Часть 1

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

Шифр: **21206492**

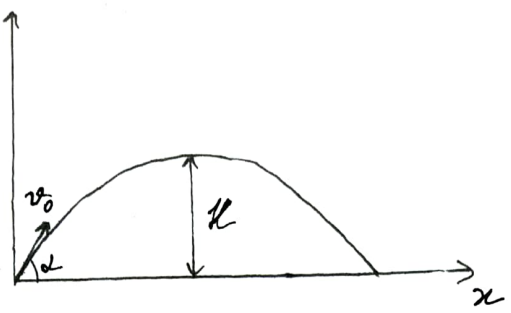
ID профиля: **130181**

Вариант 4

Физика, 10 класс, часть I, вариант 10-04.

Чистовик

(1.)



Уравнения движения для камня:

$$v_y(t) = v_0 \sin\alpha - gt$$

$$y(t) = v_0 \sin\alpha \, t - \frac{gt^2}{2}$$

Пусть t_n – время подъема до макс. высоты. Тогда:

$$v_0 \sin\alpha - g t_n = 0$$

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

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

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

$$v_0^2 \sin^2\alpha = 2gH$$

$$v_0 = \frac{\sqrt{2gH}}{\sin\alpha}$$

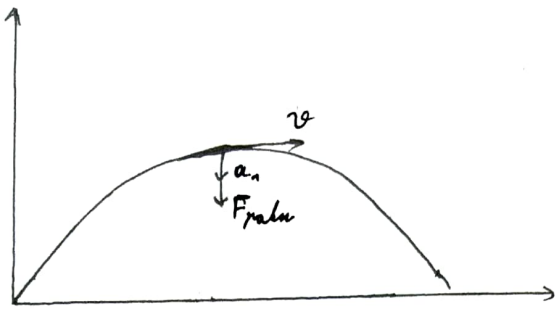
$$v_0 = \frac{\sqrt{2 \cdot 10\,м/с^2 \cdot 10\,м}}{0{,}5\sqrt{2}} = 2\sqrt{100\,м^2/с^2} = 20\,м/с$$

Найдем радиус кривизны траектории в верхней точке.

$$a_n = g = \frac{v_0^2 \cos^2\alpha}{R}$$

$$R = \frac{v_0^2 \cos^2\alpha}{g}$$

$$R = \frac{(20\,м/с)^2 \cdot \left(\frac{\sqrt{2}}{2}\right)^2}{10\,м/с^2} = \frac{200\,м^2/с^2}{10\,м/с^2} = 20\,м$$



Так как скорость постоянна, равнодействующая сила может быть направлена только вдоль радиуса кривизны траектории

$$F_{равн} = m a_n$$

$$F_{равн} = \frac{1}{2} mg$$

$$a_n = \frac{g}{2}$$

$$a_n = \frac{v^2}{R}$$

$$v = \sqrt{a_n R} = \sqrt{0{,}5 g R}$$

$$v = \sqrt{0{,}5 \cdot 10 м/с^2 \cdot 20 м} = \sqrt{100 м^2/с^2} = 10 м/с$$

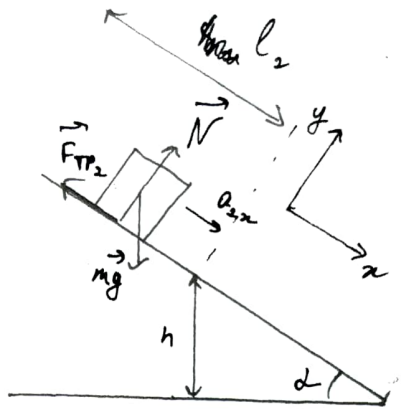
Ответ: 1) $v_0 = 20 м/с$

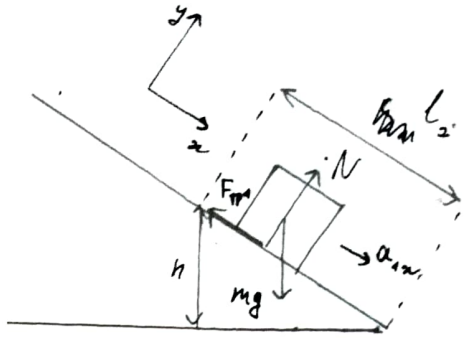
2) $v = 10 м/с$

Физика, 10 класс, часть I, вариант 10-04

Чистовик

(2)





II Закон Ньютона:

$\vec{N} + m\vec{g} + \vec{F}_{тр\,2} = m\vec{a}_{2x}$

x: $mg\sin\alpha - F_{тр_2} = m a_{2x}$

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

$\vec{N} + m\vec{g} + \vec{F}_{тр_1} = m\vec{a}_{1x}$

x: $mg\sin\alpha - F_{тр\,1} = m a_{1x}$

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

Закон Амонтона - Кулона:

