Часть 1

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

Шифр: **21202075**

ID профиля: **807367**

Вариант 1

Чистовик.

№2.

Дано:

T_0

ν

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

$C_M = 2R\frac{T}{T_0}$; $C_M = \alpha T$

$C = C_M \nu$ $\quad \alpha = \frac{2R}{T_0}$

1) $Q_1 = \nu\int_{T_1}^{T_2} C\,dT = \nu\int_{T_1}^{T_2} \alpha T\,dT = \frac{\nu\alpha T^2}{2}\Big|_{T_1}^{T_2} =$

$= \left|\frac{\nu\alpha}{2}\left(T_2^2 - T_1^2\right)\right| = \frac{\nu\alpha}{2}\cdot\frac{11}{36}T_0^2 =$

$= \frac{2R}{T_0\cdot 2}\cdot\frac{11}{36}\cdot T_0^2 = \frac{11\nu R T_0}{36}$

1) Q_1 - ?

$\left(T_1 = T_0,\ T_2 = \frac{5}{6}T_0\right)$

2). T_{min} - ?

3). A_{min} - ?

2). $A_г = Q - \Delta U$

$Q = \nu\int_{T_0}^{T_{min}} C\,dT = \left|\frac{\nu\alpha}{2}\left(T_{min}^2 - T_0^2\right)\right|$; $\Delta U = \frac{3}{2}\nu R\left(T_{min} - T_0\right)$

$A_г = \left|\frac{2R\nu}{T_0\cdot 2}\left(T_{min}^2 - T_0^2\right) - \frac{3}{2}\nu R\left(T_{min} - T_0\right)\right| = \left|\nu R\left(T_{min} - T_0\right)\left(\frac{T_0 + T_{min}}{T_0} - \frac{3}{2}\right)\right|$

$A_г = \nu R T_0 - \frac{3}{2}\nu R T_0 - \frac{\nu R T_{min}^2}{T_0} + \frac{3}{2}\nu R T_{min}$; дифференцируем по T_{min}.

$A_г' = -\frac{\nu R}{T_0}\cdot 2T_{min} + \frac{3}{2}\nu R$

$A_г' = 0$

$\frac{3}{2} = \frac{2T_{min}}{T_0}$

$3T_0 = 4T_{min}$

$T_{min} = \frac{3}{4}T_0$

3). $A_{min} = \frac{1}{4}T_0\nu R\left(\frac{1,75T_0}{T_0} - 1,5\right) =$

$= \frac{1}{16}\nu R T_0$

Ответ: 1) $Q_1 = \frac{11}{36}\nu R T_0$ 3). $A_{min} = \frac{1}{16}\nu R T_0$

2). $T_{min} = \frac{3}{4}T_0$

Чистовик. Физика, 11кл, 1 часть.

№1.

Дано:

$\cos\alpha = \frac{3}{5}$

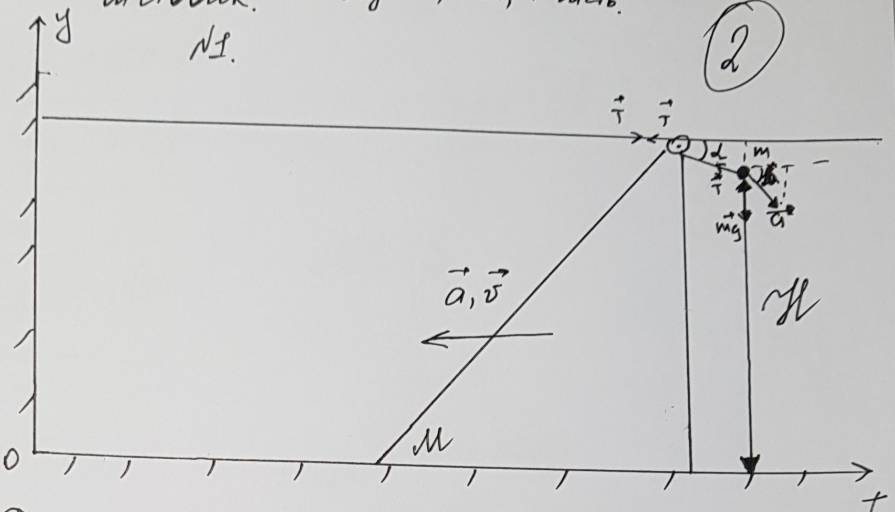
Ж

1) β - ?

