Часть 1

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

Шифр: **21200418**

ID профиля: **276446**

Вариант 4

Задача №2

1/ $Q' = \sum \Delta Q_i = \partial \sum C(T_i) \Delta T_i = \partial \cdot \frac{9}{5} R \cdot \frac{1}{T_0} \sum T_i \Delta T_i = \partial \frac{9}{5} R \cdot \frac{1}{T_0} \int_{T_0}^{\frac{7}{4}T_0} T \, dT =$

$= \partial \cdot \frac{9}{5} R \cdot \frac{1}{T_0} \cdot \frac{1}{2} \left(\frac{9}{16} T_0^2 - T_0^2 \right) =$

$Q = -Q' = \partial R \frac{9}{10} \cdot \frac{7}{16} T_0 = \frac{63}{160} \partial R T_0$

$Q(T) = \partial \frac{9}{5} R \frac{1}{T_0} \int_{T_0}^{T} T \, dT = \frac{9}{2 \cdot 5} \partial R \cdot \frac{1}{T_0} \left(T^2 - T_0^2 \right) = A + \Delta U$

$\Delta U(T) = \partial C_v (T - T_0)$

$A(T) = Q(T) - \Delta U(T) = \frac{9}{2 \cdot 5} \partial \cdot R \cdot \frac{1}{T_0} (T^2 - T_0^2) - \partial C_v (T - T_0)$

$\frac{\partial A}{\partial T} = 0 = \frac{9}{10} \cdot 2 \partial R \cdot \frac{1}{T_0} T - \partial \frac{3}{2} R$

$T = \frac{\frac{3}{2} \cdot \frac{10}{9 \cdot 2} \cdot \partial R T_0}{\partial R} = \frac{5}{6} T_0$

$A = \frac{9}{2 \cdot 5} \partial R \cdot \frac{1}{T_0} \left(\frac{25}{36} T_0^2 - T_0^2 \right) - \partial C_v \left(\frac{5}{6} T_0 - T_0 \right) =$

$= -\partial R \cdot \frac{11}{36} T_0 \cdot \frac{9}{10} + \partial \cdot \frac{3}{2} R \cdot \frac{1}{6} T_0 = -\partial R T_0 \left(\frac{11}{40} - \frac{1}{4} \right) = -\frac{1}{40} \partial R T_0$

$|A| = \frac{1}{40} \partial R T_0$

Ответ: $Q = \frac{63}{160} \partial R T_0$

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

$A = -\frac{1}{40} \partial R T_0$

(1)