$F_{тр\,2} = \mu_2 N$

$F_{тр\,1} = \mu_1 N$

$N = mg\cos\alpha$

$F_{тр\,2} = \mu_2 mg\cos\alpha$

$mg\sin\alpha - \mu_2 mg\cos\alpha = m a_{2x}$

$a_{2x} = g(\sin\alpha - \mu_2\cos\alpha)$

$F_{тр\,1} = \mu_1 mg\cos\alpha$

$mg\sin\alpha - \mu_1 mg\cos\alpha = m a_{1x}$

$a_{1x} = g(\sin\alpha - \mu_1\cos\alpha)$

$\sin\alpha = \sqrt{1-\cos^2\alpha} = \sqrt{1-\frac{576}{625}} = \sqrt{\frac{49}{625}} = \frac{7}{25}$

$a_{2x} = 10\,м/с^2\left(\frac{7}{25} - 0{,}06\cdot\frac{24}{25}\right) =$

$= 2{,}224\,м/с^2$

$a_{1x} = 10\,м/с^2\left(\frac{7}{25} - 0{,}5\cdot\frac{24}{25}\right) =$

$= -0{,}2\,м/с^2$

Так как на высотах, больших, чем h, коробка увеличивает скорость, а на меньших высотах уменьшает, наибольшая скорость у коробки будет на высоте h

Физика, 10 класс, часть I, вариант 10-04

Чистовик.

Уравнения движения корабля для меньших высот:

$$v_{max} + a_{1x} t_1 = 0$$

$$v_{max} t_1 + \frac{a_{1x} t_1^2}{2} = l_1$$

$$l_1 = \frac{h}{\sin\alpha}$$

$$t_1 = -\frac{v_{max}}{a_{1x}}$$

$$-\frac{v_{max}^2}{a_{1x}} + \frac{v_{max}^2}{2a_{1x}} = \frac{h}{\sin\alpha}$$

$$v_{max}^2 = \frac{-2a_{1x}h}{\sin\alpha} = \frac{-2 \cdot (-2\ м/с^2) \cdot 1{,}4\ м \cdot 25}{7} = 20\ м^2/с^2$$

$$v_{max} = \sqrt{20\ м^2/с^2} = 2\sqrt{5}\ м/с \approx 4{,}5\ м/с$$

Уравнения движения корабля для больших высот:

$$0 + a_{2x} t_2 = v_{max}$$

$$t_2 = \frac{v_{max}}{a_{2x}}$$

$$\frac{a_{2x} t_2^2}{2} = l_2$$

$$l_2 = \frac{v_{max}^2}{2a_{2x}}$$

$$l_2 = \frac{20\ м^2/с^2}{2 \cdot 2{,}224\ м/с^2} = 4{,}5\ м.$$

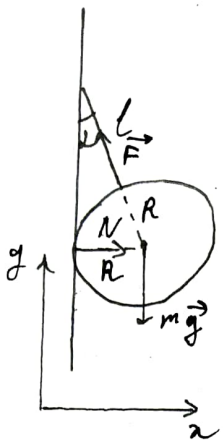
$$S = l_1 + l_2 = 4{,}5\ м + \frac{1{,}4\ м \cdot 25}{7} = 9{,}5\ м.$$

Ответ: 1) $v_{max} = 2\sqrt{5}\ м/с \approx 4{,}5\ м/с$

2) $S = 9{,}5\ м$

Условие

(3)



$$\sin\alpha = \frac{R}{l+R} = \frac{8\,см}{8\,см+8\,см} = \frac{1}{2}$$

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

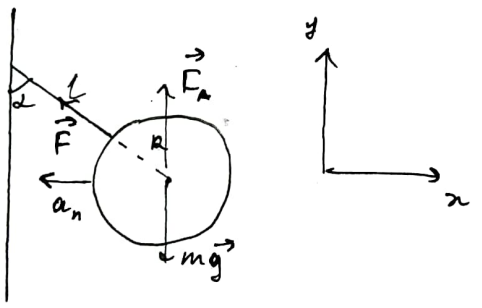
II Закон Ньютона:

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

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

$$F = \frac{mg}{\cos\alpha}$$

$$F = \frac{5\,кг \cdot 10\,м/с^2 \cdot 2}{\sqrt{3}} \approx 60\,Н.$$



(Во второй части решения используются обозначения, не связанные с первой частью)

II Закон Ньютона

$$\vec{F} + \vec{F_A} + m\vec{g} = m\vec{a}$$

$$x: \; F\sin\alpha = m a_n$$

$$y: \; F\cos\alpha + F_A - mg = 0.$$

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

$$F_A = 21{,}15\,Н$$

Физика, 10 класс, I часть, вариант 10-04

Чистовик.

$$F = \frac{mg - F_A}{\cos\alpha}$$

$$F = \frac{(5{,}2\ кг \cdot 10\ м/с^2 - 21{,}95\ Н) \cdot 2}{\cos 20^\circ} \approx 61\ Н.$$

$$a_n = \frac{F \sin\alpha}{m} = \omega^2 (l + R) \sin\alpha$$

$$\omega^2 = \frac{F}{m(l+R)} = \frac{4\pi^2}{T^2}$$

$$T = \sqrt{\frac{4\pi^2 m (l+R)}{F}}$$

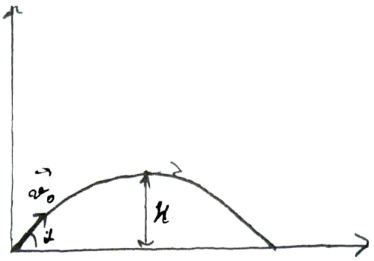
$$T \approx 7{,}3\ с$$

Ответ: 1) $F = 60\ Н$

2) $T = 7{,}3\ с$

Черновик

1.



