

Часть 1

Олимпиада: **Физика, 10 класс (1 часть)**

Шифр: **21205697**

ID профиля: **827410**

Вариант 4

Упробле
12

$$\cos = \frac{24}{25}$$

$$h = 1.4$$

$$\mu_1 = 0.5$$

$$\mu_2 = 0.06$$

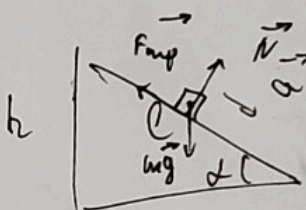


$$l = \frac{24}{\cos} = \frac{24}{\frac{24}{25}} = 25$$

$$= \sqrt{\frac{(25-24)(25+24)}{25^2}} = \frac{4}{25} = \sin$$

$$l = \frac{25}{4} h = \frac{25 \cdot 1.4}{4} = 8.75$$

$$= 5 \text{ m}$$



$$F_{mp} - mg \sin \alpha = ma$$

$$\mu_1 mg \cos \alpha - mg \sin \alpha = ma$$

$$5 \cdot \frac{24}{25} - \frac{40}{25} = 2 = a$$

$$v_{max} = at$$

$$v_{max} t - \frac{at^2}{2} = l$$

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

$$t = \sqrt{\frac{2l}{a}} = \sqrt{5}$$

$$v = 2\sqrt{5}$$

$$\frac{v^2}{4} = 5$$

л 3 (програм - е)

$$T = \frac{2\pi}{\sqrt{\frac{F \sin \alpha}{m \cdot r}}}$$

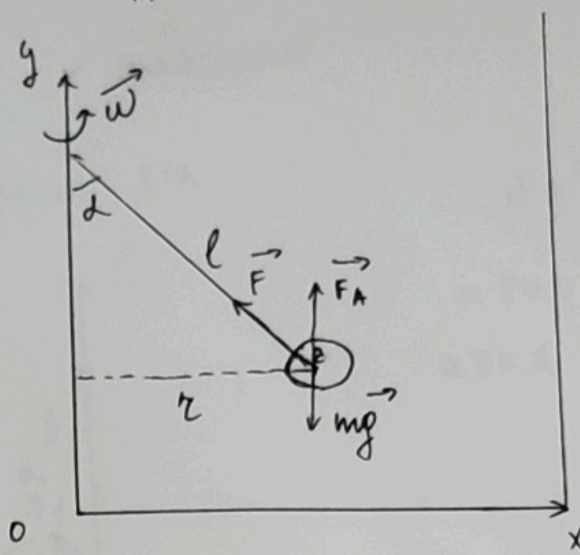
$$T = \frac{6.28}{\sqrt{\frac{99.71 \cdot \frac{31}{2}}{5.2 \cdot 0.139}}} = 0.58 \text{ c}$$

Отвечу 1) $F = 60 \text{ H}$ 2) $T = 0.58 \text{ c}$.

Умножим

$$\tau = \sin \alpha \cdot (l + R)$$

$$\tau = 0,139 \text{ м}$$



$$\cos \alpha = \frac{1}{2}$$

$$\sin \alpha = \frac{\sqrt{3}}{2}$$

В 3-й координате:

$$\vec{F}_A + \vec{F} + m\vec{g} = \vec{0}$$

$$O_y: -mg + F_A + F \cos \alpha = 0$$

$$F \cos \alpha = mg - F_A$$

$$F_A = \rho_b V_m g \quad V_m = \frac{4}{3} \pi R^3 \Rightarrow$$

$$\Rightarrow F_A = \rho_b \frac{4}{3} \pi R^3 g$$

$$F \cos \alpha = mg - \rho_b \frac{4}{3} \pi R^3 g$$

$$F = \frac{mg - \rho_b \frac{4}{3} \pi R^3 g}{\cos \alpha}$$

$$F = \frac{52 - 1000 \cdot \frac{4}{3} \cdot 3,14 \cdot 0,08^3 \cdot 10}{\frac{1}{2}} =$$

$$= 99,71 \text{ Н}$$

$$O_x: F \sin \alpha = m a_y$$

$$a_y = \frac{r \omega^2}{R}$$

$$F \sin \alpha = m \omega^2 R \Rightarrow$$

$$\Rightarrow \omega = \sqrt{\frac{F \sin \alpha}{m R}}$$

$$r = \omega R \Rightarrow a_y = \omega^2 R$$

x N - кол. во об

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$$T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\frac{F \sin \alpha}{m R}}} = \frac{2\pi}{\sqrt{\frac{F \sin \alpha}{m R}}} = 6 + 6$$

(6)

N3

Решення:

CU

Дано:

$R = 8 \text{ см}$

$l = 8 \text{ см}$

$m = 5,2 \text{ кг}$

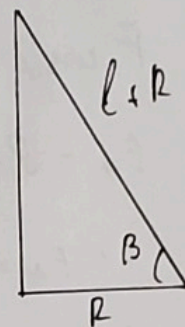
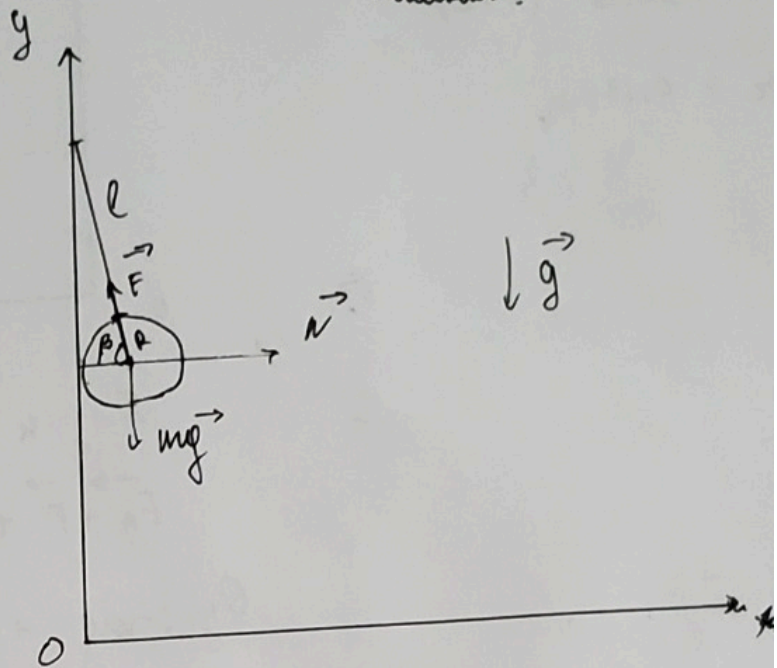
$0,08 \text{ м}$

