_0 + \frac{3}{4}T_0\right)}{2} = \frac{9}{10} \cdot \frac{7}{16} T_0$$

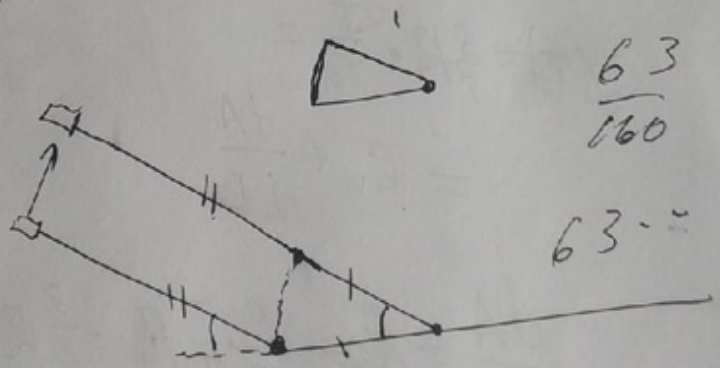
$$\frac{9}{10} \cdot \frac{25}{36} - \frac{3}{2} \cdot \frac{5}{6} + \frac{6}{10} =$$

$$= \frac{5}{8} - \frac{5}{4} + \frac{3}{5}$$

18-15-
10

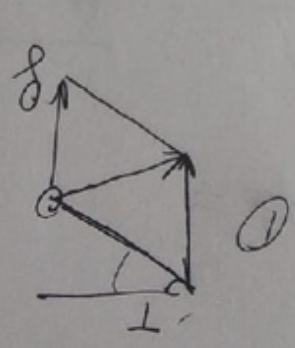
$\frac{3}{10}$ R

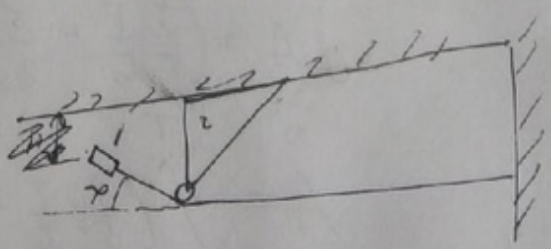


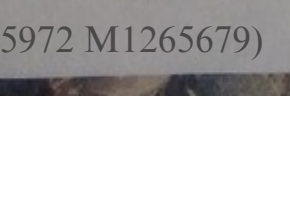


$\frac{63}{160}$

63·







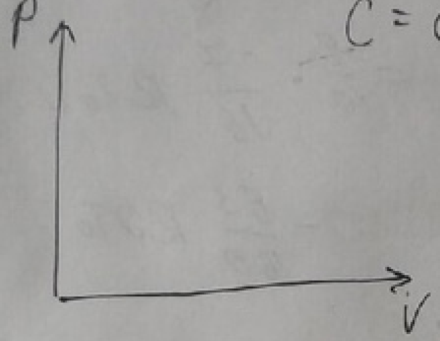
21201255 (U55972 M1265679)

Черновик

$C(T) = \frac{9}{5} R \cdot \frac{T}{T_0}$ $\quad C = C_v + \frac{dA}{dT}$

T_0

$C = C_v + \frac{dA}{dT}$



$C = \frac{3}{2} R + \frac{dA}{dT}(T)$

$\frac{9}{5} R \cdot \frac{T}{T_0}$ $\quad dQ = dU + dA$ $\quad C(T) = \frac{3}{2} R + \frac{dA}{dT}(T)$

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

~~$\frac{3}{2} R + \frac{dA}{dT}(T)$~~ $\quad C = \frac{dQ}{dT}$

$\frac{dA}{dT} = \left(\frac{3}{2} - \frac{9}{5}\frac{T}{T_0}\right) R$

$C = C_v + \frac{dA}{dT}$

~~$-\frac{15-18}{10} \frac{T}{T_0} R$~~

~~$dA = \frac{3}{10} \frac{T}{T_0} R\, dT$~~

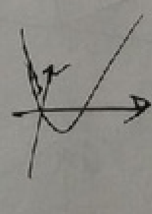
$C(T) = \frac{9}{5} R \cdot \frac{T}{T_0} =$

