Часть 1

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

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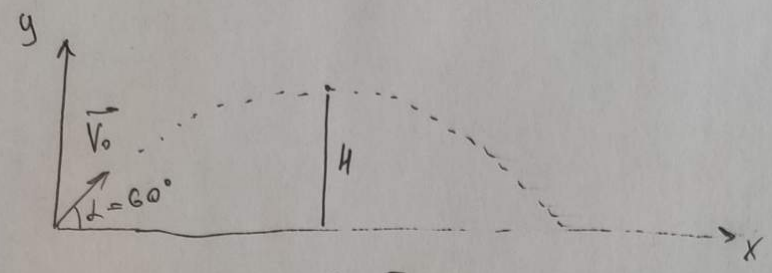
ID профиля: **383545**

Вариант 3

№1 Класс 10 Вариант 10-3

1) $V_0 = ?$



$S = 17$ м

1) $\begin{cases} \vec{a} = \text{const} \\ \vec{V} = \vec{V_0} + \vec{a}t \\ \vec{r} = \vec{r_0} + \vec{V_0}t + \dfrac{\vec{a}t^2}{2} \end{cases} \Rightarrow$ $x: \begin{cases} a_x = 0 \\ V_x = V_0\cos\alpha \\ x = V_0\cos\alpha\, t \end{cases}$ $y: \begin{cases} a_y = -g \\ V_y = V_0\sin\alpha - gt \\ y = V_0\sin\alpha\, t - \dfrac{gt^2}{2} \end{cases}$

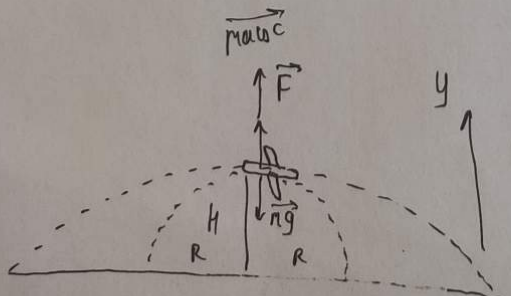
тело упало $\Rightarrow$ $y = 0 \Rightarrow$ $\begin{cases} \dfrac{gt^2}{2} - V_0\sin\alpha\, t = 0 \\ V_0\cos\alpha\, t = S \end{cases} \Rightarrow$ $t \neq 0$ $\begin{cases} t = \dfrac{2V_0\sin\alpha}{g} \\ V_0\cos\alpha \cdot \dfrac{2V_0\sin\alpha}{g} = S \end{cases} \Rightarrow$

$$V_0 = \sqrt{\frac{g \cdot S}{2\cos\alpha\sin\alpha}} = \sqrt{\frac{10\,м/с^2 \cdot 17\,м}{2 \cdot \frac{1}{2} \cdot \frac{\sqrt{3}}{2}}} = \sqrt{\frac{340\,м^2/с^2}{\sqrt{3}}} = \sqrt{\frac{340}{1{,}73}}\,м/с \approx 14{,}0\,м/с = 14\,м/с$$

2) траектория наивысшая $\Rightarrow V_y = 0 \Rightarrow V_0\sin\alpha - gt_в = 0 \Rightarrow t_в = \dfrac{V_0\sin\alpha}{g}$

$$H = y(t_в) = V_0\sin\alpha \cdot \frac{V_0\sin\alpha}{g} - \frac{g}{2} \cdot \frac{V_0^2\sin^2\alpha}{g^2} = \frac{V_0^2\sin^2\alpha}{2g} = \frac{(14\,м/с)^2 \cdot \frac{3}{4}}{2 \cdot 10\,м/с^2} = 7{,}35\,м$$

$\vec{mg} + \vec{mg} + \vec{ma_{уск}} = 0.$ (1)