$0,08 \text{ м}$

1) $F = ?$

2) $\alpha = 60^\circ$

$T = ?$



$\cos \beta = \frac{R}{l+R}$
 $\cos \beta = \frac{1}{2} \Rightarrow \sin \beta = \frac{\sqrt{3}}{2}$

II 3-й Ньютона:

$\vec{F} + \vec{N} + m\vec{g} = \vec{0}$

$O_y: F \sin \beta - mg = 0 \Rightarrow F \sin \beta = m g$

~~$O_x: N - F \cos \beta = 0 \Rightarrow F \cos \beta = N$~~

$F = \frac{mg}{\sin \beta}$

$F = \frac{5,2 \cdot 10 \cdot 2}{\sqrt{3}} = 60 \text{ Н}$

Умножим на $g \cdot l_1$

$$\vec{v} = \vec{v}_0 + \vec{v}_0 t + \frac{\vec{a}_1 t^2}{2}$$

$$0_x \cdot l_1 = v_1 t$$

$$l_1 = \frac{v_1^2}{2a_1} \quad a_1 = g \sin \alpha - \mu_1 g \cos \alpha$$

$$a_1 = \frac{70}{25} - \frac{5 \cdot 24}{25} = -\frac{24}{25} \Rightarrow$$

$\Rightarrow a_1$ направ против O_x

\Downarrow

$$l_1 = \frac{v_1^2}{-2a_1}$$

$$v_1 = \sqrt{-2 l_1 a_1} = v_{\max}$$

$$v_1 = v_0$$

$$l_1 = \frac{v_0}{\sin \alpha} \Rightarrow v_1 = \sqrt{-2 \frac{v_0}{\sin \alpha} a_1} = v_{\max}$$

$$v_{\max} = \sqrt{4 \cdot \frac{25}{4} \cdot 1,4} = 4,47 \text{ м/с}$$

$$S = l_1 + l_2$$

$$v_2 = v_0 \text{ нач}$$

$$a_2 = g \sin \alpha - \mu_2 g \cos \alpha$$

$$l_2 = \frac{v_2^2}{2a_2}$$

$$a_2 = \frac{40}{25} - \frac{0,06 \cdot 10 \cdot 24}{25}$$

$$= \frac{40 - 14,4}{25} = 2,224 \frac{\text{м}}{\text{с}^2}$$

$$l_2 = \frac{v_2^2}{2a_2}$$

$$l_2 = \frac{20}{2 \cdot 2,224} = 4,5 \text{ м}$$

$$S = l_1 + l_2$$

$$S = 4,5 + 5 = 9,5 \text{ м}$$

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Ответ: 1) $4,47 \text{ м/с} = v_{\max}$

2) $S = 9,5 \text{ м}$

(4)

Дано:

$$\cos \alpha = \frac{24}{25}$$

$$h = 1,4 \text{ м}$$

$$\mu_1 = 0,5$$

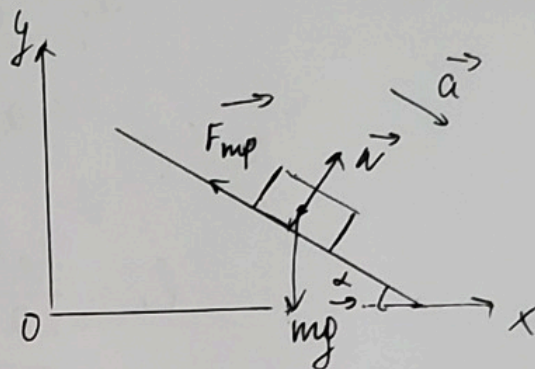
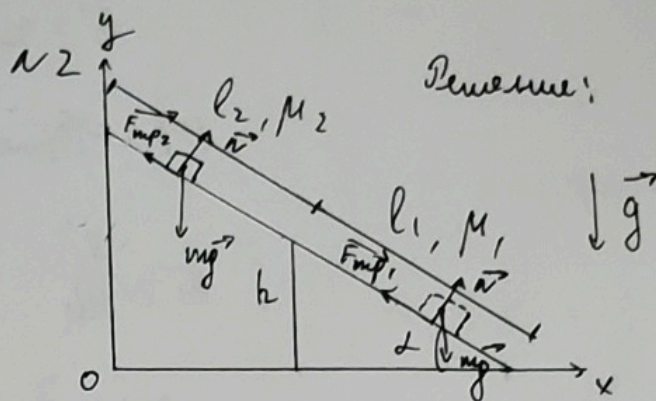
$$\mu_2 = 0,06$$

$$v_{\text{нач}} = 0$$

$$v_{\text{кон}} = 0$$

$$1) v_{\text{max}} = ?$$

$$2) S = ?$$



И з-н Ньютона:

$$\vec{N} + m\vec{g} + \vec{F}_{mp} = m\vec{a}$$

$$O_y: N - mg \cos \alpha = 0 \Rightarrow N = mg \cos \alpha$$

$$O_x: -F_{mp} + mg \sin \alpha = ma$$

$$F_{mp} = \mu N = \mu mg \cos \alpha$$

||

$$-\mu mg \cos \alpha + mg \sin \alpha = ma \Rightarrow$$

$$\Rightarrow a = g \sin \alpha - \mu g \cos \alpha$$

т.к. $v_{\text{нач}} = 0$ и $v_{\text{кон}} = 0$, а

$\mu_1 > \mu_2$, то на участке l_1 коробки задерживались \Rightarrow

$\Rightarrow v_{\text{max}} = v$, (скор. при попаре)

$$\times \cos \alpha = \frac{24}{25} \Rightarrow$$

$$\Rightarrow \sin \alpha = \sqrt{1 - \cos^2 \alpha}$$

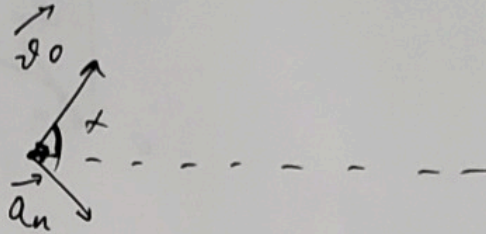
$$\sin \alpha = \sqrt{\frac{25^2 - 24^2}{25^2}} = \frac{7}{25}$$

Умножен

$$\vec{v} = \text{const}$$

$$\vec{a}_\tau = \vec{0} \quad \vec{a} = \vec{a}_\tau + \vec{a}_n = \vec{a}_n$$

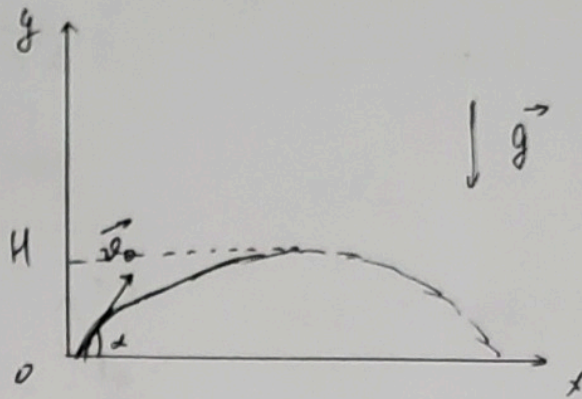
или напомним:



Dano:
 $\alpha = 45^\circ$
 $H = 10 \text{ м}$
 $v_0 = ?$

н.т.

Решение:



$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{\vec{g} t^2}{2}$$

$$\vec{v} = \vec{v}_0 + \vec{g} t$$

Oy: $v_y = v_0 \sin \alpha - g t$

$$y = y_0 + v_0 \sin \alpha t - \frac{g t^2}{2}$$

в момент, где $H = h_{\text{max}}$ $v_y = 0$

⇓

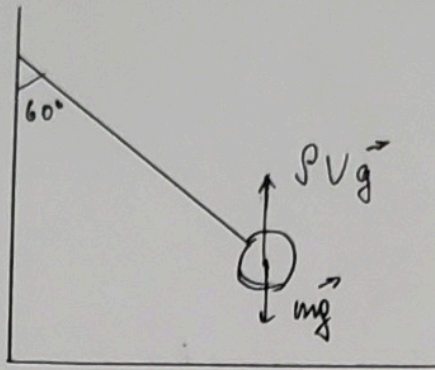
$$0 = v_{ym} = v_0 \sin \alpha - g \tau \Rightarrow \tau = \frac{v_0 \sin \alpha}{g}$$

$$H = v_0 \sin \alpha \tau - \frac{g \tau^2}{2} = \frac{v_0^2 \sin^2 \alpha}{g} - \frac{v_0^2 \sin^2 \alpha}{2g} = \frac{v_0^2 \sin^2 \alpha}{2g} \Rightarrow v_0 = \frac{\sqrt{2gH}}{\sin \alpha}$$

$$v_0 = \frac{10 \sqrt{2}}{(\sqrt{2})^{-1}} = 20 \text{ м/с}$$

Ответ: $v_0 = 20 \text{ м/с}$.

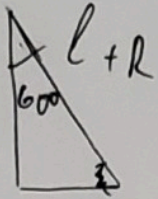
Упробана



$$mg - pVg =$$

$$= 52 - 1000 \cdot \frac{4}{3} \pi \cdot 0,08^3 =$$

$$= 52$$



$$\frac{\sqrt{3}}{2} \cdot 0,16 = \sqrt{3} \cdot 0,8$$

$$R = 0,139 \text{ m}$$

$$T \cos \alpha = 49,855$$

$$T = 99,71 \text{ H}$$

$$m \frac{v^2}{R} = T \sin \alpha$$

$$m \cdot \frac{\omega^2 R^2}{R} = T \sin \alpha$$

$$m \omega^2 R = T \sin \alpha$$

$$\omega = \sqrt{\frac{T \sin \alpha}{m R}} = \sqrt{\frac{99,71 \cdot \frac{\sqrt{3}}{2}}{5,2 \cdot 0,139}} =$$

