Часть 1

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

Шифр: **21200737**

ID профиля: **342273**

Вариант 1

$T \sin\alpha = mg - ma\sin\beta$

$T \cos\alpha = ma\cos\beta$

$tg\,\alpha = \dfrac{g - a\sin\beta}{a\cos\beta}$

$tg\,\beta = 2$

$tg\,\alpha = \dfrac{5}{3} \quad \dfrac{4}{5} = \dfrac{4}{3}$

$\dfrac{8}{3} + 1$

$\dfrac{11}{3}$

$\dfrac{2}{\sqrt{5}} \quad \dfrac{1}{\sqrt{5}}$

$2 - \dfrac{6}{5}$

$\dfrac{10-6}{5} = \dfrac{2}{\sqrt{5}}$

$\dfrac{4}{3}\,\dfrac{1}{\sqrt{5}} + \dfrac{2}{\sqrt{5}} \cdot \dfrac{2}{\sqrt{5}}$

$\dfrac{T_0^2}{2} - \dfrac{3T_0^2}{2}$

$\dfrac{2\dfrac{T_0^2}{4} - \dfrac{3T_0^2}{2} + T_0^2}{2T_0}$

$\dfrac{9}{16} - \dfrac{9}{8} + \dfrac{1}{2}$

$\underline{625}$

$\dfrac{9}{16} - \dfrac{18}{16} + \dfrac{8}{16}$

$\dfrac{17-18}{16} = \dfrac{1}{16}$

$\dfrac{g\sin\beta}{tg\alpha\cos\beta + \sin\beta}$

$\dfrac{g}{tg\alpha\, ctg\beta + 1}$

$\dfrac{2}{3} + \dfrac{3}{3}$

$\dfrac{1}{2}\dfrac{4}{3} + 1$

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Чистовик

№1

$S^2 = S_1^2 + S_2^2$

3) $S_1 = x(1-\cos\alpha) = \frac{a_2 t^2}{2}(1-\cos\alpha)$

(S_1 – гориз. перемещ. шара влево)

(x – перемещ. клина (a_2 – уск. клина))

$S_2 = x\sin\alpha = \frac{a_2 t^2}{2}\sin\alpha$

S_2 – верт. перем. шара вниз

$$\frac{at^2}{2} = \frac{a_2 t^2}{2}\sqrt{(1-\cos\alpha)^2 + \sin^2\alpha}$$

$$a = a_2\sqrt{2-2\cos\alpha}$$

$$ma\cos\beta = T\cos\alpha$$

$$Ma_2 = T\sin\alpha$$

$$\frac{Ma_2}{ma\cos\beta} = \operatorname{tg}\alpha$$

$$\frac{M\cancel{a_2}}{m\cancel{a_2}\sqrt{2-2\cos\alpha}\cos\beta} = \operatorname{tg}\alpha$$

$$\frac{M}{m} = \operatorname{tg}\alpha\cos\beta\sqrt{2-2\cos\alpha} = \frac{4\cdot\cancel{5}}{\cancel{5}\cdot 3\cdot\sqrt{5}}\cdot\sqrt{2-\frac{6}{5}} =$$

$$= \frac{4\sqrt{5}}{15}\cdot\frac{2}{\sqrt{5}} = \frac{8}{15} \qquad \frac{M}{m} = \frac{8}{15} \qquad \frac{m}{M} = \frac{15}{8}$$

2) $$a_2 = \frac{a}{\sqrt{2-2\cos\alpha}} = \frac{g}{(\operatorname{tg}\alpha\cos\beta + \sin\beta)\sqrt{2-2\cos\alpha}} = \frac{g}{\left(\frac{4}{3\sqrt{5}} + \frac{2}{\sqrt{5}}\right)\frac{2}{\sqrt{5}}}$$

$$a_2 = \frac{g}{\frac{8}{15} + \frac{4}{5}} = \frac{g\,15}{20} = \frac{3g}{4}$$

$1{,}875$

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Ответ: $\operatorname{tg}\beta = 2$; $\frac{3}{4}g$; $\cancel{\frac{8}{15}}$; $\sqrt{\frac{10H}{3g}}$