$= C_v + \frac{dA}{dT}$

$= \frac{9}{10} \cdot \frac{T^2 - T_0^2}{T_0} R - \frac{3}{2} R (T - T_0)$

$\frac{dA}{dT} = \frac{9}{5} \cdot \frac{T}{T_0} R - \frac{3}{2} R$

$dA = \left(\frac{9}{5}\frac{T}{T_0} - \frac{3}{2}\right) R\, dT$



$A = \int_{T_0}^{T} \left(\frac{9}{5} \cdot \frac{T}{T_0} - \frac{3}{2}\right) R\, dT =$

Чистовик

$$\frac{dA}{dT}(T_x) = 0$$

$$\Downarrow$$

$$T_x = \frac{5}{6} T_0$$

$$A_{min} = -\left(T_0 - \frac{5}{6} T_0\right) \cdot \frac{\frac{3}{10} \nu R + 0}{2} =$$

$$= -\frac{1}{40} \nu R T_0$$

Чистовик

№ 2

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

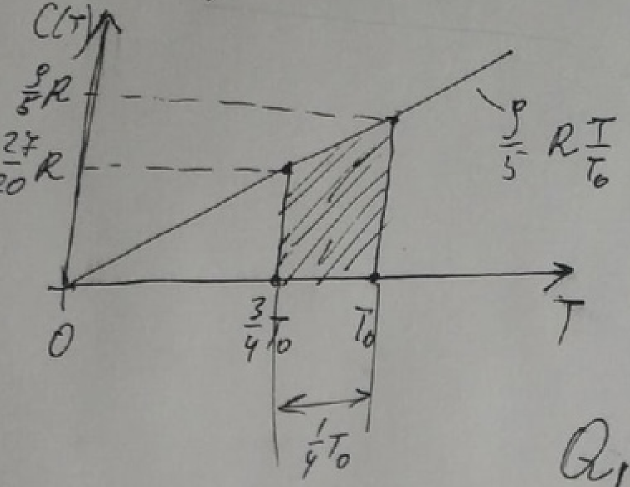
ν; T_0;

1) Q_1 - ?

2) $|A_{min}|$ - ?

3) A_{min} - ?

1) изобразим $C(T)$:



т.к. $C = \frac{dQ}{dT}$

$dQ = C(T)\,dT$

$\Downarrow$

$\frac{Q_1}{\nu}$ равно площади заштр. обл. на рисунке

$$Q_1 = \nu \cdot \frac{1}{4} T_0 \cdot \frac{\frac{27}{20} R + \frac{9}{5} R}{2} =$$

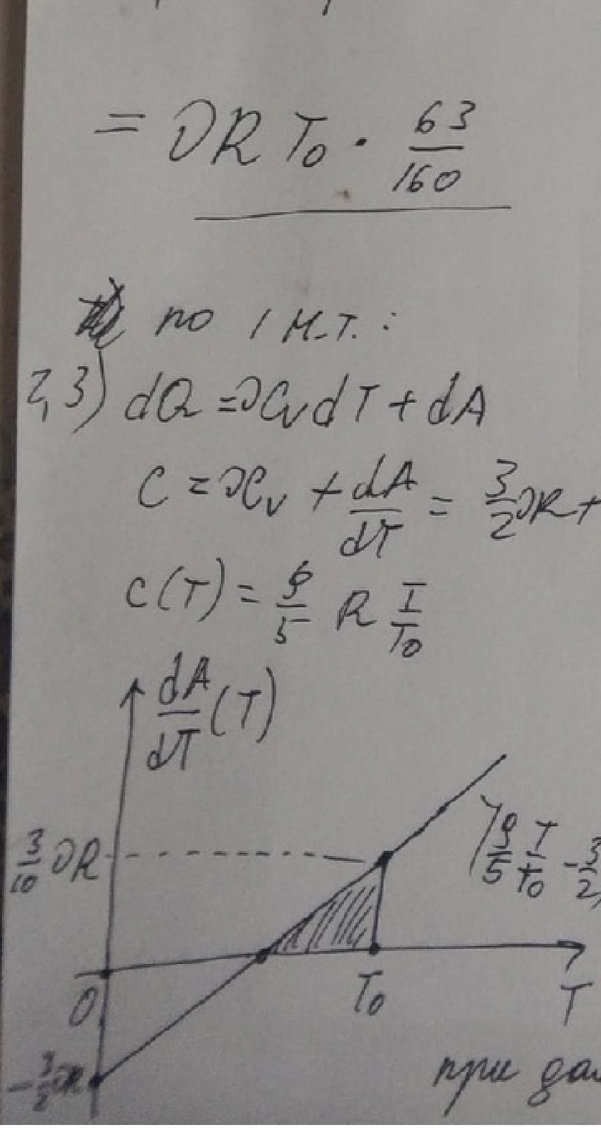
$$= \nu R T_0 \cdot \frac{63}{160}$$

по I н.т.:

2, 3) $dQ = \nu C_V dT + dA$

$C = \nu C_V + \frac{dA}{dT} = \frac{3}{2} \nu R + \frac{dA}{dT} \Rightarrow \frac{dA}{dT} = \left(\frac{9}{5} \frac{T}{T_0} - \frac{3}{2}\right) \nu R$

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



$\left(\frac{9}{5} \frac{T}{T_0} - \frac{3}{2}\right) \nu R$

при охлаждении на dT газ будет совершать работу $\frac{dA}{dT}(T) \cdot dT$, где $dT < 0 \Rightarrow A_{min} =$ площади заштр. ч., а при дальнейшем охлаждении газ начнёт совершать ту работу, т.к. $\frac{dA}{dT}(T) < 0$

Чистовик

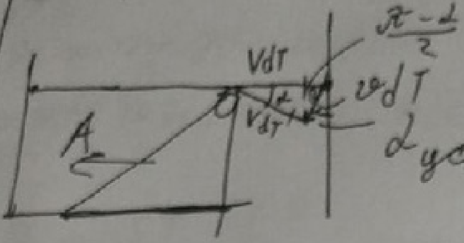
№ 1

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

A, g

1) $\alpha_{уск}$ – ?
2) A – ?
3) $\frac{m}{M}$ – ?
4) T – ?

1) Из кинематической связи:



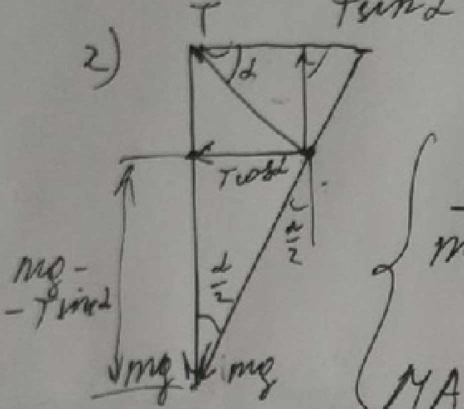
$\alpha_{уск} = \frac{\pi}{2} - \frac{\pi - \alpha}{2} = \frac{\alpha}{2}$

$\cos(\alpha) = 2\cos^2\left(\frac{\alpha}{2}\right) - 1$

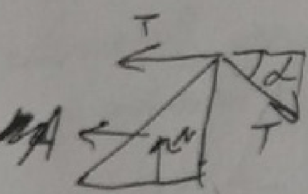
$\cos\left(\frac{\alpha}{2}\right) = \sqrt{\frac{\cos\alpha + 1}{2}} =$

$= \frac{5}{\sqrt{34}}$

2)



$$\begin{cases} \frac{T\cos\alpha}{mg - T\sin\alpha} = \frac{\sqrt{1-\cos^2\frac{\alpha}{2}}}{\cos\frac{\alpha}{2}} = \frac{3}{5} \\ MA = T(1-\cos\alpha) \end{cases}$$



$T = \frac{\frac{3}{5}mg}{\frac{8}{17} + \frac{3}{5}\cdot\frac{15}{17}} = \frac{3}{5}mg$

$A = \frac{\frac{3}{5}mg}{M}\cdot\frac{9}{17} = \frac{m}{M}\cdot\frac{27}{105}g$

Часть 2

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

Шифр: **21201255**

ID профиля: **55972**

Вариант 4

Мистовая

№ 3

$C_2 = C$

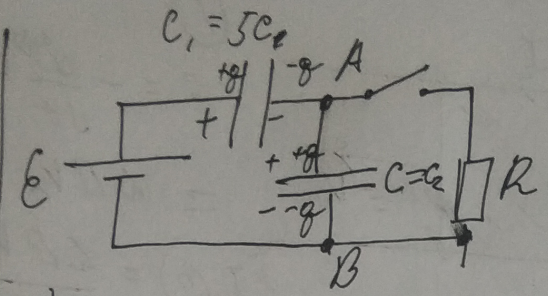
$C_1 = 5C$

1) $I_R(0) - ?$

2) $Q - ?$

3) $I_{C2} = I_0$

$I_R - ?$



1) сразу после замыкания:

$U_R = U_{C2} = \frac{5}{6}\mathcal{E}$

$I_R(0) = \frac{5\mathcal{E}}{6R}$

$q_{C_1} = q_{C_2}$

$U = \frac{q}{C}$

$\frac{U_1}{U_2} = \frac{1}{5}$

$U_1 = \frac{1}{6}\mathcal{E}$

$U_2 = \frac{5}{6}\mathcal{E}$, до замыкания ключа

после размыкания:

$I_R = \dot{q}_1 - \dot{q}_2$, $U_R = U_{C2}$

$P = U_R I_R$, на ост. эл-ах тепло не выд-ся.

