Часть 1

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

Шифр: **21203514**

ID профиля: **100613**

Вариант 3

Чистовик

№ 1

Дано:
$\cos\alpha = \frac{5}{13}$
H

1) β (угол между ... шара и гориз.)
2) $a_{кл}$
3) $\frac{m \text{ (шара)}}{M \text{ (клина)}}$
4) t

1) $x_{изн} = \Delta x + \ell \cos\alpha$
$x_{кон} = (\Delta x + \ell)\cos\alpha$

$S_x = x_{изн} - x_{кон} = \Delta x(1 - \cos\alpha)$

$h_x = \Delta x \sin\alpha$

$tg\,\beta = \frac{h_x}{S_x} = \frac{\Delta x \sin\alpha}{\Delta x(1-\cos\alpha)} = \frac{\sin\alpha}{1-\cos\alpha}$

$tg\,\beta = \frac{\frac{12}{13}}{1 - \frac{5}{13}} = \frac{12}{8} = \frac{3}{2} = 1{,}5$

2) ~~$\sum h_x = H \quad ; \sum S_x = S$~~
~~$H = \Delta x' \sin\alpha; \quad \Delta x' = \frac{H}{\sin\alpha}$~~
~~$S = \Delta x'(1-\cos\alpha) = \frac{H(1-\cos\alpha)}{\sin\alpha}$~~

$a_{кл} = g\,ctg\,\beta = \frac{g(1-\cos\alpha)}{\sin\alpha}$

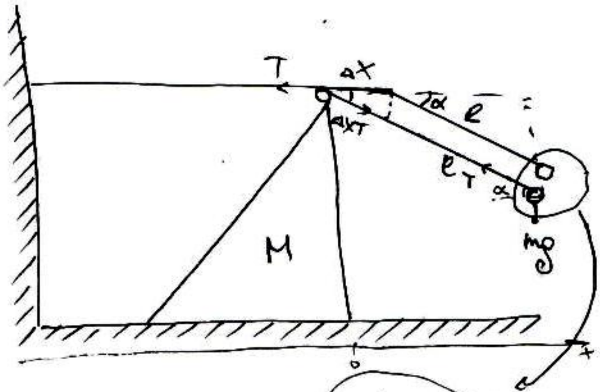
$a_{кл} = \frac{g}{1{,}5} = \frac{2}{3}g$

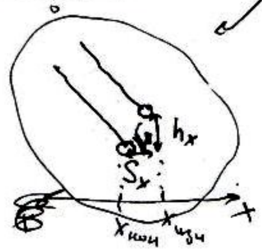
3) $\begin{cases} M a_{кл} = T \sin\alpha \\ T\sin\alpha = mg \end{cases}$

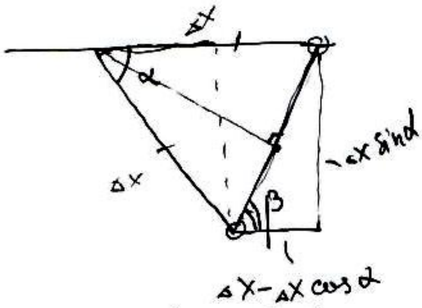
$\frac{m}{M} = \frac{a_{кл}}{g} = ctg\,\beta \quad ; \frac{m}{M} = \frac{2}{3}$

4) $H = \frac{gt^2}{2} \; ; t = \sqrt{\frac{2H}{g}}$

Ответ: $1{,}5 \; ; \frac{2}{3}g ; \; \frac{2}{3} \; ; \sqrt{\frac{2H}{g}}$







$tg\,\beta = \frac{\sin\alpha}{1-\cos\alpha}$

1

Чистовик

№ 2

Дано:
$\nu; T_0; \frac{3}{5}T_0$
$C(T) = 3R\frac{T}{T_0}$

1) Q_1 (>0)
2) T_1
3) A_{min}

1) $Q_i = \nu C \Delta T_i = \frac{3\nu R}{T_0} T_i \Delta T_i$

$Q_1 = \sum Q_i$

$\int \frac{3\nu R}{T_0} T \Delta T = \frac{3\nu R}{T_0} \cdot \frac{T^2}{2}$

$Q_1 (\gamma) = - \frac{3\nu R}{T_0} \cdot \frac{T_1^2 - T_0^2}{2} = \frac{3\nu R (T_0^2 - \frac{9}{25}T_0^2)}{2T_0} = \frac{3 \cdot 16}{2 \cdot 25} \nu R T_0 = \underbrace{\frac{24}{25} \nu R T_0}$