№2 Чистовик Физика

$$C(T) = 2R\frac{T}{T_0} \qquad i = 5$$

$$Q'(T) = C(T)\nu = 2R\frac{T}{T_0}\nu$$

$$Q(T) = \nu\int_{T_0}^{\frac{5}{6}T_0} 2R\frac{T}{T_0}\,dT = \nu\frac{2R\left(\left(\frac{5}{6}T_0\right)^2 - T_0^2\right)}{2T_0} = \nu R\,\frac{25-36}{36}\,T_0 =$$

$$= -\frac{11}{36}RT_0\nu$$

газ отдаст $-Q = \frac{11}{36}RT_0\nu$

$$Q = A + \Delta U$$

$$Q = \nu R\,\frac{T_1^2 - T_0^2}{T_0}$$

$$\Delta U = \frac{5}{2}\nu R(T_1 - T_0)$$

$$\frac{\nu R}{T_0}(T_1 - T_0)(T_1 + T_0) = A + \frac{5}{2}\nu R(T_1 - T_0)$$

$$\nu R(T_1 - T_0)\left(\frac{T_1 + T_0}{T_0} - \frac{5}{2}\right) = A$$

$$\frac{A}{\nu R} = (T_1 - T_0)\left(\frac{2T_1 - 3T_0}{2T_0}\right) = \frac{2T_1^2 - 5T_1T_0 + 3T_0^2}{2T_0}$$

Минимум работы достигается в минимуме числителя $T_1 = \frac{+5T_0}{4}$ ($\frac{-b}{2a}$ парабола с ветвями вверх)

Отв.: $\frac{3T_0}{4}$

$$A_{min} = \nu R \cdot \frac{\frac{2\cdot 9T_0^2}{16} - 3T_0\frac{3T_0}{4} + T_0^2}{2T_0} = \nu R\left(\frac{9}{16}T_0 - \frac{9T_0}{8} + \frac{T_0}{2}\right) =$$

$$= -\frac{\nu RT_0}{16}$$

Отв.: $-\frac{\nu RT_0}{16}$

(минимальная по модулю работа — 0; достигается при $\frac{T_0}{2}$)

Ответ: $\frac{11}{36}R\nu T_0$; $\frac{3T_0}{4}$; $-\frac{\nu RT_0}{16}$

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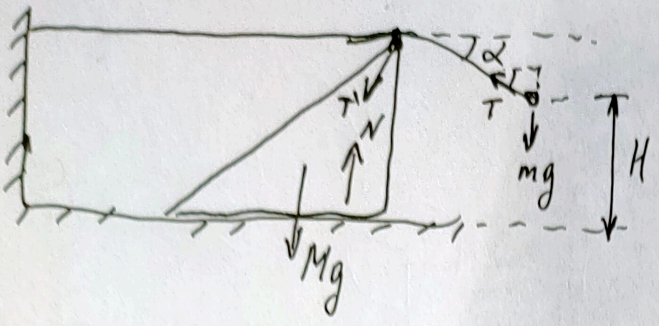
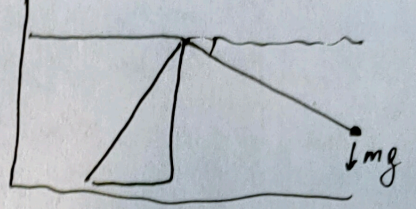
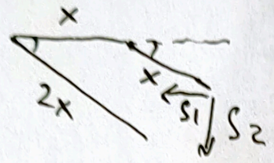
Чистовик   Физика

N1





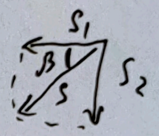
$a \uparrow\uparrow S$



$-x\cos\alpha - x_0\cos\alpha$

$S_1 = x + x_0\cos\alpha - \cancel{2x\cos\alpha} = x(1-\cos\alpha)$

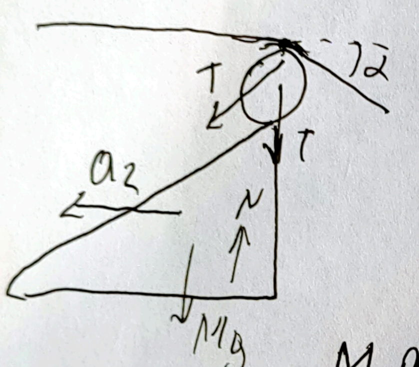
$S_2 = 2x\sin\alpha - x\sin\alpha = x\sin\alpha$



