

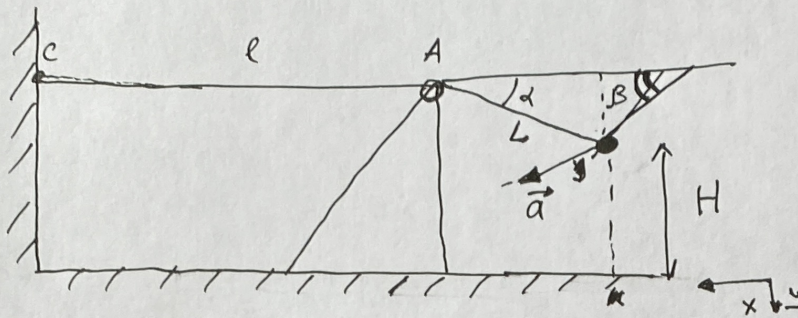
# Часть 1

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

Шифр: **21200844**

ID профиля: **126419**

Вариант 1



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

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

1)  $\beta$  - ?

2)

1) Пусть  $L$  - длина нити ~~всей~~ (всей)  
 $l$  - длина CA

$(x, y)$  - координаты шара

Тогда  $x = l + (L-l) \cdot \cos \alpha$

$y = H - (L-l) \cdot \sin \alpha$

$\Delta l$  - удлинение участка с шаром

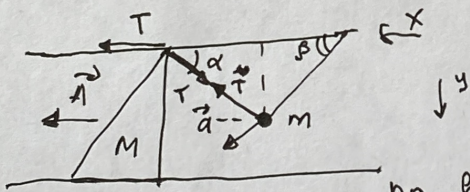
$$\operatorname{tg} \beta = \frac{\Delta y}{\Delta x} = \frac{\Delta l \cdot \sin \alpha}{\Delta l (1 - \cos \alpha)} = \frac{4}{5} : \frac{2}{5} = 2$$

т.к.  $\alpha = \text{const}$

Шар движется по прямой, значит  $m$  во  
 ускорение направлено вдоль траектории движения

Ответ:  $\operatorname{tg} \beta = 2$  ( $\beta = \arctg 2$ )

2)



Пусть  $T$  - сила натяжения нити;  $a$  - ускорение шара  
 $A$  - ускорение клина

по втор. зак. Ньютона:

Тогда:

$$\begin{cases} m a \cdot \cos \beta = T \cdot \cos \alpha & (0x) \\ m a \cdot \sin \beta = m g - T \cdot \sin \alpha & (0y) \\ M \cdot A = T - T \cdot \cos \alpha = T(1 - \cos \alpha) \\ a \cdot \cos \beta = A \cdot (1 - \cos \alpha) \end{cases}$$

$$a \cdot \cos \beta = \ddot{x} = \ddot{l} (1 - \cos \alpha) = A(1 - \cos \alpha)$$

1) см.р.

ученобак

$$\begin{cases} ma \cdot \cos \beta = T \cdot \frac{3}{5} \\ ma \cdot \sin \beta = mg - T \cdot \frac{4}{5} \\ M \cdot A = T \left(1 - \frac{3}{5}\right) = \frac{2}{5} T \\ \underline{a \cdot \cos \beta = \frac{2}{5} A} \Rightarrow \underline{A = \frac{2A}{5 \cdot \cos \beta}} \end{cases}$$

$$\begin{cases} m \cdot A \cdot \frac{2}{5} = T \cdot \frac{3}{5} \\ M \cdot A \cdot \frac{2}{5} \cdot \operatorname{tg} \beta = mg - T \cdot \frac{4}{5} \\ T = \frac{5}{2} \cdot MA \end{cases}$$

$$\begin{cases} m \cdot A \cdot \frac{2}{5} = M \cdot A \cdot \frac{3}{2} \\ m \cdot A \cdot \frac{4}{5} = mg - M \cdot A \cdot 2 \end{cases} \Rightarrow \underline{\frac{m}{M} = \frac{15}{4}}$$

$$A \cdot \frac{4}{5} \cdot \frac{15}{4} = \frac{15}{4} \cdot g - 2A$$

$$5A = \frac{15}{4}g$$

$$\underline{A = \frac{3}{4}g}$$

Одговор:  $\frac{3}{4}g$

3) Одговор:  $\frac{m}{M} = \frac{15}{4}$

4)  $\underline{a} = \frac{2A}{5 \cos \beta} = \frac{6g}{20 \cdot \cos \beta} = \text{const}$