$\sin^2\alpha + \cos^2\alpha = 1$

$\sin^2\alpha + \frac{64}{289} = 1$

$\sin^2\alpha = \frac{289-64}{289} = \frac{225}{289} = \frac{15}{17}$

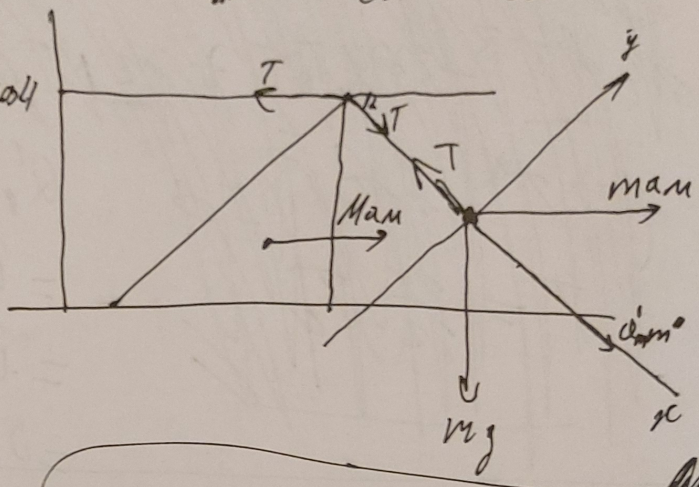
№1

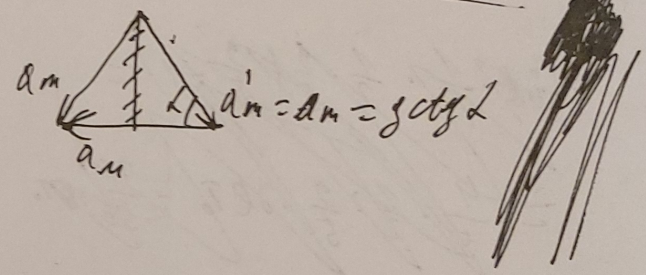
$Ma_м = T(1-\cos\alpha)$

$\dot{a}_м m = mg\sin\alpha + a_м m\cos\alpha - T(1+1\cdot\cos\alpha)$

$a_м m\sin\alpha = mg\cos\alpha \Rightarrow a_м = g\,\mathrm{ctg}\,\alpha$

$a_м = \dot{a}_м$ - усл. перем. нить





$Ma_м = T(1-\cos\alpha)$

$\dot{a}_м \cdot m = mg\sin\alpha + a_м m\cos\alpha - T$

$\vec{\dot{a}}_м = \vec{a}_м + \vec{\dot{a}}_м$

$\dot{a}_м^2 = a_м^2 + \dot{a}_м^2 - 2a_м a_м\cos\alpha =$

$= 2a_м^2(1-\cos\alpha) = 2a_м^2\left(1-\frac{8}{17}\right) =$

$= \frac{18}{17}a_м^2$

$a_м = a_м\sqrt{\frac{18}{17}} = g\,\frac{\frac{8}{17}}{\frac{15}{17}}\sqrt{\frac{2\cdot9}{17}} =$

$= g\,\frac{8}{15}\sqrt{\frac{2\cdot3}{17}}$

$\dot{a}_м m = mg\sin\alpha + a_м m\cos\alpha - T(1+\cos\alpha)$

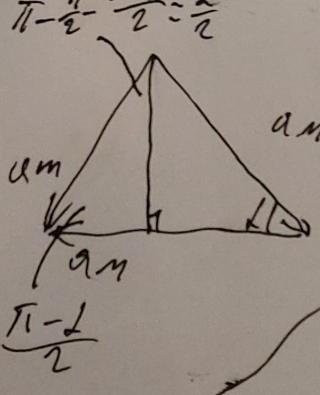
$a_м m(1-\cos\alpha) = mg\sin\alpha(1-\cos\alpha) - a_м M(1+\cos\alpha)$

$a_м(1-\cos\alpha)^2 + g\sin\alpha(1-\cos\alpha) =$

$= a_м\left(\frac{M}{m}\right)$

$\frac{M}{m} = \frac{g}{a_м}\sin\alpha(1-\cos\alpha)(1-\cos\alpha) =$

$= \frac{g}{g\frac{\cos\alpha}{\sin\alpha}}\sin\alpha(1-\cos\alpha) - (1-\cos\alpha) =$

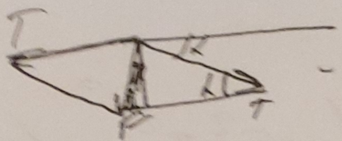


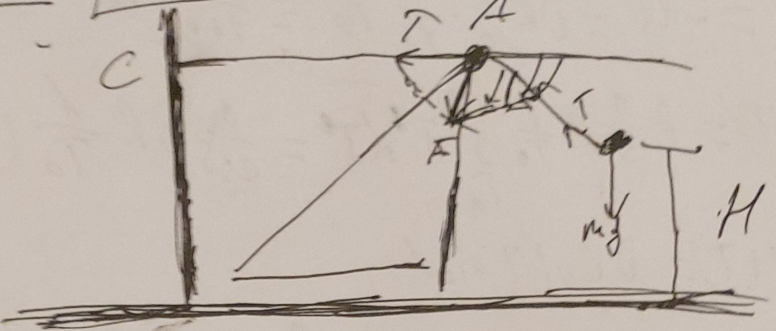
$= \frac{\left(\frac{15}{17}\right)^2}{\frac{8}{17}}\left(1-\frac{8}{17}\right) - \left(1-\frac{8}{17}\right)^2 = \frac{15\cdot15\cdot9}{8\cdot17\cdot17} - \frac{9\cdot9}{17\cdot17} = \frac{9}{17^2}\left(\frac{15^2}{8}-1\right) = \frac{9\cdot153}{17^2\cdot8} = \frac{9\cdot9}{17\cdot8} =$