2) a_1 - ?

3) $\frac{m}{M}$ - ?

4) t - ?



2

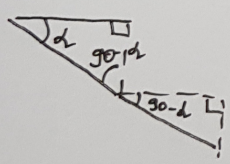
1). Рассм. шар.:

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

OY: $T\cdot\sin\alpha = mg$ – при равновесии (когда дерется)

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

$\boxed{\beta = 90 - \alpha}$ – ответ 1.



2). $a_1 = a_x = a\sin\beta$

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

$T = \frac{ma\cos\beta}{\cos\alpha}$

При движении:

OY: ~~$N\cos\beta$~~ $T\cdot\sin\alpha - mg = ma\cdot\sin\beta$.

$\frac{ma\cos\beta}{\cos\alpha}\cdot\sin\alpha - mg = ma\sin\beta$

$ma\cos\beta\cdot tg\alpha - mg = ma\sin\beta$

$ma(\cos\beta\cdot tg\alpha - \sin\beta) = mg$

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

$a_1 = \frac{g}{\cos\beta\, tg\alpha - \sin\beta}\cdot\sin\beta$

Чистовик. Физика, 11 кл., 1 часть (3)

$a_1 = \dfrac{10 \cdot 0{,}8\ g \cdot \sin(90-\alpha)}{\cos\beta \cdot tg\alpha - \sin\beta}$ $\quad tg\alpha = 1\frac{1}{3}$

$$\boxed{a_1 = \frac{g \cdot \sin(90-\alpha)}{\cos(90-\alpha)\,tg\alpha - \sin(90-\alpha)}} \text{ – ответ 2}$$

3) Рассм. кмин.

$T - T\cos\alpha = Ma_1$

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

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

$T = \dfrac{ma\cos\beta}{\cos\alpha}$

$\dfrac{ma\cos\beta}{\cos\alpha}(1-\cos\alpha) = Ma_1 \quad |:M$

$\dfrac{m}{M}\,\dfrac{a\cos\beta}{\cos\alpha}(1-\cos\alpha) = a_1$

$\dfrac{m}{M} \cdot \dfrac{g \cdot \sin(90-\alpha)}{\cos(90-\alpha)\,tg\alpha - \sin(90-\alpha)}(1-\cos\alpha) =$

$$\boxed{\frac{m}{M} = \frac{a_1}{a\cos\beta(1-\cos\alpha)} = \frac{g \cdot \sin(90-\alpha) \cdot (\cos(90-\alpha) \cdot tg\alpha - \sin(90-\alpha))}{(\cos(90-\alpha)\,tg\alpha - \sin(90-\alpha)) \cdot g \cdot \cos(90-\alpha)(1-\cos\alpha)}}$$

Ответ 3

4).

Термовик

Дано: ν
T_0
$C_M(T) = 2R\frac{T}{T_0}$

$\alpha = \frac{2R}{T_0}$
$C_M = \frac{C}{\nu}$
$C = C_M \nu$

$C_M(T) = 2R\frac{T}{T_0} \to C_M = \alpha T$

1) Q_1 - ?
$\left(T_1 = T_0,\ T_2 = \frac{5}{6}T_0\right)$

2) T_{min} - ? ($A_{\text{п}}$ - min)

1). $Q = \nu\int_{T_1}^{T_2} C\,dT = \nu\int_{T_1}^{T_2} \alpha T\,dT =$

$= \nu\,\alpha\,\frac{T^2}{2}\Big|_{T_1}^{T_2} =$

$= \nu\left|\frac{\alpha T_2^2}{2} - \frac{\alpha T_1^2}{2}\right| =$

$= \nu\left|\frac{\alpha}{2}\left(T_2^2 - T_1^2\right)\right| =$

$= \left|\frac{\nu\alpha}{2}\left(\frac{25}{36}T_0^2 - T_0^2\right)\right| =$

$= \left|\frac{\nu\alpha}{2}\left(\frac{11}{36}T_0^2\right)\right| = \frac{2R}{T_0 \cdot 2}\cdot\frac{11}{36}T_0^2 =$

$= \frac{\nu 11 R T_0}{36}$ — ответ

3). A_{min}

$\int T\,dT = \frac{T^2}{2}$ ($T' = T$)