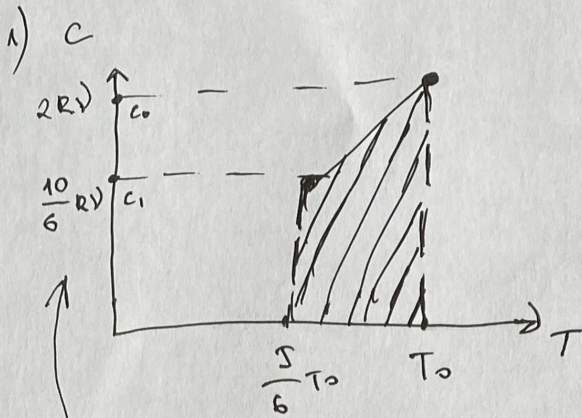
$$a \cdot \sin \beta = \frac{5g}{20} \operatorname{tg} \beta = 0,6g$$

$$\frac{a \cdot \sin \beta \cdot t^2}{2} = H \Rightarrow t = \sqrt{\frac{2H}{a \cdot \sin \beta}} = \sqrt{\frac{H}{0,3g}}$$

Одговор:  $t = \sqrt{\frac{H}{0,3g}}$

2) CMP.

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



$Q_1 = S_{\text{тр}} - \text{трапеция}$

$$Q = \frac{1}{2} \cdot RV \cdot \frac{2 + \frac{10}{6}}{2} \cdot T_0 \cdot \left(1 - \frac{5}{6}\right)^2 = \sqrt{RT_0} \cdot \frac{11}{6} \cdot \frac{1}{6} = \frac{11}{36} \sqrt{RT_0}$$

Ответ:  $\frac{11}{36} \sqrt{RT_0}$

$$c_0 = 2R \cdot \frac{T_0}{T_0} \sqrt{V} = 2R \sqrt{V}$$

$$c_1 = 2R \cdot \frac{\frac{5}{6} T_0}{T_0} \sqrt{V} = \frac{10}{6} R \sqrt{V}$$

2)  $A = Q_{\text{полн}} - \Delta E$  (по закону сохранения энергии)

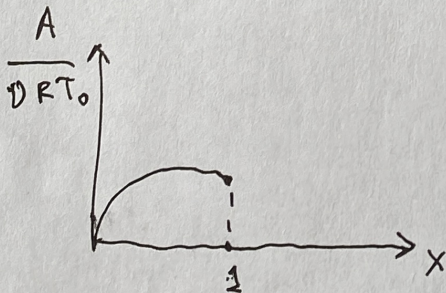
$$\Delta E = \frac{3}{2} \sqrt{R} (T - T_0)$$

$$Q_{\text{полн}} = 2 \sqrt{R} \cdot \frac{1 - \frac{T}{T_0}}{2} (T - T_0) = -\sqrt{RT_0} \left(T - \frac{T}{T_0}\right)^2$$

$$A = -\sqrt{RT_0} \left(1 - \frac{T}{T_0}\right)^2 + \frac{3}{2} \sqrt{R} T_0 \left(1 - \frac{T}{T_0}\right)$$

Зам.:  $x = 1 - \frac{T}{T_0}$

$$A = -\sqrt{RT_0} \left(x^2 - \frac{3}{2}x\right)$$



т.к. работа газа  
положит., её максимал.  
значение совп с  $x=0$

$$T = T_0 \Rightarrow A = 0$$

2) 3) Ответ:  $T = T_0, A = 0$

3  
стр.

