Часть 1

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

Шифр: **21203172**

ID профиля: **347713**

Вариант 2

Чистовик

№2

1) $\delta Q = C_V \nu\, dT$

$$Q = \nu\int C_V\, dT = \nu \int_{\frac{1}{2}T_0}^{T_0} \frac{5}{2}R\frac{T}{T_0}\, dT =$$

$$= \frac{\nu 5 R T^2}{4T_0}\Big|_{\frac{T_0}{2}}^{T_0} = \frac{15}{16}\nu R T_0$$

2) $Q = A + \frac{1}{2}\nu R\Delta T$

Из пред. пункта:

$$Q_{отд} = \frac{5}{4}\frac{\nu R}{T_0}\left(-T_0^2 + T'^2\right) < 0$$

$$A = \frac{5}{4}\frac{\nu R}{T_0}\left(-T_0^2 + T'^2\right) - \frac{3}{2}\nu R\left(T' - T_0\right)$$

$$A' = 0 = 2T'\frac{5\nu R}{4T_0} - \frac{3}{2}\nu R = 0$$

$$T' = \frac{3}{5}T_0$$

3) $\cancel{|A| = \frac{5\nu R}{4T_0}\left(T_0^2 - \frac{9}{25}T_0^2\right) - \frac{3}{2}\nu R\left(\frac{3}{5}T_0 - T_0\right) = \frac{7}{5}\nu R T_0}$

$\cancel{A = -\frac{7}{5}\nu R T_0}$

$$A = Q - \frac{1}{2}\nu R\Delta T \quad (Q < 0)$$

$$A = \frac{5}{4}\frac{\nu R}{T_0}\left(\frac{9}{25}T_0^2 - T_0^2\right) - \frac{3}{2}\nu R\left(\frac{3}{5}T_0 - T_0\right)$$

$$A = \frac{-\nu R T_0}{5}$$

2

Ответ: 1) $\frac{15}{16}\nu R T_0$; 2) $\frac{3}{5}T_0$; 3) $\cancel{-\frac{7}{5}\nu R T_0}$ $\frac{-\nu R T_0}{5}$

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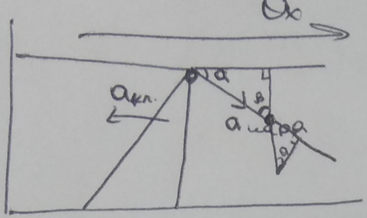
Чистовик

№1.



ускор. шара направлено под угл. β к вертикали; ~~ит~~

1) $\cos\beta = \cos(90-a) = \sin a = \frac{3}{5}$

2) т.к длина нити остаётся постоянной, то: $a_{кл} = a_{шара}$

$\sin a g = a_{кл} = a_{шар}.$

$a_{кл} = \frac{3}{5}g$

3) Запишем закон сохр. импульса на ось Ox:

$m v' = M v_{кл}$ $\quad \frac{v'}{v_{кл}} = \frac{a}{a_{кл}} = \frac{\cos a \sin a g}{\sin a g} = \cos a$

$\frac{m}{M} = \frac{v_{кл}}{v'} = \frac{1}{\cos a} = \frac{5}{4}$

4) $\frac{\sin a \, a_{ш} t^2}{2} = H$

$t = \sqrt{\frac{2H}{\sin a \, a_{ш}}} = \sqrt{\frac{2H \cdot 25}{9g}} = \frac{5}{3}\sqrt{\frac{2H}{g}}$

Ответ: 1) $\cos\beta = \sin a = \frac{3}{5}$; 2) $a_{кл} = \frac{3}{5}g$ 3) $\frac{m}{M} = \frac{5}{4}$ 4) $t = \frac{5}{3}\sqrt{\frac{2H}{g}}$ 1

