Часть 1

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

Шифр: **21200008**

ID профиля: **848745**

Вариант 4

Задача 2

$\nu_1 T_0 \cdot C(T) = \frac{g}{5}\nu\frac{T}{T_0}$ $\quad \delta Q$ - малое отд. тепло.

1) $\delta Q = \nu C(dT)\cdot(T_0 - dT) = \frac{g}{5}\nu R\frac{dT}{T_0}(T_0 - dT) = \frac{\nu g}{5}R\left(\frac{T_0\,dT}{T_0} - \frac{dT^2}{T_0}\right) = \frac{g}{5}\frac{\nu R}{T_0}(T_0 - T)dT$

$Q_1 = \int_0^{Q_1}\delta Q = \int_{T_0}^{\frac{3}{4}T_0}\frac{g\nu R}{5T_0}(T_0 - T)dT = \frac{g\nu R}{5T_0}\int_{T_0}^{\frac{1}{4}T_0}(T_0 - T\,dT) \quad Q_1 = \frac{g\nu R}{T_0 5}\left(T_0 T - \frac{T^2}{2}\right)\Big|_{T_0}^{\frac{1}{4}T_0}$

$Q_1 = \frac{g\nu R}{5T_0}\left(\left(\frac{1}{4}T_0^2 - \frac{gT_0^2}{32}\right) - \left(T_0^2 - \frac{T_0^2}{2}\right)\right) = \frac{g}{5}\frac{\nu R}{T_0}\left(\frac{(6+24-9)}{32}\right)T_0^2 = \frac{27g}{160}\nu R T_0$

2) Q - отданное тепло $\Rightarrow$ $-Q$ - полученное $\quad T_K$ - искомая T min A

$-Q = \Delta U + A$

$A = -Q - \Delta U$

$-Q = -\frac{g\nu R}{5T_0}\left(T_0 T - \frac{T^2}{2}\right)\Big|_{T_0}^{T_K}$ $\quad -Q = \frac{-g\nu R}{5T_0}\left(\left(T_0 T_K - \frac{T_K^2}{2}\right) - \left(T_0^2 - \frac{T_0^2}{2}\right)\right)$

$-Q = -\frac{g\nu R}{5T_0}\left(T_0 T_K - \frac{T_K^2}{2} - \frac{T_0^2}{2}\right)$

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

$A = -Q - \Delta U = -\frac{g\nu R}{5T_0}\left(-\frac{T_K^2}{2} + T_0 T_K - \frac{T_0^2}{2}\right) - \frac{3}{2}\nu R(T_K - T_0)$

$A = \frac{3\nu R}{10}\left(\frac{3T_K^2}{T_0} - 6T_K + 3T_0 - 5T_K + 5T_0\right) = \frac{3\nu R}{10}\left(\frac{3T_K^2}{T_0} - 11T_K + 8T_0\right)$

Т.к. парабола, ветви вверх $\Rightarrow$ min A в вершине $\quad T_{\text{вершины}} = T_K = \frac{11}{6}T_0$

3) $A = \frac{3\nu R}{10}\left(\frac{3}{10}\cdot\frac{121}{36}T_0 - \frac{11}{6}\cdot 11 T_0 + 8T_0\right)$

$A = \frac{3\nu R}{10}\left(\frac{121}{120}T_0 - \frac{121}{6}T_0 + 8T_0\right)$

(2)

Числовик

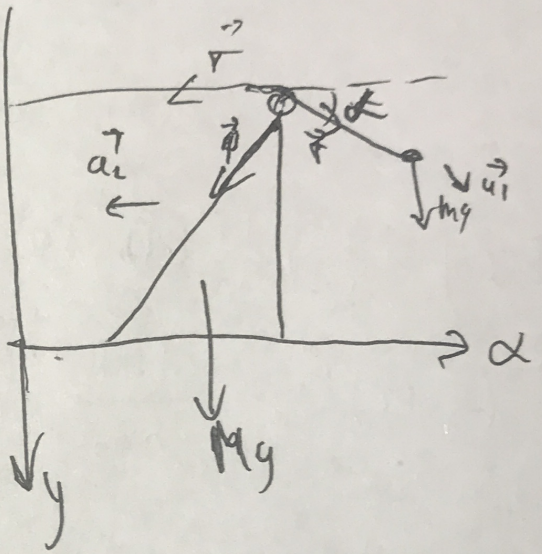
Задача 1

$ma_1 \cos\beta = T\cos\alpha$

$-ma_2 = -P\sin\alpha$

$P = \sqrt{2T^2 - 2T^2\cos\alpha}$

$-T\sin\alpha + mg = ma_1 \sin\beta$



$ma_1 \cos\beta = T\cos\alpha$

$ma_2 \sin\beta = -T\sin\alpha + mg$

2) рассмотрим малое тепло ΔQ, отводимое от газа (T - температура газа в данный момент)

