

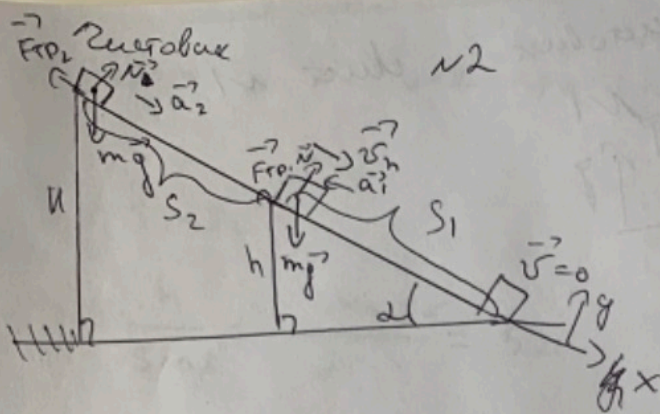
# Часть 1

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

Шифр: **21205046**

ID профиля: **124238**

Вариант 4



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

$$\Rightarrow \sin \alpha = \frac{7}{25}$$

$$\text{Т.к. } \sin^2 \alpha + \cos^2 \alpha = 1$$

$$y: N = mg \cos \alpha$$

$$x: ma_2 = mg \sin \alpha - F_{\text{тр}2} ; F_{\text{тр}2} = \mu_2 N$$

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

$$a_2 = 2.8 - 0.576 = 2.224 \frac{m}{c^2}$$

$$x: -m a_1 = -F_{\text{тр}1} + mg \sin \alpha$$

$$m a_1 = F_{\text{тр}1} - mg \sin \alpha ; F_{\text{тр}1} = \mu_1 N$$

$$a_1 = \mu_1 m g \cos \alpha - mg \sin \alpha$$

$$a_1 = 4.8 - 2.8 = 2 \frac{m}{c^2}$$

$v_h$  - ск. в точке  $h$  - максимална, Т.к. после  $h$  коробка будет замедляться.

$$0 = v_h - a_1 t_1$$

$$t_1 = \frac{v_h}{a_1}$$

$$x: S_1 = v_h t_1 - \frac{a_1 t_1^2}{2}$$

$$S_1 = \frac{h}{\sin \alpha}$$

$$\frac{h}{\sin \alpha} = \frac{v_h^2}{a_1} - \frac{v_h^2 \cdot a_1}{2 a_1^2} = \frac{v_h^2}{2 a_1}$$

$$\text{Other: } v_{\text{max}} = 4.5 \frac{m}{c}$$

$$v_h = \sqrt{\frac{2 a_1 h}{\sin \alpha}} =$$

$$= \sqrt{\frac{2 \cdot 2 \frac{m}{c^2} \cdot 1.4 m}{7} \cdot 25} =$$

$$= \sqrt{20} \frac{m}{c} = 4.5 \frac{m}{c}$$

Задание

лист №3  
№2 (продолжение)

$$S = S_1 + S_2$$

$$S_1 = \frac{h}{\sin \alpha} = \frac{1,4 \mu \cdot 25}{7} = 5 \mu$$

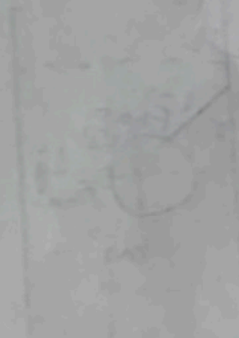
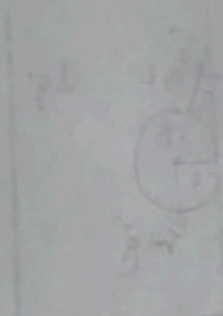
$$v_h = a_2 t_2 \quad t_2 = \frac{v_h}{a_2}$$