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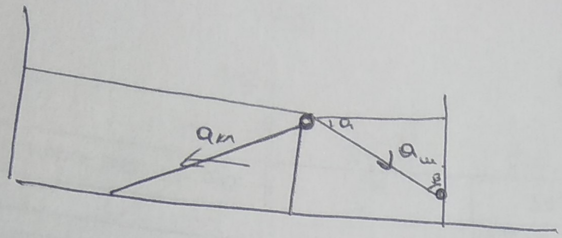


$a_{кл} = a_{ш}.$

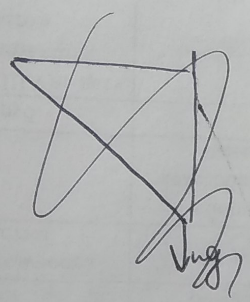
$\sin\beta = \sin(90 - a) = \cos a$

1)

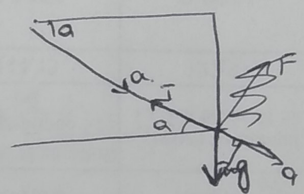
$\boxed{\sin\beta = \cos a}$

$\sin\beta = \frac{4}{5}$ или $\cos\beta = \frac{3}{5}$

2) $\sin a \cancel{g} =$



$\cancel{a_к = a_ш.}$

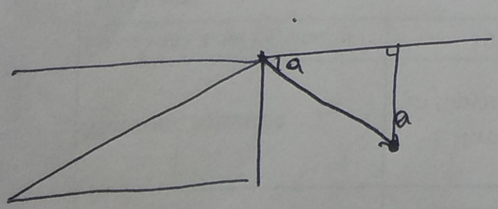


$\cancel{Max} = (T - T\cos a) = T(1 - \cos a)$

$\sin a g - T \cancel{\cos} = m a_ш.$

$\cancel{F = \cos a n g}$

1



$$\frac{\sin a\, a_ш.\, t^2}{2} = H$$

$$t = \sqrt{\frac{2H}{\sin a\, a_ш.}}$$

$$\sin^2 a = \left(\frac{3}{5}\right)^2 = \frac{9}{25}$$

$$t = \sqrt{\frac{2H}{\sin^2 a g}}$$

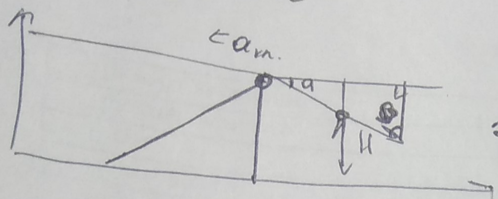
4)

$$t = \sqrt{\frac{2H}{\frac{9}{25} g}} = \sqrt{\frac{2H \cdot 25}{9g}} =$$

$$= \frac{5}{3}\sqrt{\frac{2H}{g}}$$

№1

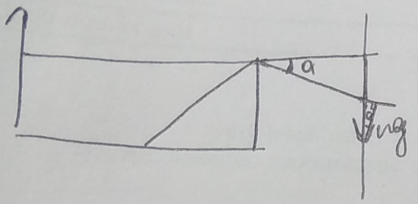
$\cos a = \frac{4}{5}$

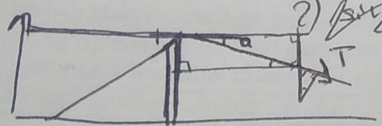


1) $\cos\beta = \cos(90-a) = \sin a = \sqrt{1-\cos^2 a} = \sqrt{1-\frac{16}{25}} = \boxed{\frac{3}{5}}$

2)

$a_{кл} = a_{шара}$





2) $\boxed{\sin a\, mg} = a_{шар}$

$T = \sin a\, mg$

2) $\sin a g = a_{кл} = a_{шар}$ (вдоль нити)