$\alpha = 45°$

$H = 10$ м.

$v_0 - g t_{под} = 0$

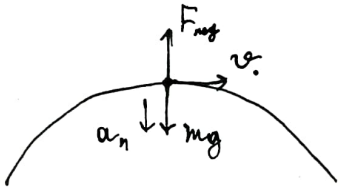
$t_{под} = \frac{v_0}{g}$

$H = v_0 t_{под} - \frac{g t_{под}}{2} = \frac{v_0^2}{g} - \frac{v_0^2}{2g} = \frac{v_0^2}{2g}$

$v_{0\sin\alpha} = \sqrt{2gH}$

$\frac{\sqrt{2}}{2} v = \sqrt{2gh}$

$v = 2\sqrt{gh} = 2 \cdot \sqrt{100} = 20$ м/с



$F_{под} - mg = -\frac{1}{2} mg$

$F_{под} = \frac{1}{2} mg$

$m a_n = \frac{1}{2} mg$. $\quad a_n = \frac{1}{2} g = \frac{v^2}{R}$

$R = \frac{v_0^2 \cos^2\alpha}{g} =$

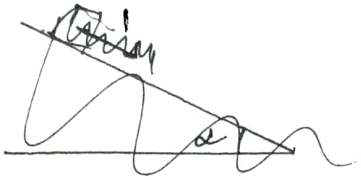
$R = \frac{v_0^2 \cos^2\alpha}{g} = \frac{v_0^2}{2g} = \frac{400 м^2/с^2}{20 м/с^2} = 20$ м

$\frac{v^2}{R} = \frac{1}{2} g$

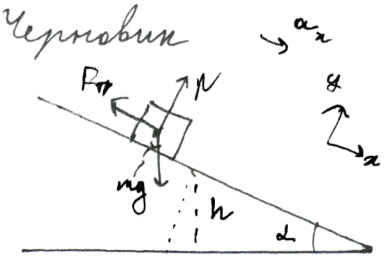
$v^2 = \frac{1}{2} gR = \sqrt{\frac{1}{2} gR} = 10$ м/с

Физика 10-04

2)



Чертёж



$F_{тр} = \mu N$

$N - mg\cos\alpha = 0$

$ma_{1x} = mg\sin\alpha - \mu N$

$N = mg\cos\alpha$

$ma_{1x} = mg\sin\alpha - \mu mg\cos\alpha$

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

$\sin\alpha = \sqrt{1 - \frac{24\cdot 24}{25\cdot 25}} = \sqrt{1 - \frac{576}{625}} = \sqrt{\frac{49}{625}} = \frac{7}{25}$

$a_{1x} = g(\sin\alpha - \mu_1\cos\alpha) = 10\,м/с \cdot \left(\frac{7}{25} - 0{,}5\cdot\frac{24}{25}\right) = 10\,м/с\left(\frac{7-12}{25}\right) = 10\,м/с \cdot \frac{-1}{5} = -2\,м/с$

$a_{2x} = g(\sin\alpha - \mu_2\cos\alpha) = 10\,м/с \cdot \left(\frac{7}{25} - 0{,}06\frac{24}{25}\right) = 2{,}224\ м/с$

$v_{max}t_1 + \frac{a_{1x}t_1^2}{2} = \frac{h}{\sin\alpha}$

$v_{max} + a_{1x}t_1 = 0$

$t_1 = -\frac{v_{max}}{a_{1x}}$

$-\frac{v_{max}^2}{a_{1x}} + \frac{v_{max}^2}{2a_{1x}} = \frac{h}{\sin\alpha}$

$v_{max}^2 = -\frac{2a_{1x}h}{\sin\alpha}$

$v_{max} = \sqrt{\frac{-2a_{1x}h}{\sin\alpha}} = \sqrt{\frac{2\cdot 2\cdot 14\cdot 25}{7}}$

$l_1 = \frac{h}{\sin\alpha} = \frac{14\,м\cdot 25}{7} = 0{,}2\,м\cdot 25 = 5$

$\sqrt{2a_{1x}l} = \sqrt{2\cdot 2\cdot 5} = 2\sqrt{5}$

$0 + a_{2x}t_2 = v_{max}$

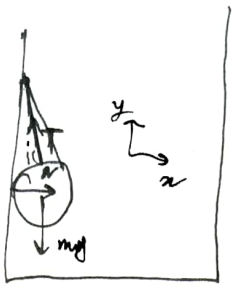
$t_2 = \frac{v_{max}}{a_{2x}}$

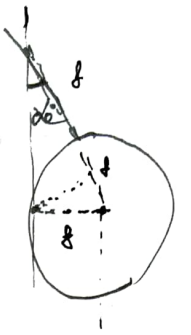
$l_2 = \frac{a_{2x}t_2^2}{2} = \frac{v_{max}^2}{2a_{2x}} = \frac{20}{2\cdot 2{,}224} = 4{,}5$

$L = l_1 + l_2 = 5\,м + 4{,}5\,м = 9{,}5\,м.$

Черновик

3.