термован

N2

He  
 $\downarrow$   
 $T_0$   
 $C(T) = 2R \frac{T}{T_0}$

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

$\Delta T = \frac{T_0}{6}$   
 $i = 3$

$\Delta U = \frac{3}{2} \nu R \cdot \frac{T_0}{6} = \nu R \frac{T_0}{4}$

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

$C_M \cdot M \cdot \Delta T = Q$

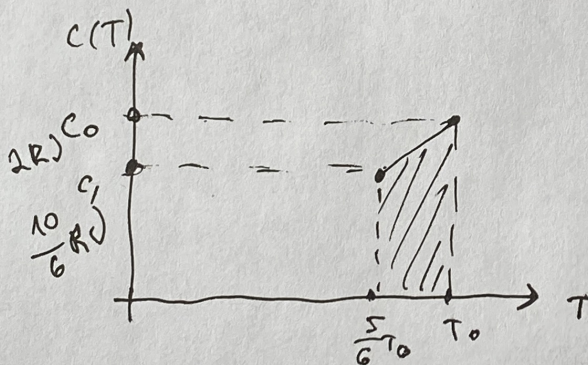
$P_0 V_0 = \nu R \cdot T_0$

$P_0 V_1 = \nu R \cdot \frac{5}{6} T_0$

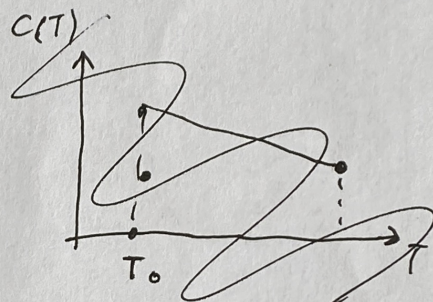
$A < 0$

$m = \text{const}$

$\frac{dC}{dT} = \frac{2R}{T_0}$



~~$Q = \frac{3}{2} \nu R T_0$~~



$C_1 = 2R \cdot \frac{5/6 T_0}{T_0} = \frac{5}{3} R$

$C_0 = 2R$

$S = \frac{1}{6} T_0 \cdot \left( \frac{5}{3} R + 2R \right) \cdot \frac{1}{2} =$   
 $= \frac{11}{6} R \cdot \frac{1}{6} T_0 \cdot \frac{1}{2} =$   
 $= \frac{11}{72} T_0 R$

$S = \frac{1}{2} R V \cdot \frac{2 + \frac{10}{6}}{2} \cdot T_0 \cdot \frac{1}{6} =$

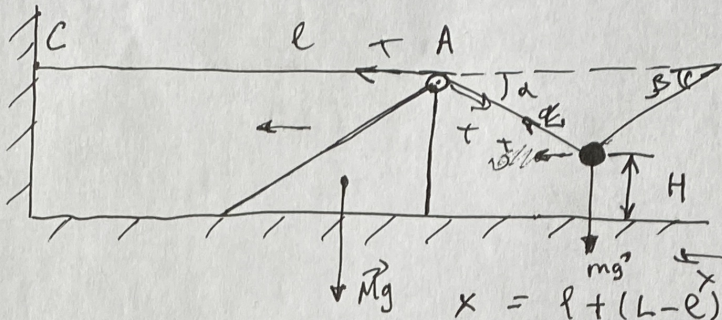
$= R V \cdot T_0 \cdot \frac{2R}{6 \cdot 2} \cdot \frac{1}{6} = \frac{11}{36} R T_0$

2)  $A = 0$  - изохор.

$T = T_0$

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

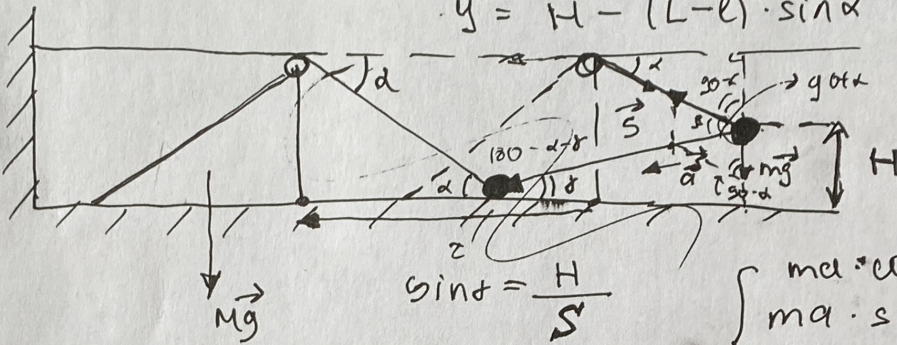
$$\sin \alpha = \frac{4}{5}$$



$$x = l + (L-l) \cdot \cos \alpha$$

$$y = H - (L-l) \cdot \sin \alpha$$

- 1)  $\beta - ?$
- 2)  $\alpha - ?$
- 3)