3) $\cancel{\cos a\, T = M a_{кл}}$

$\cancel{\cos a \sin a\, mg = M a_{кл} = M \sin a g}$

$\cancel{\cos a\, m = M}$

$\cancel{\frac{m}{M} = \frac{1}{\cos a} = \frac{5}{4}}$

2

$\cancel{mgH = m\frac{v^2}{2} + M\frac{v_{кл}^2}{2}}$

$\frac{v}{v_{кл}} = \frac{a}{a_{кл}} = \frac{\cos a \sin a g}{\sin a g}$

$m v = M v_{кл}$

$m\frac{v}{v_{кл}} = M$

$m\frac{4}{5} = M$

3) $\boxed{\frac{m}{M} = \frac{5}{4}}$

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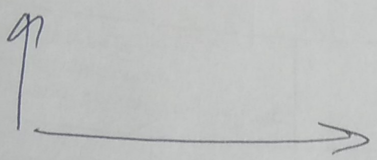
T_0 ↓ $\quad C(T)=\frac{5}{2}R\frac{T}{T_0}$



$\delta Q = C_v \nu dT$

$\delta Q = C_v \nu dT$

$Q = \nu\int C_v\, dT = \nu\int_{\frac{1}{2}T_0}^{T_0} \frac{5}{2}R\frac{T}{T_0}\, dT =$

$= \frac{\nu\frac{5}{2}R}{T_0}\left.\frac{T^2}{2}\right|_{\frac{T_0}{2}}^{T_0} =$

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

$= \frac{\nu\frac{5}{2}R}{T_0}\left(\frac{4T_0^2}{8}-\frac{T_0^2}{8}\right) =$

$= \frac{\nu\cdot\frac{5}{2}R}{T_0}\left(\frac{3T_0^2}{8}\right) =$

1) $= \frac{\nu\cdot 5R\cdot 3T_0^2}{2T_0\cdot 8} = \boxed{\frac{15\nu R T_0}{16}}$

$Q = \frac{\nu\cdot\frac{5}{2}R}{T_0}\int_{T'}^{T_0} T\, dT$

$Q = \frac{5\nu R}{2T_0}\left.\frac{T^2}{2}\right|_{T'}^{T_0}$

$\frac{5\nu R}{2T_0}\left(\frac{T_0^2}{2}-\frac{T'^2}{2}\right) =$

$\frac{5\nu R}{4T_0}\left(T_0^2-T'^2\right)$

отдает.

$Q = A_{min} + \frac{1}{2}\nu R\Delta T$

③

$-Q + \frac{1}{2}\nu R\Delta T = A_{min}$

$Q = A_{max} + \frac{1}{2}\nu R(T_0 - T_1)$

$+\frac{5\nu R}{4T_0}\left(T_0^2-T'^2\right) = A + \frac{3}{2}\nu R\,(T'-T_0)$

$$A = \frac{5\nu R}{4T_0}\left(T_0^2 - T'^2\right) - \frac{3}{2}\nu R\left(T_0 - T'\right)$$

A'

$$\left(T'^2 - T_0^2\right)\cdot\frac{5\nu R}{4T_0} - \frac{3}{2}\nu R\left(T' - T_0\right) = A$$

$$\left(T'^2 \cdot \frac{5\nu R}{4T_0} - \frac{3}{2}\nu R T'\right)' = A'$$

$$2T' \cdot \frac{5\nu R}{4T_0} - \frac{3}{2}\nu R = 0$$

2) $$T' = \frac{3}{2}\,\frac{\nu R \cdot 4T_0}{2\cdot 5\nu R} = \frac{\cancel{12}\,3T_0}{4\cdot 5} = \boxed{\frac{3}{5}T_0}$$

3) $$A = \frac{5\nu R}{4T_0}\left(T_0^2 - \frac{9}{25}T_0^2\right) - \frac{3}{2}\nu R\left(\frac{3}{5}T_0 - T_0\right) =$$

$$= \frac{5\nu R}{4T_0}\,T_0^2\,\frac{16}{25} + \frac{3}{2}\nu R T_0 \frac{2}{5} =$$

$$= \frac{4\nu R T_0^{\cancel{2}}}{\cancel{20}\cdot 5} + \frac{3}{5}\nu R T_0 = \frac{4}{5}\nu R T_0 + \frac{3}{5}\nu R T_0 =$$