$\int T\,dT = \frac{T^2}{2}$

$R = \frac{\text{Дж}}{\text{К} \cdot \text{моль}}$

$\left[\frac{\text{моль} \cdot \text{К} \cdot \text{Дж}}{\text{К} \cdot \text{моль}}\right]$

$\int T\,dT$

2) $C = \alpha T$ $\alpha = \frac{2R}{T_0}$ $c_м = \frac{C}{\nu}$

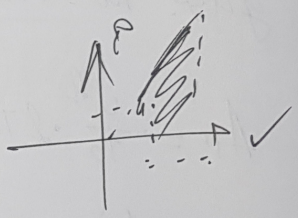
$Q = A_Г + \Delta U$ $C = \frac{2R}{T_0} T$

$C T_0 = 2RT$

$A_П = Q - \Delta U$ $T = \frac{C T_0}{2R}$

$A_П = \frac{\nu\alpha}{2}\left(T_0^2 - T_{min}^2\right) - \frac{3}{2}\nu R\left(T_0 - T_{min}\right)$

$C = \frac{\Delta Q}{\Delta T} = \frac{Q_1 - Q_2}{T_0 - T_{min}} =$ $C_1 = 2R$



$C_1 = \frac{Q_1}{T_0} \Big| \cdot T_0$

$C_1 T_0 = Q_1 = 2RT_0$

$C_2 = \frac{Q_1 - Q_2}{T_0 - T_{min}} = \frac{2RT_0 - \int C dT}{}$

$A_П = \frac{\nu R}{T_0}\left(T_0^2 - T_m^2\right)$

$\left(T_0 + T_m\right) +$

$Q = \int_{T_0}^{T_{min}} C dT = \frac{\nu\alpha}{2}\left(T_0^2 - T_{min}^2\right)$

$+ \frac{3}{2}\nu R\left(T_0 + T_m\right) -$

$A_Г = \nu R\left(T_0 - T_{min}\right)\left(\frac{T_0 + T_{min}}{T_0} - \frac{3}{2}\right)$ $=$

$A_Г = min$, если

$T_0 = T_{min}$

$A_Г = 0$

$-?$

$A_Г = \nu R\left(T_0 - T_0\right)\left(\frac{2T_0}{T_0} - \frac{3}{2}\right)$

3). ~~A=0~~ ~~Q=0~~

$A_T = \frac{3}{2}\nu R\left(\frac{T_0^2 - T_{min}^2}{T_0}\right) - \frac{3}{2}\nu R\left(T_0 - T_{min}\right) =$

$= \frac{3}{2}\nu R T_0 - \frac{3}{2}\nu R\frac{T_{min}^2}{T_0} - \frac{3}{2}\nu R T_0 + \frac{3}{2}\nu R T_{min} =$

$= \frac{3}{2}\nu R T_0 - \frac{3}{2}\nu R T_0 - \frac{\nu R T_{min}^2}{T_0} + \frac{3}{2}\nu R T_{min}$

диф. по T_{min}

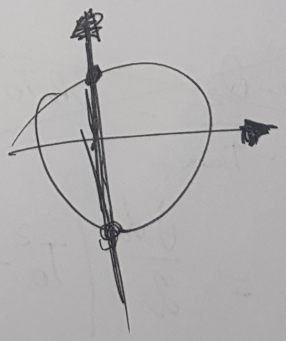
$A_T' = -\frac{\nu R}{T_0}\cdot 2T_{min} + \frac{3}{2}\nu R = \nu R\left(\frac{3}{2} - \frac{2T_{min}}{T_0}\right) = 0$

$A_T' = 0$

$\frac{3}{2} = \frac{2T_{min}}{T_0}$

$3T_0 = 4T_{min}$

$T_{min} = \frac{3T_0}{4}$



3). $T_{min} = \frac{3T_0}{4}$

$A_{12} = \nu R (T_0 - T_{min}) \left(\frac{T_0 + T_{min}}{T_0} - \frac{3}{2} \right)$

$A_{12} = \left(\nu R \frac{1}{4} T_0 \right) \left(\frac{1,75 T_0}{T_0} - \frac{3}{2} \right) =$

$= 0,25 \nu R T_0 \cdot (1,75 - 1,5) = 0,25 \nu R T_0 \cdot 0,25 =$

$= 0,0625 \nu R T_0 =$

$= \frac{1}{16} \nu R T_0$

серп.

