

Часть 1

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

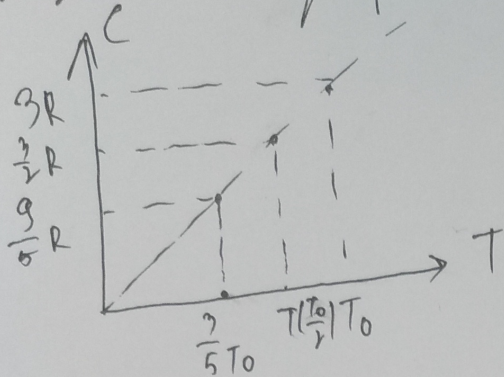
Шифр: **21201700**

ID профиля: **166969**

Вариант 3

Меморан ①

№ 2 P-и процесс (1)



$$1) Q_{1 \text{ emq}} = + S_{\text{cp}} \cdot \nu = \nu \cdot \frac{2}{5} T_0 \cdot \frac{1}{2} \cdot (3R + \frac{9}{5}R) = \frac{24}{25} \nu R T_0$$

$$2) \text{ нпу } A = A_{\text{min}}; A' = 0 \Rightarrow \delta Q = dU + \delta A - \text{нелба нарато}$$

$$\delta A = p dV - \text{манна парадом}$$

$$\text{м.к. } A' = 0 \Rightarrow p dV = 0$$

$$\Rightarrow \delta Q = dU$$

$$\delta Q = \nu \cdot C \cdot dT - \text{но эмпреженутол}$$

$$\Rightarrow \nu \cdot 3R \frac{T}{T_0} dT = \frac{3}{2} \nu R dT$$

$$\Rightarrow 3\nu R dT \left(\frac{T}{T_0} - \frac{1}{2} \right) = 0$$

$$\Rightarrow \frac{T}{T_0} = \frac{1}{2} \Rightarrow T = \frac{T_0}{2}$$

$$3) Q = \Delta U + A$$

$$Q_2 (Q(A_{\text{min}})) = \Delta U_2 + A_{\text{min}}$$

$$Q_2 = -S_{\text{cp}} \cdot \nu = -\nu \cdot \frac{T_0}{2} \cdot \frac{1}{2} (3R + \frac{3}{2}R) = -\frac{9}{8} \nu R T_0$$

$$\Delta U_2 = \frac{3}{2} \nu R \left(-\frac{T_0}{2} \right) = -\frac{6}{8} \nu R T_0$$

$$\Rightarrow -\frac{9}{8} \nu R T_0 = -\frac{6}{8} \nu R T_0 + A_{\text{min}}$$

$$\Rightarrow A_{\text{min}} = -\frac{3}{8} \nu R T_0$$

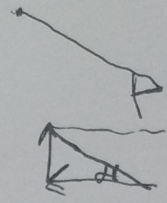
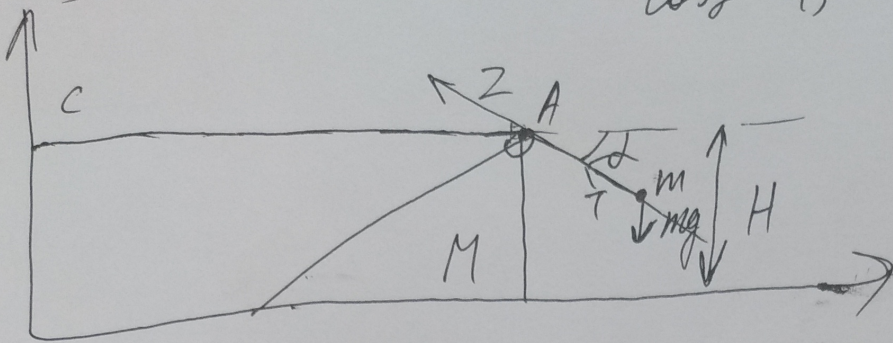
Омлем: 1) $Q_1 = \frac{24}{25} \nu R T_0$

2) $T = \frac{T_0}{2}$

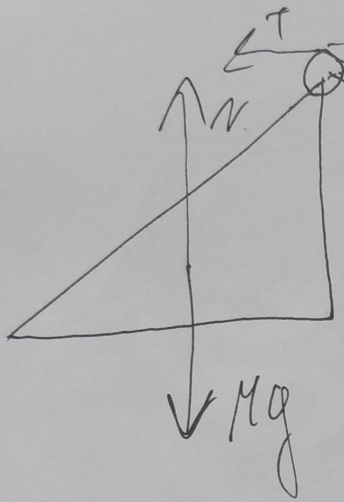
3) $A_{\text{min}} = -\frac{3}{8} \nu R T_0$

уел нобук 2

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



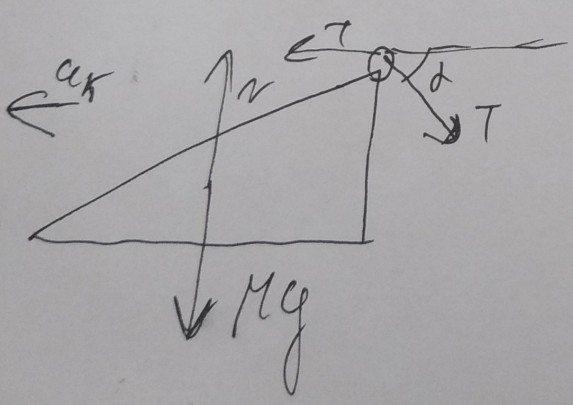
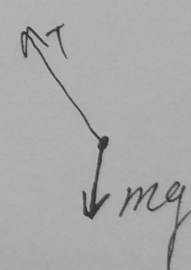
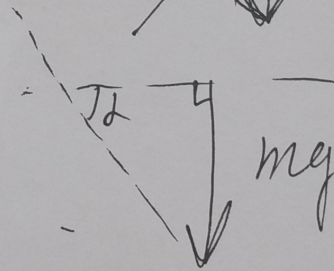
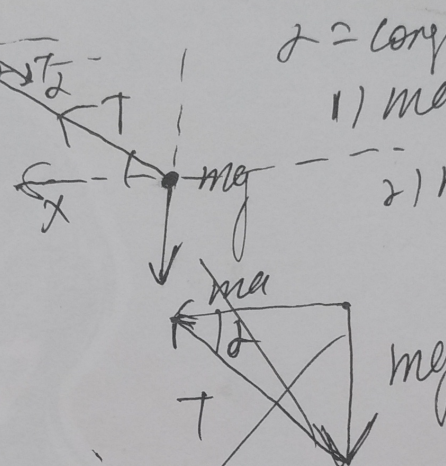
11