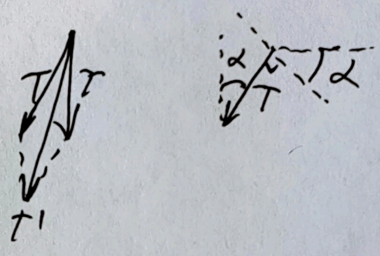
$S^2 = S_1^2 + S_2^2$

$tg\,\beta = \frac{S_2}{S_1} = \frac{\sin\alpha}{1-\cos\alpha} = \frac{\frac{4}{5}}{1-\frac{3}{5}} = \frac{4}{5} : \frac{2}{5} = 2$

1)

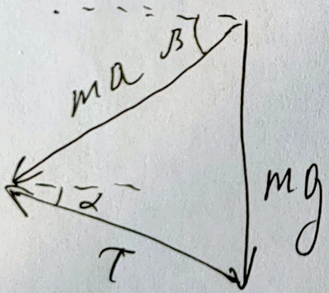


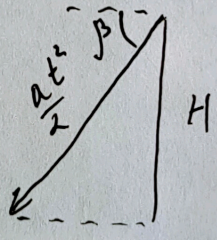
Ответ: $\beta = arctg\,2 = 0{,}79$ рад



$M a_2 = T\sin\alpha$

для шара





$\frac{at^2}{2}\sin\beta = H$

4)

$t = \sqrt{\frac{H\cdot 2}{a\cdot\sin\beta}} = \sqrt{\frac{2H}{g}(tg\,\alpha\, ctg\,\beta + 1)}$

$t = \sqrt{\frac{2H}{g}(tg\,\alpha\, ctg\,\beta + 1)}$

$t = \sqrt{\frac{2H\cdot 5}{g\,3}} = \sqrt{\frac{10H}{3g}}$

$\begin{cases} T\sin\alpha + ma\sin\beta = mg \\ T\cos\alpha = ma\cos\beta \end{cases}$

$\begin{cases} T\sin\alpha = m(g - a\sin\beta) \\ T\cos\alpha = ma\cos\beta \end{cases}$

$tg\,\alpha = \frac{g - a\sin\beta}{a\cos\beta}$

$g - a\sin\beta = a\,tg\,\alpha\cos\beta$

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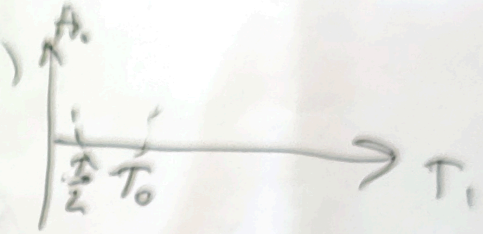
$a = \frac{g}{tg\,\alpha\cos\beta + \sin\beta}$

$\nu \frac{2RT^2}{2T_0}$

$$Q = A + \Delta U$$

$(T_1 - T_0)(2T_1 - T_0)$



$$\nu R \frac{T_1^2 - T_0^2}{T_0} = A + \nu R (T_1 - T_0)$$

$\frac{T_0}{2} \cdot \frac{?}{4} T_0 - T_0$

$$\nu R \left(\frac{2T_1 + 2T_0 - 3T_0}{2T_0} \right.$$

$\frac{9 - 18 + 8}{16}$

$$(T_1 - T_0) \frac{2T_1 - T_0}{2T_0}$$

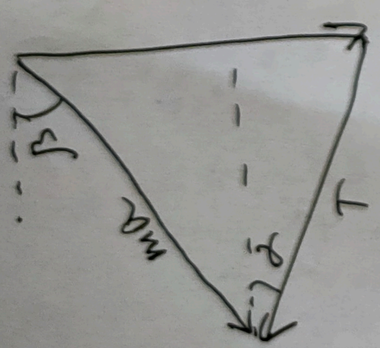
(1)