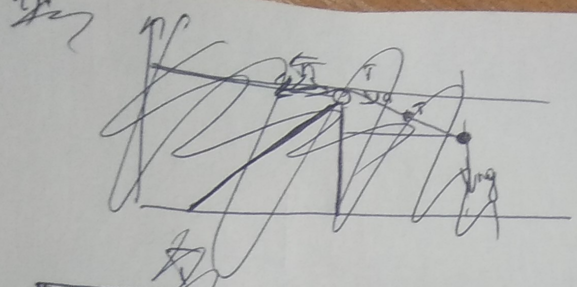
3) $$= \boxed{\frac{7}{5}\nu R T_0}$$

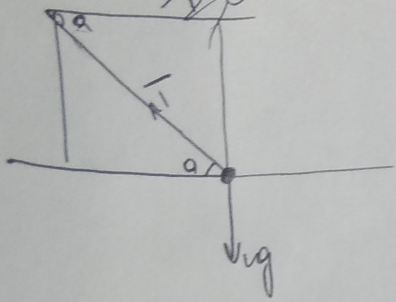
4

$$\cancel{\frac{5\nu R\left(T_0^2 - T'^2\right)}{4T_0} - \frac{3}{2}\nu R\left(T' - T_0\right) = A}$$

$$\cancel{-\frac{5\nu R T'^2}{4T_0} - \frac{3}{2}\nu R T' = A}$$

$$\cancel{-\frac{5\nu R T'}{2T_0} - \frac{3}{2}\nu R = 0}$$





$\cancel{\sin\alpha T}\; mg - \sin\alpha T = ma_1$

$T\cos\alpha = a$

$-Q = A + \frac{3}{2}\nu R\Delta T$

$-Q - \frac{3}{2}\nu R\Delta T = A.$

$\frac{5}{4}\frac{\nu R}{T_0}\left(\frac{9}{25}T_0^2 - T_0^2\right) - \frac{3}{2}\nu R\left(\frac{3}{5}T_0 - T_0\right) = A.$

$\frac{5}{4}\frac{\nu R}{T_0}\left(\frac{9-25}{25}T_0^2\right) + \frac{3}{2}\nu R\left(+\frac{2}{5}T_0\right) = A$ 5

$-\frac{\cancel{5}}{\cancel{4}}\frac{\nu R}{T_0}\frac{\cancel{16}^{4}}{\cancel{25}_{5}}T_0^2 + \frac{3}{5}\nu R T_0 = A.$

$-\frac{4\nu R T_0^{\cancel{2}}}{\cancel{T_0}\cdot 5} + \frac{3}{5}\nu R T_0 = A.$

$-\frac{4}{5}\nu R T_0 + \frac{3}{5}\nu R T_0 = A.$

$A = -\frac{\nu R T_0}{5}$

$$\frac{5}{4}\frac{\nu R}{T_0}\left(T'^2 - T_0\right) - \frac{3}{2}\nu R\left(T' - T_0\right) = A.$$

$$T' =$$

$$\frac{5}{4}\frac{\nu R}{T_0}\left(\frac{9}{25}T_0^2 - T_0^2\right) - \frac{3}{2}\nu R\left(\frac{3}{5}T_0 - T_0\right) = A$$

$$\frac{5}{4}\frac{\nu R}{T_0}\left(T_0^2\right)\left(\frac{9}{25} - \frac{25}{25}\right) - \frac{3}{2}\nu R T_0\left(\frac{3}{5} - \frac{5}{5}\right) = A.$$

$$\frac{5}{4}\nu R T_0\left(-\frac{16}{25}\right) + \frac{3}{\cancel{2}}\nu R T_0\left(+\frac{\cancel{2}}{5}\right) = A.$$