$\sin^2\alpha = \frac{1}{2}$

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

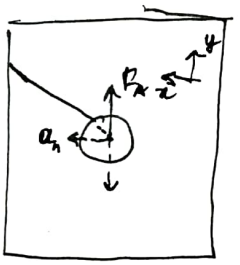
$x: \quad N - T\sin\alpha = 0$

$y: \quad T\cos\alpha - mg = 0$

$T = \frac{mg}{\cos\alpha}$ — сила натяжения

$T = \frac{ma}{\cos\alpha} = \frac{5{,}2\,кг \cdot 10\,м/с^2 \cdot 2}{\sqrt{3}} \approx 60\,Н.$

$N = T\sin\alpha = mg\,\mathrm{tg}\,\alpha$



$x: \quad F_1\sin\beta = m a_n$

$y: \quad F_1\cos\beta = mg$

$F_1 = \frac{mg}{\cos\beta}$

$a_n = \frac{F_1\sin\beta}{m} = g\,\mathrm{tg}\,\beta$

$a_n = \omega^2 R_0 = \omega^2 (l+R)\sin\beta = \frac{4\pi^2}{T^2}(l+R)\sin\beta$

$\omega = \frac{2\pi}{T}$

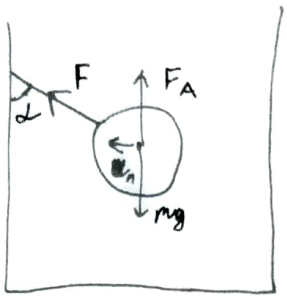
$g\frac{\sin\beta}{\cos\beta} = \frac{4\pi^2}{T^2}(l+R)\sin\beta$

$\frac{gT^2}{\cos\beta} = 4\pi^2(l+R)$

$T = \sqrt{\frac{4\pi^2(l+R)\cos\beta}{g}} = \ldots \approx 5{,}62\,с.$

Условие

Физика, 10-04
61.



$x: \quad F \sin\alpha = m a_n$

$y: \quad F\cos\alpha + F_A = mg$

$F_A = \rho_в V g = \frac{4}{3}\pi R^3 \rho_в g = 21{,}45\ Н$

$F = \dfrac{\left(m - \frac{4}{3}\pi R^3 \rho_в\right) g}{\cos\alpha} = 61\ Н$

$a_n = \dfrac{\left(m - \frac{4}{3}\pi R^3 \rho_в\right) g \operatorname{tg}\alpha}{m} = 0{,}5875 \operatorname{tg}\alpha$

$a_n = \omega^2 (R+l) = \dfrac{4\pi^2}{T^2}(R+l)$

$T^2 = \dfrac{4\pi^2 (R+l)\sin\alpha}{a_n} = \dfrac{4\pi^2 (R+l)\, m \cos\alpha}{\left(m - \frac{4}{3}\pi R^3 \rho_в\right) g}$

$a_n = F_{ун} \cdot \sin\alpha$

$m \dfrac{4\pi^2 (R+l)\sin\alpha}{T^2} = F \sin\alpha$

$\dfrac{4\pi^2 (R+l)\, m}{F_{ун}} = T^2 \qquad T \approx 7{,}33\ с$

Часть 2

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

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Вариант 4

Физика, 10 класс, часть 2, вариант 10-04

Чистовик.

(4) 1) $Q_1 = cm(t_{кип} - t_0)$

$Q_1 = 4180\ Дж/(кг \cdot К) \cdot 0{,}01\ кг \cdot (100°С - 20°С) = 3344\ Дж$

2) $Q_2 = m_в r$.

$Q_2 = 0{,}01\ кг \cdot 2{,}26 \cdot 10^6\ Дж/кг = 22600\ Дж$.

$Q_2 < Q - Q_1$, поэтому вся вода перейдет в пар.

$Q_3 = Q - Q_1 - Q_2$ кп

$Q_3 = 33000\ Дж - 3344\ Дж - 22600\ Дж = 7056\ Дж$

~~Q = Q + Q~~

Так как поршень легкий, а стенки гладкие, давление газа внутри цилиндра равно наружному давлению: $p = p_0$

$Q_3 = c_p m \Delta t_п$

$\Delta t_п = \frac{Q_3}{c_p m}$

$\Delta t_п = \frac{7056\ Дж}{2200\ Дж/(кг \cdot К) \cdot 0{,}01\ кг} = 321\ К$

$t_п = t_{кип} + \Delta t_п = 373\ К + 321\ К = 694\ К$.