$\frac{3}{4} T_0 + T_0 =$

$= 1,75 T_0$

$\frac{1}{4} \cdot \frac{1}{4} =$

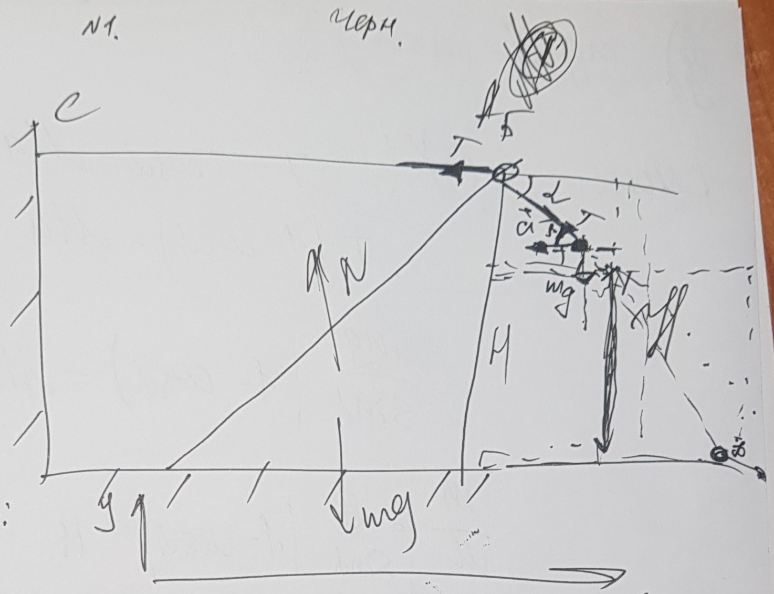
$T = \frac{3T_0}{4}$

Дано:

$\cos\alpha = \frac{3}{5}$

H

N1. Черн.



Найти:

1) $\frac{\beta}{g_a}$? (к поверхности).

2) a - ?

3) $\frac{m}{M}$ - ?

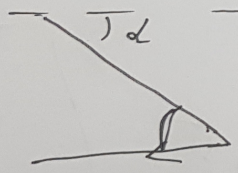
4) t - ?

1). шар:

OX: $T\cos\alpha = ma\cos\alpha$

~~OY:~~ $\boxed{\alpha = \beta}$ $T\cdot\sin\alpha = mg$

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



~~ΔABC~~ ~~ΔOSA~~

$\sin\alpha = \frac{8}{10} = \frac{4}{5}$

ЗСЭ:

~~1.~~ $mgH = (m+M)\frac{v^2}{2}$,

$v = at$;

$T - ma$

$a = \frac{T}{m} = \frac{mg}{\sin\alpha\cdot m} = \frac{g}{\sin\alpha} = \frac{5g}{4}$ ← Уск. с-мы.