$dQ = U_{C2} \cdot I_R dt =$

$= U_{C2} \cdot (dq_1 - dq_2) =$

$= \frac{q_2}{C} \cdot (-6\,dq_2)$

$Q = \int_{\frac{5}{6}\mathcal{E}C}^{0} -\frac{6 q_2 dq_2}{C}$

$= \frac{25}{12}\mathcal{E}^2 C$

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

$dq_1 = -5\,dq_2$

$\frac{dq_1}{C_1} + \frac{dq_2}{C_2} = 0$

$q_1(0) = q_2(0) = \frac{5}{6}\mathcal{E}C$

$q_1(\infty) = 5\mathcal{E}C$

$q_2(\infty) = 0$

т.к. на резисторе ток течь не будет $\Rightarrow U_{C2} = 0$, $U_{C1} = \mathcal{E}$

3) $I_{C2} = -I_0$

$\frac{dq_1}{dt} = -\frac{C_1}{C_2} \cdot \frac{dq_2}{dt} = 5I_0$

$I_R = \dot{q}_1 - \dot{q}_2 = 6I_0$

Чистовик

№4

$B; l$

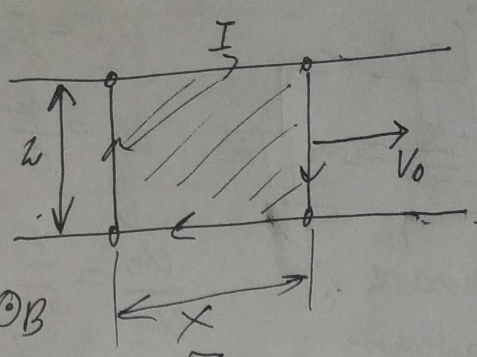
1: $2m; R; V_0$

2: $\frac{m}{2}; 5R$

1) $a_1(0) - ?$

2) $V_{1;2}(\infty) - ?$

3) $\Delta x(\infty) - ?$



① $\mathcal{E} = -\frac{d\Phi}{dt} = lBV_0$

$I_1(0) = \frac{lBV_0}{6R}$

$F_A = IlB = \frac{l^2B^2V_0}{6R}$, напр. против ск.-ти

$a_1(0) = \frac{F_A}{2m} = \frac{l^2B^2V_0}{12mR}$

② $\mathcal{E} = -\frac{d\Phi}{dt} = lB(V_1 - V_2)$

$I = \frac{lB}{6R}(V_1 - V_2)$, $F_{A\,1;2} = \frac{lB}{6R}(V_1 - V_2)$, по напр. в разные стороны

т.к. сила Ампера действует, пока $V_1 \neq V_2$, $V_1(\infty) = V_2(\infty)$

$a_1 = -\frac{1}{12} \cdot \frac{l^2B^2}{mR}(V_1 - V_2)$

$a_2 = \frac{1}{3} \cdot \frac{l^2B^2}{mR}(V_1 - V_2)$, т.е. $dV_1 = -4dV_2$

$\Delta V_1 = -4\Delta V_2$

$V_1(0) = V_0$

$V_2(0) = 0$

$V_1(\infty) = V_1(0) + \Delta V_1 = V_2(\infty)$

$V_1 = V_2 = \frac{4}{5}V_0$

$\Delta V_1 = -\frac{4}{5}V_0$

$\Delta V_2 = \frac{1}{5}V_0$

③ из пр. П.