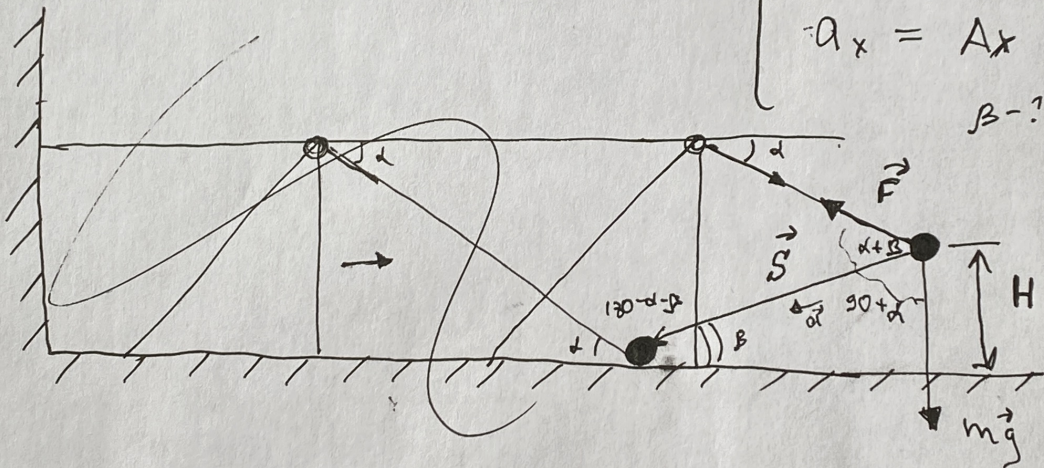


$$\sin \alpha = \frac{H}{S}$$

$$\begin{cases} m \alpha \cdot \cos \beta = T \cdot \cos \alpha \\ m \alpha \cdot \sin \beta = mg - T \cdot \sin \alpha \\ M \alpha = T (1 - \cos \alpha) \end{cases}$$

$$a_x = A_x$$

$\beta - ?$



$$3MA = mg - 2MA$$

$$5MA = mg$$

$$\frac{m}{M} = \frac{5A}{g} \cdot \frac{3}{4}$$

$$\begin{cases} m \cdot A \cdot \frac{2}{5} = T \cdot \frac{3}{5} \\ M \cdot A \cdot \frac{2}{5} + T \sin \beta = mg \cdot \frac{4}{5} \\ T = \frac{5}{2} \cdot MA \end{cases}$$

~~$$m \cdot A \cdot \frac{2}{5} = \frac{5}{2} \cdot MA$$~~

~~$\frac{m}{M} = ?$~~

~~$$m \cdot A \cdot \frac{2}{5} = \frac{3}{5} \cdot \frac{5}{2} \cdot MA$$~~

$$\frac{m}{M} = \frac{15}{4}$$

Сопровож

8/10

$$1) Q = C_M \cdot M \cdot \Delta T$$

~~W = P \cdot \Delta T~~

$$\Delta A = -\frac{1}{8} \nu R T_0$$

$$\Delta U = -\frac{3}{2} \nu R \cdot \frac{T_0}{8} = -\frac{1}{4} \nu R T_0$$

$$Q = -\frac{2}{8} \nu R T_0 - \frac{3}{4} \nu R T_0 = -\frac{5}{4} \nu R T_0$$

$$Q_1 = \frac{5}{4} \nu R T_0$$

4)