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

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

$$-\Delta Q = -\frac{9}{5 T_0} \nu R T (T_0 - T)$$

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

$$\Delta A = \frac{3\nu R}{10} \left(-\frac{6 T_0 T}{T_0} + \frac{6T^2}{T_0} - 5T + 5T_0 \right)$$

$$\Delta A = \frac{3\nu R}{10} \left(-11T + \frac{6T^2}{T_0} + 5T_0 \right)$$

$$T = \frac{11}{12} T_0$$

$$\Delta A = \frac{3\nu R}{10} \left(\frac{-121}{12} T_0 + \frac{6 \cdot 121}{144} T_0 + 5T_0 \right)$$

$$\Delta A = \left(\frac{6 \cdot 121 - 12 \cdot 121}{144} + 5 \right) \cdot \frac{3\nu R}{10} T_0$$

$$\Delta A = -\frac{6 \cdot 121}{144} + 5$$

$$-\frac{121}{24} + \frac{120}{24} = \frac{1}{24} \cdot \frac{3}{10} \nu R T_0$$

$$-\frac{1}{80} \nu R T_0$$

24-9 +16

$Q' = -\frac{9JR}{5T_0}$ (

Q - отдано

2)

$\delta Q^* = \Delta U + A$

$A = \delta Q^* + \Delta U$

$A = -Q - \Delta U$

$\delta Q^* = -\delta Q$

$\delta Q^* = \frac{9}{5} JR \frac{1}{T_0} (T_0 - dT)$

$\delta Q^* = \frac{9}{5} \frac{JR}{T_0} (-dT T_0 + dT^2)$

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

$A = \frac{9JR}{5T_0} ((T T_0 - dT^2) - \frac{3}{2} JR (T - T_0) = \frac{3JR}{5T_0} ((T T_0 - dT^2) - \frac{5}{2}(T + T_0))$

$A = \frac{3JR}{10} (6T T_0 - dT^2 \cdot 6 / T_0$

$A = \frac{3JR}{T_0} (6T T_0 - \frac{dT^2 \cdot 6}{T_0} - \frac{5dT}{2} + 5T_0$

$-Q = \frac{9JR}{5T_0} (T_0 T_K - \frac{T_K^2}{2}) \Big|_{T_0}^{T_K}$

$-Q = \frac{-9JR}{6T_0} ((T_0 T_K - \frac{T_K^2}{2}) - \frac{T_0^2}{2})$

$-Q = \frac{-9JR}{5T_0} (\frac{3}{2} - \frac{T_K^2}{2} + T_0 T_K - \frac{T_0^2}{2})$

$\Delta U = \frac{3}{2} JR (T_K - T_0) = \frac{3}{2} JR (T_K - T_0)$

$A = -Q - \Delta U = \frac{-9JR}{5T_0} (-\frac{T_K^2}{2} + T_0 T_K - \frac{T_0^2}{2}) - \frac{3}{2} JR (T_K - T_0)$

$A = \frac{3JR}{10} (\frac{6T_K^2}{2T_0} - 6T_K + \frac{T_0 \cdot 6}{2} - 5T_K + 5T_0)$

$A = \frac{3JR}{10} (\frac{3T_K^2}{T_0} - 11T_K + 8T_0)$ - парабола ветви вверх $\Rightarrow$

вершина параболы - min значение

$T_K = \frac{-11}{6} T_0$

$\frac{21}{10} = 1\ 24 - 9 - 16$

21200008 (U848745 M1265781)

Чистовик

(1)