Уравнение состояния идеального газа:

$pV = \frac{m}{M_{H_2O}} R t_п$

$V = \frac{m R t_п}{M_{H_2O} p}$

$V = \frac{0{,}01\ кг \cdot 8{,}31\ Дж/(К \cdot моль) \cdot 694\ К}{0{,}018\ кг/моль \cdot 10^5\ Па} = 0{,}032\ м^3$

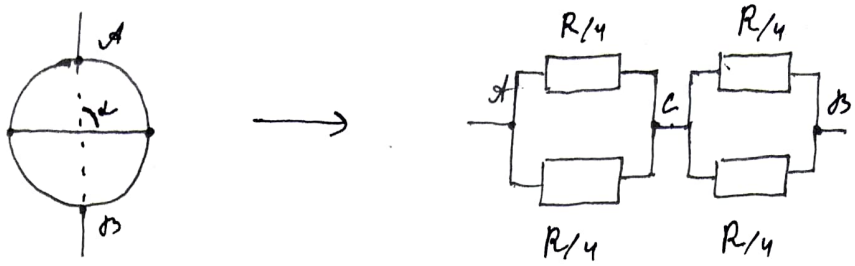
Ответ: 1) $Q_1 = 3344\ Дж$

2) $V = 0{,}032\ м^3$

Физика, 10 класс, часть 2, вариант 10-04

Указания

(5) 1)



$$\frac{1}{R_{AC}} = \frac{1}{R/4} + \frac{1}{R/4} = \frac{8}{R}$$

$$R_{AC} = \frac{R}{8}$$

$$\frac{1}{R_{CB}} = \frac{1}{R/4} + \frac{1}{R/4} = \frac{8}{R}$$

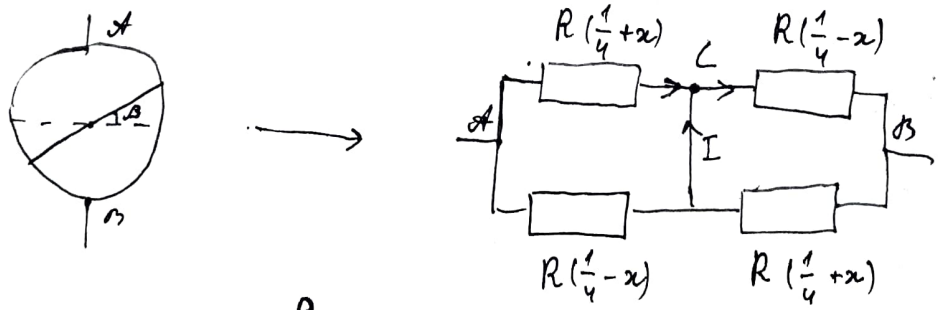
$$R_{CB} = \frac{R}{8}$$

$$R_{AB} = R_{AC} + R_{CB} = \frac{R}{4}$$

$$P = \frac{I^2}{R_{AB}} = \frac{4I^2}{R}$$

$$P = \frac{4 \cdot (24\ В)^2}{72\ Ом} = 32\ Вт$$

2).



где $x = \frac{B}{2\pi}$

$$R_{AC} = \frac{R^2(\frac{1}{4}+x)(\frac{1}{4}-x)}{R(\frac{1}{4}+x)+R(\frac{1}{4}-x)} = \frac{R(\frac{1}{4}+x)(\frac{1}{4}-x)}{\frac{1}{2}} = \frac{R(\frac{1}{2}+2x)(\frac{1}{2}-2x)}{2}$$

$$R_{CB} = \frac{R^2(\frac{1}{4}+x)(\frac{1}{4}-x)}{R(\frac{1}{4}+x)+R(\frac{1}{4}-x)} = R_{AC}$$

Физика, 10 класс, часть 2, вариант 10-04.

Чистовик

Так как сопротивления последовательных участков равны, то и напряжения на них равны.

$$U_{AC} = U_{CB} = \frac{U}{2}.$$

Запишем правило Кирхгофа для т. C:

$$\frac{U/2}{R\left(\frac{1}{4}+x\right)} + I = \frac{U/2}{R\left(\frac{1}{4}-x\right)}$$

$$I = \frac{U}{2R}\left(\frac{1}{\frac{1}{4}-x} - \frac{1}{\frac{1}{4}+x}\right)$$

$$\frac{\frac{1}{4}+x \div \frac{1}{4}+x}{\frac{1}{16}-x^2} = \frac{2IR}{U}$$

$$\frac{2x}{\frac{1}{16}-x^2} = \frac{2IR}{U}$$

$$\frac{x}{\frac{1}{16}-x^2} = \frac{IR}{U}$$

$$\frac{IR}{U} = \frac{0{,}5\ A \cdot 2\ Om}{24\ B} = \frac{3}{2}$$

$$\frac{x}{\frac{1}{16}-x^2} = \frac{3}{2}$$

$$2x = \frac{3}{16} - 3x^2$$

$$3x^2 + 2x - \frac{3}{16} = 0$$

Физика, 10 класс, часть 2, вариант 10-04

Чистовик

Решим квадратное уравнение

$$3x^2 + 2x - \frac{3}{16} = 0$$

$$D = 4 + 4 \cdot \frac{9}{16} = \frac{16+9}{4} = \frac{25}{4}$$

$$x = \frac{-2 + \frac{5}{2}}{2 \cdot 3} = \frac{1}{12}$$

$$\frac{\beta}{2\pi} = \frac{1}{12}$$

$$\beta = \frac{\pi}{6} = 30^\circ$$

3) $R_{xc} = R_{cos} = \frac{R}{2}\left(\frac{1}{2} + 2x\right)\left(\frac{1}{2} - 2x\right) =$