$$= \sqrt{119,33} = 10,9 \text{ рад/с}^{-1}$$

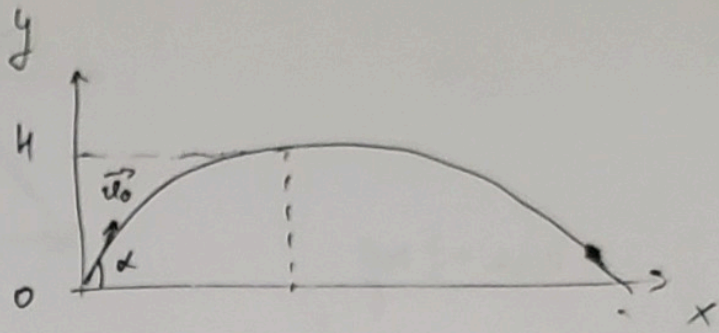
$$T = \frac{2\pi}{\omega} = \frac{2\pi}{10,9} = 1,435 \text{ с} = \frac{2\pi}{\nu} =$$

$$= 0,58 \text{ с.}$$

$$\alpha = 45^\circ$$

$$H = 10 \text{ m}$$

refresken



$$v_y = 0 \quad \text{at}$$

$$v_0 \sin \alpha = g t$$

$$t = \frac{v_0 \sin \alpha}{g}$$

$$y = v_0 t - \frac{g t^2}{2} = \frac{v_0^2 \sin \alpha}{g} - \frac{g v_0^2 \sin^2 \alpha}{2g}$$

$$= H$$

$$\frac{v_0^2 \sin^2 \alpha}{g} - \frac{v_0^2 \sin^2 \alpha}{2g} =$$

$$= \frac{v_0^2 \sin^2 \alpha}{2g}$$

$$10 = \frac{x^2 \cdot 10.7^2}{20}$$

$$\frac{200}{0.7^2} = x^2 \quad x = \frac{10\sqrt{2}}{0.7} =$$

$$= \frac{10\sqrt{2}}{\sqrt{2}} = \boxed{20 \text{ m/s}}$$

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Дано:

$$R = 8 \text{ см}$$

$$l = 8 \text{ см}$$

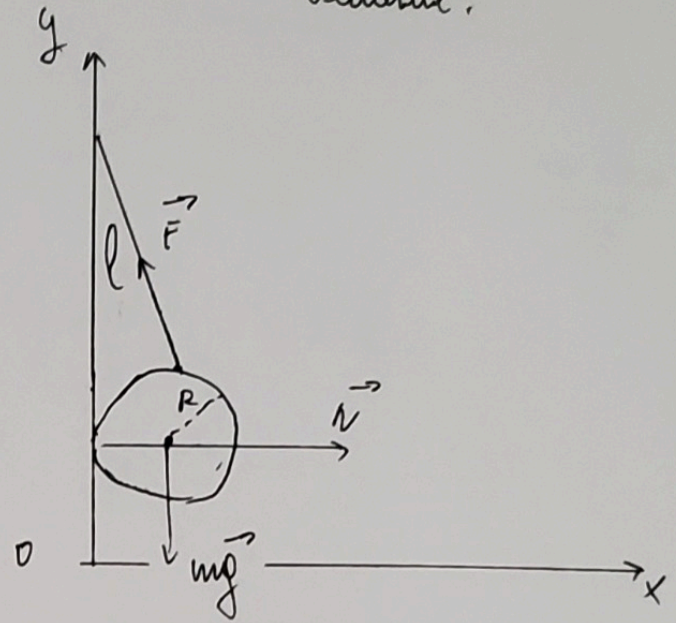
$$m = 9,2 \text{ м}$$

$$1) F = ?$$

$$2) \alpha = 60^\circ$$

$$T = ?$$

Решение:



II закон Ньютона:

$$\vec{F} + \vec{N} + m\vec{g} = 0$$

$$O_y: N$$

$$mg \sin \alpha - \mu_2 mg \cos \alpha = 0$$

$$\frac{40}{25} - \frac{0,06 \cdot 10 \cdot 24}{25} =$$

$$= \frac{40 - 0,6 \cdot 24}{25} = \frac{40 - 14,4}{25} = 2,224$$

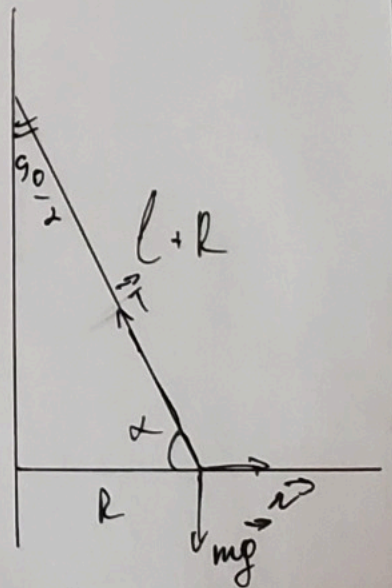
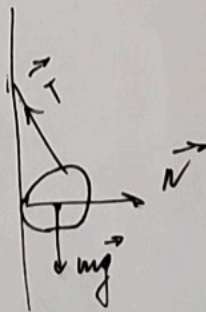
$$\frac{(2\beta)^2}{2 \cdot 2,224} = 9,5 \mu$$

$$S = s + l$$

$$\frac{20}{2 \cdot 2,224} = 4,5 \mu$$

$$S = 9,5 \mu.$$

N 3.