Задача 2

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

δQ - малое отд. тепло

1) $\delta Q = \vartheta C(\Delta T) \cdot (\Delta T - T_0) = \frac{9}{5} \vartheta R \frac{\Delta T}{T_0} (\Delta T - T_0) = \frac{9 \vartheta R}{5 T_0} (-\Delta T T_0 + T \Delta T) = \frac{9 \vartheta R}{5 T_0} \Delta T (-T_0 + T)$

$$Q_{12} = \int_{Q_1}^{Q_2} \delta Q = \int_{T_1}^{\frac{3}{4}T_0} \frac{9 \vartheta R}{5 T_0} (-T_0 + T) \Delta T = \frac{9 \vartheta R}{5 T_0} \int_{T_0}^{\frac{3}{4}T_0} (-T_0 + T) dT = \frac{9 \vartheta R}{5 T_0} \left(-T_0 T + \frac{T^2}{2} \right) \Big|_{T_0}^{\frac{3}{4}T_0}$$

$$Q_{12} = \frac{9 \vartheta R}{5 T_0} \left(-\frac{3}{4} T_0^2 + \frac{9 T_0^2}{32} + T_0^2 - \frac{T_0^2}{2} \right) = \frac{9}{5} \frac{R T_0}{T_0} \frac{1}{32} T_0^2 = \frac{9}{160} \vartheta R T_0$$

2) Рассм малое тепло ΔQ, отводимое от газа (T - темп после очередного изм.)

ΔA - работа при данном изм.

$$\Delta Q = \vartheta C (T - T_0) = \vartheta \frac{9}{5} R \frac{T}{T_0} (T - T_0)$$

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

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

$$-\Delta Q = -\frac{9 \vartheta R}{5 T_0} (T_0 - T) = -\frac{9 \vartheta R}{5} \left(T - \frac{T^2}{T_0} \right)$$

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

$$\Delta A = -\frac{9}{5} \vartheta R \left(T - \frac{T^2}{T_0} \right) - \frac{3}{2} \vartheta R (T - T_0) = \frac{3 \vartheta R}{10} \left(-6T + \frac{6T^2}{T_0} - 5T + 5T_0 \right)$$

$$\Delta A = \frac{3 \vartheta R}{10} \left(-11T + \frac{6T^2}{T_0} + 5T_0 \right)$$ ← парабола, ветви вверх ⇒ вершина - min A

$$T = T_{верш.} = \frac{11}{12} T_0$$

3) $$\Delta A\left(\frac{11}{12} T_0\right) = \frac{3 \vartheta R}{10} \left(-\frac{121}{12} T_0 + \frac{6 \cdot 121}{144} T_0 + 5 T_0 \right) = \frac{3 \vartheta R}{10} \left(\frac{-12 \cdot 121 + 6 \cdot 121}{144} + 5 \right) T_0$$

$$\Delta A = \frac{3 \vartheta R}{10} \left(-\frac{6 \cdot 121}{144} + 5 \right) T_0 = \frac{3 \vartheta R}{10} \left(-\frac{121}{24} + \frac{120}{24} \right) T_0 = -\frac{3 \vartheta R}{10} \frac{1}{24} = -\frac{\vartheta R T_0}{80}$$

Ответ: 1) $\frac{9}{160} \vartheta R T_0$ 2) $\frac{11}{12} T_0$ 3) $-\frac{\vartheta R T_0}{80}$

$$Q = \int \frac{9}{5} R \frac{dT}{T_0} (T - T_0)$$

$$\int_{\frac{3}{4}T_0}^{T_0} \frac{\frac{9}{5} J R}{T_0} (T dT - T_0 dT) = \int_{T_0}^{\frac{3}{4}T_0} \frac{9 J R}{5 T_0} d(T - T_0)$$

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

$$\frac{9}{32} T_0^2 - \frac{3}{4} T_0^2 - \frac{T_0^2}{2} + T_0^2$$

$$9 - 24 + 16$$

Задача 2

ν, T_0, γ

1) $Q = \nu c_\Delta T$

~~$\Delta Q = \nu c(T) dT = \frac{1}{2}\nu R \frac{T}{T_0}(T - T_0)$~~

δQ – отданное тепло

$\delta Q = \nu c(dT)(T_0 - dT) = \nu \frac{9}{5} R \frac{dT}{T_0}(T_0 - dT) = \frac{9}{5}\nu R\left(\frac{dT^2}{T_0} - \frac{T_0 dT}{T_0}\right) = \frac{9}{5}\nu R\left(\frac{T dT}{T_0} - \frac{T_0 dT}{T_0}\right)$

$Q_1 = \int_0^{Q_1} \delta Q = \int_{T_0}^{\frac{3}{4}T_0} \frac{9}{5}\nu R \frac{dT}{T_0}(T - T_0) = \frac{9}{5}\nu R \int_{T_0}^{\frac{3}{4}T_0} \frac{1}{T_0}(T - 1)dT = \frac{9}{5}\frac{\nu R}{T_0}\left(\right.$