$= \left(\frac{1}{2} + \frac{1}{6}\right)\left(\frac{1}{2} - \frac{1}{6}\right)\frac{R}{2} = \left(\frac{3}{6} + \frac{1}{6}\right)\left(\frac{3}{6} - \frac{1}{6}\right)\frac{R}{2} = \frac{4}{6} \cdot \frac{2}{6} \cdot \frac{R}{2} = \frac{1}{9}R$

$R_{общ} = R_{xc} + R_{cos} = \frac{1}{9}R + \frac{1}{9}R = \frac{2}{9}R$

$$P_2 = \frac{U^2}{R_{общ}} = \frac{9U^2}{2R}$$

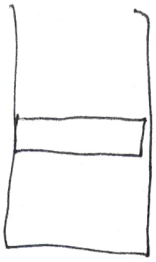
$$P_2 = \frac{9 \cdot (24\,В)^2}{2 \cdot 72\,Ом} = 36\,Вт.$$

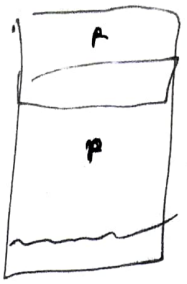
Ответ: 1) $P = 32\,Вт$

2) $\beta = 30^\circ$

3) $P_2 = 36\,Вт$

Черновик.





$Q_1 = cm(t_{кип} - t_0) = 4180 \frac{Дж}{кг \cdot °C} \cdot 0{,}01 кг \cdot (100°C - 20°C) = 3344 Дж$

$Q_{исп.} = Q - Q_1 = 33000 Дж - 3344 Дж = 29656 Дж$

$Q_2 = m_п r = 0{,}01 кг \cdot 2{,}26 \cdot 10^6 \frac{Дж}{кг} = 22600 Дж$

$Q_3 = Q_{исп.} - Q_2 = 29656 Дж - 22600 Дж = 7056 Дж.$

$Q_3 = c_p m \Delta t_p =$

$273 + 100 + 321 = 694$

$\Delta t_p = \frac{Q_3}{c_p m} = \frac{7056 Дж}{2200 \frac{Дж}{кг \cdot °C} \cdot 0{,}01 кг} = 324°C$

$pV = \frac{m}{M} RT$

$V = \frac{mRT}{Mp} = \frac{0{,}01 кг \cdot 8{,}31 \frac{Дж}{К \cdot моль} \cdot 694 К}{0{,}018 кг/моль \cdot 10^5 Па} =$

$0{,}032 м^3$

$\left(\frac{1}{2} + \frac{6}{40}\right)\left(\frac{1}{2} - \frac{6}{40}\right) = \frac{20+6}{40} \cdot \frac{20-6}{40} = \frac{26 \cdot 14}{1600} =$

P_2 ***

0,005

$\frac{40}{40} + \frac{13}{40}$ $\frac{13}{40} R$

$\frac{7}{40} R$

$\frac{1}{R_{общ}}$ $\frac{40}{13R} + \frac{40}{7R} = \frac{40(13+7)}{91R} = \frac{800}{91R}$

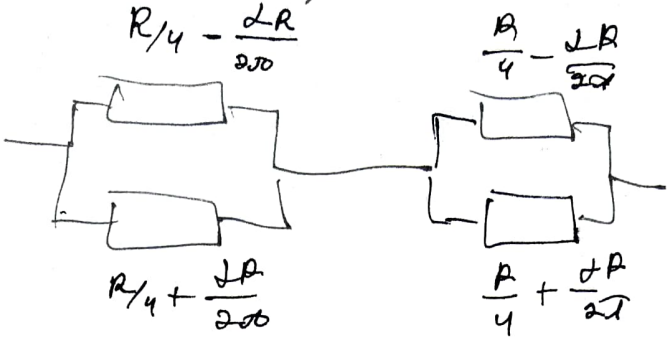
$P_{об} = \frac{91 \cdot R}{800}$

$R_{общ} = \frac{91 R}{400}$

$R_3 = \frac{400 \cdot u^2}{91} = 35,16$ Вт

черновик

(5) 2)



$$\frac{1}{R_0} = \frac{1}{\frac{R}{4} - \frac{\Delta R}{2\pi}} + \frac{1}{\frac{R}{4} + \frac{\Delta R}{2\pi}} = \frac{\frac{R}{4} + \frac{\Delta R}{2\pi} + \frac{R}{4} - \frac{\Delta R}{2\pi}}{\frac{R^2}{16} - \frac{\Delta^2 R^2}{4\pi^2}} =$$

$$= \frac{\frac{R}{2}}{\frac{R^2}{16} - \frac{\Delta^2 R^2}{4\pi^2}} = \frac{1}{\frac{R}{8} - \frac{\Delta^2 R}{2\pi^2}}$$