$$\alpha = \text{const}$$

$$1) \max_x = T \cos \alpha$$

$$2) \max_y = T \sin \alpha - mg$$



$$m \cdot k \cdot \alpha = \text{const}$$

$$\max_k \max_x = T - T \cos \alpha$$

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

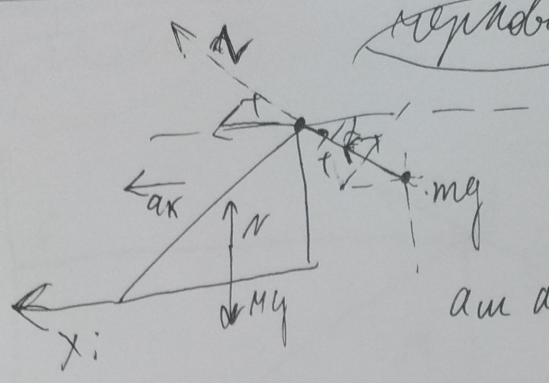
$$\max_x = T \cos \alpha$$

$$v \frac{dv}{dt} =$$

~~ax~~

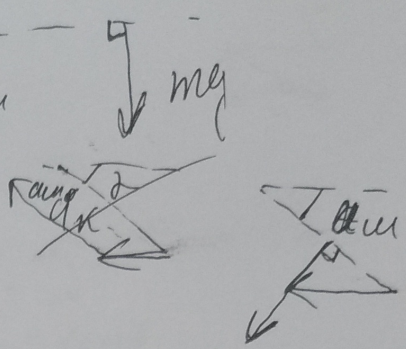
$$2: a_k = a_m$$

непробив



или $\gamma = \cos \alpha \Rightarrow a_{\text{ком}} \parallel \text{норми}$

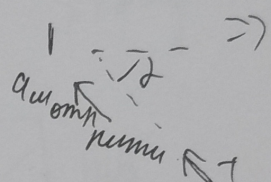
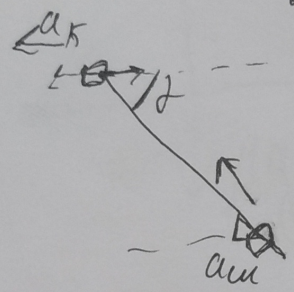
||
 $a_{\text{м}} \text{ адв } \uparrow \text{ норми}$



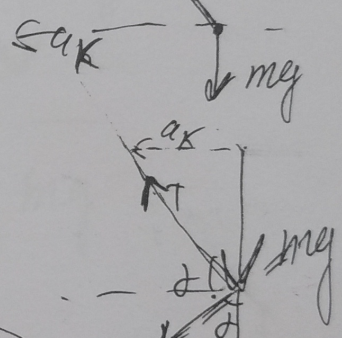
$1) \text{ Max} = T(1 - \cos \alpha)$

$\vec{a}_{\text{м}} = \vec{a}_{\text{норми}} + \vec{a}_{\text{омн}}$

$dx = x \cos \alpha$
 $\Rightarrow dy = x \sin \alpha$



укрепление шара и катанка правили
 в направлении на норми



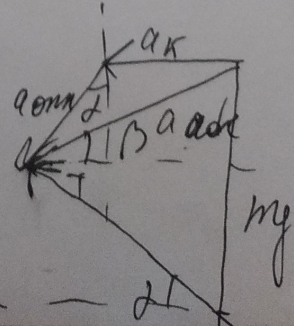
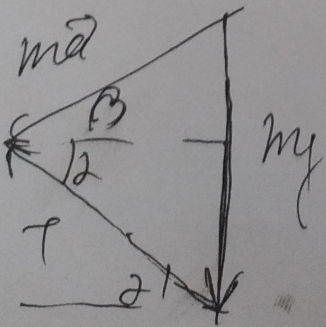
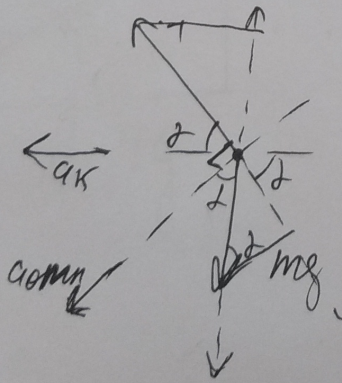
$\text{tg } \beta = \frac{mg - T \sin \alpha}{T \cos \alpha} = \text{const}$ [$mg = \rho l (\sin \alpha \cos \alpha)$]

$\text{tg } \beta = \text{const}$

$\text{max} = T \cos \alpha$

$2) m a_x \cos \alpha = T - mg \sin \alpha$

$3) m a_{\text{омн}} \cos \alpha = mg - T \sin \alpha$



Учешба 4

$$m_1 - T \sin \beta = m a \sin \beta \quad a^2 = a_x^2 + a_{\text{омн}}^2 + 2 a_x a_{\text{омн}} \cos \beta$$