$\delta Q = \nu c(dT)(T_0 - dT) = \nu \frac{1}{5} R \frac{dT}{T_0}(T_0 - dT) = \frac{9}{5}\nu R\left(\frac{T_0 dT}{T_0} - \frac{dT^2}{T_0}\right) =$

$= \frac{9}{5}\nu R\left(\frac{T_0 dT}{T_0} - \frac{T dT}{T_0}\right) = \frac{9}{5}\nu R \cdot \frac{dT}{T_0}(T_0 - T)$

$Q_1 = \int_0^{Q_1} \delta Q = \int_{T_0}^{\frac{3}{4}T_0} \frac{9}{5}\frac{\nu R}{T_0}(T_0 - T)dT = \frac{9\nu R}{5T_0}\int_{T_0}^{\frac{3}{4}T_0}(T_0 - T)dT = \frac{9\nu R}{5T_0}\left(\left(\frac{3}{4}T_0 T_0 - \frac{9T_0^2}{16 \cdot 2}\right) - \left(T_0^2 - \frac{T_0^2}{2}\right)\right)$

$Q_1 = \frac{9\nu R}{5T_0}\left(\left(\frac{3}{4}T_0^2 - \frac{9T_0^2}{32}\right) - \left(T_0^2 - \frac{T_0^2}{2}\right)\right) = \frac{9}{5}\frac{\nu R}{T_0}\left(-\frac{T_0^2}{2} + \frac{3}{4}T_0^2 - \frac{9T_0^2}{32}\right) =$

$= \frac{9}{5}\frac{\nu R}{T_0}\left(\frac{-16 + 24 - 9}{32}\right)T_0^2 = \frac{9\nu R \cdot 31 T_0^2}{5 \cdot 32 \cdot T} = \frac{279\nu R T_0}{160} = \frac{279}{160}\nu R T_0$

2) $\min A$ при $\min \Delta V$

Q' – подведенное к газу тепло

$\delta Q = \nu \frac{9}{5} R \frac{dT}{T_0}(T_0 - dT)$

~~$Q = \Delta U + A$~~

$Q' = \Delta U + A$

$A =$

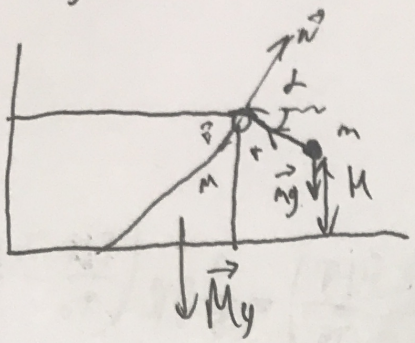
$Q' - \Delta U = A$

$Q' = Q$

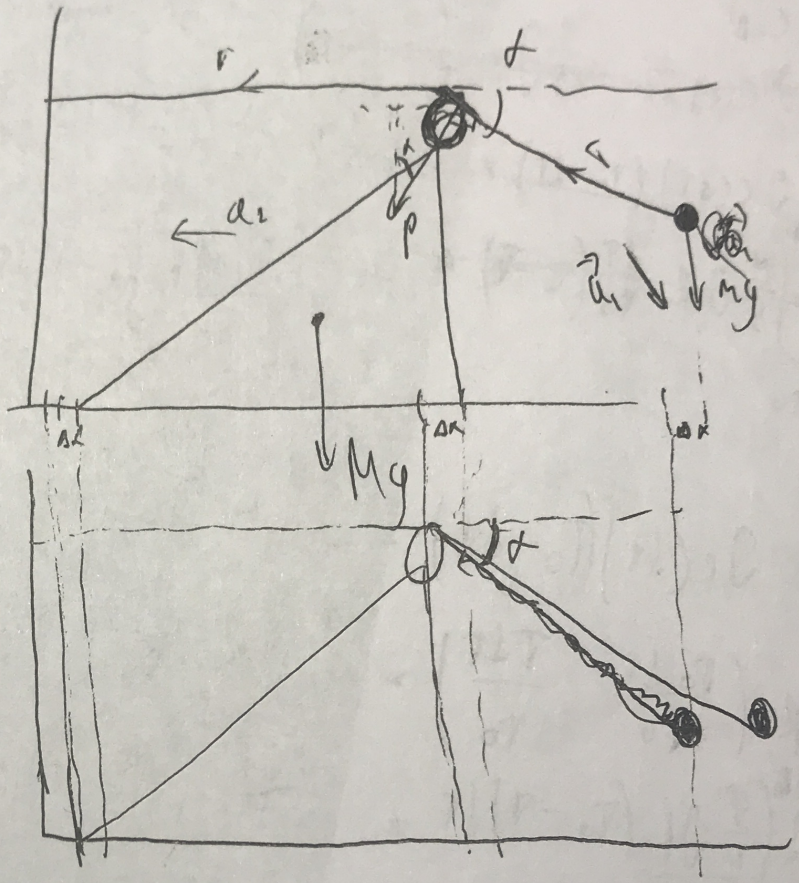
из 1 пункта $Q' = -\frac{9\nu R}{T_0 5}\left(T_0 T - \frac{T^2}{2}\right)\Big|_{T_0}^{TK}$