$$\cos \alpha = \frac{1}{2} \Rightarrow \alpha = 60^\circ$$

$$\sin \alpha = \frac{\sqrt{3}}{2}$$

$$T \cos \alpha = N$$

$$T \sin \alpha = mg$$

$$T \frac{\sqrt{3}}{2} = 52$$

$$T = \frac{104}{\sqrt{3}} = 60 \text{ H.}$$

$$R = 0,06 \mu$$

$$l = 0,08 \mu$$

$$m = 5,2 \mu$$

$$T = ?$$

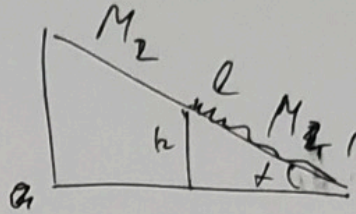
Упроблема 12

$$\cos = \frac{24}{25}$$

$$h = 1,4$$

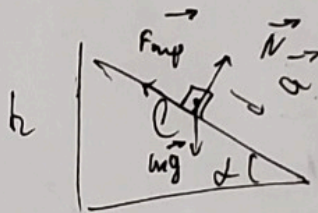
$$\mu_1 = 0,5$$

$$\mu_2 = 0,06$$



$$l = \frac{24}{\sqrt{\frac{25^2 - 24^2}{25^2}}} = \frac{(25-24)(25+24)}{25} = \frac{4}{25} = \sin$$

$$l = \frac{25}{4} h = \frac{25 \cdot 1,4}{4} = 8,75 = 5 \text{ m}$$



$$F_{mp} - mg \sin \alpha = ma$$

$$\mu_1 mg \cos \alpha - mg \sin \alpha = ma$$

$$5 \cdot \frac{24}{25} - \frac{40}{25} = 2 = a$$

$$v_{max} = at$$

$$v_{max} t - \frac{at^2}{2} = l$$

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

$$t = \sqrt{\frac{2l}{a}} = \sqrt{5}$$

$$v = 2\sqrt{5}$$

$$\frac{v^2}{4} = 5$$

$$v = 2\sqrt{5}$$

Часть 2

Олимпиада: **Физика, 10 класс (2 часть)**

Шифр: **21205697**

ID профиля: **827410**

Вариант 4

Умови

1

н 5

Решення:

Дано:

$$R = 42 \text{ Ом}$$

$$U = 24 \text{ В}$$

$$1) \angle = 90^\circ$$

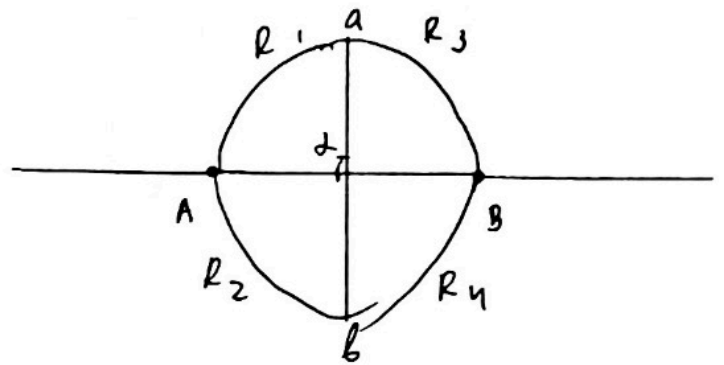
$$P = ?$$

$$2) I = 0,5 \text{ А}$$

$$P = ?$$

$$3) P_2 = ?$$

1)



$$P_{\Sigma} = \frac{P l}{S}$$

$$R = \frac{P l}{S}$$

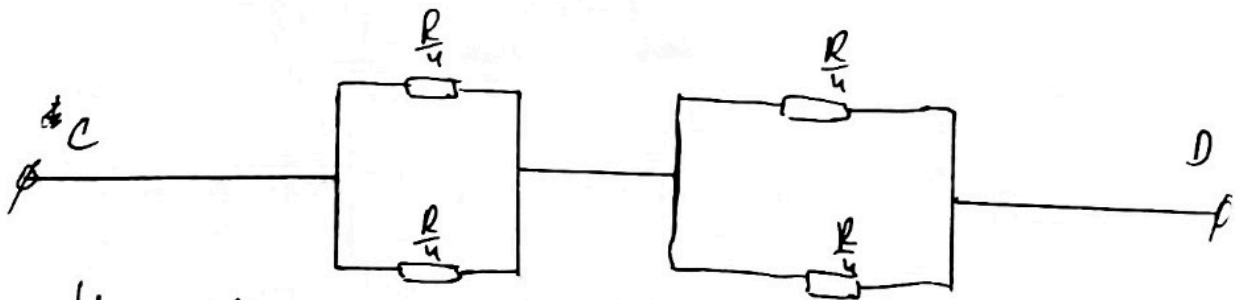
т.к. $ab \perp AB$, то $l_1 = l_2 = l_3 = l_4 \Rightarrow$

$$\Rightarrow R_1 = R_2 = R_3 = R_4 \left. \begin{array}{l} \\ \\ \end{array} \right\} \Rightarrow R_1 = R_2 = R_3 = R_4 = \frac{R}{4}$$

$$R_1 + R_2 + R_3 + R_4 = R$$

$$R_1 \cdot R_4 = R_3 \cdot R_2 \Rightarrow \text{можна}$$

перетворити на послідовну схему:



$$U_{CD} = U$$

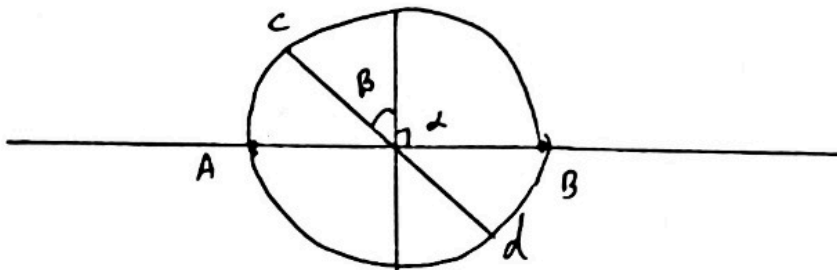
$$P_{\Sigma} = \frac{\frac{R}{4} \cdot \frac{R}{4}}{\frac{R}{4} + \frac{R}{4}} + \frac{\frac{R}{4} \cdot \frac{R}{4}}{\frac{R}{4} + \frac{R}{4}} = \frac{R}{4}$$