2) $Q = \Delta U + A$; $A = Q - \Delta U = \frac{3\nu R}{T_0} \cdot \left(\frac{T^2 - T_0^2}{2}\right) - \frac{3}{2}\nu R (T - T_0) =$
$= \frac{3}{2}\nu R (T - T_0) \cdot \left(\frac{T + T_0}{T_0} - 1\right) = \frac{3}{2}\nu R (T - T_0) \cdot \frac{T}{T_0} =$
$= \frac{3}{2}\nu R \left(\frac{1}{T_0} T^2 - T\right)$

min при $T = \frac{+1}{2\left(\frac{1}{T_0}\right)} = \underbrace{\frac{T_0}{2}} = T_1$

3) $A_{min} = \frac{3}{2}\nu R \left(\frac{1}{T_0} \cdot \frac{T_0^2}{4} - \frac{T_0}{2}\right) = \frac{3}{2}\nu R \left(\frac{T_0}{4} - \frac{2T_0}{4}\right) =$
$= -\frac{3}{2}\nu R \frac{T_0}{4} = \underbrace{-\frac{3}{8}\nu R T_0}$

Ответ: $\frac{24}{25}\nu R T_0$; $\frac{T_0}{2}$; $-\frac{3}{8}\nu R T_0$

2

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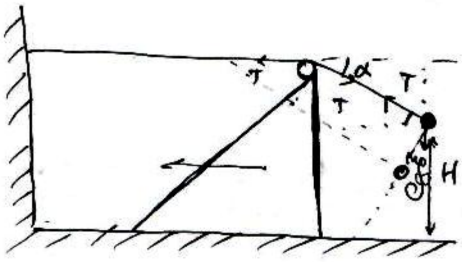
1

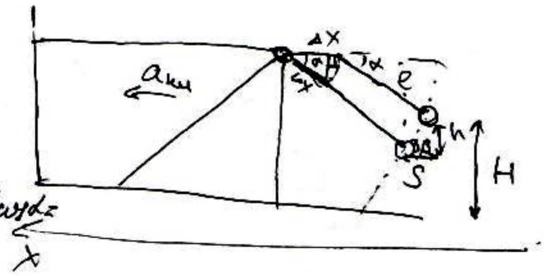
Дано:
$\alpha = \frac{5}{13}$

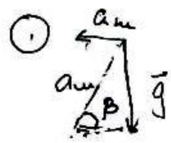
Найти:
$a_{кл}$
$\frac{m}{M_{кл}}$; t

Черновик.

~~$Ma_{кл} = T\sin\alpha$~~
~~$T\sin\alpha = mg$~~
~~$Ma_{кл x} = mg$~~







1) $x_{кузн} = \Delta x + \ell\cos\alpha$
$x_{кон} = (\Delta x + \ell)\cos\alpha$

$S = x_{кузн} - x_{кон} = \Delta x + \ell\cos\alpha - \Delta x\cos\alpha - \ell\cos\alpha =$
$= \Delta x(1-\cos\alpha)$

$h = \Delta x \sin\alpha$

$\operatorname{tg}\beta = \frac{h}{S} = \frac{\Delta x\sin\alpha}{\Delta x(1-\cos\alpha)} = \frac{\sin\alpha}{1-\cos\alpha}$;

Если $h = H = \Delta x\sin\alpha$; $\Delta x = \frac{H}{\sin\alpha}$

$S_{полн} = \Delta x(1-\cos\alpha) = \frac{H(1-\cos\alpha)}{\sin\alpha}$

$$\underline{a_{кл} = g\operatorname{ctg}\beta = \frac{g(1-\cos\alpha)}{\sin\alpha}}$$

3) $Ma_{кл} = T\sin\alpha = mg$

$\frac{m}{M} = \frac{a_{кл}}{g} = \frac{1-\cos\alpha}{\sin\alpha}$

4) $L_{кл} = \frac{H}{\sin\beta} = \frac{a_{кл} t^2}{2} = \frac{\frac{g}{\sin\beta} \cdot t^2}{2}$