$Q' = -\left(\frac{9\nu R}{5T_0}\left(T_0 TK - \frac{TK^2}{2}\right) - \left(\frac{T_0^2}{2}\right)\right)$

Задача 1



$\cos\alpha = \frac{b}{l_2}$



Ma_1

ma_2

$T\cos\alpha = ma_1 \cos\beta$

$Ma_2 = P\sin\alpha$

P_2

Часть 2

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

Шифр: **21200008**

ID профиля: **848745**

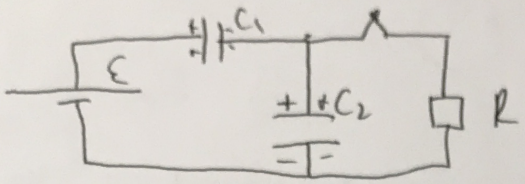
Вариант 4

(1) Чистовик

№3

$C_2 = C$

$C_1 = 5C$



до: $\mathcal{E} = U_1 + U_2$

замыкания $-q_1 + q_2 = 0$ $\quad U_1C_1 = U_2C_2$

$5CU_1 = CU_2$

$$\begin{cases} \mathcal{E} = U_1 + U_2 \\ 5CU_1 = CU_2 \end{cases} \qquad CU_2 = 5C(\mathcal{E} - U_2)$$

$U_2 = \frac{5}{6}\mathcal{E} \quad U_1 = \frac{1}{6}\mathcal{E}$

сразу после замыкания: $U_2 = I_R \cdot R$

1) $I_R = \frac{U_2}{R} = \frac{\frac{5}{6}\mathcal{E}}{R} = \frac{5\mathcal{E}}{6R}$

2) энергия до: $W_1 + W_2 = \frac{C_1U_1^2}{2} + \frac{C_2U_2^2}{2}$

энергия пост: $W_1' + W_2' = \frac{C_1\mathcal{E}^2}{2} + 0$

$A_{ист} = \mathcal{E}\Delta q = \mathcal{E}(\mathcal{E}C - U_1C)$

$(W_1' + W_2') - (W_1 + W_2) + Q = A_{ист}$

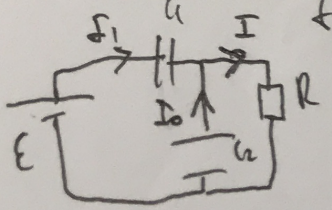
$\frac{C_1\mathcal{E}^2}{2} - \frac{C_1U_1^2}{2} - \frac{C_2U_2^2}{2} + Q = \mathcal{E}(\mathcal{E}C - U_1C)$

$\frac{5C\mathcal{E}^2}{2} - \frac{5C\mathcal{E}^2}{72} - \frac{25C\mathcal{E}^2}{72} + Q = \mathcal{E}^2C - \frac{5}{9}\mathcal{E}^2C$

$Q = \frac{5C\mathcal{E}^2}{2} - \frac{35C\mathcal{E}^2}{9} + \frac{25C\mathcal{E}^2}{72} = C\mathcal{E}^2\left(\frac{5}{2} - \frac{5}{9} + \frac{25}{72}\right) = C\mathcal{E}^2\left(\frac{180}{72} + \frac{10}{72}\right)$

$Q = C\mathcal{E}^2\frac{190}{72} = \frac{95}{36}C\mathcal{E}^2$

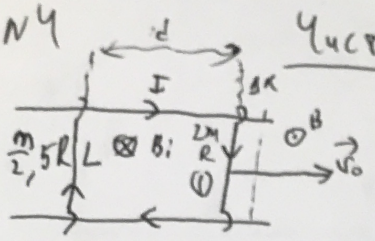
3)



$I = I_1 + I_0$

Ответ: $I_R = \frac{5\mathcal{E}}{6R}$; $Q = \frac{25}{12}C\mathcal{E}^2$

№4 Чистовик (2)