3) $mgH = (m+M)\frac{v^2}{2}$

1

Силы: OX: $T - T\cos\alpha = Ma$

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

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

$\frac{mg}{\sin\alpha}(1-\cos\alpha) = Ma \;|:M$

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

$1 - \frac{3}{5} =$

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

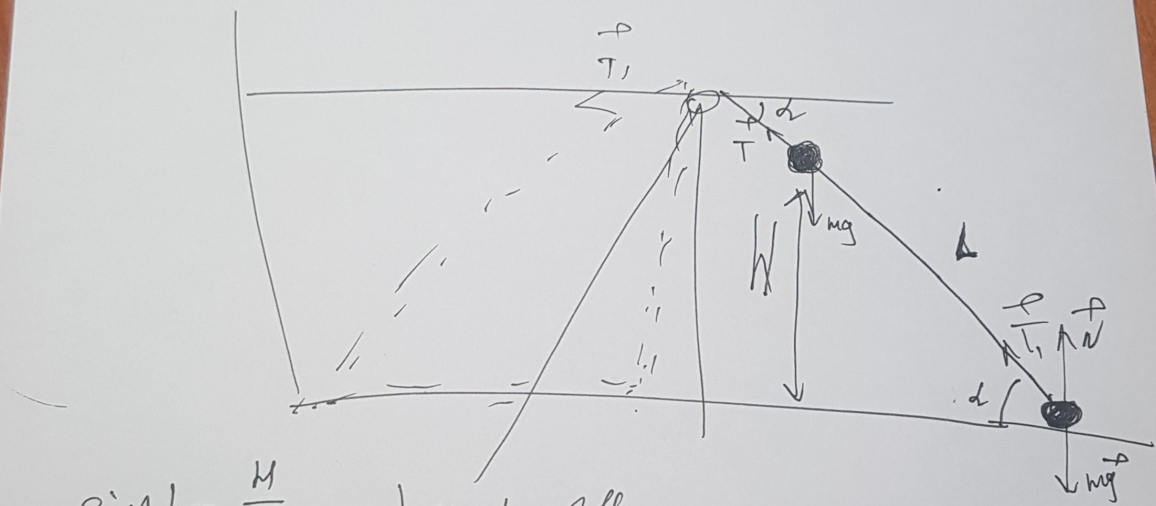
$\frac{4}{10} = \frac{2}{5}$

$=$

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

$\frac{m}{M} = \frac{1}{1-\cos\alpha} = \frac{1}{\frac{2}{5}} = \frac{5}{2} = 2{,}5$

4).



$\sin\alpha = \frac{H}{L}$ $\quad L\sin\alpha = H$

$l = \frac{H}{\sin\alpha}$

~~P ... gbuш. no OY~~

Часть 2

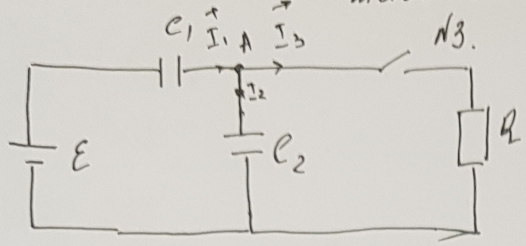
Олимпиада: **Физика, 11 класс (2 часть)**

Шифр: **21202075**

ID профиля: **807367**

Вариант 1

Чистовик. Фишка, 11 кл., 2ч. (1)



$C_2 = C$

$C_1 = 2C$

1) I_R - ?
2) Q - ?
3) I_{R_1} - ?

1). $C_0 = \frac{C_1 C_2}{C_1 + C_2} = \frac{2}{3}C$

$q_0 = \varepsilon C_0 = \frac{2}{3}\varepsilon C$

$U_{C_1} + U_{C_2} = \varepsilon$

$\frac{U_{C_1}}{U_{C_2}} = \frac{C}{2C} = \frac{1}{2}$

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

$U \sim \frac{1}{C}$

$U_{C_1} = \frac{\varepsilon}{3}$; $U_{C_2} = \frac{2}{3}\varepsilon$

$\varepsilon = U_{C_2} + U_{C_1}$; $U_{C_2} = U_R = I_R R$

$$I_R = \frac{\varepsilon - U_{C_1}}{R} = \frac{\varepsilon - \frac{\varepsilon}{3}}{R} = \frac{\frac{2}{3}\frac{\varepsilon}{R}}{1} = \boxed{\frac{2\varepsilon}{3R}}$$ - Ответ 1.

2). $W_1 = \frac{2CU_1^2}{2} = \frac{C\varepsilon^2}{9}$

$W_2 = \frac{CU_2^2}{2} = \frac{C \cdot 4\varepsilon^2}{2 \cdot 9} = \frac{2C\varepsilon^2}{9}$

$W_1 + W_2 = W_0$

$W_0 = \frac{C\varepsilon^2}{3}$

После замык. вся W в C_1.

$W_3 = \frac{2\varepsilon^2 C}{2} = C\varepsilon^2$

$\Delta W = W_3 - W_0 = \frac{2C\varepsilon^2}{3}$

Чистовик. Физика, 11 кл, 2 г. ②.

№3 (продолжение).