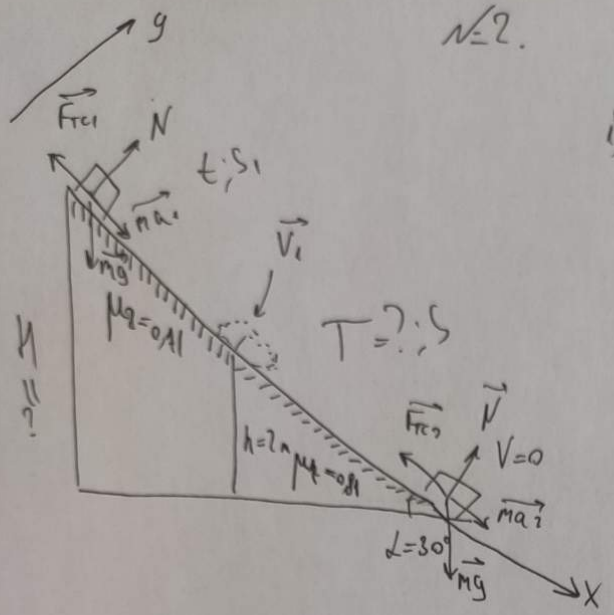
$y: mg = F + ma_{уск} \Rightarrow F = m(g - a_{уск}) =$

$$= m\left(g - \frac{(V_0/4)^2}{R}\right) = m\left(m\left(g - \frac{\left(\frac{V_0}{4}\right)^2}{H}\right)\right)$$

$$= 1\,кг \cdot \left(10\,м/с^2 - \frac{\left(\frac{14\,м/с}{4}\right)^2}{7{,}35\,м}\right)) = 8{,}33\,Н$$

Ответ: $V_0 = 14 м/с$; $F = 8,33 \Delta x$

№2.



1) $\vec{F}_{тс1} + \vec{N} + m\vec{g} = m\vec{a}_1$

X: $mg\cos(90-\alpha) - F_{тс1} = ma_{1x}$ ⇒

y: $N - mg\sin(90-\alpha) = 0$

$N = mg\cos\alpha$. $F_{тс1} = \mu_2 N = \mu_2 mg\cos\alpha$.

$mg\sin\alpha - \mu_2 mg\cos\alpha = ma_{1x}$

$a_{1x} = g(\sin\alpha - \mu_2\cos\alpha) = 10\,м/с^2 \cdot \left(\frac{1}{2} - 0{,}81\frac{\sqrt{3}}{2}\right)$

$= \frac{10;1{,}1\sqrt{3}}{2}\,м/с^2 = 4{,}05\,м/с^2$

$a_{1x} > 0$ ⇒ тело ускоряется на верхнем участке

2) $\vec{F}_{тс2} + \vec{N} + m\vec{g} = m\vec{a}_2$

X: $mg\sin\alpha - F_{тс2} = ma_{2x}$

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

$F_{тс2} = mg\cos\alpha\,\mu_1$

⇒ $mg\sin\alpha - mg\cos\alpha\,\mu_1 = ma_{2x}$

$a_{2x} = g(\sin\alpha - \cos\alpha\,\mu_1) = 10\,м/с^2 \cdot \left(\frac{1}{2} - \frac{\sqrt{3}}{2}\cdot 0{,}81\right) = -2{,}015\,м/с^2$ ⇒ тело тормозит.

2) $V_1 + a_{2x}t = 0$ ⇒ $T = \frac{-V_1}{a_{2x}}$

$A_{FTP} = (\vec{F}_T \cdot \vec{S}) = F_T \cdot S \cdot \cos 180° = -F_T S$

$S = \frac{h}{\sin\alpha} = 2h$ ⇒ $A_{FT} = -2h \cdot mg\cos\alpha\,\mu_1$

3) ЗСЭ: $\frac{mV_1^2}{2} + mgh = 0 + A_{FTP} + A_{FTP} = 0$.