$a_{отн} = a_1 - a_2 = -\frac{5}{12} \cdot \frac{l^2B^2}{mR} \cdot V_{отн}$

k

$a = -kV$

$\frac{dV}{dt} = -k\frac{dx}{dt}$

$\Delta V = -k\Delta x$

$\begin{cases} V_{отн}(0) = V_0 \\ V_{отн}(\infty) = 0 \end{cases}$

$\Delta V = V_0$

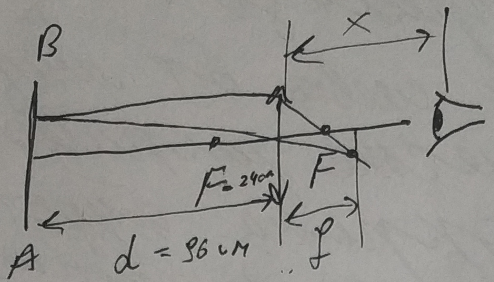
$\Delta x = \frac{V_0}{k} = \frac{V_0 \cdot mR \cdot 12}{l^2B^2 \cdot 5}$

Чистовик

№5

$F = 24$ см
$h = 9$ см
$d = 96$ см
2 чем-ака-ия

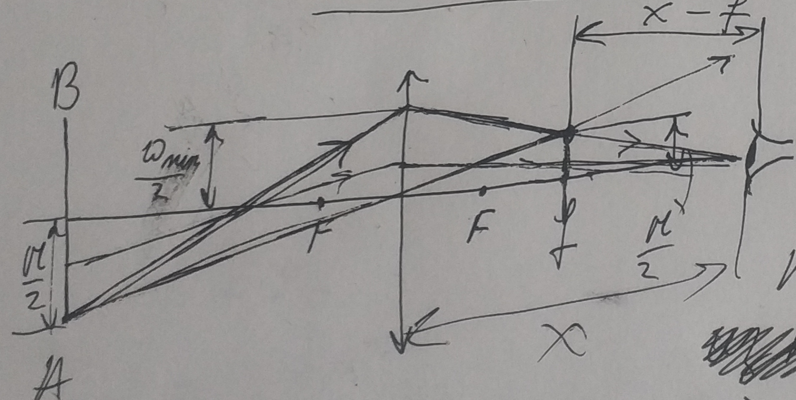
1) x - ?
2) D_{min} - ?
3)

1) 

$$f = \frac{Fd}{d-F} = 32 \text{ см}$$

т.к. глаз рассматривает это изображение на р-ии 24 см от себя, он находится на р-ии

$x = f + 24$ см $= 56$ см от линзы

2) 

чтобы увидеть весь циферблот необходимо чтобы для каждой его точки существовал луч, проходящий через линзу и попадающий в глаз.

для крайней точки A:

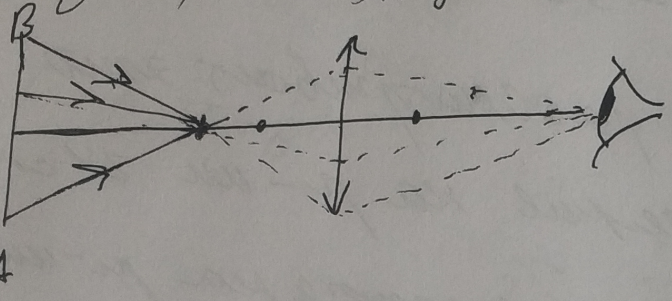
$$\frac{D_{min}}{2x} = \frac{h'}{2(x-f)}, \quad \frac{h}{d} = \frac{h'}{f}, \quad h' = \frac{h \cdot F}{d-F}$$

$$D_{min} = \frac{x}{x-f} \cdot \frac{F}{d-F} \cdot h = 7 \text{ см}$$

чистовик

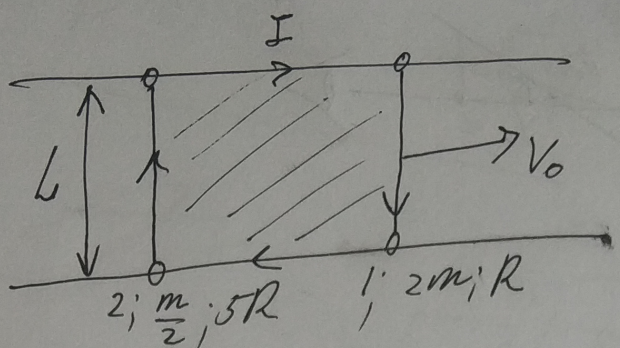
③ на рис. пред. п. видно, что все лучи, пар. в глаз проходят через точку на 42 гл. отт. оси слева от линзы.