①

$A_{ст} = \mathcal{E} \Delta q$

$q_1 = \frac{2}{3} C\mathcal{E}$

$q_3 = 2C\mathcal{E}$

$\Delta q = q_3 - q_1 = \frac{4}{3} C\mathcal{E}$

$A_{ст} = \frac{4}{3} C\mathcal{E}^2$

$Q = A_{ст} - \Delta W = \boxed{\frac{2}{3} C\mathcal{E}^2}$ – ответ 2

3) ~~$I_{C_1} = I_{C_2}$~~

~~т.к. $I_\mathcal{E} = I_{C_2} = I_R$~~

$U_{C_2} = U_R$

$I_\mathcal{E} = I_{C_2} + I_{R_1}$;

$I_{R_1} = \frac{\mathcal{E} - U_{C_1}}{R}$

$I_{C_1} = I_\mathcal{E} = I_0$

$I_0 - I_{C_2} = I_{R_1}$;

Ответ: 1) $I_R = \frac{2}{3} \frac{\mathcal{E}}{R}$

2) $Q = \frac{2}{3} C\mathcal{E}^2$

Чистовик. Физика, 11 кл, II г. (4)

№5.

Дано:

$F = 9$ см

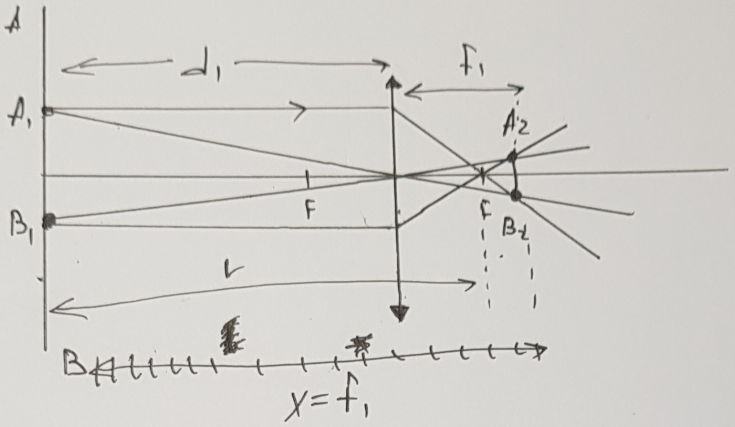
$H = 9$ см

$d_1 = 36$ см

1) x - ?

2) $D_м$ - ?

3) L - ?



1). $\frac{1}{F} = \frac{1}{d_1} + \frac{1}{f_1}$

$x = f_1 = \frac{F d_1}{d_1 - F} = 12$ см.

2). $\Gamma = \frac{f}{d} = \frac{2}{6}$; $D_м = \frac{2H}{6} = \frac{1}{3}H$;

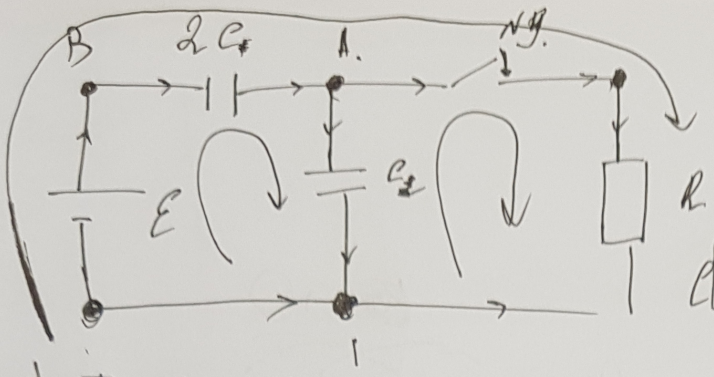
$\Gamma = \frac{D_м}{H} \Rightarrow D_м = 3$ см

3). б т. F. $L = d_1 + f_1 - F = 36 + 12 - 9 = 39$ см

Ответ: 1) $f_1 = x = 12$ см

2) $D_м = 3$ см

3) $L = 39$ см.



1). I_R - ?

2). Q - ?

3). I_{R_1} - ?

$(I_{C_1} = I_0)$

$U_{C_2} = U_R = I_{R_1} R$

$I_{R_1} = \frac{U_{C_2}}{R}$

$C = \frac{q}{U}$; $C_{общ} = ?$

$U = \frac{q}{C_1}$

$\mathcal{E} = U_{C_2} + U_{C_1}$

$\mathcal{E} = I_R R + U_{C_1}$

$\frac{\mathcal{E} - U_{C_1}}{R} = I_R$

Т. А: $I_{C_1} = I_{C_2} + I_R$; $I_{C_2} = I_{C_1} - I_R$

Т. В. $I_\mathcal{E} = I_{C_1}$

$I_\mathcal{E} = I_{C_2} + I_R = I_{C_2} + \frac{U_R}{R} = \frac{I_{C_2} R + U_R}{R} =$