$$S_2 = \frac{a_2 t_2^2}{2}$$

$$S_2 = \frac{a_2 \cdot v_h^2}{2 a_2^2} = \frac{20}{2 \cdot 2,224} = 4,5 \mu$$

$$S = 9,5 \mu$$

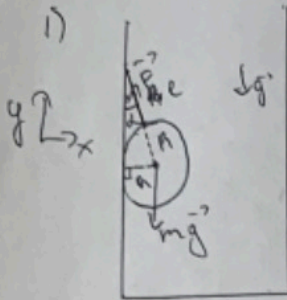
Ответ: 9,5 м



Questões

3

Questão 4



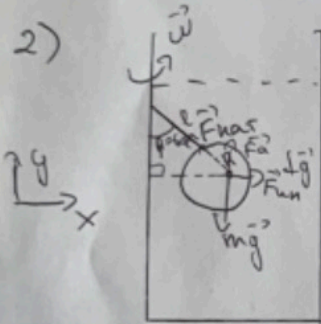
$$\sin \alpha = \frac{R}{l+R} = \frac{1}{2} \Rightarrow \alpha = 30^\circ$$

$$y: mg = F \cos \alpha$$

$$F = \frac{mg}{\cos \alpha} = \frac{5,2 \cdot 10^{-2} \cdot 10 \frac{m}{s^2}}{\sqrt{3}} \cdot 2 =$$

$$= 60 \text{ N}$$

outra:  $F = 60 \text{ N}$



$$\beta = 60^\circ \quad F_{\text{bu}} = m a_y$$

$$F_a = \rho_b V \cdot g$$

$$V = \frac{4}{3} \pi R^3$$

$$a_y = \frac{v^2}{R \sin \beta}$$

$$R \sin \beta = (l+R) \sin \beta$$

$$v = \frac{2 \pi R \sin \beta}{T}$$

$$a_y = \frac{4 \pi^2 R \sin^3 \beta}{T^2} = \frac{4 \pi^2 R \sin^3 \beta}{T^2}$$

$$x: F_{\text{na}} \sin \beta = a_y m$$

$$y: F_a + F_{\text{na}} \cos \beta = mg$$

$$F_{\text{na}} = \frac{mg - F_a}{\cos \beta}$$

$$\frac{\sin \beta}{\cos \beta} \cdot \frac{mg - F_a}{\cos \beta} = a_y m$$

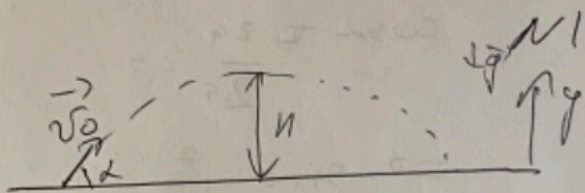
$$\frac{\sin \beta}{\cos^2 \beta} (mg - \rho_b \frac{4}{3} \pi R^3 g) = \frac{4 \pi^2 (l+R) \sin^3 \beta}{T^2} \cdot m$$

$$T = \sqrt{\frac{4 \pi^2 (l+R) m \cos^2 \beta}{2 \pi^2 (mg - \rho_b \frac{4}{3} \pi R^3 g) \sin \beta}}$$

$$= 0,732 \text{ s} \quad \text{outra: } 0,732 \text{ s}$$

B: 10-04

Задача 11



$$y: h = v_{0y} t - \frac{gt^2}{2}$$

$$v_{0y} = v_0 \sin \alpha$$

$$h = v_0 \sin \alpha t - \frac{gt^2}{2}$$

$$y: v_y = v_{0y} - gt$$

$v_y$  в момент столкновения = 0

$$0 = v_{0y} - gt$$

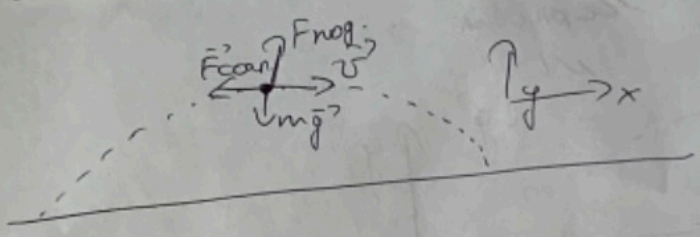
$$t = \frac{v_{0y}}{g}$$

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

$$v_0 = \sqrt{\frac{2gh}{\sin^2 \alpha}} = \sqrt{\frac{2 \cdot 10 \frac{\text{m}}{\text{s}^2} \cdot 10 \text{m}}{2}} = 20 \frac{\text{m}}{\text{s}}$$