$= \frac{81}{136}$ ②

Черновик

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





$\beta = \frac{180-\alpha}{2}$

$F = T^2 + T^2 - 2T^2\cos\alpha = 2T^2 - 2T^2\frac{16}{17} = \frac{2T^2}{17}$

$\frac{180\nu R}{T_0}T^2 + [illegible] - 33\nu R T + 18\nu R T_0 + A = 0$

$D = 1089\,\nu^2 R^2 - 4 \cdot [illegible] \cdot \frac{180\nu R}{T_0} = 0$

$1089\,\nu^2 R^2 - 1080\,\nu^2 R^2 - 72\frac{\nu R}{T_0}\cdot A = 0$

$9\nu R = 72\frac{A}{T_0} \rightarrow A = \frac{1}{8}\nu R T_0$

$33 \times 33 = 1089$

$180 \times 6 = 1080$

$18 \times 4 = 72$

Черновик

Ответ!

1/ $\frac{L}{7}$

2/

3

21200418 (U276446 M1269696)

$$Q = -Q' = \partial R \frac{9}{10} \cdot \frac{7}{16} T_0 = \frac{63}{160} \partial R T_0$$

$$Q(T) = \partial \frac{9}{5} R \frac{1}{T_0} \int_{T_0}^{T} T^* dT^* = \frac{9}{2 \cdot 5} \partial R \frac{1}{T_0} (T^2 - T_0^2) = A + \Delta U$$

$$\Delta U(T) = \partial C_v (T - T_0)$$

$$A(T) = Q(T) - \Delta U(T) = \frac{9}{2 \cdot 5} \partial R \cdot \frac{1}{T_0} (T^2 - T_0^2) + \partial C_v (T - T_0)$$

$$\frac{\partial A}{\partial T} = 0 = \frac{9}{10} \cdot 2 \partial R \frac{1}{T_0} T - \partial \frac{3}{2} k$$

$$T = \frac{\frac{3}{2} \cdot \frac{10}{9 \cdot 2} \partial k T_0}{\partial k} = \frac{5}{6} T_0$$

$$A = \frac{9}{2 \cdot 5} \partial R \frac{1}{T_0} \left(\frac{25}{36} T_0^2 - T_0^2 \right) - \partial C_v \left(\frac{5}{6} T_0 - T_0 \right) =$$

$$= -\partial R \frac{11}{36} T_0 \cdot \frac{9}{10} + \partial \frac{3}{2} R \frac{1}{6} T_0 = -\partial R T_0 \left(\frac{11}{40} - \frac{1}{4} \right) =$$

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

Черновик

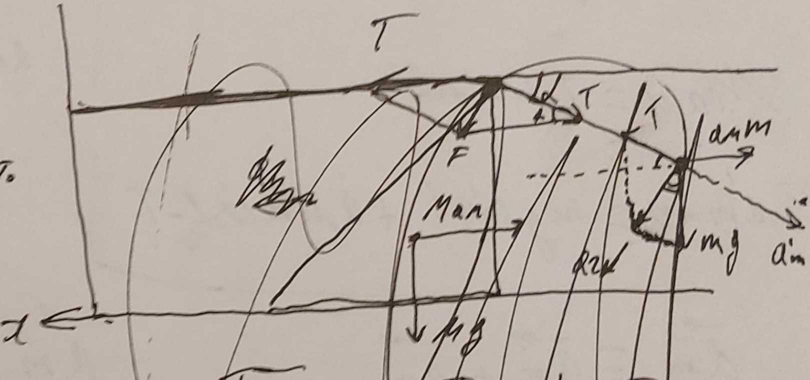
$Q'_1 = \sum_{\Delta} Q_i =$

$= \Delta \sum C(T_i)\Delta T_i =$

$= \Delta \cdot \frac{9}{5} R \frac{1}{T_0} \sum T_i \Delta T_i =$

$= \Delta \frac{9}{5} R \frac{1}{T_0} \int_{T_0}^{4T_0} T\,dT = \Delta \frac{9}{5} R \frac{1}{T_0} \cdot \frac{1}{2}(\frac{9}{10} T_0^2 \ldots)$