$H = \frac{gt^2}{2}$; $t = \sqrt{\frac{2H}{g}}$

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$$Q = C\nu\Delta T$$

$$Q = \nu 3R\frac{T}{T_0}\Delta T$$

$$\int Q = \int \nu\cdot\frac{3R}{T_0}\,T\Delta T = \frac{3\nu R}{T_0}\int T\Delta T = \frac{3\nu R}{T_0}\cdot\frac{T^2}{2}$$

$$Q_1 = \frac{3\nu R}{T_0}\cdot\frac{(T_1^2-T_0^2)}{2} = \frac{3\nu R}{\cancel{T_0}}\cdot\frac{\frac{\cancel{16}^{8}}{25}T_0^{\cancel{2}}}{\cancel{2}} = \frac{24}{25}\nu RT_0$$

$$Q = \Delta U + A_{\ast\,min.} = C\nu\Delta T = C\nu(T_1 - T_0)$$

$$Q = \nu\cdot 3R\frac{T}{T_0}(T_1 - T_0)$$

$$\frac{1}{T_0}T^2 - T$$

$$3 + \frac{3}{2} = 4{,}5 = \frac{9}{2} \qquad \cdot\frac{3}{5}$$

$$\frac{-(-1)}{\frac{1}{T_0}} = \frac{T_0}{2}$$

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№2

Дано:

$\nu; T_0; \frac{3}{5}T_0$

$C(T) = 3R\frac{T}{T_0}$

1) Q_1 (>0)

2) T_1

3) A_{min}

черновик.

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

$\nu 3R\frac{T}{T_0}$

$\int_0^{\frac{3}{5}T_0} \Delta Q = \int_0^{\frac{3}{5}T_0} \nu \cdot 3R \frac{T}{T_0} \Delta T$

$Q_1 = \nu \cdot \frac{3R}{T_0} \int_0^{\frac{3}{5}T_0} T dT$

$Q_1 = \frac{3R\nu}{T_0} \cdot \frac{T^2}{2} = \frac{3R\nu \cdot \frac{9}{25}T_0^2}{2T_0} = \frac{27}{50}\nu R T_0$

2) $Q = \Delta U + A = \nu C \Delta T$

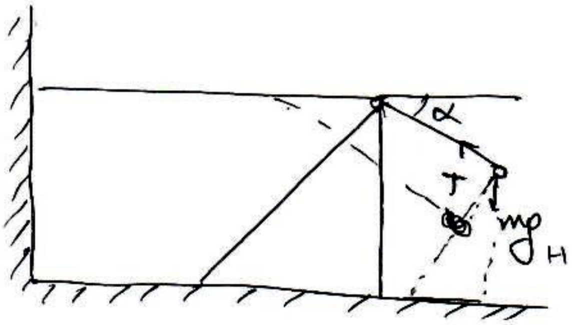
1) $\Delta Q = C\nu \Delta T = \frac{3\nu R}{T_0} T \Delta T$

$\int \frac{3\nu R}{T_0} T \Delta T = \frac{3\nu R}{T_0} \cdot \frac{T^2}{2}$

$Q_1 = -\frac{3\nu R}{T_0} \cdot \frac{T_1^2 - T_0^2}{2} = \frac{3\nu R(T_0^2 - \frac{9}{25}T_0^2)}{2T_0} = \frac{3 \cdot 16}{2 \cdot 25}\nu R T_0 = \frac{24}{25}\nu R T_0$

$3\nu R$

~~$mgH = \frac{mv^2}{2}$~~ Черновик



$ma = Mg\sin\alpha = T\frac{\sin\alpha}{a}$

Часть 2

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

Шифр: **21203514**

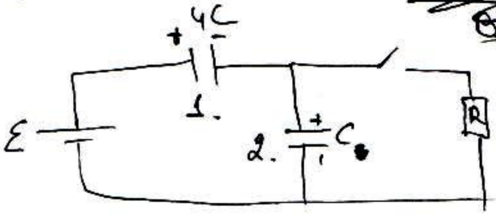
ID профиля: **100613**

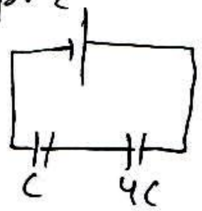
Вариант 3

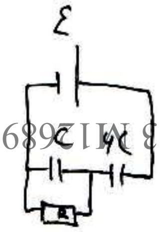
№3

~~Чистовик~~ Черновик

~~9-11-03~~







Дано:
$C_2 = C;\ C_1 = 4C$
$\mathcal{E};\ R$

1) $I_н$
2) Q
3) U_R

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1) Изн.:

$$\begin{cases} q_1 = q_2 \\ \mathcal{E} = \frac{q_1}{C} + \frac{q_2}{4C} \end{cases} \iff \mathcal{E} = \frac{5q}{4C}\ ;\ q = \frac{4C\mathcal{E}}{5}$$