$$R_{\Sigma} = 18 \text{ Ом}$$

$$P = \frac{U^2}{R_{\Sigma}}$$

$$P = \frac{24^2}{18} = 32 \text{ Вт}$$

2)



$$R_{AC} = R_1 \quad R_{CB} = R_3 \quad R_{Ad} = R_2 \quad R_{dB} = R_4$$

В силу симметрии

$$l_{AC} = l_{dB} ; l_{CB} = l_{Ad} \Rightarrow$$

$$R_1 = R_4 ; R_3 = R_2$$

также

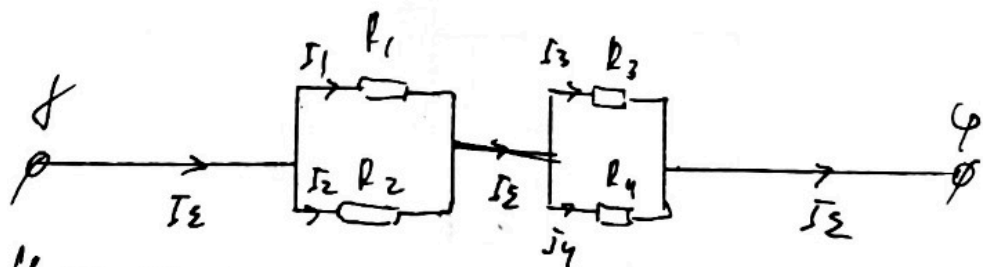
$$l_{AC} + l_{CB} = \frac{1}{2} l$$

l - гл. - хорда

и ↓

$$R_1 + R_3 = \frac{R}{2} ; \text{аналогично } R_2 + R_4 = \frac{R}{2}$$

зуб. схема



$$U_{\Sigma\Phi} = U$$

$$I_{\Sigma} = \frac{U_{\Sigma\Phi}}{R_{\Sigma}} = \frac{U_{\Sigma\Phi}}{\frac{R_1 R_2}{R_1 + R_2} + \frac{R_3 R_4}{R_3 + R_4}}$$

$$I_{\Sigma} = I_1 + I_2 \Rightarrow I_2 = I_{\Sigma} - I_1$$

Умножим

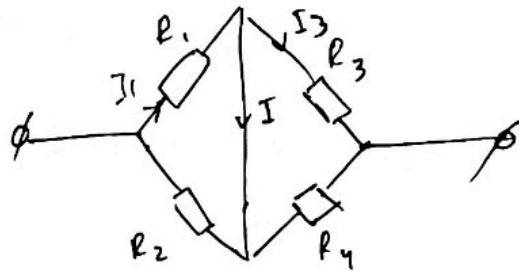
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$$I_1 R_1 = (I_2 - I_1) R_2 \quad (\text{соп. -е нар.})$$

$$I_1 = \frac{I_2 R_2}{R_1 + R_2}$$

Аналогично

$$I_3 = \frac{I_2 R_4}{R_3 + R_4}$$



По (прав. Кирхгофа)

$$I_1 - I - I_3 = 0 \Rightarrow I = I_1 - I_3$$

$$I = \frac{I_2 R_2}{R_1 + R_2} - \frac{I_2 R_4}{R_3 + R_4} =$$

$$= \frac{I_2 (R_2 - R_4)}{0,5R}$$

$$I_2 = \frac{U}{\frac{R_1 R_2}{R_1 + R_2} + \frac{R_3 R_4}{R_3 + R_4}} = \frac{0,5UR}{R_1 R_2 + R_3 R_4} =$$

$$= \frac{0,5UR}{2(0,5R - R_4)R_4} = \frac{0,25UR}{(0,5R - R_4)R_4}$$

$$I = \frac{0,5 \cdot 0,25UR^2}{(0,5R - R_4)R_4} - \frac{0,5UR}{(0,5R - R_4)}$$

$$0,5R$$

Умножим

(4)

$$0,5 I R = 0,5 U R \left(\frac{0,25 R}{(0,5 R - R_4) R_4} - \frac{1}{0,5 R - R_4} \right)$$

$$\frac{I}{U} = \frac{0,25 R - R_4}{0,5 R R_4 - R_4^2}$$

б умнож,

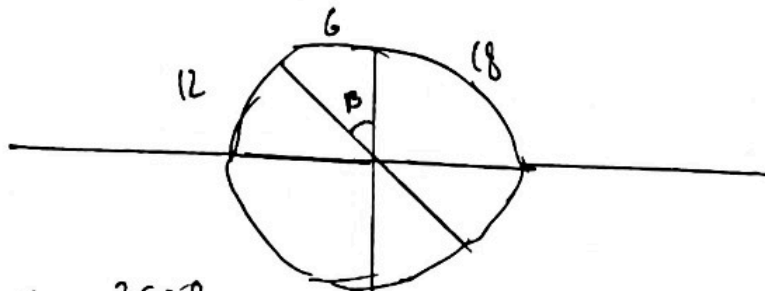
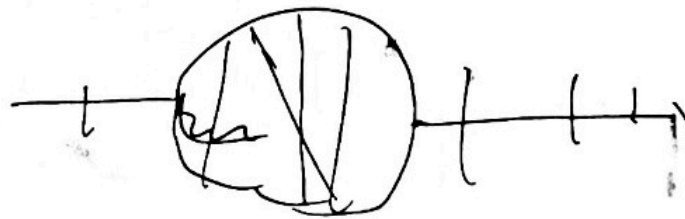
$$0,25 R R_4 - 0,5 R_4^2 = 6 R - 24 R_4$$

$$0,5 R_4^2 - 42 R_4 + 432 = 0$$

$$D = 900$$

$$\left[\begin{array}{l} R_4 = \frac{42+30}{1} = 72 \text{ - не годн.} \\ R_4 = \frac{42-30}{1} = 12 \end{array} \right.$$