$= \frac{(I_{C_1} - I_R) R + U_R}{R} =$

$= \frac{I_{C_1} R - U_\mathcal{E} + U_R}{R}$

$\mathcal{E} = U_{C_1} + U_{C_2}$

$U_{C_2} = U_R$

$\mathcal{E} = U_{C_1} + I_R R$

$I_{R_1} = \frac{\mathcal{E}}{R}$

$U_{BA} = U_{C_1}$

$\mathcal{E} - U_{C_2} = U_C$

$\mathcal{E} - I_R R = U_{C_1}$

2). ~~$Q = \Delta W = \Delta \mathcal{E} \Delta q + \Delta W_{C_1} + \Delta W_{C_2}$~~

$U_{C_1} A \mathcal{E} t$

$\mathcal{E} - U_{C_2} = U_{C_1}$

$\mathcal{E} - I_R R = U_{C_1}$

№4 So

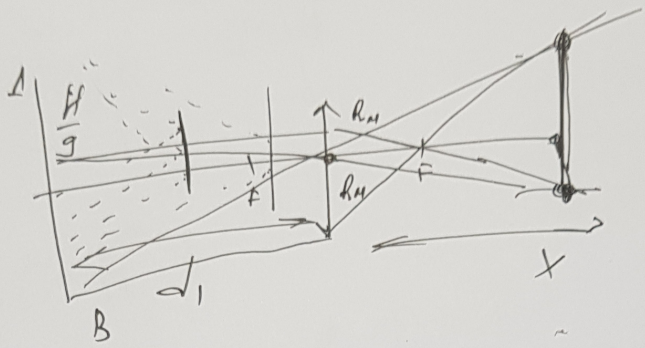
№5.

Дано:

$F = 9$ см

$H = 9$ см

$d_1 = 36$ см



1) x - ?

2) D_M - ?

3) ? L - ?

1) $\frac{1}{F} = \frac{1}{d_1} + \frac{1}{f_1}$

$X = f_1 = \frac{F d_1}{d_1 - F} = \frac{9 \cdot 36}{2} = \frac{324}{27} = 12$ см

2) $D_M = 2R_M$

$\Gamma = \frac{f}{d} = \frac{12}{36} = \frac{2}{6}$

$\Gamma = \frac{f}{d} = \frac{D_M}{H}$ — ?

$\frac{2}{6} = \frac{D_M}{H}$

$2H = 6D_M$

$D_M = \frac{2 \cdot H}{6} = \frac{2 \cdot 9}{6} = 3$ см.

3) B — ? $F = 9$ см

Дано:

B

L

$m_1 = m$

$R_1 = R$

$m_2 = 2m$

$R_2 = 2R$

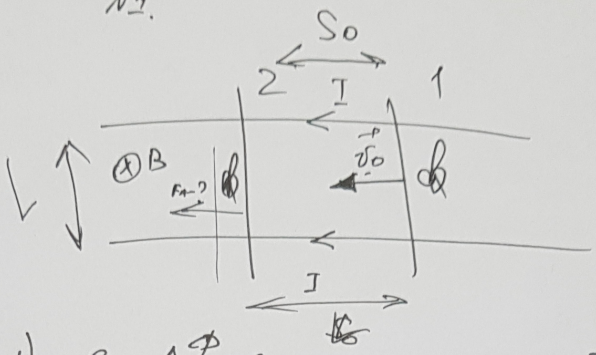
v_0

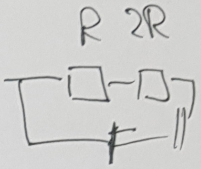
1) a_2 - ?

2) v - ?

3) I_2 - ? (S_0)

№4.





1). $\mathcal{E}_i = \frac{\Delta\Phi}{\Delta t}$;

$\Delta\Phi = B \cdot \Delta S$; $\Delta S = S_2 - S_1 =$

$\Delta S = B(L - L_1)$

$\Delta\Phi = B(L - L_1)$.

$B I_2 L = m_2 a_2$ $\quad v_2 = at$

$I_2 = \frac{2m a_2}{BL}$

$ma_2 t = B^2 L (L - L_1)$

$BI_1 L =$

$I_1 R = I_2 R$.