Ответ:  $20 \frac{\text{m}}{\text{s}}$

2)



$$ma = F_p$$

$$m \frac{dv}{dt} = F_D$$

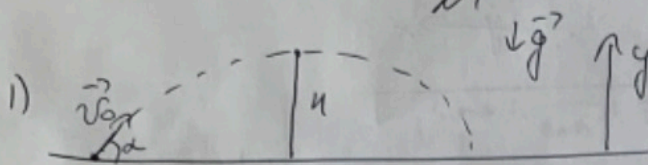
$$m \Delta v = F_D \Delta t$$

$$F_{py} = F_{noel} - mg$$

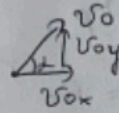
$$F_{px} = -F_{comp}$$

$$\frac{mv^2}{2} + A_p = \frac{mv^2}{2} + mgH$$

Зеркало



$$y = y_0 + v_{0y}t + \frac{a t^2}{2} \quad a = g$$



$$y: h = \frac{0}{g} + v_{0y}t - \frac{g t^2}{2}$$

$$x: \dots \quad y: v_y = v_{0y} - g t$$

$$v_{0y} = v_0 \sin \alpha$$

$$y: 0 = v_{0y} t_{\text{horiz}} - \frac{g t_{\text{horiz}}^2}{2} \quad v_y = 0 \text{ в с.н}$$

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

$$v_{0y} = \frac{g t_{\text{horiz}}}{2}$$

$$g t = v_{0y}$$

$$\frac{t_{\text{horiz}}}{2} = \frac{v_{0y}}{g}$$

$$t = \frac{v_{0y}}{g}$$

Анализ, зависимость на время пути по высоте h  
 $h$  - макс. высота пути по высоте h  
 $t = \frac{t_{\text{horiz}}}{2}$

~~h = 25~~

$$h = \frac{v_0^2 \sin^2 \alpha}{g} - \frac{g t_{\text{horiz}}^2}{2} \quad \left( \frac{t_{\text{horiz}}}{2} \right)^2 \frac{v_0^2 \sin^2 \alpha}{g^2}$$

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

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

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

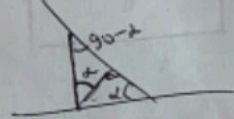
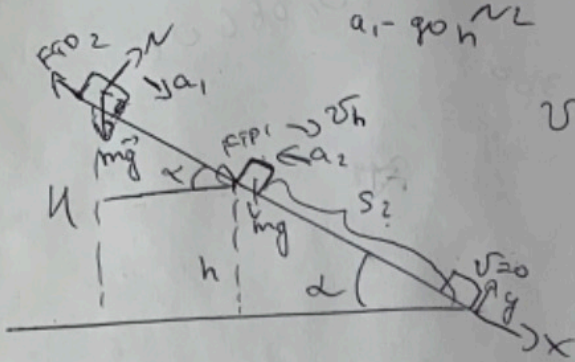
$$v_0 = \sqrt{\frac{h \cdot g}{\sin^2 \alpha}} = \sqrt{\frac{2g h}{\sin^2 \alpha}} = \sqrt{\frac{2 \cdot 10 \cdot 10 \cdot 4}{2}} = 20 \frac{\text{м}}{\text{с}}$$