Если в этом месте разположить экран, изображение экрана будет на месте глаза, тк. все лучи которые прошли бы через эту точку, попали бы в глаз.



$$f_1 = \frac{F \cdot x}{x - F} =$$

$$= 42$$



$\odot B$

$\varepsilon = \frac{-d\Phi}{dt}$

$F = q \cdot \vec{v} \times \vec{B}$

$\omega B \dot{x}$

$Q = -kV$

$\frac{dQ}{dt} = -k\frac{dx}{dt}$

$\Delta V = -k\Delta x$

I_0

$V_0 = \Delta x$

$Q_{TH} = Q_1 - Q_2 = -\frac{5}{12}\omega B^2 \cdot \frac{m}{R} \cdot V_{0TH}$

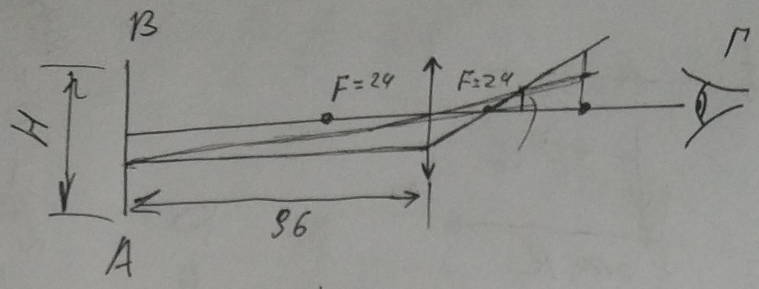
$-6I_0$