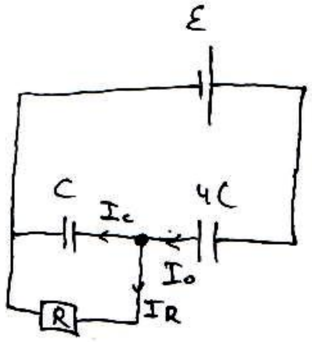
$$U_2 = \frac{q}{C} = I_н R\ ;\quad I_н = \frac{q}{CR} = \frac{4C\mathcal{E}}{5CR} = \boxed{\frac{4\mathcal{E}}{5R}}$$

2) $Q = \frac{CU_2^2}{2}$

(т.к. резистор полностью разрядит конденсатор 2, т.к. тока в цепи не будет).

$$Q = \frac{C}{2}\cdot\left(\frac{q}{C}\right)^2 = \frac{q^2}{2C} = \frac{16C^2\mathcal{E}^2}{2\cdot 25C} = \boxed{\frac{8}{25}C\mathcal{E}^2}$$

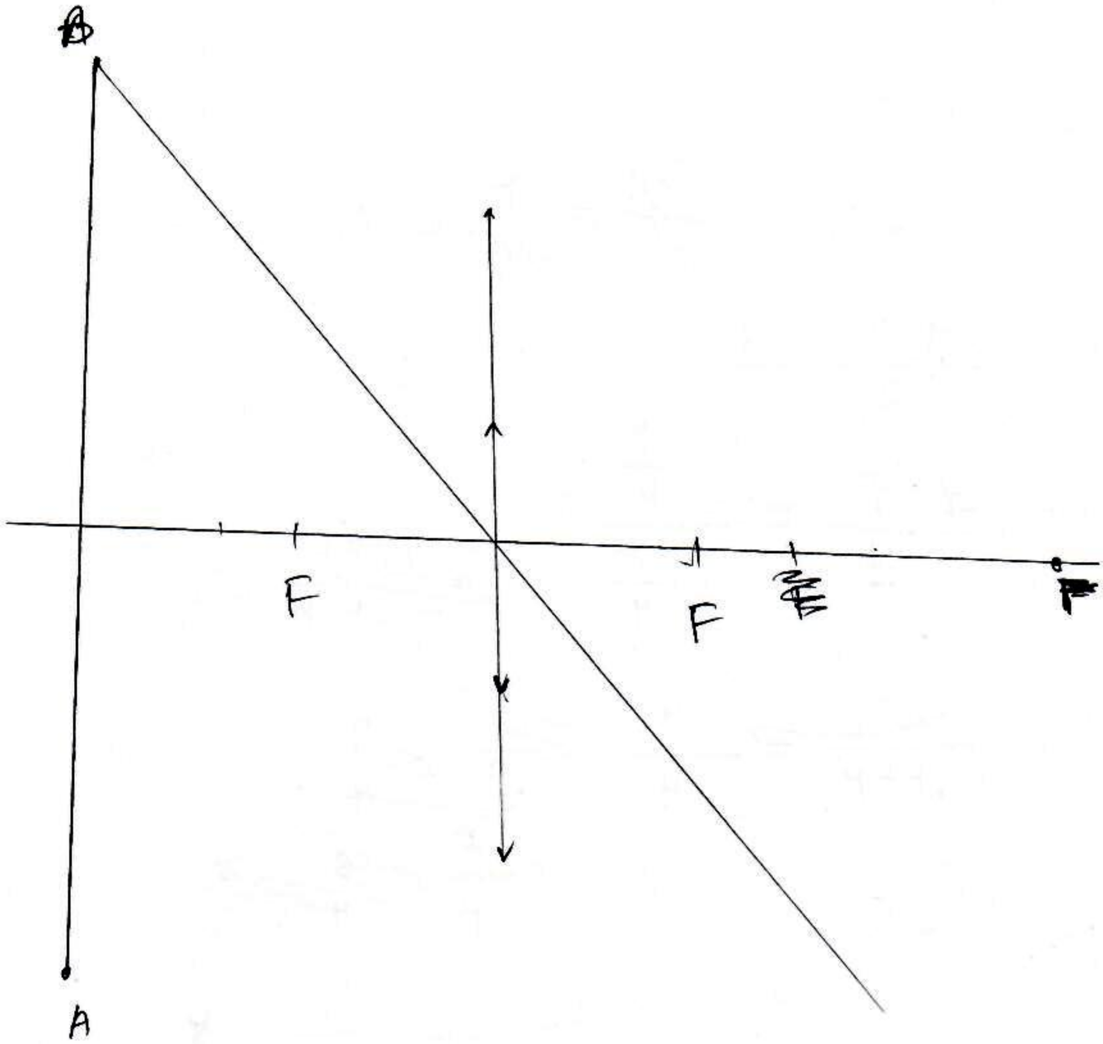
3)