Република

010784

$a_1 = 90 \text{ h}$

$v_{\text{max}} = 8 \text{ tone h}$



1) y:  $N = 0 = N - mg \cos \alpha$

$\sin^2 \alpha + \cos^2 \alpha = 1$

x:  $ma_1 = mg \sin \alpha - FTP_2$

$\sin \alpha = \frac{2}{2.5}$

$N = mg \cos \alpha$

$ma_1 = mg \sin \alpha - mg \cos \alpha \mu_2$

$a_1 = 2.8 - 0.576$

$a_1 = 2.224 \frac{\text{m}}{\text{c}^2}$

ki:  $v_n = a_1 t_1$

$s_1 = \frac{a_1 t_1^2}{2}$

2)  $N = mg \cos \alpha$

$-ma_2 = -FTP_1 + mg \sin \alpha$

$ma_2 = FTP_1 - mg \sin \alpha$

$ma_2 = mg \cos \alpha \mu_1 - mg \sin \alpha$

$a_2 = 4.8 - 2.8 = 2 \frac{\text{m}}{\text{c}^2}$

$0 = v_h - a_2 t_2$

x:  $s_2 = v_h t_2 - \frac{a_2 t_2^2}{2}$

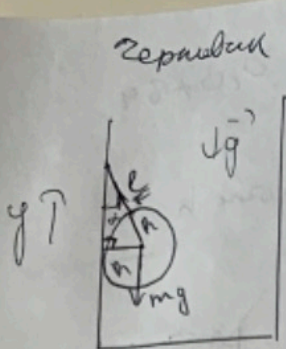
$a_2 t_2 = v_h$

$t_2 = \frac{v_h}{a_2}$

$s_2 = \frac{v_h \cdot v_h}{2 a_2}$

$v_h \left( v_h - \dots \right)$





$$\alpha = \pi 30^\circ$$

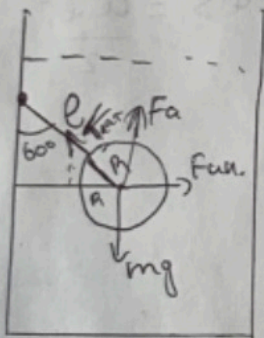
$$0,86602$$

$$y: 0 = m F \cos \alpha - mg$$

$$mg = F \cos \alpha$$

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

Ответ: 60 Н



$$F_{\text{нат}} = a_y m$$

$$a_y = \omega^2 R \cos \alpha$$

$$R \cos \alpha = (l + R) \sin 60^\circ$$

$$F_{\text{нат}} = \rho g V T$$

$$V = \frac{4}{3} \pi R^3$$

$$x: F_{\text{нат}} \sin 60^\circ = F_{\text{нат}} a_y m$$

$$y: F_{\text{нат}} + F_{\text{нат}} \cos 60^\circ = mg \quad a_y = \frac{4 \pi^2 R}{T^2}$$

$$F_{\text{нат}} = \frac{mg - F_{\text{нат}}}{\cos 60^\circ}$$

$$\tan 60^\circ \cdot (mg - F_{\text{нат}}) = a_y m$$

# Часть 2

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

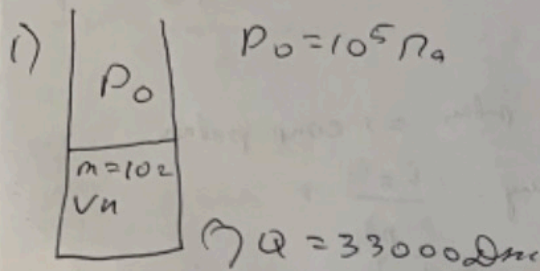
Шифр: **21205046**

ID профиля: **124238**

Вариант 4

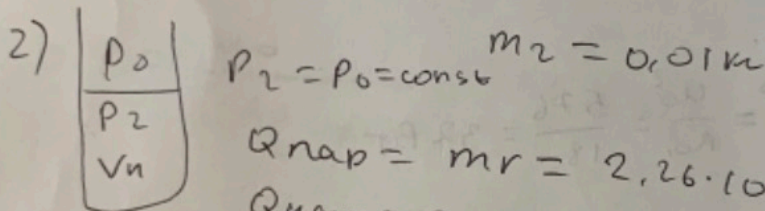
B: 10-04

Задача лист 1  
 №4



$$Q_1 = c m (t_{\text{max}} - t_0) = 4180 \frac{\text{Дж}}{\text{кг} \cdot \text{K}} \cdot 0,01 \text{ кг} \cdot 80 \text{ K} = 3344 \text{ Дж}$$

Ответ: 3344 Дж



$$Q_{\text{нагр}} = m r = 2,26 \cdot 10^6 \cdot 0,01 = 22600$$

$$Q_{\text{нагр}} = Q - Q_{\text{нагр}} - Q_1 = 7056 \text{ Дж}$$

$$p_2 V_k = \mu R T_k$$

$$\mu = 18 \frac{\text{г}}{\text{моль}}$$

$$T_n = 373 \text{ K}$$

$$Q_{\text{нагр}} = c m_2 \Delta T$$

$$\Delta T = T_k - T_n$$

$$T_k = \frac{Q_1}{c m_2} + T_n$$

$$p_2 V_k = \frac{m}{\mu} R \left( \frac{Q_1}{c m_2} + T_n \right); V_k = \frac{m R \left( \frac{Q_1}{c m_2} + T_n \right)}{\mu p_2}$$