$$T \cos \beta = m a \cos \beta$$

$$a_x = \frac{T - m g \sin \beta}{m \cos \beta}$$

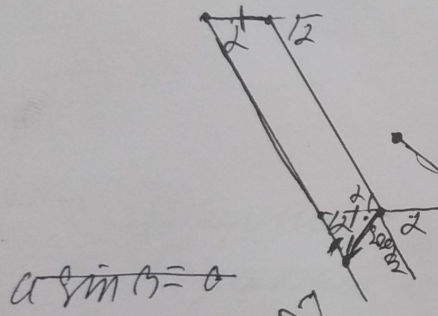
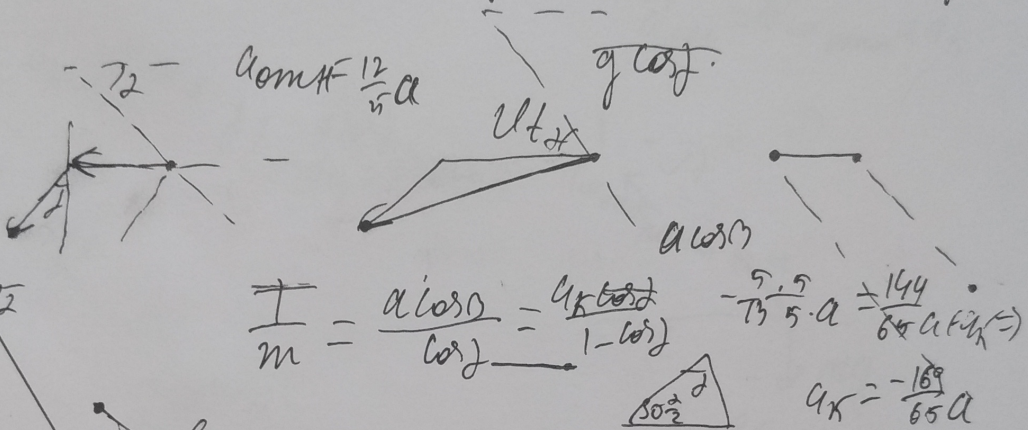
$$a_{\text{омн}} = \frac{m g - T \sin \beta}{m \cos \beta}$$

$$m^2 \cos^2 \beta a^2 = T^2 + (m g \sin \beta)^2 + 2 m g \sin \beta T + m^2 g^2 \sin^2 \beta + T^2 \sin^2 \beta + 2 T m g \sin \beta \cos \beta$$

$$m^2 \cos^2 \beta a^2 = T^2 \cos^2 \beta + m^2 g^2 \cos^2 \beta + 2 \cos \beta (T - m g)$$

$$m^2 \cos^2 \beta a^2 = T^2 \cos^2 \beta + m^2 g^2 \cos^2 \beta + 2 \cos \beta (m g T - m^2 g^2 \sin \beta - T^2 \sin \beta + m g T \sin^2 \beta)$$

$$m a_2 = T -$$



$$a \sin \beta = 0$$

$$g \sin \beta = a_{\text{омн}} \cos \beta$$

$$a = a_{\text{омн}} \frac{5}{13} \cdot \frac{13}{12} \Rightarrow$$

$$\frac{T}{m} = \frac{a_x}{1 - \cos \beta}$$

$$2) m a_x \cos \beta = T - m g \sin \beta$$

$$m a_{\text{омн}} \cos \beta = m g - T \sin \beta$$

$$m (a_{\text{омн}} + a_x \sin \beta) = m g \cos \beta$$

$$a_{\text{омн}} + a_x \sin \beta = g \cos \beta$$

$$a_{\text{омн}} = g \cos \beta - a_x \sin \beta$$

$$m a_x \cos \beta = T - m g \sin \beta$$

$$\frac{T}{m} = a_x \cos \beta + g \sin \beta$$

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

$$2) a_{x2} = a_{u2}$$

$$T \cos \beta = m (a_x + a_{\text{омн}} \sin \beta)$$

$$\frac{T}{m} = \frac{a_x + a_{\text{омн}} \sin \beta}{\cos \beta} = g$$

$$m a_x \cos \beta \sin \beta + m g \cos \beta \sin \beta = m g \cos \beta (g \cos \beta - a_x \sin \beta) =$$

$$m g - m g \sin^2 \beta$$

$$a_x \cos \beta \sin \beta + g \cos^2 \beta$$

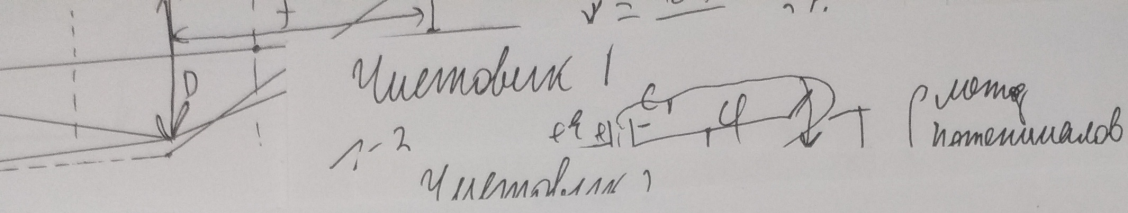
Часть 2

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

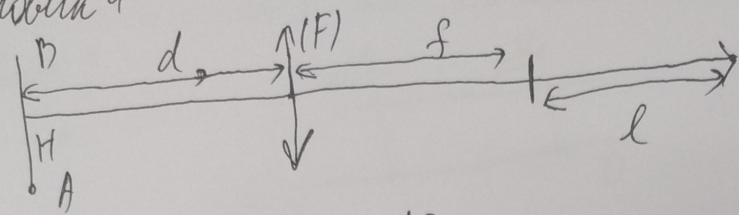
Шифр: **21201700**

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Вариант 3



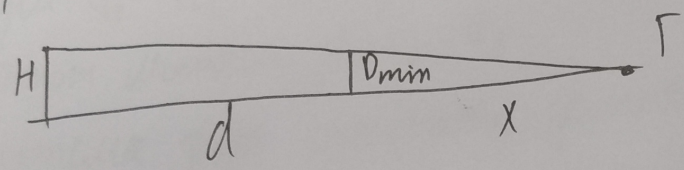
Уменьшитель 4



$$1) \frac{1}{F} = \frac{1}{d} + \frac{1}{f} \Rightarrow f = \frac{dF}{d-F} = 24 \text{ cm}$$