$\frac{mV_1^2}{2} + mgh - 2h\,mg\cos\alpha\,\mu_1 = 0$

$\frac{V_1^2}{2} + gh - 2gh\cos\alpha\,\mu_1 = 0$ ⇒ $V_1 = \sqrt{2\cdot(2gh\cos\alpha\,\mu_1 - gh)} = \sqrt{2\cdot 10\,м/с^2 \cdot 2м \cdot (2\cos\alpha\,\mu_1 - 1)}$

$= \sqrt{4\cdot 10\,м^2/с^2 \cdot \left(2\cdot\frac{\sqrt{3}}{2}\cdot 0{,}81 - 1\right)} = 4{,}015\,м/с$

4) Из п. 2 и 3:

$S = 2h$

$V_1 = 4{,}015\ м/с$

$V_1 + a_2 \times T = 0 \Rightarrow T = \frac{V_1}{-a_2 x} = \frac{4{,}015\ м/с}{2{,}015\ м/с^2} = 2с$

$\boxed{T = 2с}$

5) На верхнем участке:

~~$0 + V_1$~~

$0 + a_1 t = V_1 \Rightarrow t = \frac{V_1}{a_1 x} = \frac{4{,}015\ м/с}{4{,}05\ м/с^2} = 1с$

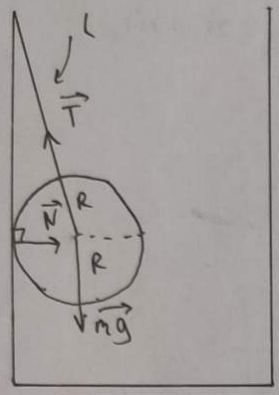
$S_1 = \underset{\downarrow\downarrow}{V_0}t + \frac{a_1 x t^2}{2} = \frac{4{,}05\ м/с^2 \cdot 1с^2}{2} \approx 2м$

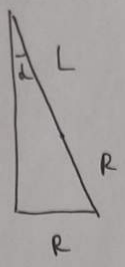
0

$H = (S_1 + S) \cdot \sin\alpha = \frac{1}{2} \cdot (2м + 4м) = 3м$

Ответ: $T = 2с$; $H = 3м$

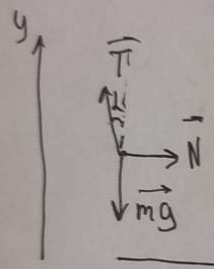
№3.





$\sin\alpha = \frac{R}{L+R} = \frac{5}{15+5} = 0{,}25 = \frac{1}{4}$

$\cos\alpha = \frac{\sqrt{(L+R)^2 - R^2}}{L+R} = \frac{\sqrt{(20)^2 - 5^2}}{20} = \frac{\sqrt{15}}{4}$



1) $\vec{mg} + \vec{T} + \vec{N} = 0$

$x: N = T\sin\alpha$

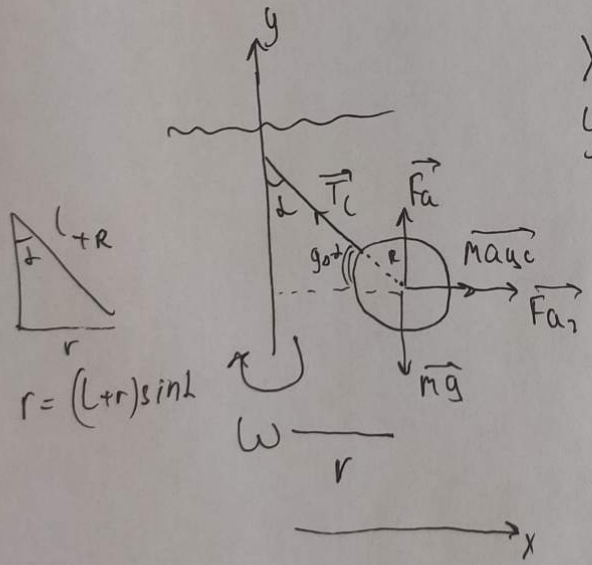
$y: \frac{mg}{\cos\alpha} = T\cos\alpha \Rightarrow N = mg\frac{\sin\alpha}{\cos\alpha} = mg \cdot \frac{1/4}{\sqrt{15}/4} = \frac{\sqrt{15}}{15} \cdot 0{,}8\text{кг} \cdot 10\text{м/с}^2 =$