$$R_0 = \frac{R}{8} - \frac{\Delta^2 R}{2\pi^2}$$

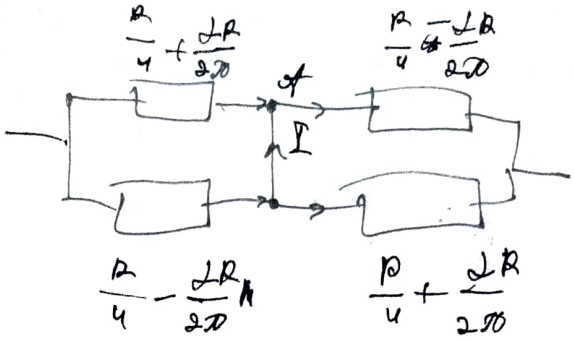
$$R_{obs} = 2R_0 = \frac{R}{4} - \frac{\Delta^2}{\pi^2} R = \frac{R}{4}\left(\frac{1}{4} - \left(\frac{\Delta}{\pi}\right)^2\right)$$

$$I R\left(\frac{1}{4} - \left(\frac{\Delta}{\pi}\right)^2\right) = U$$

$$\frac{U}{I}$$

$$\frac{1}{4} - \left(\frac{\Delta}{\pi}\right)^2 = \frac{U}{IR} = \text{ш}$$

$$\frac{\Delta}{\pi} = \sqrt{\frac{1}{4} - \frac{U}{IR}} = \sqrt{\frac{1}{4} - \frac{24 \cdot 1}{72}} = \sqrt{\frac{1}{4} - \frac{2}{3}} = \sqrt{\frac{3}{12}} - -$$



$R_{01} = R_{02} \Rightarrow U_1 = U_2 = \frac{U}{2}$

$$\frac{U}{2} \Big/ \left(\frac{R}{4}+\frac{\Delta R}{200}\right) + I = \frac{U/2}{R/4 - \frac{\Delta R}{200}}$$

$$\frac{U}{R/2+\frac{1}{50}R} + I = \frac{U}{R/2-\frac{2}{50}R}$$

$$I = \left(\frac{U}{R}\left(\frac{1}{0{,}5 - \frac{1}{50}} - \frac{1}{0{,}5+\frac{1}{50}}\right)\right) =$$

$$= \frac{U}{R}\left(\frac{0{,}5 + \frac{1}{50} - 0{,}5 + \frac{1}{50}}{\frac{1}{4}-\frac{1}{50^2}}\right) = \frac{U}{R}\frac{\frac{2}{50}}{\frac{1}{4}-\frac{1}{50^2}} =$$

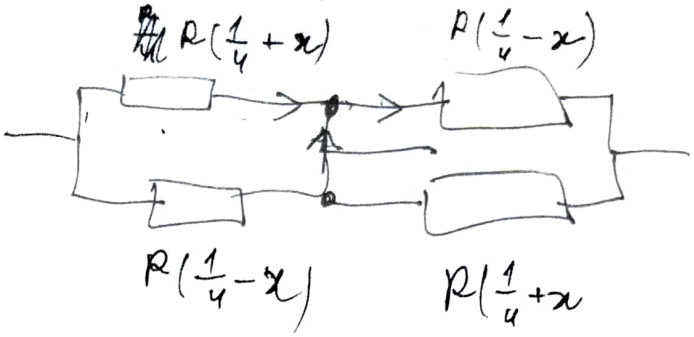
$$= \frac{U}{R}\frac{1}{\frac{50}{8} - \frac{1}{200}} = \frac{U}{R} I$$

$$\frac{50}{8} - \frac{1}{50} \qquad \frac{1}{\quad} = \frac{IR}{U}$$

$$\frac{50^2 - 4}{8 \cdot 50} = \frac{IR}{U}$$

решение.

(5) 2).



$$\frac{u/2}{R\left(\frac{1}{4}-x\right)} = \frac{u/2}{R\left(\frac{1}{2}+x\right)} + I$$

$$I = \frac{u}{R\left(\frac{1}{2}-2x\right)} - \frac{u}{R\left(\frac{1}{2}+2x\right)}$$

$$I = \frac{u}{R}\left(\frac{1}{\frac{1}{2}-2x} - \frac{1}{\frac{1}{2}+2x}\right)$$

$$\frac{IR}{u} = \frac{\frac{1}{2}+2x-\frac{1}{2}+2x}{\frac{1}{4}-4x^2} = \frac{4x}{\frac{1}{4}-4x^2} = \frac{1}{\frac{1}{16x}-x} =$$

$$= \frac{1}{\frac{1-16x^2}{16x}} = \frac{16x}{1-16x^2}$$

$$(1-16x^2)\,IR = 16x\,u$$

$$16x^2 IR + 16x\,u - IR = 0$$

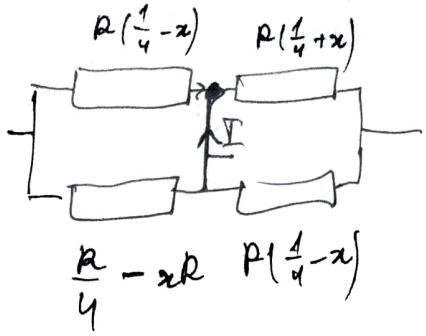
$$D = 16^2 u^2 + 16^2 I^2 R^2 =$$

$$= 2^8\left(u^2 + I^2 R^2\right) =$$

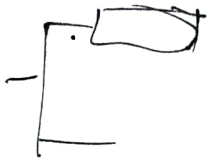
$$\sqrt{D} = 16\sqrt{u^2 + I^2 R^2}$$

$$x = \frac{16u + 16\sqrt{u^2+I^2R^2}}{2\cdot 16\,IR} = \frac{u + \sqrt{u^2+I^2R^2}}{2IR} = \frac{24+43,22}{2\cdot 0,5\cdot 72}$$