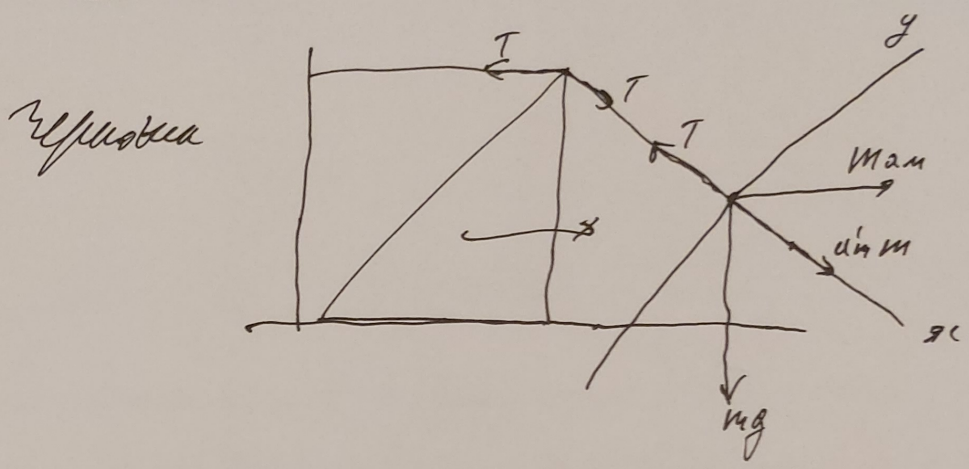
$\times \begin{array}{r} 12 \\ 12 \\ \hline 144 \end{array}$



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

$Ma_1 = T(1-\cos\alpha)$

21200418 (U276446 M1269696)


T
T
T
y
ma
dv m
x
mg

Часть 2

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

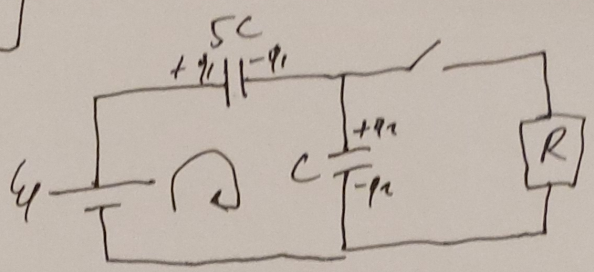
Шифр: **21200418**

ID профиля: **276446**

Вариант 4

Вариант [redacted]

Задача 3



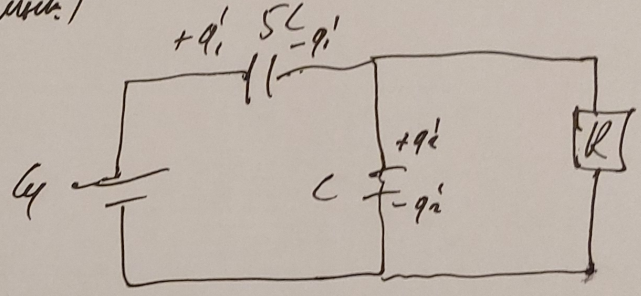
1/ $\begin{cases} \mathcal{E} = +\frac{q_1}{5C} + \frac{q_2}{C} \\ -q_1 + q_2 = 0 \Rightarrow q_1 = q_2 \end{cases}$

$\mathcal{E} = \frac{6}{5} \cdot \frac{q_1}{C} \Rightarrow q_1 = \frac{5}{6} C\mathcal{E} = q_2$

$IR = \frac{q_2}{C} = \frac{5}{6}\mathcal{E}$

$I = \frac{5}{6} \cdot \frac{\mathcal{E}}{R}$ // (сразу после размык.)