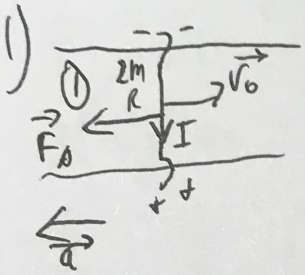
Т.к. $\Delta\Phi \uparrow$, то возникнет B_i, напр. таким образом, чтобы препятствовать изм. потока ($B_i \downarrow\uparrow B$)

$\Delta\Phi = BL(l+\Delta x) - BLl = BL\Delta x$

$|\mathcal{E}_i| = \frac{BL\Delta x}{\Delta t} = BLv_0$ ← для нач. момента времени

$|\mathcal{E}_i| = 6IR$ $\quad I = \frac{|\mathcal{E}_i|}{6R} = \frac{BLv_0}{6R}$

1)



$F_A = 2am$

$BIL = 2am$

$BL \cdot \frac{BLv_0}{6R} = 2am$

$\frac{B^2L^2v_0}{12R} = am$

$a = \frac{B^2L^2v_0}{12Rm}$

2) $2mv_0 = \frac{m}{2}mv_2 + 2mv_1$

$v = v_2 = v_1$, т.к. через продолж. промежуток времени система придет в равновесие, т.е. $\Delta\Phi = 0 \Rightarrow$ расст. между перемычками будет одинаковым $\Rightarrow$ скорости одинаковы

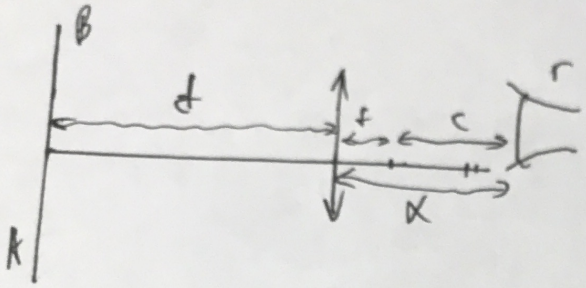
$2mv_0 = \frac{m}{2}v + 2mv$

$2v_0 = \frac{5}{2}v \qquad v = \frac{4}{5}v_0$

Ответ: $a = \frac{B^2L^2v_0}{12Rm}$ $\quad v = \frac{4}{5}v_0$

Чистовик (3)

№5



расст. от циферблата до линзы $d = 96\text{см} = 4F$

$F = 24$ см, расст. от линзы до изобр $= f$, расст. от глаза до изобр $= C$

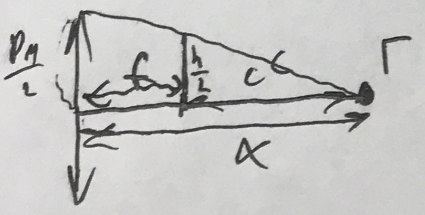
1) $\frac{1}{F} = \frac{1}{d} + \frac{1}{f}$ $\quad \frac{1}{f} = \frac{4-1}{4F} = \frac{3}{4F}$

$\frac{1}{F} = \frac{1}{4F} + \frac{1}{f}$ $\quad f = \frac{4}{3}F = \frac{4}{3} \cdot 24 = 32\text{см}$

$x = f + c = \frac{4}{3}F + c = 32 + 24 = 56\text{см}$

2) $\frac{f}{d} = \frac{h}{H} \Rightarrow h = \frac{f \cdot H}{d} = \frac{\frac{4}{3}FH}{4F} = \frac{H}{3} = 3\text{см}$ – диаметр изобр.,

[illegible]



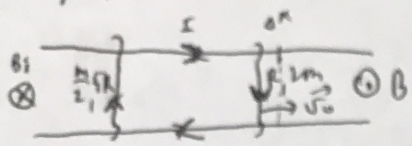
Из подобия треугольников следует:

$\frac{xC}{H} = \frac{x(C+f)}{D_M} \Rightarrow D_M = \frac{(C+f)}{C} h = \frac{x}{c} h = \frac{56}{24} \cdot 3 = 7\text{см}$

$D_M = 7\text{см}$

Ответ: $x = 56\text{см}$; $D_M = 7\text{см}$

№4



т.к происходит изменения магн. потока ф. Возникает B_i, сопр. данному изм. ч.е.