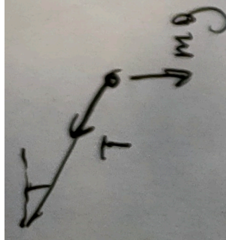
$$Q = \int c(T) \nu \, dT$$

$$Q = \int \frac{2RT}{T_0} \, dT = \frac{2RT^2}{2T_0} \Big|_{T_0}^{\frac{5}{6}T_0}$$

$$\frac{R}{T_0} T_0^2 \left(\left(\frac{5}{6} \right)^2 - 1 \right)$$

$$\frac{25 - 36}{36}$$





$$ma \cos\beta = T \cos\alpha$$

$$Ma_z = T \sin\alpha$$

$$\frac{ma}{Ma_z} = \frac{\operatorname{ctg}\alpha}{\operatorname{ctg}\beta}$$

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Часть 2

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

Шифр: **21200737**

ID профиля: **342273**

Вариант 1

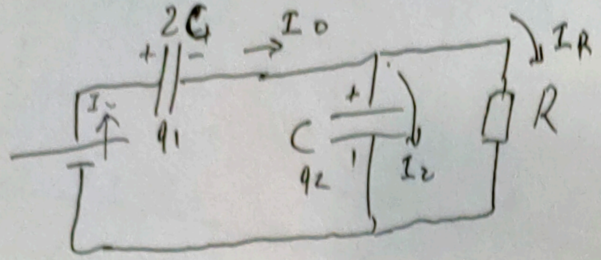
N 5 чистовик Т.В

эот

Физика

Чистовик

N 3



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

$$\mathcal{E} = \frac{q_1}{2C} + \frac{q_2}{C} = const$$

$$\mathcal{E}' = 0 = \frac{I_1}{2C} + \frac{I_2}{C}$$

$$I_1 = I_0$$

$$I_2 = I_0 - I_R$$

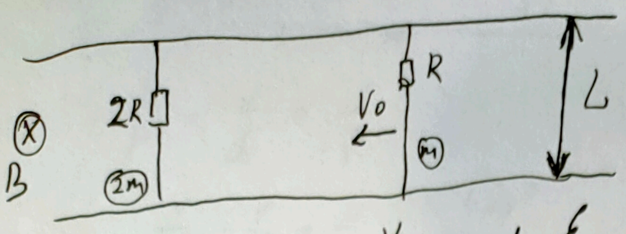
$$\frac{I_0}{2\cancel{C}} = \frac{I_R - I_0}{\cancel{C}}$$

$$I_R = \frac{3}{2} I_0$$

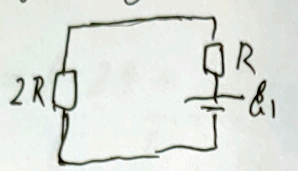
Ответ: $\frac{2\mathcal{E}}{3R}$; $\frac{2C\mathcal{E}^2}{3}$; $\frac{3}{2} I_0$

Физика

№ 4 Чистовик



По эффекту Холла: $\mathcal{E}_1 = BV_0L$



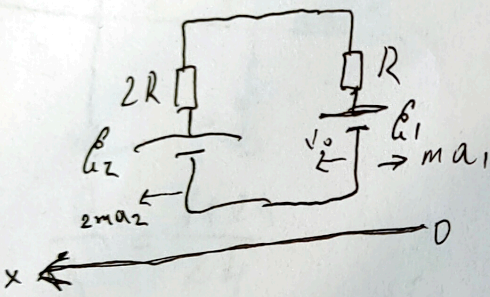
$$I_0 = \frac{\mathcal{E}_1}{3R} = \frac{BV_0L}{3R}$$

$$2ma = F_A = BLI = \frac{BLBV_0L}{3R}$$

$$a = \frac{B^2L^2V_0}{6mR}$$

(Сила ампера всегда является тормозящей силой ~~.....~~ Значит в конце $F_A = 0$ (тока нет))

$$2ma_{2x} = BLI(t) = \frac{BL(\mathcal{E}_1 - \mathcal{E}_2)}{3R} = \frac{B^2L^2(V_{1x} - V_{2x})}{3R}$$



$$ma_{1x} = \frac{B^2L^2(V_{1x} - V_{2x})}{3R}$$

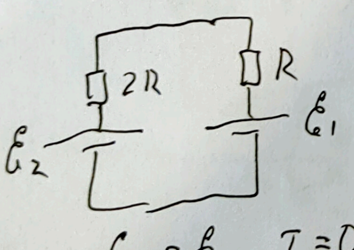
(Интегрируем по dt)

$$2mV_{2x} = \frac{B^2L^2}{3R}(S - S_0)$$

$$m(V_{1x} - V_0) = \frac{B^2L^2}{3R}(S - S_0)$$

($S - S_0$ – измен. расстояния между рельсам.)