$$= \frac{0,01 \text{ кг} \cdot 8,31 \left( \frac{7056 \text{ Дж}}{2200 \frac{\text{Дж}}{\text{кг} \cdot \text{K}} \cdot 0,01 \text{ кг}} + 373 \text{ K} \right)}{0,018 \frac{\text{кг}}{\text{моль}} \cdot 10^5 \text{ Па}} = \frac{4,01}{10^5 \text{ Па}} \cdot 693 =$$

$$= 4,032 \cdot 10^{-3}$$

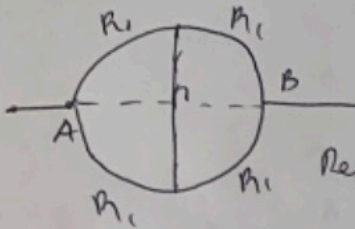
Ответ:  $0,004032 \text{ м}^3$

1)

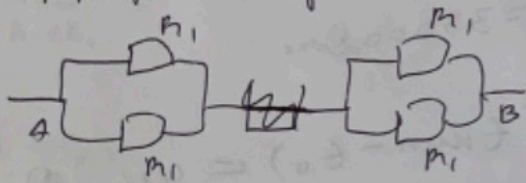
$R = 220 \text{ M}$

$U_0 = 24 \text{ B}$

Всe резисторы равны  $\Rightarrow$  комп. равны



Нерепущенa cхемa:



$R_{01} = \frac{R_1}{2} + \frac{R_1}{2} = R_1$

$R_1 = \frac{R_0}{4}$ , т.к.  $R_1$  - резисторa оdнaкoвaнa

$R_{01} = \frac{R_0}{4} = 180 \text{ M}$

$P_1 = U_0 I_0 = \frac{U_0 \cdot U_0}{R_{01}} = \frac{U_0^2}{R_{01}} = \frac{576}{18} = 32 \text{ BТ}$

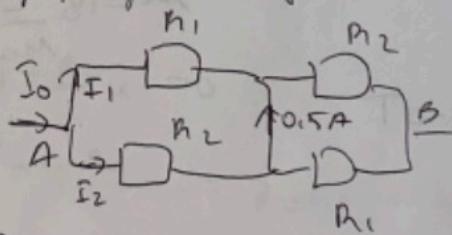
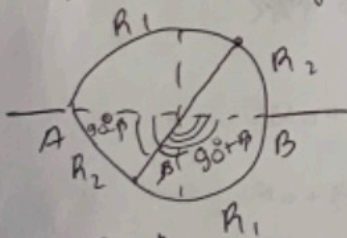
Ответ: 32 BТ

2)

пусть  $R_1 > R_2$

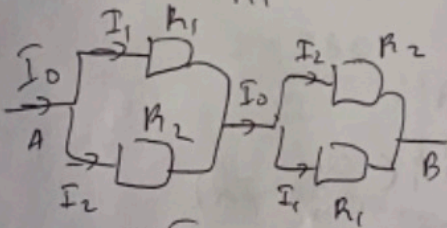
$R_1 + R_2 = \frac{R_0}{2}$

нерепущенa cхемa:



$I_0 = \frac{U_0 (R_1 + R_2)}{2R_1 R_2}$

т.к.  $R_{02} = \frac{R_1 R_2}{R_1 + R_2}$



$I_1 + I_2 = I_0$

$I_1 = \frac{R_2}{R_1 + R_2} \cdot I_0$

$I_2 = \frac{R_1}{R_1 + R_2} \cdot I_0 \Rightarrow$

$\Rightarrow \frac{R_1 I_0}{R_1 + R_2} = 0,5 \text{ A} + \frac{R_2 I_0}{R_1 + R_2}$  (но I параллельно резисторам)