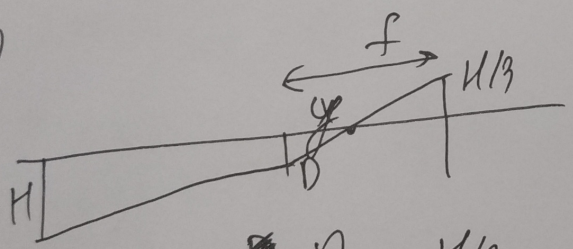
$$\Rightarrow x = l + f = 48 \text{ cm}$$

2)



$$\frac{x}{D_{\min}} = \frac{d+x}{H} \Rightarrow D_{\min} = H \cdot \frac{x}{d+x} = \frac{2}{5} H = \frac{18}{5} \text{ cm} = 3,6 \text{ cm}$$

3)

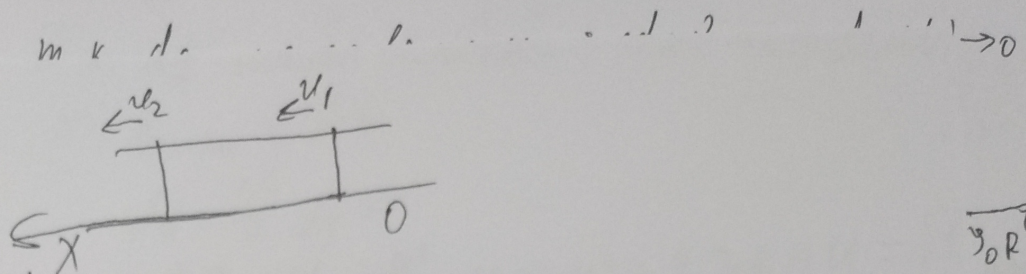


$$\Rightarrow \frac{D_{\min}}{y} = \frac{H/3}{f-y} \Rightarrow \frac{f}{y} - 1 = \frac{H}{3D_{\min}}$$

$$y = \frac{24 \cdot 6}{11} \approx 13,1 \text{ cm}$$

Ответ: 1) $x = 48 \text{ cm}$; 2) $D_{\min} = 3,6 \text{ cm}$; 3) $y = 13,1 \text{ cm}$

Чиселбик 2



Чиселбик 3

$$2ma_1 = F_A$$

$$ma_2 = F_A$$

$$x: v_1 = -v_0 + \int a_1 dt$$

$$v_2 = \int a_2 dt$$

м.к. ξ_{i2} би брелер улуруталарга, а ξ_{i1} саралар тулуруталарга \rightarrow

\Rightarrow кпу $\xi_{i1} = \xi_{i2}$ макс урунагем и F_A саралар павна 0 \Rightarrow

б эмом домоним $v_1 = v_2 = v_K$

5) саралар буре перемьерек тулуруталар по OX:

\Rightarrow по 3У:

$$2mv_0 = mv_2 + 2mv_1 = 3mv_K \Rightarrow v_K = \frac{2}{3}v_0$$

$$6) 2ma_1 = \frac{B^2 L^2}{4R} (v_1 - v_2)$$

$$\frac{8mR}{B^2 L^2} \cdot \frac{-\Delta v_1}{\Delta t} = \frac{\Delta S_{omn}}{\Delta t} \Rightarrow \frac{8mR}{B^2 L^2} \cdot -\Delta v_1 = \Delta S_{omn}$$

процессулурупуе буре брелер омлоготук

$$\Rightarrow \frac{8mR}{B^2 L^2} \cdot \left(-\left(\frac{2}{3}v_0 - v_0\right)\right) = \Delta S_{omn}$$

$$\Rightarrow S_{omn} = \frac{8mRv_0}{3B^2 L^2}$$

$$\frac{2v_0}{R}$$

\Rightarrow расмаранне менекке перемьерекке

$$L = S_0 + S_{omn} \Rightarrow$$

$$L(t_{yem}) = S_0 + \frac{8mRv_0}{3B^2 L^2}$$

Омлен: 1) $a_1 = \frac{B^2 L^2 v_0}{8mR}$ 2) $v_1(t_{yem}) = v_2(t_{yem}) = v_K = \frac{2}{3}v_0$

$$3) L(t_{yem}) = S_0 + \frac{8mRv_0}{3B^2 L^2}$$

Чиселбик 4

Числитель 2

м.к. dq - малая левая $\Rightarrow |dq|^2 \rightarrow 0 \Rightarrow d(|dW|) \rightarrow 0$

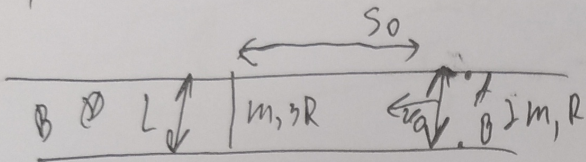
$$\Rightarrow P_{\text{пот}} = dQ$$

$$dQ = \frac{U^2}{R} dt \Rightarrow$$

$$\int \gamma_0 dt = \frac{U^2}{R} dt \Rightarrow U^2 = \gamma_0 R \Rightarrow U = \sqrt{\gamma_0 R}$$

Примем: 1) $\gamma_0 = \frac{4\ell}{5R}$; 2) $Q = \frac{8}{5} C \ell^2$ 3) $U = \sqrt{\frac{4}{5} \gamma_0 R}$

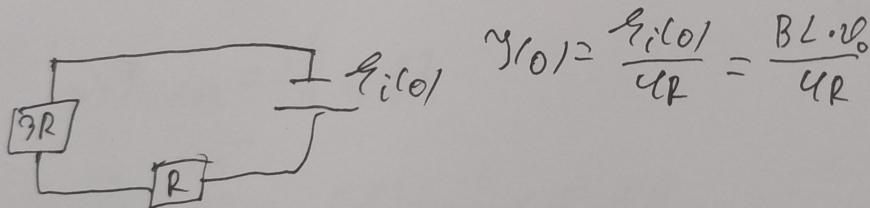
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1) при движении проводника в МП возникает \mathcal{E}_i между концами в проводниках, определяемая формулой:

$$\mathcal{E}_i = B v L \sin \alpha$$

2) в нач. момент:

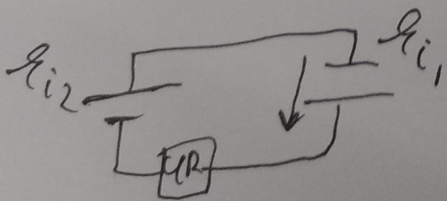


$$\gamma(0) = \frac{\mathcal{E}_i(0)}{4R} = \frac{B L v_0}{4R}$$

3) в нач. мом

$$2m a_1(0) = F_A(0) \Rightarrow a_1(0) = \frac{B^2 L^2 v_0}{2m \cdot 4R} \Rightarrow a_1 = \frac{B^2 L^2 v_0}{8mR}$$

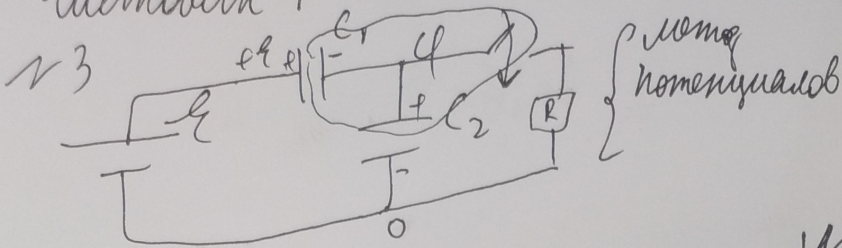
4) в произвольный момент времени.



м.к. $\mathcal{E}_{i1} > \mathcal{E}_{i2} \Rightarrow$

$$\gamma = \frac{\mathcal{E}_{i1} - \mathcal{E}_{i2}}{4R} = \frac{B L (v_1 - v_2)}{4R}$$

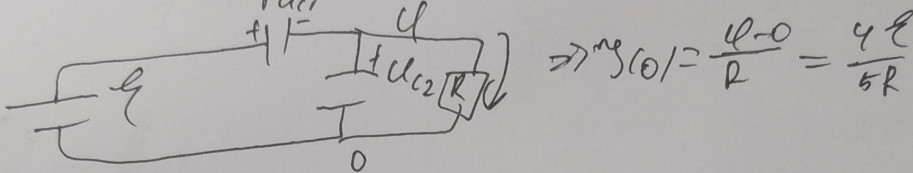
Учебник 1



0) по 3C3: $4(\epsilon - q) + C(q - 0) = 0$
 $\Rightarrow q = \frac{4}{5} \epsilon$; $U_{C1} = \frac{\epsilon}{5}$; $U_{C2} = \frac{4}{5} \epsilon$

$W_{погружена} = \frac{4C\epsilon^2}{2 \cdot 25} + \frac{C16\epsilon^2}{2 \cdot 25} = \frac{2}{5} C\epsilon^2$

1) сразу после замыкания кистора напряжения на конденсаторах и на резисторе $\Rightarrow U_{C1(0)} = U_{C1}^*$; $U_{C2(0)} = U_{C2}^*$



$\Rightarrow \mathcal{I}(0) = \frac{\epsilon - 0}{R} = \frac{4\epsilon}{5R}$

2) в том. поле $\mathcal{I}_{C1} = \mathcal{I}_{C2} = 0 \Rightarrow \mathcal{I}_R = 0 \Rightarrow U_R = 0$

$\Rightarrow U_{C1} = \epsilon \Rightarrow W(\text{вым}) = \frac{4C\epsilon^2}{2} = 2C\epsilon^2$

$A_{\text{ум}} = \Delta W + Q$

$A_{\text{ум}} = \epsilon \Delta q$; $\Delta q = q_2 - q_1$; где $q_1 = q_{C1}(\text{погружена}) = \frac{4C\epsilon}{5}$

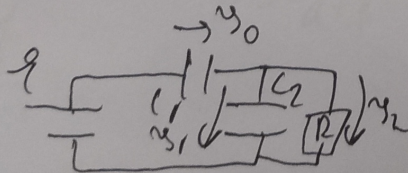
$q_{C1}(\text{вым}) = 4C\epsilon$

$\Rightarrow A_{\text{ум}} = \frac{16}{5} C\epsilon^2$

$\Rightarrow \frac{16}{5} C\epsilon^2 = 2C\epsilon^2 - \frac{2}{5} C\epsilon^2 + Q$

$Q = \frac{8}{5} C\epsilon^2$

3)



Р-м закон тока мого кольца $\mathcal{I}_{C1} = \mathcal{I}_0$

$\Rightarrow \mathcal{I}_0 = \frac{dq}{dt} \Rightarrow dq = \mathcal{I}_0 dt$

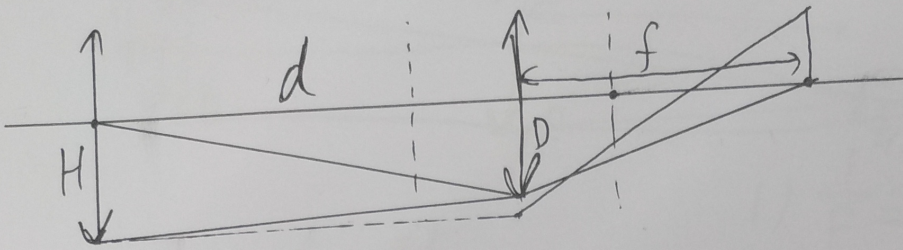
$\mathcal{I}_0 = \mathcal{I}_1 + \mathcal{I}_2 \Rightarrow dq = dq_1 + dq_2$