уст. режим:



$\mathcal{E}_1 = \mathcal{E}_2 \quad I = 0$

$V_1 = V_2$

$$2V_{2x} = V_{1x} - V_0$$

$$V_0 = V_{1x} - 2V_{1x} = -V_{1x}$$

По модулю $V_1 = V_2 = V_0$

$$S = \frac{-2mV_0 3R}{B^2L^2} + S_0$$

Ответ: $\frac{B^2L^2V_0}{6mR}$; V_0; $-\frac{6mV_0R}{B^2L^2} + S_0$

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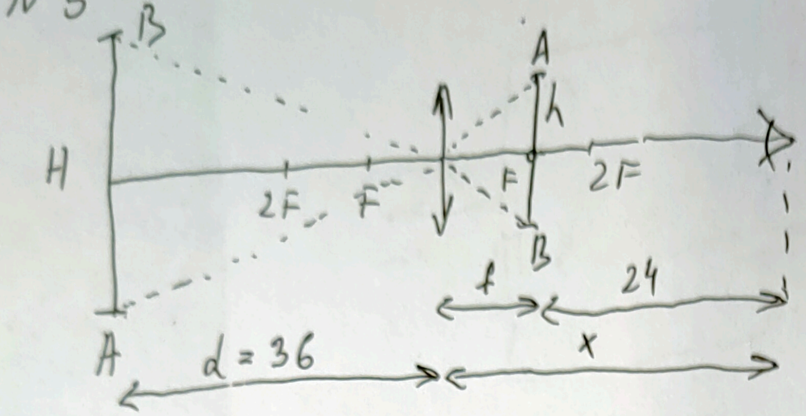
Чистовик Физика

№5



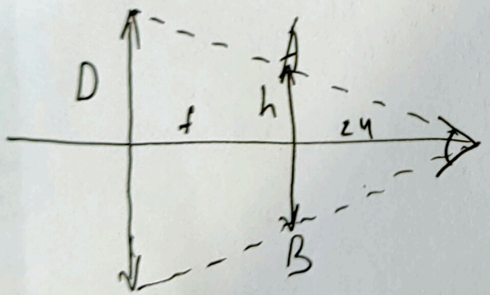
$$\frac{1}{F} = \frac{1}{d} + \frac{1}{f}$$

$$\frac{1}{f} = -\frac{1}{36} + \frac{1}{9} = \frac{4-1}{36} = \frac{3}{36} = \frac{1}{12} \qquad f = 12\text{ см}$$

$$x = f + 24 = \underline{36\text{ см}}$$

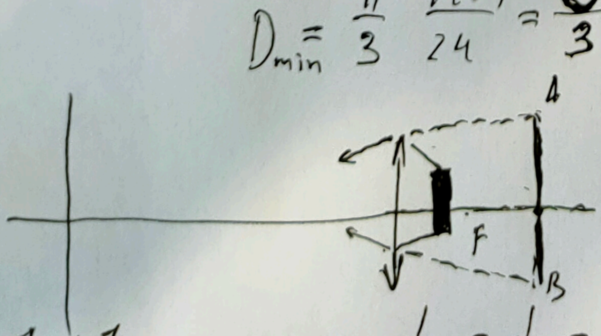
$$\Gamma = \frac{h}{H} = \frac{f}{d} = \frac{12}{36} = \frac{1}{3}$$

$$h = \frac{H}{3}$$



$$\frac{D}{h} = \frac{f+24}{24}$$

$$D_{min} = \frac{H}{3} \cdot \frac{f+24}{24} = \frac{9}{3} \cdot \frac{12+24}{24} = \frac{36 \cdot 3}{24} = \cancel{\frac{36}{2}} = \underline{4{,}5\text{ см}}$$



Если поместить экран справа от линзы перед фокусом его мнимое изобр. наложится на изобр. картины.

$$\frac{1}{F} = \frac{1}{d_1} - \frac{1}{f_1} \qquad \frac{1}{9} = \frac{1}{d_1} - \frac{1}{12}$$

$$\frac{1}{d_1} = \frac{7}{36} \qquad d_1 = \frac{36}{7} = 5\frac{1}{7}\text{ см}$$