резобан

дуг  $\sim 3$

$\sim 5$  (про формулу)

$$I_0 = \frac{U_0 (R_1 + R_2)}{2R_1 R_2}$$

$$\frac{R_1 I_0}{R_1 + R_2} = 0,5 + \frac{R_2 I_0}{R_1 + R_2}$$

$$\Rightarrow \frac{R_1 U_0}{2R_1 R_2} = 0,5 + \frac{R_2 U_0}{2R_1 R_2}$$

$$0,5 = \frac{U_0}{2R_1 R_2} (R_1 - R_2)$$

$$R_1 + R_2 = \frac{R_0}{2}$$

$$R_1 = \frac{R_0}{2} - R_2$$

$$0,5 = \frac{U_0}{2\left(\frac{R_0}{2} - R_2\right)R_2} \left(\frac{R_0}{2} - 2R_2\right)$$

$$\frac{R_0}{2} R_2 - R_2^2 = \frac{R_0}{2} U_0 - 2R_2 U_0$$

$$R_2^2 - R_2 \left(2U_0 + \frac{R_0}{2}\right) + \frac{R_0}{2} U_0 = 0$$

$$D = \left(2U_0 + \frac{R_0}{2}\right)^2 - 4 \frac{R_0}{2} U_0 = 7056 - 3456 = 3600$$

$$R_{2,1,2} = \frac{84 \pm 60}{2}; \begin{cases} R_2 = +24 \text{ ом} \\ R_2 = 12 \text{ ом} \end{cases} \text{ не подходит по уст.}$$

$$R_1 = \frac{R_0}{2} - 24 \text{ ом}$$

$$\frac{R_2}{R_1} = \frac{1}{2} \Rightarrow \frac{90^\circ - \beta}{90^\circ + \beta} = \frac{1}{2}$$

$$180^\circ - 2\beta = 90^\circ + \beta$$

$$\beta = 30^\circ$$

$$\text{Ответ: } 30^\circ$$

Задача

лист 4

№ 5 (продолжение)

$$3) P_2 = I_0^2 R_0 = \frac{U_0^2}{R_0}$$

$$R_0 = \frac{2R_1R_2}{R_1+R_2} = \frac{2 \cdot 24 \cdot 24}{24+24} = 16 \text{ ом}$$

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

Ответ: 36 Вт

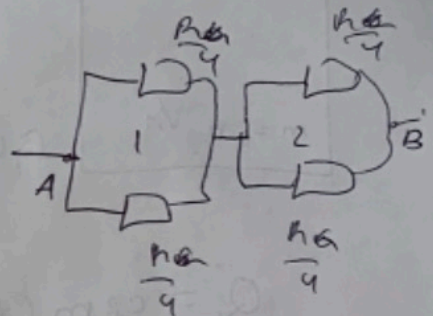
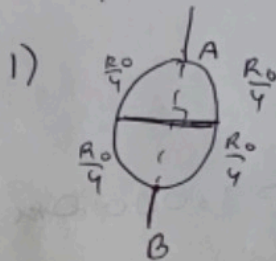
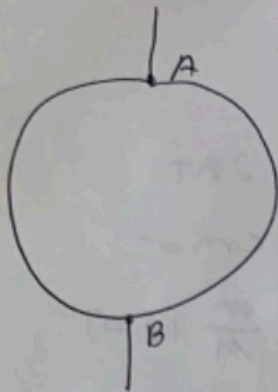
результиру

N5

$R_0 = 72 \text{ Ом}$

$U_0 = 24$

$L = 25 \text{ Вт}$



$R_1 = \frac{8}{R_0}$

$R_1 = \frac{R_0}{8}$

$R_2 = \frac{2R_0}{8}$

$R_{01} = \frac{R_0}{4}$

$P_1 = U_0 I_1 =$

$= \frac{U_0^2}{R_{01}} =$

$= \frac{24 \cdot 24}{18} = 32 \text{ Вт}$

$I_0 \cdot \frac{2}{4+2}$

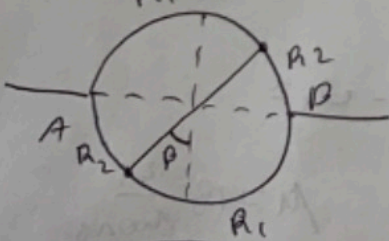
6A

4  
2

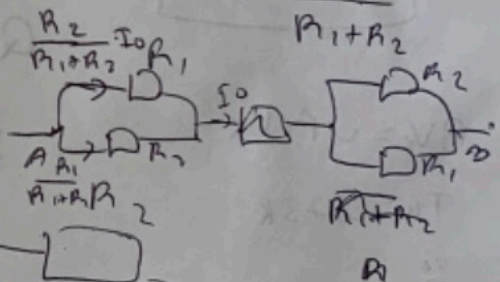
$I_0 = \frac{U_0 (R_1 + R_2)}{2R_1 R_2}$