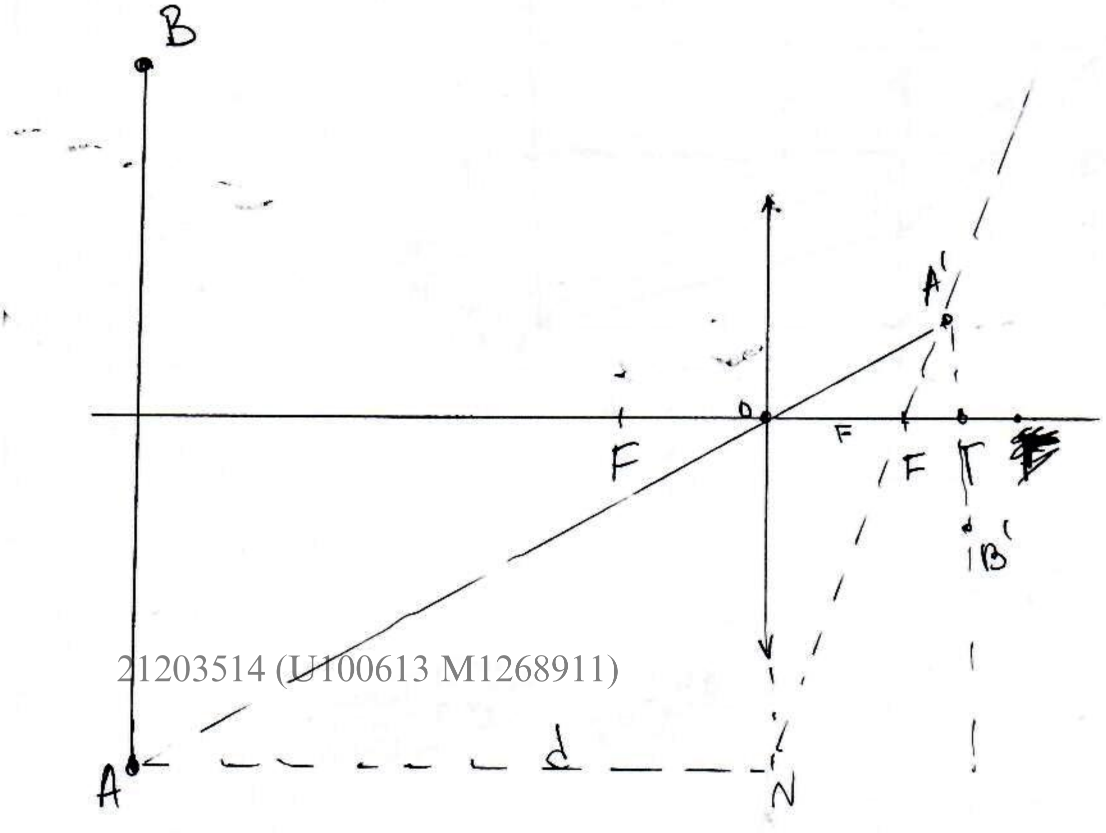


~~$I_0 = I_c + I_R$~~

~~Ответ: $\frac{4\mathcal{E}}{5R}$; $\frac{8}{25}C\mathcal{E}^2$~~

Черновик





$\frac{d}{F} =$

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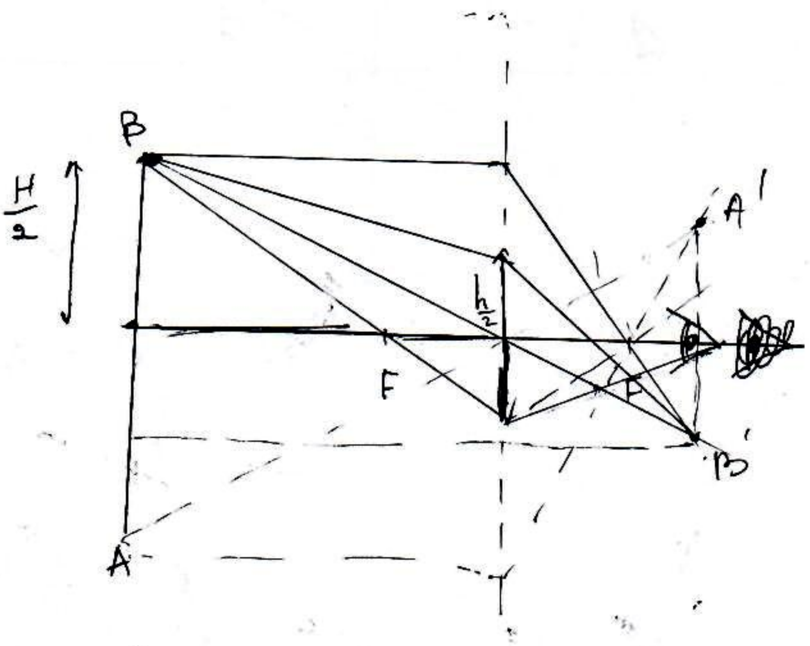
$$\varepsilon = \frac{I}{4R}$$



$$\cancel{\frac{H}{2} = \frac{h}{2} = \frac{d}{d'}}$$

$$\cancel{\frac{H}{h} = \frac{d}{d'}} \qquad \frac{H}{h} = \frac{d+d'}{d'}$$

$$h = \frac{H \cdot d'}{d+d'}$$

$$\frac{\frac{h}{2}}{\frac{H}{2}} = \frac{F}{d-F}$$

$$\frac{h}{H} = \frac{F}{d-F}$$

$$W = \frac{CU^2}{2} = \frac{q^2}{2C}$$

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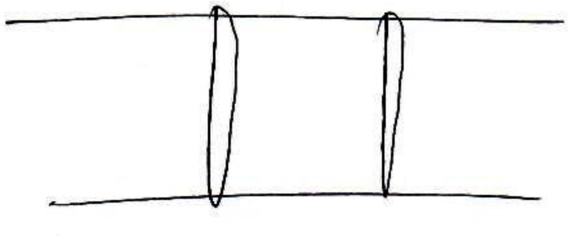
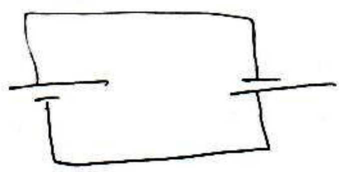