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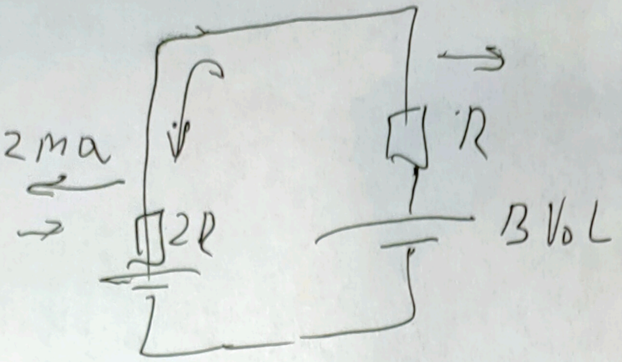
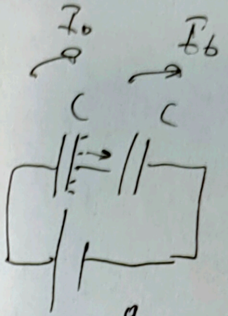
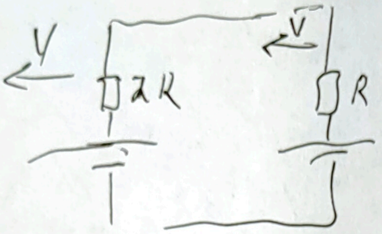
от картины 41,1см; от изобр. — 6,85см

Ответ: 36 см; 18 см; 5,14 см





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



$$q = 2CU_1 \qquad \frac{I_0}{C} + \frac{I_0}{C} = 0$$

$$U = \frac{q}{2C}$$

$$\frac{3A}{2} + \dots = 0 \qquad q_1 = CU_2$$

$$U_2 = I_R R$$

$$U_2 = (q - q_1)' R$$

$$q = 2CU_1$$

$$U_2 = (2CU_1 - CU_2)' R \qquad U_1' + U_2' = 0$$

$$\frac{U_2}{CR} = 2U_1' - U_2'$$

$$-3U_2'$$

$$U_2 = -3CRU_2'$$

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$I_R R = \frac{q_2}{C}$ $\quad \frac{q_2}{C} = I_R R$ $\quad \mathcal{E} = \frac{q_1}{2C} + \frac{q_2}{C}$

$I_0 = I_2 + I_R$

$\mathcal{E} = 2C I_0 +$ $\quad \frac{\dot q_2}{C} = R \dot I_R$ $\quad \dot{\mathcal{E}} = \frac{I_1}{2C} + \frac{I_2}{C} = 0$

$+$

$\mathcal{E} = \frac{q_0}{2C} + \frac{q_2}{C} =$ $\quad \frac{I_0 - I_R}{C} = \dot I_R R$

$= \frac{q_0}{2C} + I_R R$

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

$\frac{1}{9} = \frac{1}{d} - \frac{1}{12}$

$I_0 - I_R = \dot I_R RC$

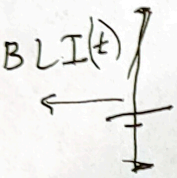
$q_1 = 2CU_1$ $\quad \frac{1}{d} = \frac{7}{36}$ $\quad d = \frac{36}{7}$

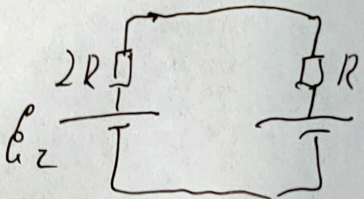
$q_2 = CU_2$

$U_1 + U_2 = \mathcal{E}$ $\quad \mathcal{E} = \Phi' = B S' = B(a_0 - V_0 t)L =$

$\mathcal{E} = BLV_0$

$\Phi = B(S_0 - S)L$





$\mathcal{E} = -\Phi' = +BL(V_{1x} + V_{2x})$

$2ma_{1x} = B^2L^2 \frac{V_{1x} + V_{2x}}{3R}$

$\mathcal{E}_1 = BLV_1(t)$

$ma_{2x} = B^2L^2 \frac{V_{1x} + V_{2x}}{3R}$

$\mathcal{E}_2 = BLV_2(t)$

$2m(V_{1x} - V_0) = B^2L^2 \frac{\Delta S}{3R}$

$I = \frac{BL(V_1(t) - V_2(t))}{3R}$

$m V_{2x} = B^2L^2 \frac{\Delta S}{3R}$

$\leftarrow \quad 2ma_2 = \frac{B^2L^2(V_1(t) - V_2(t))}{3R}$

$2V_{1x} - 2V_0 = V_{2x}$

$2V_{1x} - V_{2x} = 2V_0$

$\rightarrow \quad ma_1 = \frac{B^2L^2(V_1(t) - V_2(t))}{3R}$

$\frac{1}{F} = \frac{2}{F}$

$\frac{1}{9} = \frac{1}{d} + \frac{1}{36}$

$2mV_2 = \frac{B^2L^2}{3R}(S_1 - S_2)$

$\frac{1}{d} = \frac{5}{36}$

$m(V_1 - V_0) = \frac{B^2L^2}{3R}(S_1 - S_2)$ $\quad \frac{1}{F} = -\frac{1}{F} + \frac{1}{}$