$$Q_1 = \frac{C_M \cdot M \cdot \Delta T}{\frac{11}{72} T_0 R}$$

$$Q = \nu \cdot C_V \cdot \Delta T = \frac{11}{72} T_0 \nu R$$

~~$\Delta T = \frac{1}{8} T_0$~~

$$C_V \cdot \Delta T = \frac{11}{72} T_0 R$$

$$2) A = \frac{3}{2} \nu R \Delta T$$

# Часть 2

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

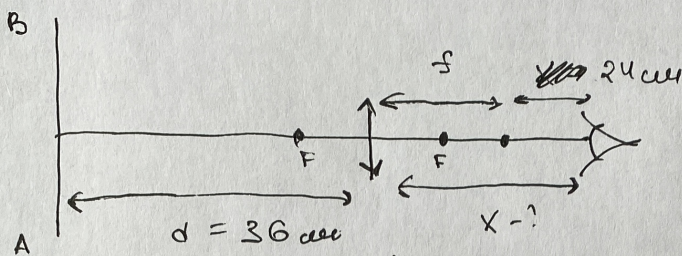
Шифр: **21200844**

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Вариант 1



Тестовая  
№ 5



Дано:  
 $F = 9 \text{ см}$   
 $H = 9 \text{ см}$   
 $d = 36 \text{ см}$   
 accommodation. 24 см

По формуле линзы:

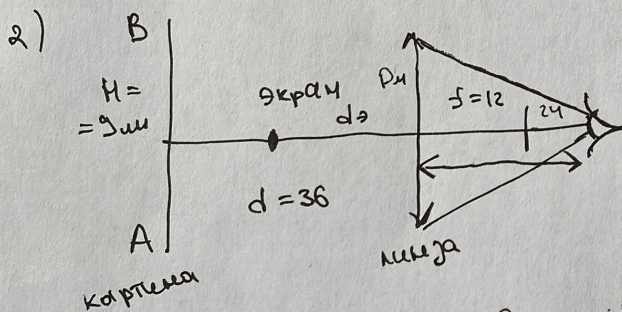
$$1) \quad \frac{1}{f} + \frac{1}{d} = \frac{1}{F}$$

$$\frac{1}{f} = \frac{1}{F} - \frac{1}{d} = \frac{1}{9} - \frac{1}{36} = \frac{1}{12}$$

$$\Rightarrow f = 12 \text{ см}$$

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

Ответ:  $x = 36 \text{ см}$



Размер изображения:

$$H \cdot \frac{f}{d} = 9 \cdot \frac{12}{36} = 3 \text{ см}$$

$$D_n = 3 \text{ см} \cdot \frac{36^3}{24^2} = 4,5 \text{ см}$$

Ответ:  $D_n = 4,5 \text{ см}$

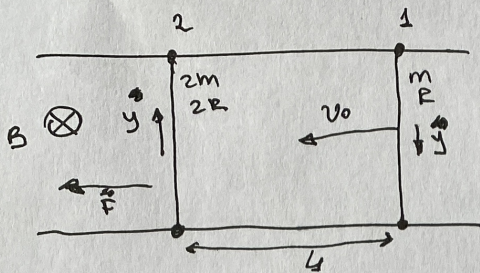
3) Изображение экрана должно находиться в т.глаз:

$$\frac{1}{x} + \frac{1}{d_2} = \frac{1}{F}$$

$$\frac{1}{d_2} = \frac{1}{9} - \frac{1}{36} = \frac{1}{12} \Rightarrow d_2 = 12 \text{ см}$$

Ответ: экран м/у картинкой и линзой  
на расст. 12 см от линзы

① стр.



$$1) \quad \mathcal{E} = - \frac{d\Phi}{dt} = - B \cdot L \cdot v_0$$

$$y = \frac{\mathcal{E}}{3R} = \frac{BLv_0}{3R}$$

$$F = 2ma = BL \cdot y$$

$$a = \frac{BLY}{2m} = \frac{B^2 L^2 \cdot v_0}{2m \cdot 3R} = \frac{B^2 L^2 \cdot v_0}{6mR}$$

Омсьем:  $\frac{B^2 \cdot L^2 \cdot v_0}{6mR}$

2) Аљсць  $v_1$  - скопосць 1 ~~перемощ.~~  
 $v_2$  - скопосць 2 перемощ.