$\frac{dQ_1}{dt} = -\frac{dQ_2}{dt} = -5I_0$

$I_2 = I_1 - I_0$

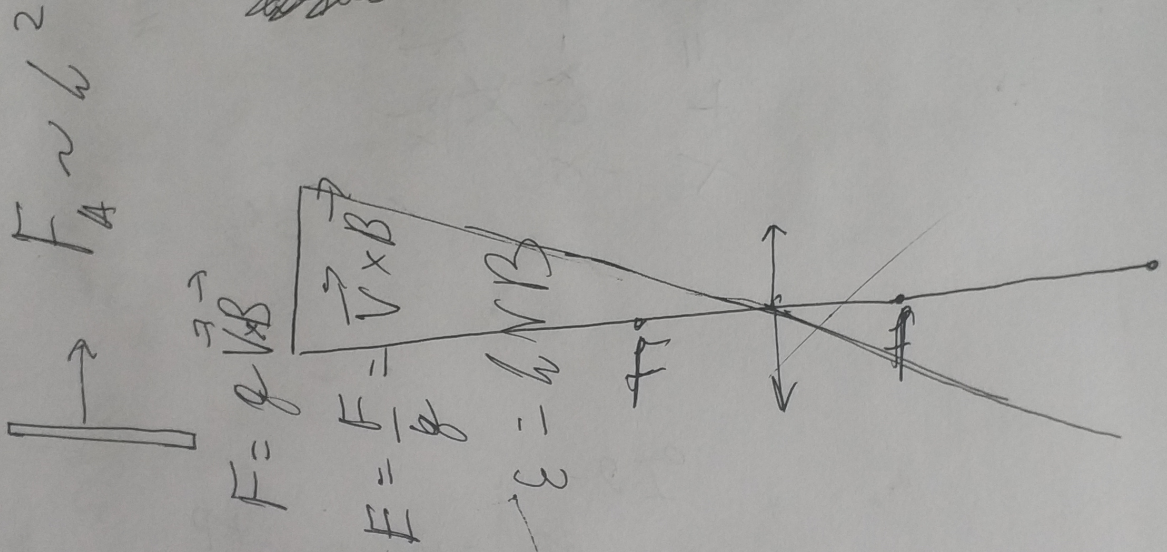
$I_2 R = \frac{\Phi_2}{C}$

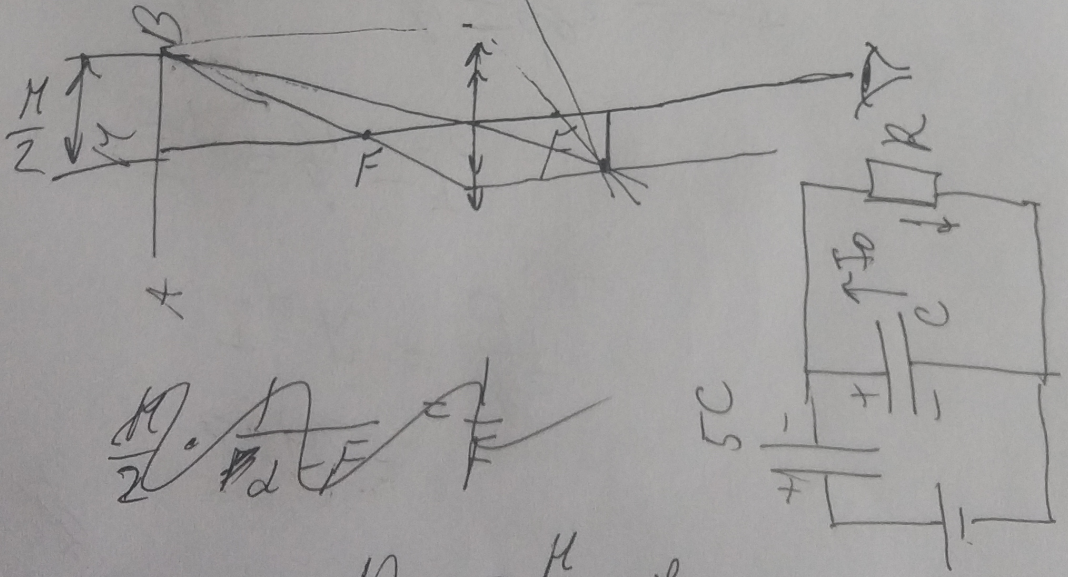
21201255 (U55972 M1265680)



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

$$f=\frac{Fd}{d-F}=\frac{96\cdot 32}{64}=32\ \text{см}$$



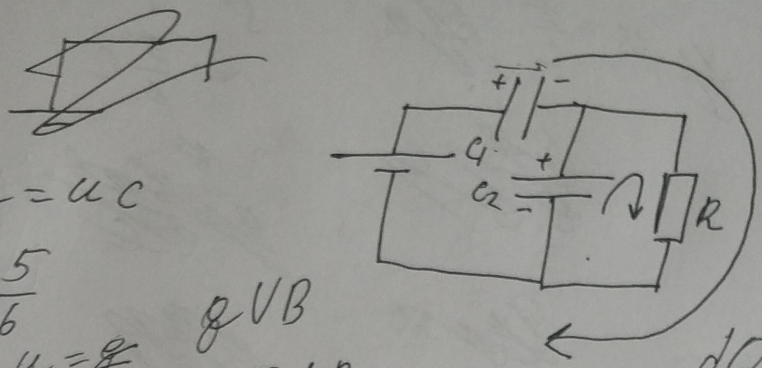


$$\frac{H}{2}\cdot\frac{1}{d}=\frac{1}{F}$$

$$W_{min}=\frac{H}{2d}\cdot f$$

$q_1(0) = q_2(0) = \frac{5}{6}\frac{\varepsilon}{C}$ → $q_1(\infty) = \frac{\varepsilon}{5C}$