$\Rightarrow \delta A_{\text{ум}} = d(\Delta W) + dQ$

$\delta A_{\text{ум}} = \epsilon dq = \epsilon \mathcal{I}_0 dt$

$d(\Delta W) = \frac{dq_1^2}{8C} + \frac{dq_2^2}{2C}$; м.к. dq -масса

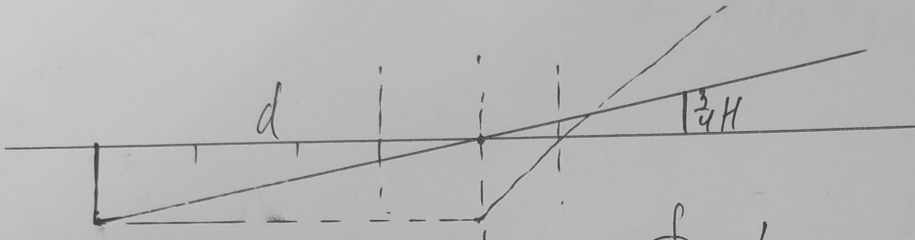
Чертеж 4



$$\frac{1}{18} = \frac{1}{42} + \frac{1}{x}$$

$$x = \frac{18 \cdot 42}{42 - 18} = 24$$

$$\Gamma = \frac{f}{d} = \frac{24}{42} = \frac{1}{3}$$

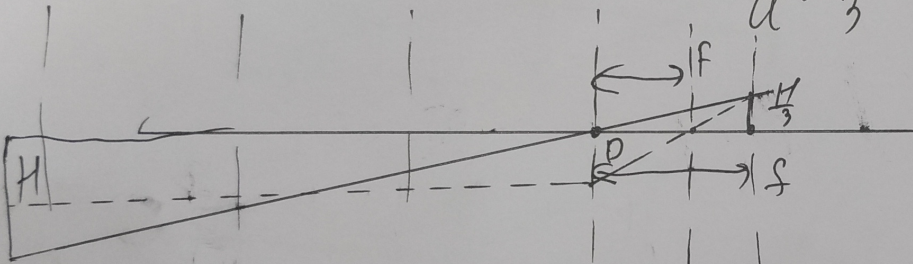


$$\frac{f}{d} = \frac{1}{3}$$

$$\frac{4}{6 \cdot 2 \cdot 9} = \frac{1}{8 \cdot 9} + \frac{3}{9 \cdot 8}$$

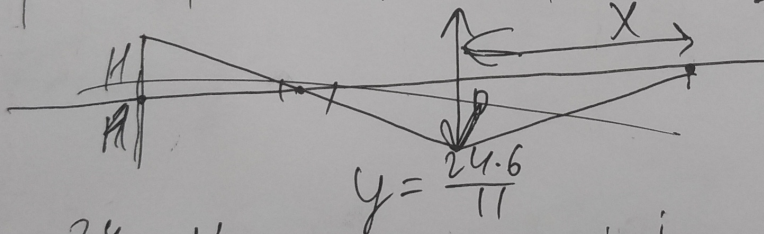
$$\frac{3}{9 \cdot 8} = \frac{1}{8} = \frac{8 \cdot 8}{8} = 24$$

$$f = 24$$



$$\frac{D}{x} = \frac{F}{f} \Rightarrow$$

$$D = \frac{F}{H} \cdot x$$

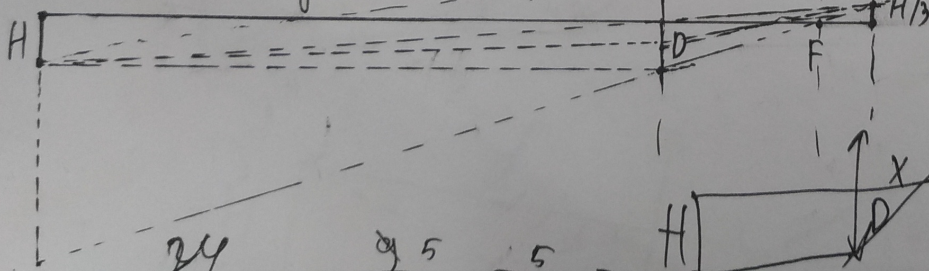


$$y = \frac{24.6}{11}$$

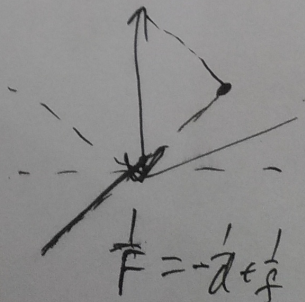
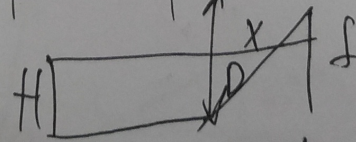
$$\frac{24}{y} = \frac{11}{6} \Rightarrow 11y = 24 \cdot 6$$

$$\frac{F}{f - f} = \frac{D_{min}}{\frac{11}{3}} \Rightarrow$$

$$D_{min} = \frac{H}{3} \cdot \frac{18}{6} = 11$$



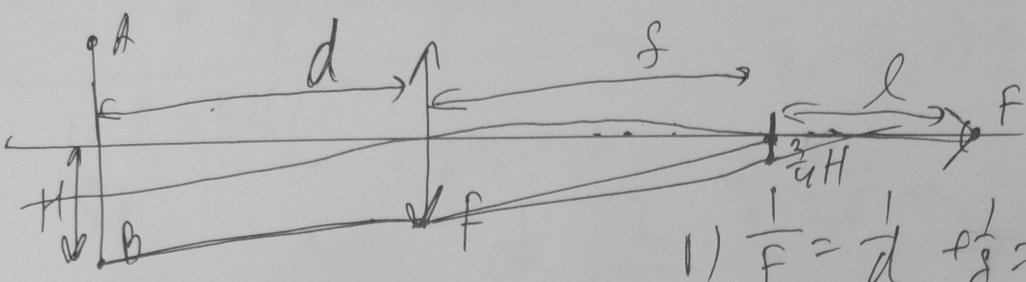
$$\frac{24}{y} - 1 = \frac{9.5}{3 \cdot 18 \cdot 2} = \frac{5}{6} \Rightarrow$$



$$f = -d + f$$

$$\frac{f - x}{x} = \frac{H}{3} \Rightarrow \frac{D_{min}}{x} = \frac{11}{3} \Rightarrow \frac{f}{x} - 1 =$$

высота?