Черновик

Если линза собирающая, то всё с „+"

$$\frac{1}{d}+\frac{1}{d'}=\frac{1}{F}; \quad \frac{1}{d'}=\frac{1}{F}-\frac{1}{d}=\frac{d-F}{dF};$$

$$d'=\frac{dF}{d-F}$$





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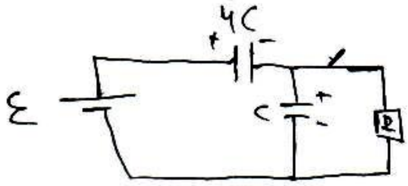
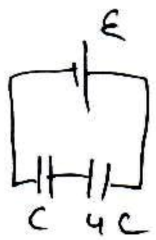
Чистовик
В. 11-03





Дано:
$C_2 = C$; $C_1 = 4C$
$\mathcal{E}$; R

1) $I_н$
2) Q 3) U_R

1) Уст:

$$\begin{cases} q_1 = q_2 = q \\ \mathcal{E} = \frac{q_1}{C} + \frac{q_2}{4C} \end{cases}, \text{ т.е. } \mathcal{E} = \frac{5q}{4C};\ q = \frac{4C\mathcal{E}}{5}$$

$$U_{Rн} = U_{2н} = \frac{q}{C} = \frac{4\mathcal{E}}{5}, \text{ тогда } \boxed{I_н = \frac{U_{Rн}}{R} = \frac{4\mathcal{E}}{5R}}$$