$$\mathcal{E} = - B \cdot L (v_1 - v_2)$$

$$y = \frac{BL}{3R} (v_1 - v_2)$$

$$a_2 = \dot{v}_2 = \frac{BL}{2m} \cdot \dot{y}$$

$$a_1 = \dot{v}_1 = - \frac{BL}{m} \cdot \dot{y}$$

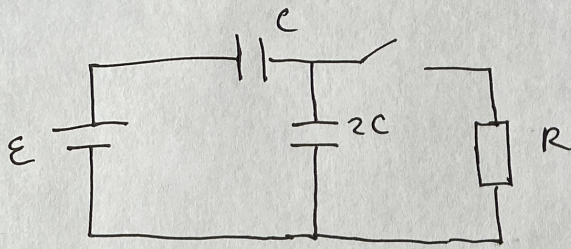
$$\ddot{y} = \frac{BL}{3R} (\dot{v}_1 - \dot{v}_2) = - \frac{B^2 L^2}{3Rm} \left( y - \frac{y}{2} \right) = - \frac{B^2 L^2 \cdot y}{6Rm}$$

y

2

смп.

Ucmobur  
N3



$$1) \begin{cases} \frac{q}{2C} + \frac{q}{C} = \varepsilon \\ \frac{q}{C} = YR \end{cases} \quad t=0$$

$$q = \frac{2\varepsilon C}{3}$$

$$Y = \frac{q}{CR} = \frac{2\varepsilon}{3R}$$

Jawab:  $Y = \frac{2\varepsilon}{3R}$

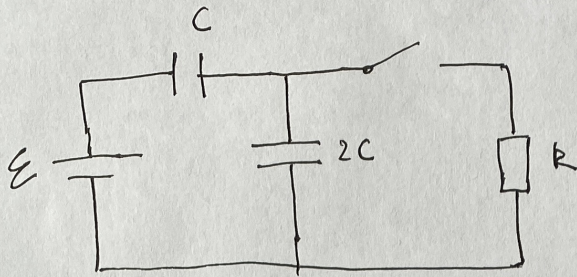
$$2) \begin{cases} \frac{q_1}{2C} + \frac{q_2}{C} = \varepsilon \\ \frac{q_2}{C} = YR \\ \dot{q}_1 = Y_1 \\ \dot{q}_2 = Y_2 \\ Y_1 = Y + Y_2 \end{cases}$$

$$\begin{cases} q_1 = \frac{q_2}{2R} + q_2 \\ q_1 = 2\varepsilon C - 2q_2 \end{cases}$$

3) amp.

~~Task 1~~ ~~Task 2~~ ~~Task 3~~ ~~Task 4~~ ~~Task 5~~ ~~Task 6~~ ~~Task 7~~ ~~Task 8~~ ~~Task 9~~ ~~Task 10~~ ~~Task 11~~ ~~Task 12~~ ~~Task 13~~ ~~Task 14~~ ~~Task 15~~ ~~Task 16~~ ~~Task 17~~ ~~Task 18~~ ~~Task 19~~ ~~Task 20~~ ~~Task 21~~ ~~Task 22~~ ~~Task 23~~ ~~Task 24~~ ~~Task 25~~ ~~Task 26~~ ~~Task 27~~ ~~Task 28~~ ~~Task 29~~ ~~Task 30~~ ~~Task 31~~ ~~Task 32~~ ~~Task 33~~ ~~Task 34~~ ~~Task 35~~ ~~Task 36~~ ~~Task 37~~ ~~Task 38~~ ~~Task 39~~ ~~Task 40~~ ~~Task 41~~ ~~Task 42~~ ~~Task 43~~ ~~Task 44~~ ~~Task 45~~ ~~Task 46~~ ~~Task 47~~ ~~Task 48~~ ~~Task 49~~ ~~Task 50~~ ~~Task 51~~ ~~Task 52~~ ~~Task 53~~ ~~Task 54~~ ~~Task 55~~ ~~Task 56~~ ~~Task 57~~ ~~Task 58~~ ~~Task 59~~ ~~Task 60~~ ~~Task 61~~ ~~Task 62~~ ~~Task 63~~ ~~Task 64~~ ~~Task 65~~ ~~Task 66~~ ~~Task 67~~ ~~Task 68~~ ~~Task 69~~ ~~Task 70~~ ~~Task 71~~ ~~Task 72~~ ~~Task 73~~ ~~Task 74~~ ~~Task 75~~ ~~Task 76~~ ~~Task 77~~ ~~Task 78~~ ~~Task 79~~ ~~Task 80~~ ~~Task 81~~ ~~Task 82~~ ~~Task 83~~ ~~Task 84~~ ~~Task 85~~ ~~Task 86~~ ~~Task 87~~ ~~Task 88~~ ~~Task 89~~ ~~Task 90~~ ~~Task 91~~ ~~Task 92~~ ~~Task 93~~ ~~Task 94~~ ~~Task 95~~ ~~Task 96~~ ~~Task 97~~ ~~Task 98~~ ~~Task 99~~ ~~Task 100~~