$R_1 > R_2$

$R_{02} = \frac{2R_1 R_2}{R_1 + R_2}$

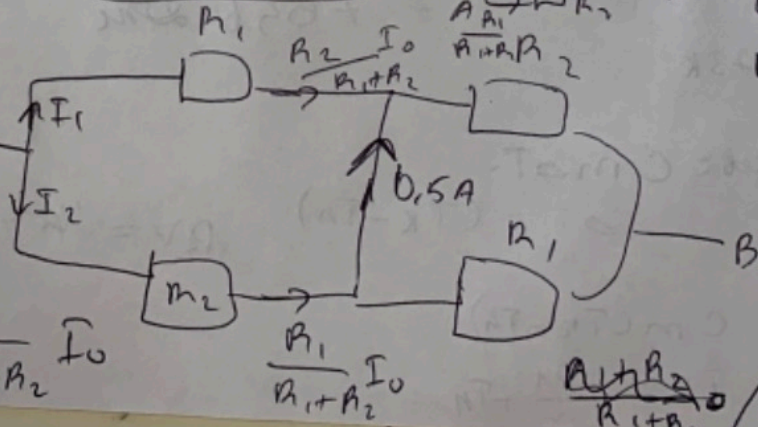


$R_1 + R_2 = \frac{R_0}{2}$



$\frac{I_0 (R_1 - R_2)}{R_1 + R_2} = 0,5$

$\frac{R_2 I_0}{R_1 + R_2} + 0,5 = \frac{R_1}{R_1 + R_2} I_0$

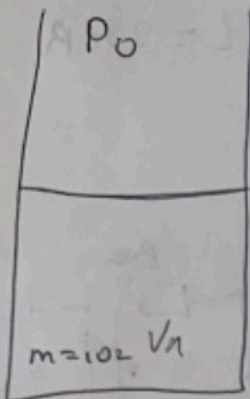


$0,5 = \frac{U_0 (R_1 - R_2)}{2R_1 R_2}$

репробук

14

$$P_0 = 10^5 \text{ Pa}$$



$$Q = 33000 \text{ Дж}$$

$$Q = \Delta T$$

$$C m \Delta T$$

$$\frac{m}{M} R \Delta T$$

C =

$$P_2 V_n = \nu n R T_n$$

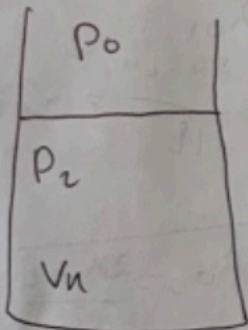
$$P_2 V_k = \nu n R T_k$$

$$\frac{V_n}{V_k} = \frac{T_n}{T_k} \quad \nu n = \frac{\nu n R T_n}{R T_n}$$

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

$$= 4180 \frac{\text{Дж}}{\text{кг} \cdot \text{К}} \cdot 0,01 \text{ кг} \cdot 80 \text{ К} = 3344 \text{ Дж}$$

конечное состояние



$$m_2 = 0,01 \text{ кг}$$

$$P_0 = P_2$$

$$P_2 V_n = \nu n R T_n$$

$$Q = \nu n R T_n$$

$$\nu n = \frac{P_2 V_n m}{R T_n}$$

$$Q_{\text{наподо}} = m r = 2,26 \cdot 10^6 \cdot 0,01$$

$$= 22600 \text{ Дж}$$

$V_n =$

$$Q_{\text{нагр}} = Q - Q_{\text{нап}} - Q_1 =$$

$$= 7056 \text{ Дж}$$

$$\mu = 18 \frac{\text{г}}{\text{моль}}$$

$$P_2 V_k = \nu n R T_k$$

$$T_n = 273 \text{ К}$$

$$Q_{\text{нагр}} = C m \Delta T$$

$$\Delta T = (T_k - T_n)$$

$$Q_n = C m (T_k - T_n)$$

$$T_k = \frac{Q_n}{C m} + T_n$$

$$P_2 V = \nu n R \left( \frac{Q_n}{C m} + T_n \right)$$