$$R_4 = R_1 = 12 \text{ Ом} \Rightarrow R_2 = R_3 = 24 \text{ Ом}$$



$$B = \frac{360^\circ}{12} = 30^\circ$$

Умножение

(5)

$$P_{\Sigma} = P_1 + P_2 + \frac{P_1 P_2}{P_1 + P_2} + \frac{P_3 P_4}{P_3 + P_4}$$

$$P_{\Sigma} = \frac{24 \cdot 12}{36} + \frac{24 \cdot 12}{36} = 16 \text{ Вт}$$

$$P_2 = \frac{4^2}{P_2} = 24$$

$$P_2 = \frac{24^2}{16} = 36 \text{ Вт}$$

Ответ: 1) $P = 32 \text{ Вт}$

2) $P = 30 \text{ Вт}$

3) $P_2 = 36 \text{ Вт}$

Учебник (6)

нч.

Решение:

Дано: C_u
 $m = 102 \quad 0,01 \text{ м}$

$t_0 = 20^\circ \text{C}$

$P_0 = 10^5 \text{ Па}$

$D = 33 \text{ К Дж} \quad 33000 \text{ Дж}$

$Q_1 = ?$

$V_{\text{газ}} = ?$

$$Q_1 = c_u m (t_{\text{кон}} - t_0)$$

$$Q_1 = 4180 \cdot 0,01 (100 - 20) = 3344 \text{ Дж}$$

$$Q_{\text{кон}} = m L$$

$$Q_{\text{кон}} = 2,26 \cdot 10^6 \cdot 0,01 = 22600 \text{ Дж}$$

$$Q_{\text{ост}} = Q - Q_1 - Q_{\text{кон}}$$

$$Q_{\text{ост}} = 33000 - 3344 - 22600 = 7056 \text{ Дж}$$

$$Q_{\text{ост}} = C_u m (t_{\text{кон}} - t_{\text{кон}})$$

$$t_{\text{кон}} = t_{\text{кон}} + \frac{Q_{\text{ост}}}{C_u m}$$

$$t_{\text{кон}} = 100 + \frac{7056}{2200 \cdot 0,01} = 420,73^\circ \text{C}$$

$$T_{\text{кон}} = 420,73 + 273 = 693,73 \text{ К}$$

$$P_0 V = \nu R T_{\text{кон}}$$

$$P_0 V = \frac{m}{M} R T_{\text{кон}}$$

$$V = \frac{m R T_{\text{кон}}}{M P_0}$$

$$V = \frac{10 \cdot 8,31 \cdot 693,73}{18 \cdot 10^5} = 0,032 \text{ м}^3 = 32 \text{ л}$$

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Ответы: 1) $Q_1 = 3344 \text{ Дж}$
 2) $V = 32 \text{ л}$

Упробум.
N 4

$$m = 0,01 \text{ м.}$$

$$t_1 = 20^\circ \text{C}$$

$$P_0 = 10^5 \text{ Па}$$

$$Q = 33 \text{ Дж.}$$

$$0,01 \cdot 80 \cdot 4180 = Q_1$$

$$Q_1 = 3344 \text{ Дж}$$

$$2,26 \cdot 10^6 \cdot 0,01 = 22600 \text{ Дж.}$$

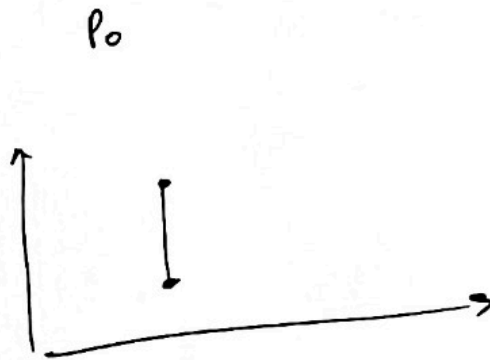
$$0,00056$$

$$Q_{\text{sum}} = 4056 \text{ Дж.}$$

$$0,01 \cdot 2200 \cdot X = 4056$$

$$X = \frac{4056}{0,01 \cdot 2200} = \frac{4056}{22}$$

$$s \cdot \frac{0,01}{18} \cdot 80$$



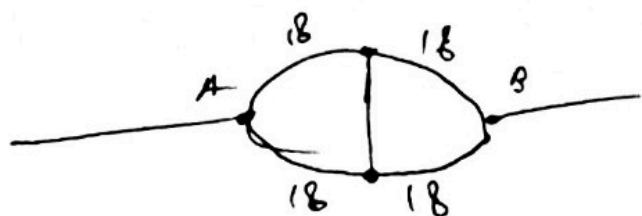
$$P_0 V_0 = \nu R T_0$$

ре�рновик 15.