N3

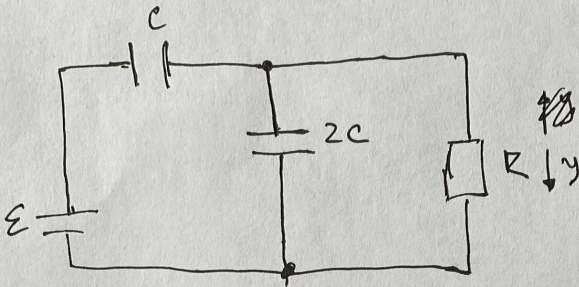


$$1) \begin{cases} \frac{q}{2C} + \frac{q}{C} = \varepsilon \\ \frac{q}{C} = \gamma R \end{cases} \quad t=0$$

$$q = \frac{2\varepsilon C}{3}$$

$$\gamma = \frac{q}{CR} = \frac{2\varepsilon}{3R}$$

$$\text{Answer: } \gamma = \frac{2\varepsilon}{3R}$$



$$2) \begin{cases} \frac{q_1}{2C} + \frac{q_2}{C} = \varepsilon \\ \frac{q_2}{C} = \gamma R \\ \dot{q}_1 = \gamma_1 \\ \dot{q}_2 = \gamma_2 \\ \gamma_1 = \gamma + \gamma_2 \end{cases}$$

$$\begin{cases} \dot{q}_1 = \frac{q_2}{RC} + \dot{q}_2 \\ q_1 = 2\varepsilon C - 2q_2 \end{cases}$$

$$\Rightarrow -2\dot{q}_2 = \frac{q_2}{RC} + \dot{q}_2 \Rightarrow \dot{q}_2 = -\frac{q_2}{3RC}$$

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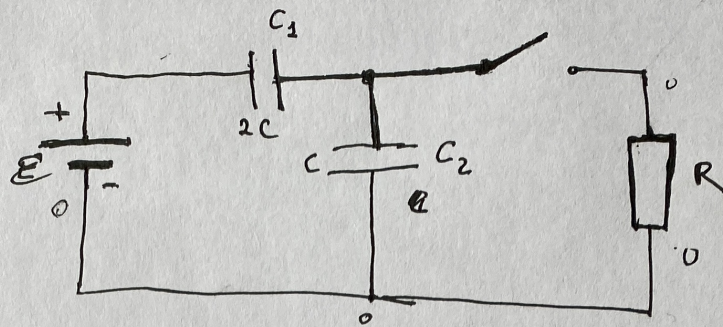
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терновик

N3

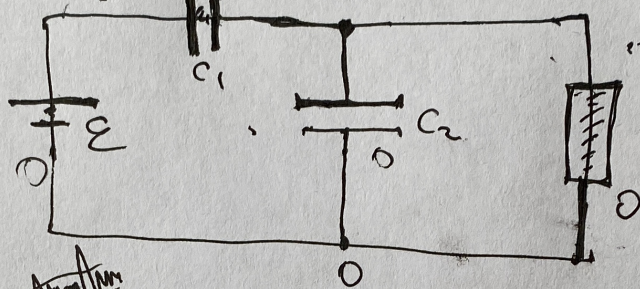


- $C_2 = C$   
 $C_1 = 2C$   
 1)  $U$  - ?  
~~1)  $U$  - ?~~  
 2)  $Q$  - ?  
 3)