$$-\frac{\cancel{5}}{\cancel{4}}\nu R T_0 \frac{\cancel{16}^{\,4}}{\cancel{25}\,5} + \frac{3}{5}\nu R T_0 = A$$

$$-\frac{4}{5}\nu R T_0 + \frac{3}{5}\nu R T_0 = A.$$

$$\nu R T_0\left(\frac{3}{5} - \frac{4}{5}\right) = A. \qquad 6$$

$$A = \frac{-\nu R T_0}{5}$$

Часть 2

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

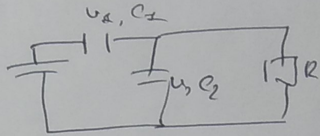
Шифр: **21203172**

ID профиля: **347713**

Вариант 2

Чистовик

№ 3



1) $u_1+u_2=\mathcal{E}$

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

$q_1=\frac{3C\mathcal{E}}{4}$ $\qquad q_1=q_2$

$q_1=C_2u$

$u=\frac{q_1}{C_2}=\frac{3}{4}\mathcal{E}$

$I=\frac{u}{R}=\frac{3\mathcal{E}}{4R}$

2) $W_0=\frac{q_1^2}{2C_1}+\frac{q_1^2}{2C_2}=\frac{3}{8}C\mathcal{E}^2$

$W_{кн}=\frac{q_1^2}{2C_1}=\frac{(C_1\mathcal{E})^2}{2C_1}=\frac{3}{2}C\mathcal{E}^2$

$\Delta q=3C\mathcal{E}-\frac{3}{4}C\mathcal{E}=\frac{9}{4}\mathcal{E}C$

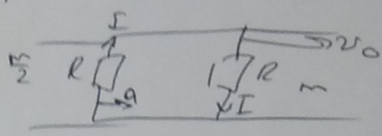
$\mathcal{E}\Delta q+\frac{3}{8}C\mathcal{E}^2=\frac{3}{2}C\mathcal{E}^2+Q$

$Q=\frac{9}{8}C\mathcal{E}^2$

Ответ: 1) $\frac{3\mathcal{E}}{4R}$ 2) $\frac{9}{8}C\mathcal{E}^2$

1

№4 Чистовик



1) $\mathcal{E} = -\frac{d\varphi}{dt} = Bl v_0$

$I = \frac{\mathcal{E}}{5R} = \frac{Bl v_0}{5R}$

$F = IlB = \frac{(lB)^2 v_0}{5R} = m_2 a_2$

$a_2 = \frac{2(lB)^2 v_0}{5Rm}$

Ответ: 1) $\frac{2(lB)^2 v_0}{5Rm}$

2

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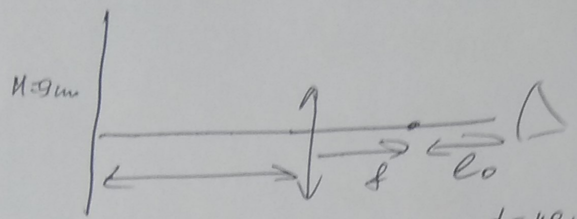
№5 Инсовик



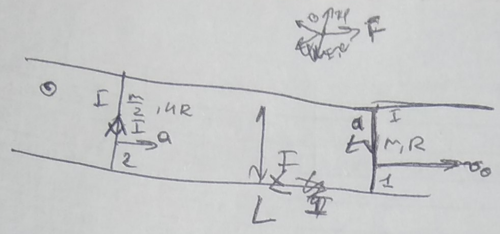
3

$\frac{1}{d}+\frac{1}{f}=\frac{1}{F}$ $\quad d=48$ см
$F=12$ см.

1) $f=16$ см $\quad f+l_0=x$

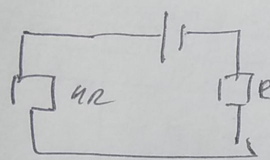
$f+24$ см $=40$ см — расстояние от линзы

Ответ: 1) 40 см.