$d = 36/5$

$mV_2 = mV_1 - mV_0$

$\frac{1}{9} = \frac{1}{d} + \frac{1}{36}$ $\quad V_0 = V_1 - V_2$ $\quad \frac{1}{9} = -\frac{1}{d} + \frac{1}{12}$

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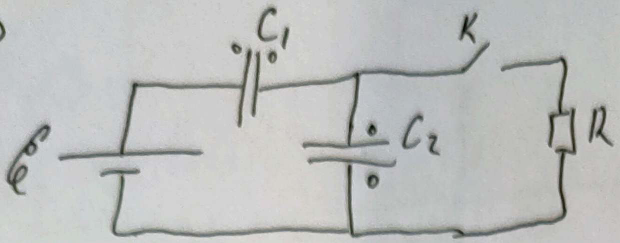
$\frac{1}{d} =$

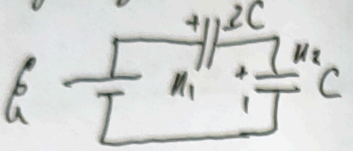
$\frac{1}{d} = \frac{1}{12} - \frac{1}{9} = \frac{3-}{4 \cdot 3 \cdot 3}$

Чистовик — Физика

№3



до замыкания ключа:



$$\mathcal{E} = U_1 + U_2 = \frac{q_1}{C_1} + \frac{q_2}{C_2}$$

по ЗСЗ: $q_1 = q_2 = q$

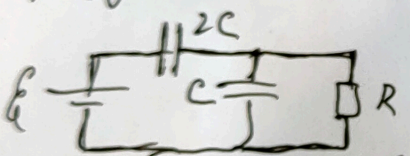
$(0 = -q_1 + q_2)$

$$\mathcal{E} = \frac{q}{2C} + \frac{q}{C} = \frac{3q}{2C}$$

$$U_1 = \frac{q}{2C} = \frac{\mathcal{E}}{3}$$

$$U_2 = \frac{q}{C} = \frac{2}{3}\mathcal{E}$$

сразу после K:

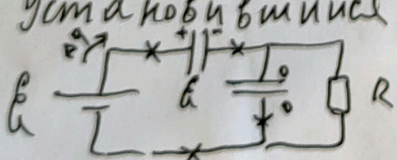


$$U_R = U_2 = \frac{2\mathcal{E}}{3}$$

$$I_0 R = \frac{2\mathcal{E}}{3}$$

$$\underline{I_0 = \frac{2\mathcal{E}}{3R}}$$

Установившийся режим (ток через конденс. не идёт)



Очевидно, через резис. R ток тоже идти не сможет.

$$0 \cdot R = U_R' = U_2' = 0$$

$$U_1' = \mathcal{E}$$

$$A_{\mathcal{E}} = \Delta U + Q$$

$$\Delta U = \frac{2C\mathcal{E}^2}{2} - \left(\frac{2C\mathcal{E}^2}{2 \cdot 9} + \frac{C\left(\frac{2}{3}\mathcal{E}\right)^2}{2}\right) = C\mathcal{E}^2 - \frac{C\mathcal{E}^2}{9} - \frac{2}{9}C\mathcal{E}^2$$

$$\Delta U = \frac{2}{3}C\mathcal{E}^2$$

$$A_{\mathcal{E}} = \mathcal{E}\Delta q = \mathcal{E}\left(2C\mathcal{E} - \frac{2C\mathcal{E}}{3}\right) = \frac{4}{3}C\mathcal{E}^2$$

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$$Q = -\frac{2}{3}C\mathcal{E}^2 + \frac{4}{3}C\mathcal{E}^2 = \underline{\frac{2}{3}C\mathcal{E}^2}$$