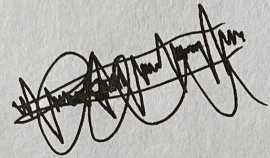
$Q =$

$U = R \cdot I$

сразу после замыкания:



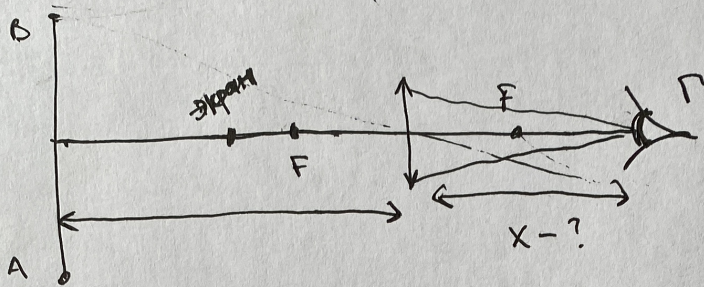
$\uparrow U$  - ?



$$\begin{aligned}
 \varepsilon &= \frac{q}{2C} + \frac{q}{C} = \frac{3q}{2C} \Rightarrow q = \frac{2C \cdot \varepsilon}{3} \\
 \frac{q}{C} &= U R \Rightarrow U = \frac{q}{CR} = \frac{2C \cdot \varepsilon}{3 \cdot C \cdot R} = \frac{2\varepsilon}{3R}
 \end{aligned}$$

А икологур. - ма аи боити на расседемт. иол  
некомор. расседемт

$F = 9 \text{ см}$   
 $H = 9 \text{ см}$   
 36 см



$$\frac{1}{f} + \frac{1}{d} = \frac{1}{F} \Rightarrow \frac{1}{f} = \frac{1}{9} - \frac{1}{36} = \frac{1}{12} \text{ ф}$$

$$F = \frac{f}{d} = \frac{12}{36} \Rightarrow 9 \cdot \frac{1}{3} = 3 \text{ см} - \text{изображ.}$$

$3 \cdot \frac{36}{24} = 4.5 \text{ см}$

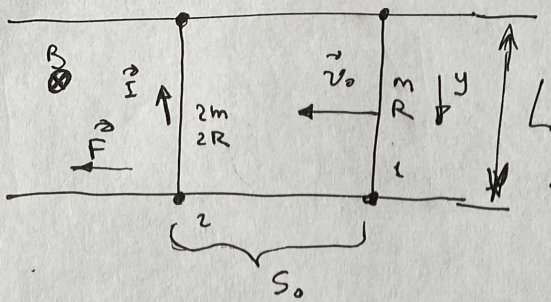
3)  $\frac{1}{8} + \frac{1}{d_2} = \frac{1}{f}$

$$\frac{1}{d_2} = \frac{1}{9} - \frac{1}{36} = \frac{1}{12}$$

$d_2 = 12 \text{ см}$

перемещение монеты!

14



- 1)  $a_c = ?$
- 2)

Дано:  
 $B, m, R,$   
 $v_0$

$$1) \quad \mathcal{E} = -\frac{d\Phi}{dt} = -B \cdot L \cdot v_0$$

$$I = \frac{\mathcal{E}}{3R} = \frac{BLv_0}{3R}$$

$$2ma = I = BL \cdot y$$

$$a = \frac{-BLI}{2m} = \frac{B^2 L^2 v_0}{6mR}$$

$$a = \frac{BLy}{2m} \cdot \frac{BLv_0}{3R} = \frac{B^2 L^2 v_0}{6mR}$$

$$2) \quad \mathcal{E} = -BL \cdot (v_1 - v_2)$$

$v_1$  — скорость 1

$v_2$  — скорость 2

$$I = \frac{BL}{3R} (v_1 - v_2)$$

$$a_2 = \dot{v}_2 = \frac{BL}{2m} \cdot I$$

$$a_1 = \dot{v}_1 = -\frac{BL}{m} \cdot I$$

$$\dot{I} = \frac{BL}{3R} (v_1 - v_2) = -\frac{B^2 L^2}{3Rm} \left(1 - \frac{1}{2}\right) y = -\frac{B^2 L^2}{6Rm} \cdot y$$