$\Phi = BS$

$$\mathcal{E} = -\frac{d\Phi}{dt} = B\dot{S} = BL\upsilon$$



$$I = \frac{\mathcal{E}}{5R} = \frac{BL\upsilon_0}{5R}$$

$$F = I\ell B = \frac{BL\upsilon_0}{5R}\cdot \ell B = \frac{(\ell B)^2\upsilon_0}{5R} = m_2 a_2$$

$$a_2 = \frac{(\ell B)^2\upsilon_0}{5Rm_2} = \frac{2(\ell B)^2\upsilon_0}{5Rm}$$

$$L = \frac{at^2}{2}$$

$$t = \sqrt{\frac{2L}{a}}$$

$$\cancel{\upsilon} = at = a\cdot\sqrt{\frac{2L}{a}} = \sqrt{2La}$$

$$\upsilon_2 = \sqrt{2L\cdot\frac{2(\ell B)^2\upsilon_0}{5Rm}} = \sqrt{\frac{4L^3B^2\upsilon_0}{5Rm}}$$

1

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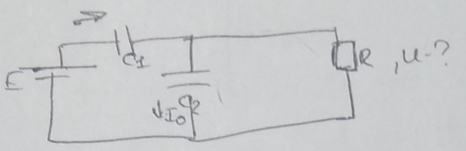
$I = \frac{3\mathcal{E}}{4R}$

3)



$I_1 = \frac{\mathcal{E}}{R}$

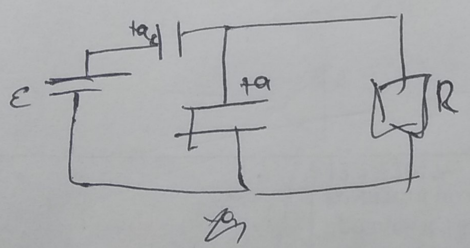
$I_0 + I_2 = I_1$

$I_2 = I_1 - I_0 = \frac{\mathcal{E}}{R} - I_0 = \frac{U_R}{R}$

$I_R = \frac{\frac{q_2}{C_2}}{R}$

$\boxed{U_R = \mathcal{E} - I_0 R}$

2)



$I = \frac{\mathcal{E} - \frac{q_1}{C_1}}{R} = \frac{\mathcal{E} - \frac{3C\mathcal{E}}{4\,3C}}{R} = \frac{3\mathcal{E}}{4R} \quad \left(\frac{\mathcal{E} - \frac{\mathcal{E}}{4}}{R}\right) = \frac{3\mathcal{E}}{4R}$

②

$\frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{C}$

$\frac{1}{C} + \frac{1}{3C} = \frac{1}{C}$

$\frac{4}{3C} = \frac{1}{C}$

$\boxed{C = \frac{3C}{4}}$

$W_0 = \frac{1}{2} C U^2$

$W_1 = \frac{1}{2} 3C a^2$

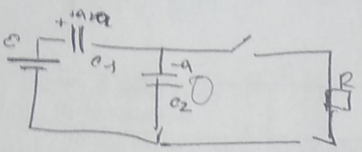
$\boxed{W_0 = \frac{1}{2} \frac{3C}{4} \cdot \mathcal{E}^2 = \frac{3C\mathcal{E}^2}{8}}$

$A_{ист} = \mathcal{E}\Delta q$

$A_{ист} + W_0 = W_м + Q$

$q_0 = \frac{3}{4} C \mathcal{E}$

$q_м = \mathcal{E} 3C$



$I = 0$

$C_2 = C$

$C_1 = 3C$

$$\frac{1}{C_1}+\frac{1}{C_2}=\frac{1}{C}$$

$$\frac{1}{C} = \frac{C_2+C_1}{C_1C_2} = \frac{C_1C_2}{C_1+C_2} = C' = \frac{3C\cdot C}{4C} = \frac{3}{4}C$$