5



u



$$I = \frac{u/2}{R(\frac{1}{4}-x)} - \frac{u/2}{R(\frac{1}{4}+x)}$$

$$\frac{2uIR}{u} = \frac{1}{\frac{1}{4}-x} - \frac{1}{\frac{1}{4}+x} = \frac{\frac{1}{4}+x-\frac{1}{4}+x}{\frac{1}{16}-x^2} =$$

$$= \frac{2x}{\frac{1}{16}-x^2}$$

$$\frac{IR}{u} = \frac{x}{\frac{1}{16}-x^2}$$

$$\frac{IR}{u} = \frac{32}{24} = \frac{4}{3} = \frac{x}{\frac{1}{16}-x^2}$$

$$3x = \frac{1}{4} - 4x^2$$

$$4x^2 + 3x - \frac{1}{4} = 0$$

$$D = 9 + 4 = 13$$

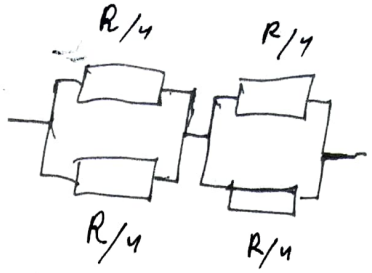
$$x = \frac{-3+\sqrt{13}}{2}$$

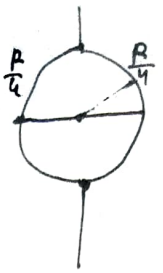
$$\frac{3}{40}\pi$$

$$\beta = \frac{3}{40}\pi =$$

Чертежник.

(5.) а)

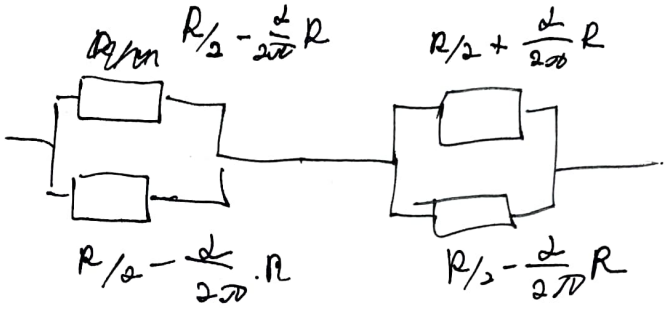




$R/4 + R/4 = R/2$

$$P = \frac{U^2}{R/4} = \frac{4U^2}{R} = \frac{4 \cdot 24\,В \cdot 24\,В}{72\,Ом} = 32\,Вт$$

2) .



$$R_{общ} = 2R_0 = \text{Ом}$$

$$\frac{1}{R_0} = \frac{1}{0{,}5R - \frac{\alpha}{2\pi}R} + \frac{1}{0{,}5R + \frac{\alpha R}{2\pi}} = \frac{0{,}5R + \frac{\alpha}{2\pi}R + 0{,}5R - \frac{\alpha R}{2\pi}}{\frac{1}{4}R^2 - \left(\frac{\alpha}{2\pi}\right)^2 R^2} =$$

$$= \frac{1}{\frac{1}{4}R - \left(\frac{\alpha}{2\pi}\right)^2 R^2}$$

$$R = \frac{1}{4}R - \left(\frac{\alpha}{2\pi}\right)^2 R \qquad R_{общ} = \frac{1}{2}R - \frac{1}{2}\left(\frac{\alpha}{2\pi}\right)^2 R$$

$$\frac{U}{\frac{1}{4}R - \left(\frac{\alpha}{2\pi}\right)^2 R} = I$$

$$\frac{1}{2}R\left(1 - \frac{\alpha}{2\pi}\right)^2$$

$$\frac{1}{4}R - \left(\frac{\alpha}{2\pi}\right)^2 R = \frac{U}{I}$$

$$\left(\frac{1}{4} - \frac{\alpha}{2\pi}\right) = \frac{I\omega}{R} \qquad \frac{12}{47}$$

$$\frac{\alpha}{2\pi} = \frac{1}{4} - \frac{I\omega}{R} =$$

$$\frac{\alpha}{2\pi} = \frac{1}{6} \qquad \alpha = \frac{\pi}{3} = 60°$$

$$\frac{1}{R} = \frac{1}{R/12 + 5R/12} = \frac{12}{R} + \frac{12}{5R} = \frac{60}{5R} + \frac{12}{5R} = \frac{72}{5R}$$

$$1 - \frac{2\omega}{}$$

$$\left(1 - \frac{\alpha}{\pi}\right)\frac{1}{\theta} R =$$

$$1 - \frac{\alpha}{\pi} = \frac{2\omega}{IR}$$

$$\frac{\alpha}{\pi} = 1 - \frac{2\omega}{IR} =$$