$q_2(\infty) = 0$



$q = uC$

$\frac{5}{6}$

$u = \frac{q}{C}$

$q = uC$

qVB

IlB

$I = \dot{q}_1 - \dot{q}_2$

$dQ = RI^2 dt$

$\frac{5}{6}\varepsilon C$

$u_2 = \frac{q_2}{C}$

$dQ = u_2 \cdot I\,dt =$

$= u_2(dq_1 - dq_2) =$

$\frac{q_2}{C}(dq_1 - dq_2)$

dq_1

$-\frac{5}{6}$

$\mu = \frac{q}{C}$

$\frac{5}{6}$

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

$V_0 + \Delta V_1 = 4\Delta V_1$

$\frac{25}{6}\varepsilon^2 C^2$

$\Delta V_1 =$

$\frac{\Delta q_1}{5C} + \frac{\Delta q_2}{C} = 0$

$\frac{25}{12}\varepsilon^2 C$

$\Delta V_1 =$

$V_1(0) = V_0$

$V_2(0) = 0$

$\frac{4}{5}$

$dq_1 = -5\,dq_2$

$V_1 = V_2$

$-dV_2 = 4\,dV_1$

$dV_1 = \frac{1}{12}\cdot\frac{l^2B^2}{mR}\cdot(V_1 - V_2)\,dt$

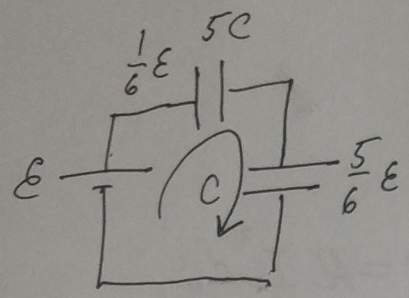
$dV_1 = \frac{dV_2}{4}$

$dV_2 = 4\,dV_1$

Черновик

$u = \frac{q}{C}$

$C \frac{1}{\frac{1}{5} + \frac{1}{1}} = \frac{5}{6} C$



$\frac{5}{6}\frac{\varepsilon}{C}$

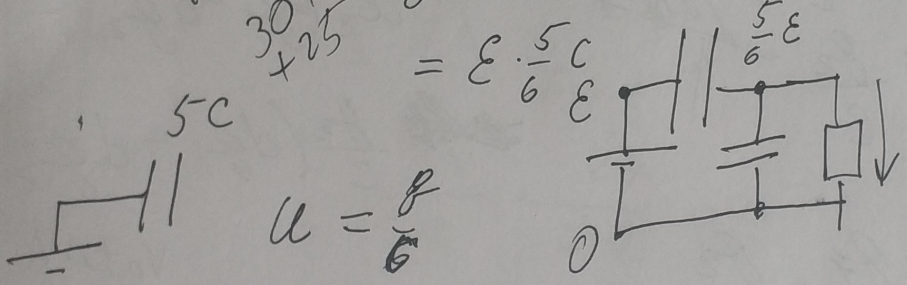
q

120

$30+30+25+35$

$q = uC =$

$= \varepsilon \cdot \frac{5}{6} C$

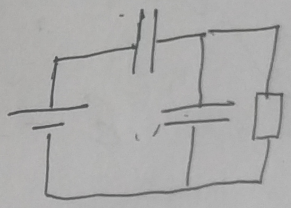


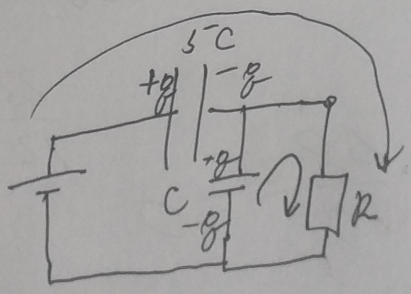
$u = \frac{q}{6}$

$\frac{1}{5}$

$q_1(0) = q_2(0) =$

$= \frac{5}{6} \varepsilon C$

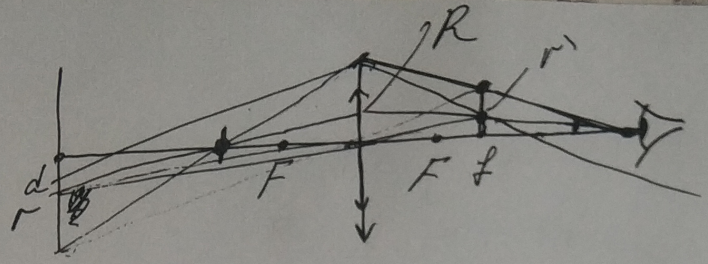




$\varepsilon = u_1 + IR$

$\varepsilon = u_1 + u_2$

$u_2 = IR$



$$\frac{r}{d} = \frac{r'}{f} \qquad r' = \frac{Fr}{d-F}$$

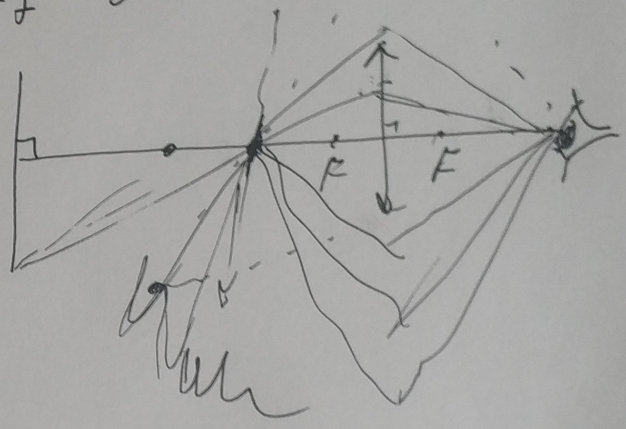
$$\frac{r'}{X-f} = \frac{R}{X}$$

$$R = \frac{X}{X-f} \cdot \frac{Fr}{d-F}$$

8

$$\frac{32}{32-24} \cdot \frac{1}{3} \cdot \frac{24}{8} \cdot \frac{3}{4}$$

$$\frac{56}{24} \cdot \frac{24}{32} \cdot \frac{4}{4}$$



$$f = \frac{dF}{d-F} = \frac{56 \cdot 24}{32} = 42$$

$$\frac{56 \cdot 24}{32}$$