$$U_1+U_2=\mathcal{E}$$

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

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

$$\frac{4q_1}{3C}=\mathcal{E}$$

$$q_1=\frac{3C\mathcal{E}}{4}=q_2$$

$$q_2 = C_2U$$

$$U = \frac{q_2}{C_2} = \frac{3C\mathcal{E}}{4C} = \frac{3}{4}\mathcal{E}$$

1) $I = \frac{U}{R} = \frac{3\mathcal{E}}{4R}$

3

2) $q_1' = C_1\mathcal{E}$

$$W_0 = \frac{q_1^2}{2C_1}+\frac{q_2^2}{2C_2} = \frac{q_1^2}{2\cdot 3C}+\frac{q_1^2\cdot 3}{2C\cdot 3} = \frac{4q_1^2}{6C} = \frac{2}{3}\frac{q_1^2}{C} =$$

$$= \frac{2}{3}\cdot\left(\frac{3C\mathcal{E}}{4}\right)^2\frac{1}{C} = \frac{3C\mathcal{E}^2}{8} = \boxed{\frac{3}{8}C\mathcal{E}^2}$$

$$W_{кн} = \frac{q_1'^2}{2C_1} = \frac{(C_1\mathcal{E})^2}{2C_1} = \frac{1}{2}C_1\mathcal{E}^2 = \frac{1}{2}\cdot 3C\mathcal{E}^2 = \frac{3}{2}C\mathcal{E}^2$$

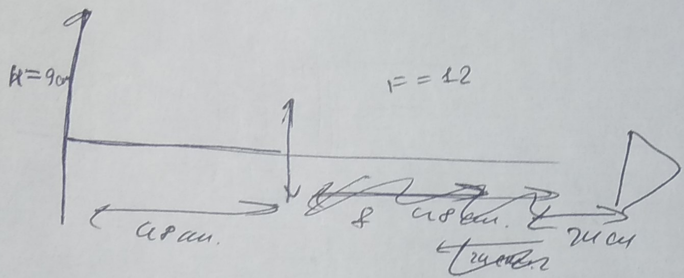
$\Delta q = 3C\varepsilon - \frac{9}{4}\varepsilon C = \varepsilon C\left(3-\frac{3}{4}\right) = \boxed{\frac{9}{4}\varepsilon C}$

$\varepsilon \cdot \Delta q + \frac{3}{8}C\varepsilon^2 = \frac{3}{2}C\varepsilon^2 + Q$ 21-12

$Q = \varepsilon^2 \cdot \frac{9}{4}C + \frac{3}{8}C\varepsilon^2 - \frac{3}{2}C\varepsilon^2 =$

$= C\varepsilon^2\left(\frac{18}{8} + \frac{3}{8} - \frac{12}{8}\right) = \boxed{\frac{9}{8}C\varepsilon^2}$

2)

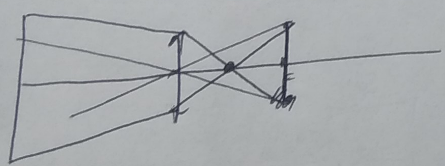


$$\frac{1}{d}+\frac{1}{f}=\frac{1}{F}$$

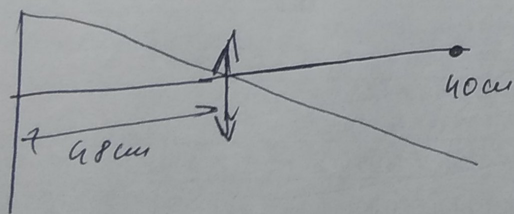
$$\frac{1}{f}=\frac{1}{F}-\frac{1}{d}=\frac{d-F}{Fd}=\frac{48-12}{48\cdot 12}=\frac{36}{48\cdot 12}=\frac{3}{48}=\frac{1}{16}$$

$f = 16$ см.

1) $f + 24$ см $= 16+24 = 40$ см.



5



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