После размык.:



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

$\frac{q_2'}{C} = 0 \Rightarrow q_2' = 0 \Rightarrow q_1' = 5\mathcal{E}C \; (U_1 = \mathcal{E})$

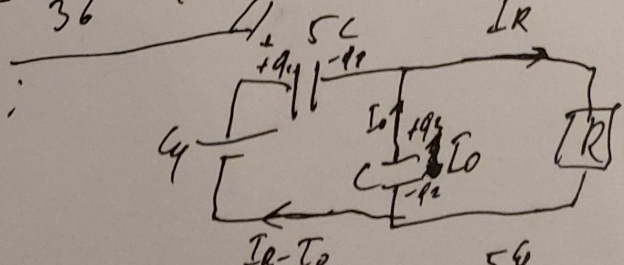
З.С.Э.:

$\frac{q_1^2}{2 \cdot 5C} + \frac{q_2^2}{2C} + A_\delta = \frac{q_1'^2}{2 \cdot 5C} + \frac{q_2'^2}{2 \cdot C} + Q_R$

$\frac{5C\mathcal{E}^2}{2 \cdot 36} + \frac{25C\mathcal{E}^2}{2 \cdot 36} + (5\mathcal{E}C - \frac{5}{6}\mathcal{E}C)\mathcal{E} = \frac{25\mathcal{E}^2C^2}{2 \cdot 5C} + Q_R$

$Q_R = C\mathcal{E}^2 \left(\frac{15 + 6.25 - 5 \cdot 18}{36} \right) = \frac{75}{36} C\mathcal{E}^2 = \frac{25}{12} C\mathcal{E}^2$

Когда через C_2 идет ток I_0:



$\begin{cases} \frac{q_2}{C} = I_R \cdot R \\ \mathcal{E} = \frac{q_1}{5C} + \frac{q_2}{C} \end{cases}$

$\frac{\dot{q}_1}{5C} + \frac{\dot{q}_2}{C} = 0$

$\dot{q}_1 + 5\dot{q}_2 = 0 \Rightarrow (I_R - I_0) - I_0 = 0 \Rightarrow I_R = 2I_0$ //

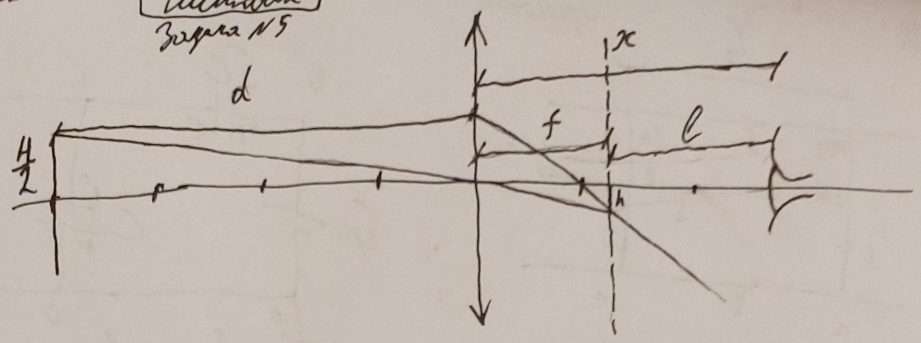
Ответ: 1/ $\frac{5\mathcal{E}}{6R}$

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

3/ $2I_0$

(1)

Чистовик
Задача №5



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

(l - расстояние между линзами)

$\frac{1}{96} + \frac{1}{f} = \frac{1}{24}$

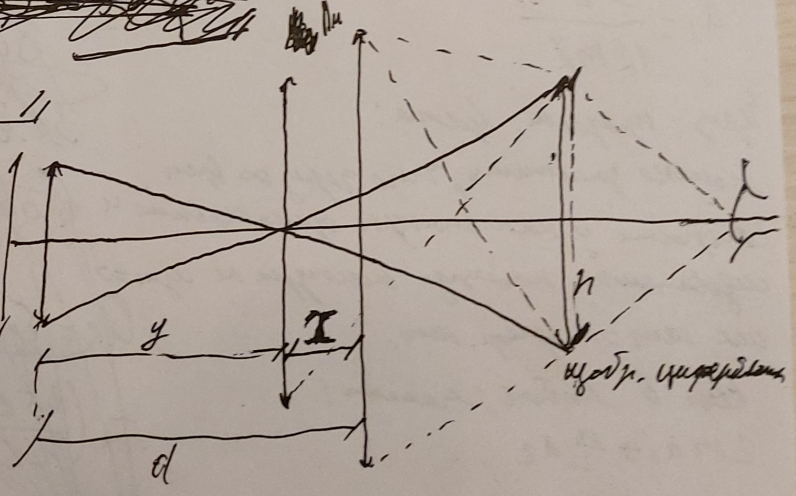
$\frac{1}{f} = \frac{1}{24} - \frac{1}{96} = \frac{4-1}{96} = \frac{3}{96} = \frac{1}{32}$