$\Delta\Phi = BL(L+\Delta x) - BL^2 = BL\Delta x$

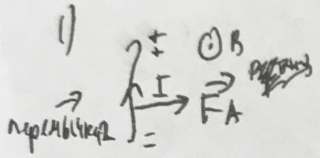
$|\mathcal{E}_i| = \frac{BL\Delta x}{\Delta t} = BLv_0$

$\mathcal{E}_i = IGR$

$BLv_0 = CIR$

$I = \frac{BLv_0}{6R}$

1)



$F_A = \frac{m}{2}a$

$BIL = \frac{m}{2}a$

$BL\frac{BLv_0}{6R} = \frac{m}{2}a$

$a = \frac{B^2L^2v_0}{3Rm}$

2) $2mv_0 = \frac{m}{2}v_2 + 2mv_1$

$v = v_2 = 2v_1$, т.к через продолж. прон. времени система придет в равновесие, т.е. $\Delta\Phi = 0$ =>

=> расстояние между перемычками будет одинаковым. => и скорости будут одинаковы

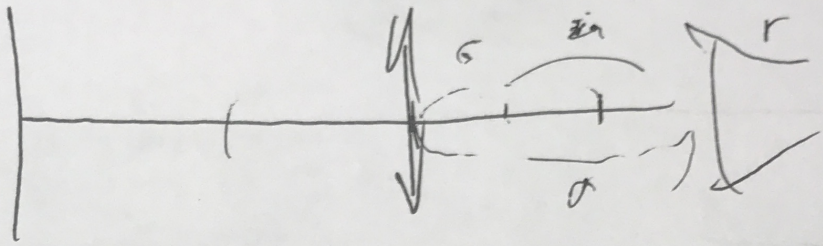
$2mv_0 = \frac{m}{2}v + 2mv$

$2v_0 = \frac{5}{2}v \cdot v = \frac{4}{5}v_0$

Ответ: $a = \frac{B^2L^2v_0}{3Rm}$

N5

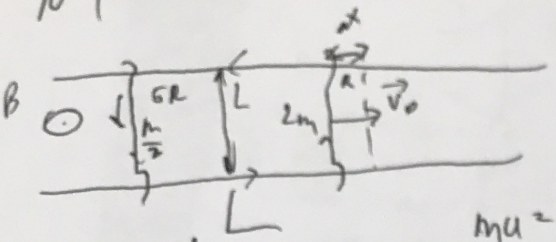
1)



$$\frac{1}{F} = \frac{1}{4F} + \frac{1}{f}$$

$$\frac{1}{f} = \frac{4-1}{4F}$$

N4



$\Phi = BLx$

$|\mathcal{E}_i| = \left|\frac{BL\Delta x}{\Delta t}\right| = |BLv_0|$

$\mathcal{E}_i = I6R$

$BLv_0 = 6IR$

$I = \frac{BLv_0}{6R}$

$\frac{m}{2}a = F_A$

$\frac{m}{2}a = BIL$

$\frac{m}{2}a = BL\frac{BLv_0}{6R}$

$q = \frac{2B^2L^2v_0}{6Rm}$

$q = \frac{B^2L^2v_0}{3Rm}$

$\frac{5}{2}mv - 2mv_0 = -F_A\Delta t$

$v = \frac{5}{2}a_0t$

$v = v_0 - a_0t$

$\Delta t = \frac{v_0}{2a}$

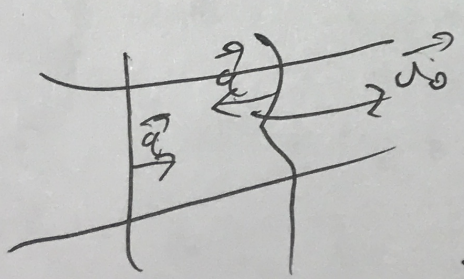
$\frac{5}{2}mv - 2mv_0 = -\frac{B^2L^2v_0}{6R}\cdot\frac{v_0}{2}$

$F_A = \frac{BLv_0}{2R}$

$\frac{5}{2}v - 2v_0 = -\frac{1}{4}v_0$

$\frac{5}{2}v = \frac{9}{4}v_0$

$v = \frac{9}{10}v_0$



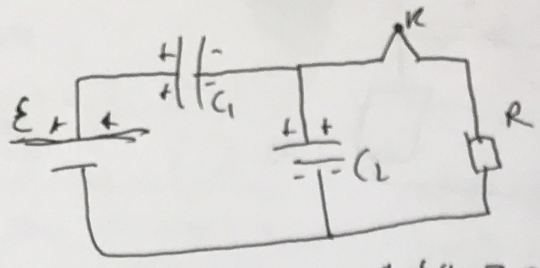
$a = B^2L^2(v_0 - at)$

$\int v_1 = \int v_0t - \frac{at^2}{2}$

№

$C_2 = C$

$C_1 = 5C$



до замык.