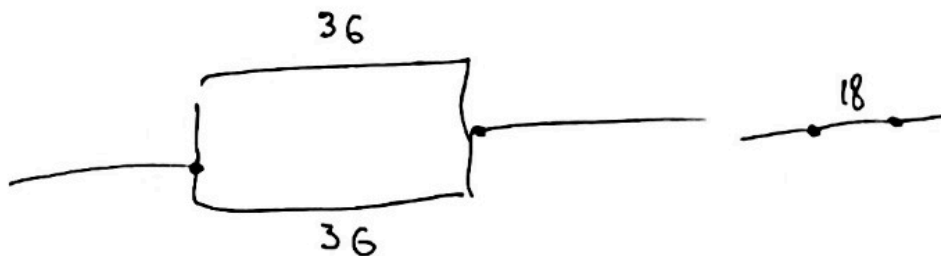
$R = 42 \text{ Ом}$

$U = 24 \text{ В}$

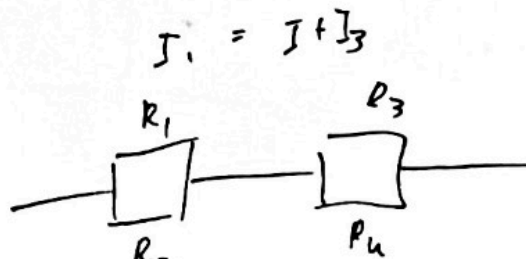
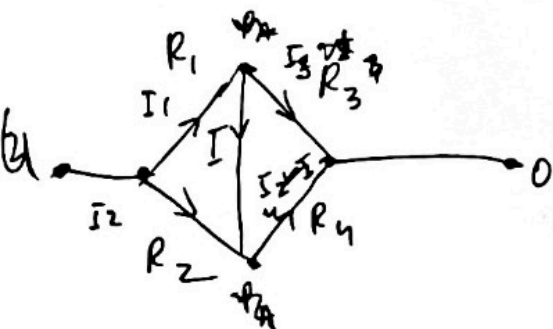
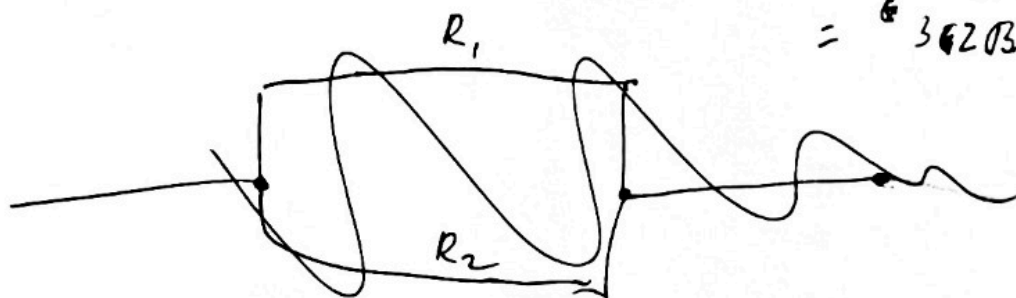
a1



a2



$$\frac{U^2}{R} = \frac{24 \cdot 24}{18} = 36 \text{ Вт}$$



$$\bar{I} = \frac{R_1 \cdot U}{\frac{R_1 R_2}{R_1 + R_2} + \frac{R_3 R_4}{R_3 + R_4}}$$

$$I_1 R_1 = (I - I_1) R_2$$

$$I_1 R_1 = I R_2 - I_1 R_2$$

$$I_1 = \frac{I R_2}{R_1 + R_2} \quad I_3 = \frac{I R_4}{R_3 + R_4}$$

черновик

$$I = \frac{I R_2}{R_1 + R_2} - \frac{I R_4}{R_3 + R_4}$$

$$R_1 + R_2 = R_3 + R_4 = 0.5 R$$

$$I = \frac{I_{\Sigma} R_2 - I_{\Sigma} R_4}{0.5 R}$$

$$R_2 = 0.5 R - R_4$$

$$I = \frac{0.5 I_{\Sigma} R - 2 I_{\Sigma} R_4}{0.5 R}$$

$$I = \frac{0.5 I_{\Sigma} R - 2 I_{\Sigma} R_4}{0.5 R} =$$

$$I_{\Sigma} = \frac{4 \cdot 0.5 R}{R_1 R_2 + R_3 R_4}$$

$$\frac{0.5 I_{\Sigma} \cdot 0.5 R}{0.5 R}$$

\Rightarrow

$$R_2 = 0.5 - R_4 \quad I_{\Sigma} = \frac{0.5 U R}{(0.5 - R_4) \cdot (0.5 R_4) + 2 R_3 R_4} =$$

$$= \frac{0.25 U R}{0.25 (0.5 R - R_4) R_4}$$

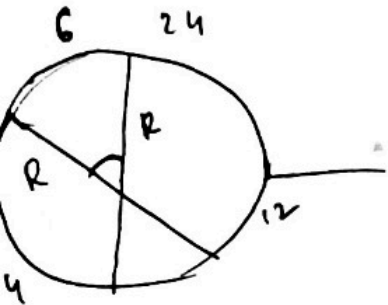
$I_{\Sigma} =$

$$I = \frac{0.5 \cdot 0.25 U R^2}{(0.5 R - R_4) R_4} - \frac{2 \cdot 0.5 U R}{(0.5 R - R_4)}$$

$$\frac{\quad}{0.5 R}$$

керноблик

$$0,5 I R = 0,5 U R \left(\frac{0,25 R}{(0,5 - R_4) R_4} - \frac{1}{0,5 R - R_4} \right) =$$



$$\beta = 30^\circ$$

$$I R = \frac{0,25 R - R_4}{(0,5 R - R_4) R_4} \cdot U$$

$$\frac{I}{U} = \frac{0,25 R - R_4}{0,5 R R_4 - R_4^2}$$

$$0,5 I R_4$$

$$0,25 R R_4 - 0,5 R_4^2 = 6 R - 24 R_4$$

$$18 R_4 - 0,5 R_4^2 = 6 \cdot 432 - 24 R_4$$

$$0,5 R_4^2 + 42 R_4 + 432 = 0$$

$$D = 1764 - 2 \cdot 432 = 900$$

$$\sqrt{D} = 30$$

$$R_4 = \frac{42 \pm 30}{1} = 12$$

$$R_1 = 12$$

$$R_2 = R_3 = 24$$

$$\frac{2 \cdot 24 \cdot 24}{36} = 8$$

$$P_2 = \frac{24 \cdot 24}{16} = 36 \text{ Вт}$$