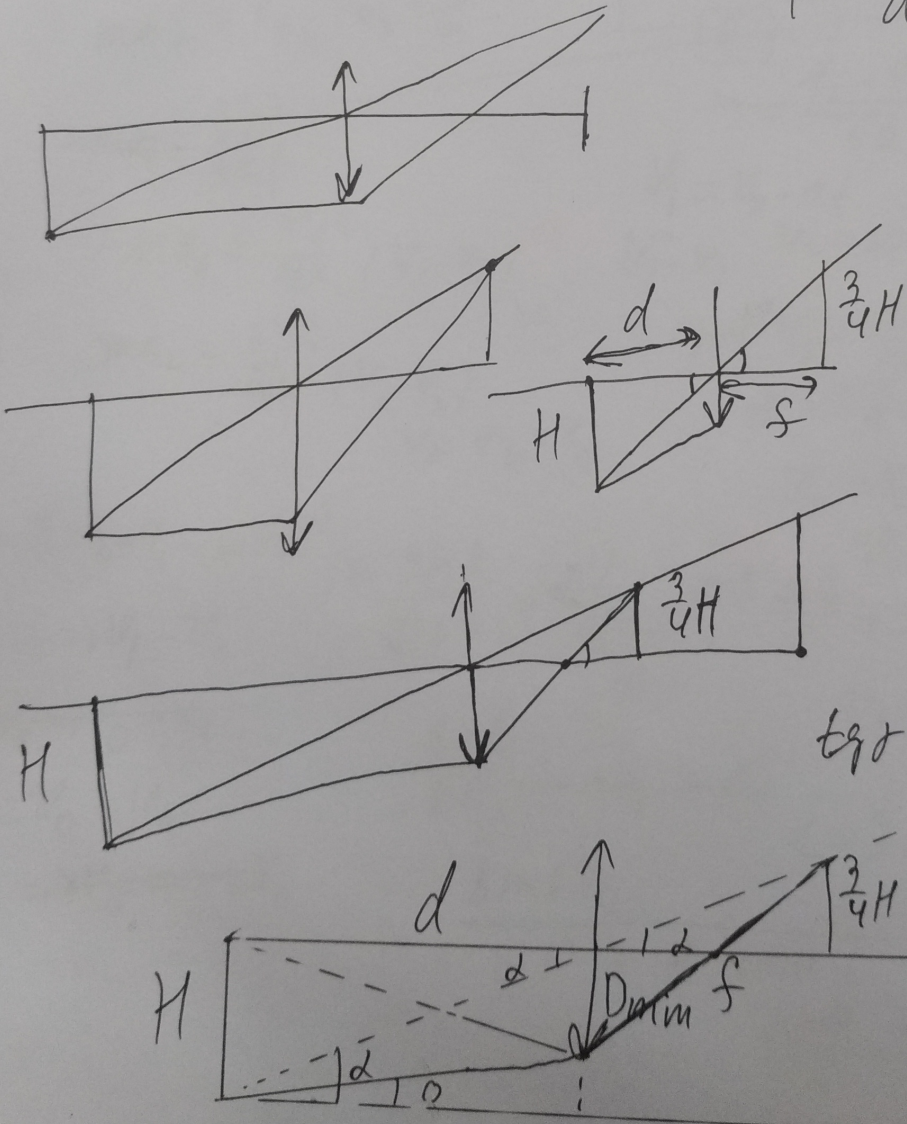
$$1) \frac{1}{F} = \frac{1}{d} + \frac{1}{f} \Rightarrow 72/3 = 24$$

$$f = \frac{dF}{d-F} \Rightarrow x = l + f = 24 + \frac{72 \cdot 18}{72 - 18} = 48$$

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$$F = \frac{f}{d} = \frac{54}{72} = \frac{3}{4}$$

$$\frac{36}{90} = \frac{3}{4}$$



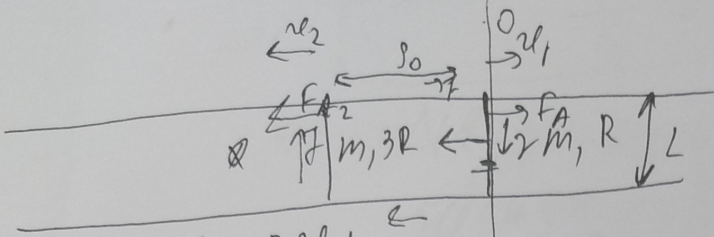
$$\operatorname{tg} \alpha = \frac{H}{d}$$

$$\operatorname{tg} \beta = \frac{H-d}{d}$$



Experiment 1

Experiment 2



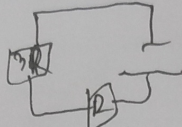
1) $\epsilon_i = B v L$

$2a_1 = a_2 = a$

2)

$a_1 = a$

$a_2 = 2a$



3) $2ma_0 = F_{A0} \Rightarrow 2ma_0 = \frac{B^2 L^2}{4R} v_0 \Rightarrow a_0 = \frac{F_A}{2m}$

$v_0 = \frac{B v_0 L}{4R} \Rightarrow v_1 = v_0 - \text{Sachtdt}$

$l = l_0 + \Delta s = l_0 + \frac{4mRv_0}{3B^2L^2}$

$F_{A1} = F_{A2} \Rightarrow \sum p_i = \text{const}$

$\epsilon^2 =$

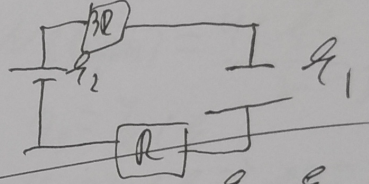
$\epsilon^2 =$

$\frac{2}{5} c \epsilon^2$

$v_2 = \text{Sachtdt}$

$v_1 = v_0 - \frac{v_2}{2}$

4) $2ma_1 = F_{A1} \quad 2a_1 = a_2 \Rightarrow ma_2 = F_{A2} \quad a_2 = \frac{F_A}{m}$