$\mathcal{E} = U_1 + U_2$

$-q_1 + q_2 = 0$

$q_1 = q_2$

$C_1U_1 = C_2U_2$

$5CU_1 = CU_2$

$\begin{cases} \mathcal{E} = U_1 + U_2 \\ 5CU_1 = CU_2 \end{cases}$

$5(\mathcal{E} - U_2) = U_2$

$5\mathcal{E} = 6U_2$

$U_2 = \frac{5}{6}\mathcal{E} \qquad U_1 = \frac{1}{6}\mathcal{E}$

Сразу после замык. $U_2 = \frac{5}{6}\mathcal{E}$

1) $U_2 = I_1R$

$I_1R = \frac{U_2}{R} = \frac{\frac{5}{6}\mathcal{E}}{R} = \frac{5\mathcal{E}}{6R}$

2) ~~$W_1 + W_2 = W_1' + W_2' + Q$~~

$(W_1' + W_2') - (W_1 + W_2) + Q = A_{ист}$

$W_2' = 0$

$W_1' = \frac{5C\mathcal{E}^2}{2}$

$W_1 = \frac{5CU_1^2}{2}$

$W_2 = \frac{CU_2^2}{2}$

$A_{ист} = \mathcal{E}\Delta q = \mathcal{E}(q_1' - q_1) = \mathcal{E}(\mathcal{E}5C - 5CU_1)$

$\frac{5C\mathcal{E}^2}{2} - \frac{5CU_1^2}{2} + \frac{CU_2^2}{2} + Q = \mathcal{E}(\mathcal{E}5C - 5CU_1)$

$Q = \mathcal{E}^2 5C - 5CU_1\mathcal{E} - \frac{5C\mathcal{E}^2}{2} + \frac{5CU_1^2}{2} + \frac{CU_2^2}{2}$

$Q = \frac{\mathcal{E}^2 5C}{2} - \frac{5C\mathcal{E}^2}{6} + \frac{5C\mathcal{E}^2}{72} + \frac{5C25\mathcal{E}^2}{72}$

$Q = C\mathcal{E}^2\left(\frac{5}{2} - \frac{5}{6} + \frac{5}{72} + \frac{125}{72}\right)$

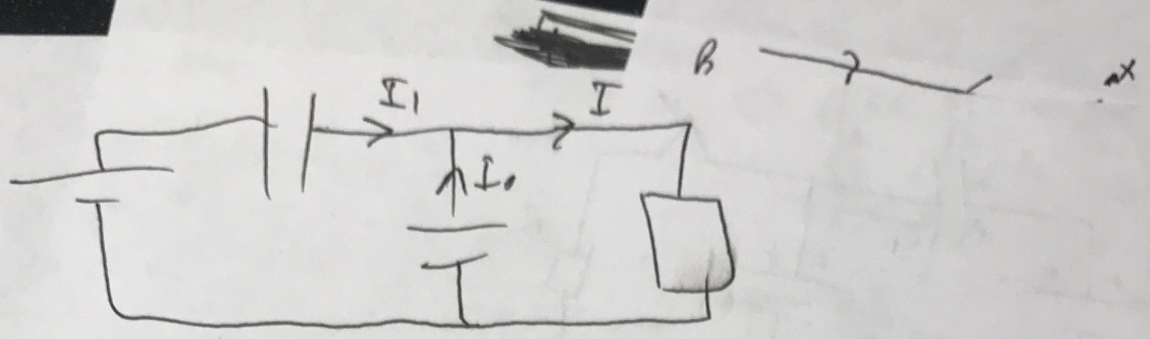
$Q = \mathcal{E}^2\left(\frac{10}{6} + \frac{27}{72}\right)$

$Q = \mathcal{E}^2\left(\frac{147}{72}\right)$

$Q = \mathcal{E}^2\left(\frac{49}{24}\right)$

№4

3)



$I = I_1 + I_0$

$I_1 = \dot{q}_1$ $\quad I_2 = \dot{q}_2$ $\quad \frac{1}{4} - \frac{1}{96}$

$\mathcal{E} = u_1 + u_1$

$\mathcal{E} = u_1 + IR$

$\mathcal{E} = u_1 + (I_1 + I_0)R$

$\mathcal{E} = \frac{q_1}{C} + (I_1 + I_0)R$

$\mathcal{E} = \frac{q_1}{C} + I_1 R + I_0 R$

$\frac{4-1}{96} = \frac{3}{96}$

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