$f = 32$

$\frac{f}{d} = \frac{h}{H} \Rightarrow h = \frac{f}{d} \cdot H = \frac{32}{96} \cdot \frac{9}{2} = \frac{1}{3} \cdot \frac{9}{2} = \frac{3}{2}$

$x = l + f = 24 + 32 = 56$ см //

2/ $D_л$ - диаметр линзы



$\Gamma = \frac{h}{H} = \frac{f}{d} = \frac{1}{3}$

$D_л = \frac{h \cdot l}{l - f} = \frac{D_л}{h} = \frac{l}{l-f} = \frac{56}{56-32} = \frac{56}{24}$

$D_л = \frac{56}{24} \cdot 3 = \frac{56}{8} = 7$ см //

3/ $\begin{cases} \frac{H}{y} = \frac{D}{x} \\ x + y = d \Rightarrow y = d - x \end{cases}$

$\frac{H}{d-x} = \frac{D}{x}$

$H x = D d - D x \Rightarrow x = \frac{dD}{H+D} = \frac{96 \cdot 7}{3+7} = 42$

Ответы: 1/ 56
2/ 7
3/ 42

42 см между линзами

5С

Задача 4

1/ $\mathcal{E}_{i0} = BV_0L$

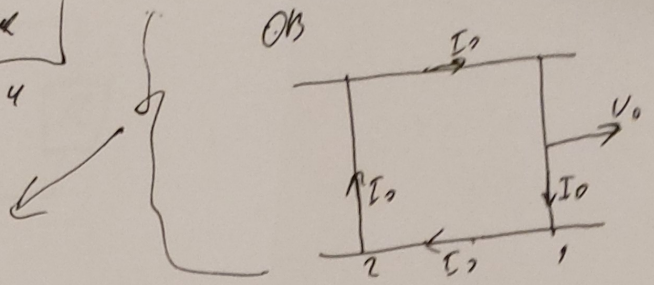
$\mathcal{E}_i = I_0 \cdot 6R$

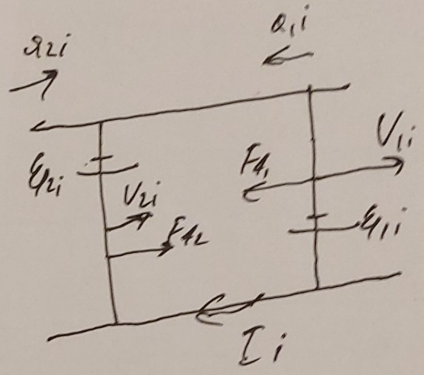
$I_0 = \frac{\mathcal{E}_i}{6R} = \frac{BV_0L}{6R}$

$F_{A10} = I_0BL = \frac{B^2L^2V_0}{6R}$

$2m a_{10} = F_{A10}$

$a_{10} = \frac{B^2L^2V_0}{12Rm}$ /





$\mathcal{E}_{1i} - \mathcal{E}_{2i} = I_i 6R$

$I_i = \frac{BL}{6R}(V_{1i} - V_{2i})$

$F_{A1i} = F_{A2i} = I_iBL = \frac{B^2L^2}{6R}(V_{1i} - V_{2i})$

$a_{1i} \cdot 2m = F_{A1i}$
$a_{2i} \cdot m/2 = F_{A2i}$ $\Rightarrow a_{1i} \cdot 2m + a_{2i} \cdot m/2 = 0$

$V_1 \cdot 2m + V_2 \cdot \frac{m}{2} = 0$

$4\Delta V_1 + \Delta V_2 = 0$

$4(V_1 - V_0) + (V_2 - 0) = 0$

$4V_1 - 4V_0 + V_2 = 0$

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

($V_{1i} = V_{2i} \Rightarrow |F_{A1}| = |F_{A2i}|$)

Когда выровняются скорости перестанет меняться поток $\Rightarrow$ пропадёт сила $\Rightarrow$ пропадёт ускорение.