$\gamma = \frac{R_1 - R_2}{5R} = \frac{R(1/2 + 1/2)}{5R}$

$2ma_1 = \frac{B^2 L^2}{5R} v_1$

$v_1 = v_0 - at$

$2ma_1 = \frac{B^2 L^2}{4R} (v_1 - v_2)$

$v_1 - v_2$

$v_2 = 2at$

$ma_2 = \frac{B^2 L^2}{4R} (v_1 - v_2)$

$v_1 = v_2 = v_k$

nyu $v_1 = v_2, a_1 = a_2 = 0$

$\Rightarrow v_k = v_1 = v_2$

$v_1 = v_0 - \text{Sachtdt}$

$v_2 = 2 \text{Sachtdt}$

$\Rightarrow -2m \cdot v_0 = 2mv_1 - mv_2$

$-2v_0 = 2v_1 - v_2$

$-2v_0 = 2v_0 - v_2$

$-2v_0 = v_k$

$\Rightarrow v_k = -2v_0$

$-2v_0 = -3v_k$

$2v_0 = 3v_k \Rightarrow v_k = \frac{2}{3} v_0$

$\frac{8mR}{B^2 L^2} \frac{-\Delta v_1}{\Delta t} = \frac{\Delta s_1}{t} + \frac{\Delta s_2}{t} \Rightarrow$

$v_1 = v_0 - \frac{v_2}{2}$

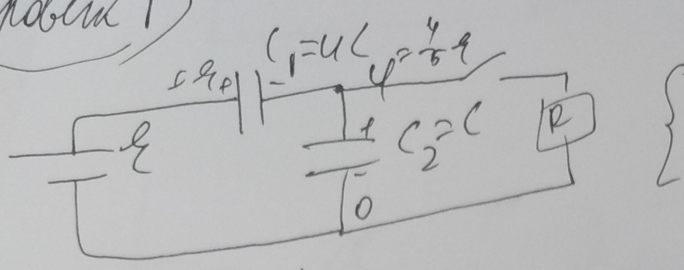
$\frac{8mR}{B^2 L^2} \Delta v_1 = \Delta s \quad L = S$

$\frac{8mRv_0}{B^2 L^2} = \Delta s_{\text{omn}} \Rightarrow$

$\Rightarrow 8ma_1 \frac{8mR}{B^2 L^2} \frac{-\Delta v_1}{\Delta t} = \Delta s_1 + \Delta s_2 \Rightarrow$

Задача 1

3)



$$0 = -4(\varepsilon - q) + 8q = 0$$

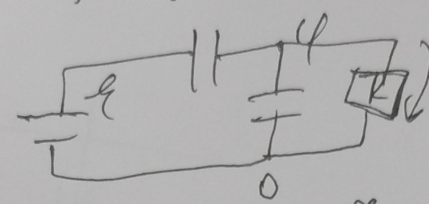
$$5q = 4\varepsilon \Rightarrow q = \frac{4}{5}\varepsilon$$

$$U_{C1} = \frac{\varepsilon}{5}; U_{C2} = \frac{4}{5}\varepsilon$$

$$W_0 = \frac{UC}{2} \cdot \frac{\varepsilon^2}{25} + \frac{C}{2} \cdot \frac{16\varepsilon^2}{25} =$$

$$\frac{20}{50} C\varepsilon^2 = \frac{2}{5} C\varepsilon^2$$

1)



$$I_{C1} = \frac{\varepsilon}{R} = \frac{4\varepsilon}{5R}$$

2) Выводим по КЗ $I_1 = I_2 = 0 \Rightarrow I_R = 0 \Rightarrow U_{C1} = \varepsilon; U_{C2} = 0$
 $\Rightarrow W(\text{вып}) = \frac{4C\varepsilon^2}{2} = 2C\varepsilon^2$

Автом = $\varepsilon \Delta q$ $q_1 = \frac{4}{5}C\varepsilon$ $q_2 = 4C\varepsilon \Rightarrow \Delta q = \frac{16}{5}C\varepsilon$
 $\frac{16}{5}C\varepsilon^2 = 2C\varepsilon^2 - \frac{2}{5}C\varepsilon^2 + 0$ $q = UC \Rightarrow \Delta q = R =$

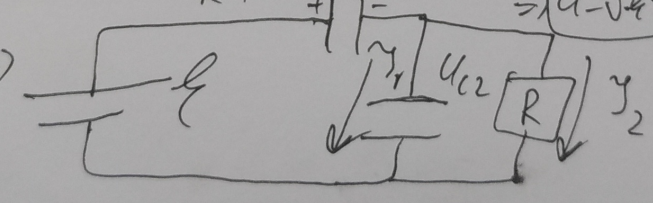
$$Q = \left(\frac{16}{5} - \frac{10}{5} + \frac{2}{5} \right) = \frac{8}{5} C\varepsilon^2$$

$$U_R = U_{C2}$$

3)

$$\varepsilon \int_0^t dt = \frac{U_2}{R} dt \Rightarrow U_2 = \varepsilon \text{ or } U_2 = \sqrt{2} \varepsilon \text{ or } U_2 = \frac{q}{C}$$

$$\varepsilon dq = \frac{U_2}{R} dt \Rightarrow$$



$$\Rightarrow q_{C1} =$$

$$I_2 R = U \quad U_{C1} + U_{C2} = \varepsilon$$

$$U_{C2} = \frac{q}{C}$$

$$\Delta U = q_3 - q_1$$

$$q_3 = C U_{C1} \Rightarrow$$

$$C U_{C1} = q \Rightarrow$$

$$C U = q$$

$$q_3 dt = C dU_{C1}$$

$$U_{C1} = \frac{q_1}{C}$$

$$q_3 - q_1 = C(\varepsilon - U)$$

$$dW = \frac{dQ}{2t}$$

$$dq = q_3 dt \quad dq = dq_1 + dq_2$$

$$dq = C dU$$

$$q - q_1 = \frac{\Delta q}{t}$$

$$\Rightarrow dW \rightarrow 0 \Rightarrow$$

$$\varepsilon dq = dQ \Rightarrow q_3 = q_1 + q_2$$

$$q_3 dt = C dU_{C1}$$