2) $\mathcal{E} = \frac{q_1'}{4C}$; $q_1' = 4C\mathcal{E} = 5q$

$$W_н + A = W_к + Q$$

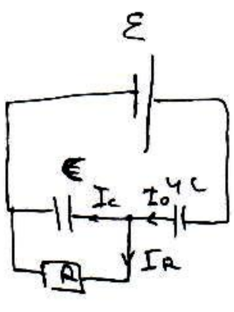
$$\frac{q^2}{2\cdot 4C} + \frac{q^2}{2C} + \mathcal{E}(q_1' - q) = \frac{q_1'^2}{2\cdot 4C} + Q$$

$$\frac{5q^2}{8C} + 4q\mathcal{E} = \frac{25q^2}{8C} + Q$$

$$\frac{16}{5}C\mathcal{E}^2 = \frac{\cancel{20}^{4}}{\cancel{8}}\cdot\frac{\cancel{16}^{2}}{\cancel{25}_{5}}C\mathcal{E}^2 + Q$$

$$Q = \frac{16-8}{5}C\mathcal{E}^2 = \boxed{\frac{8}{5}C\mathcal{E}^2}$$

3)



$$I_0 = I_c + I_R$$

Ответ: $\frac{4\mathcal{E}}{5R}$; $\frac{8}{5}C\mathcal{E}^2$

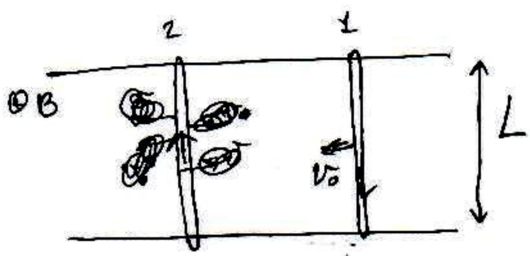
1

Чистовик

№ 4

Дано:
L; $2m$; R
m; $3R$; v_0
S_0

$a_н$; v; S



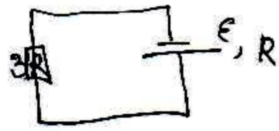
1) $\mathcal{E} = B v_0 L = I \cdot 4R$; $I = \dfrac{B v_0 L}{4R}$

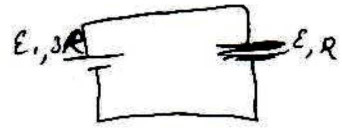
$F_A = IBL$

$$F_A = \frac{B^2 L^2 v_0}{4R}$$

$2m a_н = F_A$

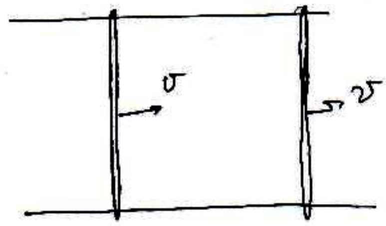
$$a_н = \frac{B^2 L^2 v_0}{8Rm}$$





2) $|2m v_0| = (2m+m) v$

$$v = \frac{2}{3} v_0$$

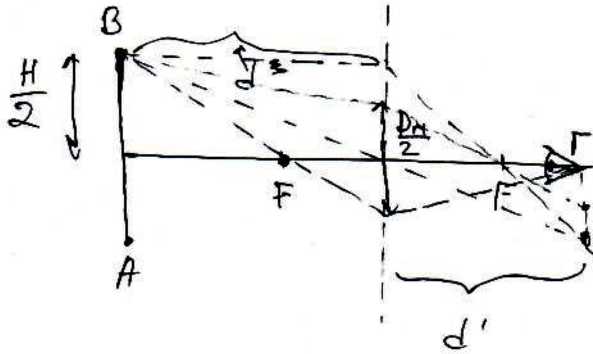


Ответ: $\dfrac{B^2 L^2 v_0}{8Rm}$; $\dfrac{2}{3} v_0$

2

№5

Чистовик



Дано:
F = 18 см
H = 9 см
d = 72 см
S = 24 см

X ; $D_{мин}$; L

1) $\frac{1}{F} = \frac{1}{d} + \frac{1}{x}$

$\underbrace{x = \frac{dF}{d-F}}$

$x = \frac{72 \cdot 18}{72-18} = \frac{1296}{54} = \underbrace{24\,(см)}$

2) $\frac{\frac{D_м}{2}}{\frac{H}{2}} = \frac{F}{d-F}$

$\underbrace{D_м = \frac{HF}{d-F}}$; $D_м = \frac{9 \cdot 18}{72-18} = \frac{162}{54} = \underbrace{3\,(см)}$

3)

Ответ: 24 см ; 3 см

3

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