3/ $a_{1i} \cdot 2m = -F_{A1i} = -\frac{B^2L^2}{6R}(V_{1i} - V_{2i})$

$2m\Delta V_{1i} = -\frac{B^2L^2}{6R}(\Delta S_{1i} - \Delta S_{2i}) = -\frac{B^2L^2}{6R}\Delta S_i$

$2m(V_K - V_0) = -\frac{B^2L^2}{6R}\Delta S$

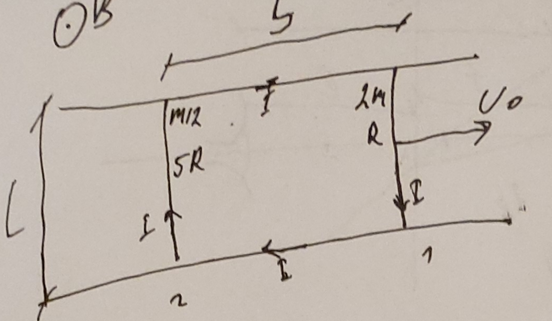
$\frac{2m}{5}V_0 = \frac{B^2L^2}{6R}\Delta S \Rightarrow \Delta S = \frac{2mV_0 \cdot 6R}{5B^2L^2} = \frac{12}{5} \cdot \frac{mV_0R}{5B^2L^2}$

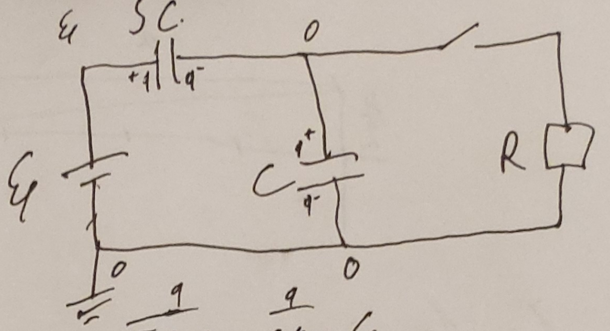
Ответы: 1/ $\frac{B^2L^2V_0}{12Rm}$

2/ $\frac{4}{5}V_0$

3/ $\frac{12}{5} \cdot \frac{mV_0R}{B^2L^2}$

Черновик





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

$$2ma_1 = IBL$$

$$\mathcal{E} = -\frac{d\Phi}{dt} = -\frac{LB(S+dx) - LBS}{dt} = -\frac{LB\,dx}{dt} = -LBV_0$$

$$\frac{6q}{5C} = \mathcal{E}$$

$$q = \frac{5}{6}C\mathcal{E}$$

$$\frac{q}{C} = I_1 R$$

$$I_1 = \frac{q}{CR} = \frac{5C\mathcal{E}}{6CR} = \frac{5\mathcal{E}}{6R}$$

$$I = \frac{\mathcal{E}}{R} = \frac{LBV_0}{6R}$$

$$2ma_1 = \frac{LBV_0}{6R}\cdot BL$$

$$a_1 = \frac{B^2L^2V_0}{12mR}$$

Через продолж. время:
можно заметить, что через это время скорости у обоих стержней одинаковыми и следовательно площадь контура не изм. => тока нет => ускор. нет.

~~$Q_R = \mathcal{E}\Delta q - \Delta W_1 - \Delta W_2$~~

В любой момент:

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

$$a_2 = 4a_1$$

$$\begin{cases} u = 0 + a_2 t \\ u = V_0 - a_1 t \end{cases}$$

$$u = a_2 t$$

$$-u + V_0 = a_1 t$$

$$\frac{a_2}{a_1} = \frac{u}{V_0 - u} = 4$$

$$u = 4V_0 - 4u$$

$$u = \frac{4}{5}V_0$$