$I_2 = \frac{U}{2R} = \frac{\mathcal{E}_i}{2R} = \frac{\Phi'}{2R} =$

$= \frac{B \cdot \Delta S}{2t R} \Rightarrow$

$\frac{2ma_2}{BL} = \frac{B \Delta S}{t \cdot 2R} = B(L - L_1)$

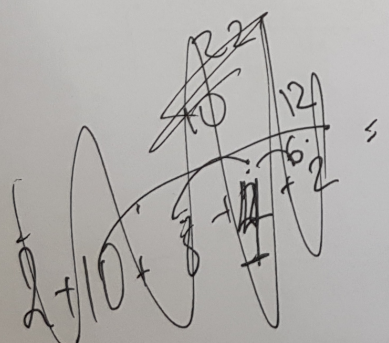
$\frac{2ma_2}{BL} = \frac{B \cdot B(L - L_1)}{t \cdot 2R}$

$2ma_2 t = B^2 L \cdot B(L - L_1)$

$F_a - m_2 g = m_2 a_2$

$I_i = \frac{\mathcal{E}_i}{3R} = B \cdot 4(5-5')$

$B I_i l = 2mg = 2ma_2$



$2+10+8+4+4 = 28$

Числовик №4. Физика, 11кл, 2ч. (3)

Дано:

B

$L = l$

$m_1 = m$

$R_1 = R$

$m_2 = 2m$

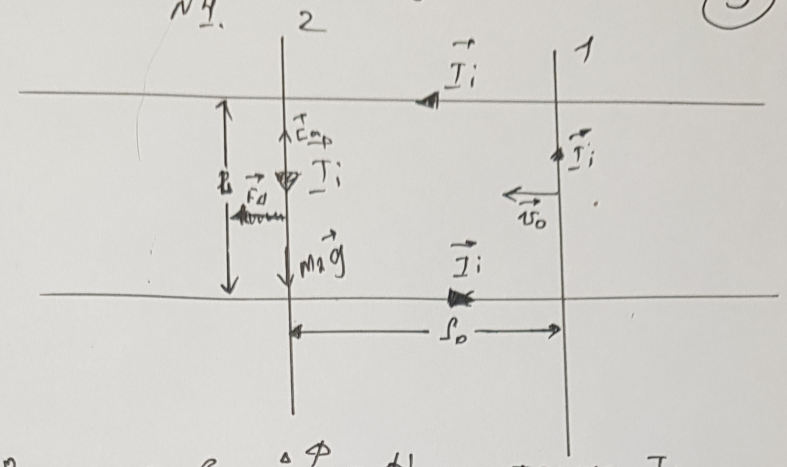
$R_2 = 2R$

v_0

1) a_2 - ?

2) v_2 - ?

3) S - ? (S_0)



2). Возникнет $\mathcal{E}_i = \frac{\Delta\Phi}{\Delta t} = \Phi'$, а также I_i

$\Delta\Phi = B \cdot \Delta S \cdot \cos 0°$ $\quad \Delta S = L(S_0 - S')$

$\mathcal{E}_{i1} = v_0 BL$ $\quad F_A = 2mg$, т.к. через проводник время $v = const$.

$\mathcal{E}_{i2} = v_2 BL$ $\quad I_2 = \frac{2mg}{Bl}$

$I_2 = \frac{\mathcal{E}_{i1} + \mathcal{E}_{i2}}{BL \cdot 3R}$

$I_2 = \frac{(v_0 + v_2)Bl}{3R}$

$(v_0 + v_2)B^2l^2 = 6mgR$

$v_0 B^2 l^2 + v_2 B^2 l^2 = 6mgR$

$\boxed{\frac{6mgR}{B^2l^2} - \frac{v_0}{I} = v_2}$ - Ответ 2.

1). $v_2 = v_{20} + at$

$BI_2 l = 2ma_2$; $I_2 = \frac{2ma_2}{Bl} = \frac{(v_0 + v_2)Bl}{3R}$

$6ma_2R = \frac{6mgR}{Bl \cdot 3R}$

$a_2 = \frac{mg}{Bl \cdot mR} = \frac{g}{BlR}$

Ответ: 1). $a_2 = \frac{g}{BlR}$

2). $v_2 = \frac{6mgR}{B^2l^2} - v_0$