$= 2{,}066\text{ Н}$

F_{a2} – сила архимеда, действующая в бок

$\vec{mg} + \vec{F_a} + \vec{ma_{цс}} + \vec{F_{a2}} + \vec{T} = 0.$

$\begin{cases} X: F_{a2} + ma_{цс} = T\sin\alpha \\ y: F_a + T\cos\alpha = mg \end{cases} \Rightarrow$



$\begin{cases} (\rho_в V_ш + m)a_{цс} = T\sin\alpha \\ \cancel{\rho_в V_ш \cdot g - m)} \\ T\cos\alpha = g(m - \rho_в V_ш) \end{cases} \Rightarrow$

$tg\alpha = \frac{(\rho_в V_ш + m)\cdot\omega^2 r}{g(m - \rho_в V_ш)} = (5)$

$\Rightarrow \frac{\sin\alpha}{\cos\alpha} = tg\alpha = \frac{(\rho_в V_ш + m)\cdot\omega^2(L+R)\sin\alpha}{g(m - \rho_в V_ш)} \Rightarrow \cos\alpha = \frac{g(m - \rho_в \cdot \frac{4}{3}\pi R^3)}{(m + \rho_б \cdot \frac{4}{3}\pi r^3)\cdot\omega^2(L+R)}$

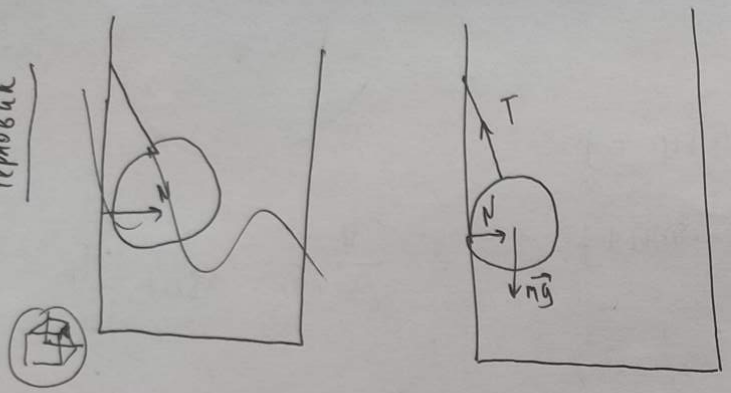
$$\cos\alpha = \frac{10\,м/с^2\left(0{,}8\,кг - 1000\,кг/м^3 \cdot \frac{4}{3} \cdot 3{,}14\,(0{,}05\,м)^3\right)}{\left(0{,}3\,кг + 1000\,кг/м^3 \cdot \frac{4}{3} \cdot 3{,}14 \cdot (0{,}05\,м)^2 \cdot (10\,рад/с)^2 (0{,}05+0{,}15)\,м\right)} =$$

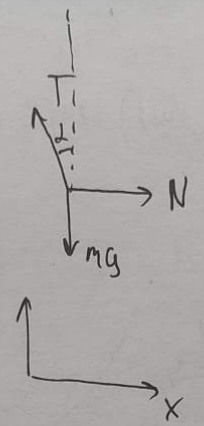
$$= 0{,}1047 \Rightarrow \underline{\alpha \approx 84^\circ} \approx \underline{1{,}47\,рад}$$

Ответ: 2Н; 84° = 1,47 рад.

(6)

Чертовик





$\left(\frac{4}{3}\pi r^3\right)''' = \left(\frac{4}{3}\pi\, 3r^2\right)'' = (4\pi r^2)' =$

$375 = 5 \cdot 75 = 5 \cdot 25 \cdot 3$

$\sqrt{1-0,1^2}$

$\sqrt{400-25} =$

$= \sqrt{375} =$

$\frac{5\sqrt{15}}{20} =$

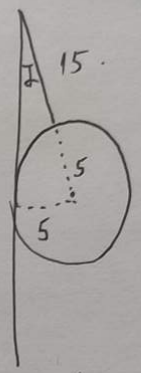
$\frac{\sqrt{15}}{4}$

$\sqrt{1-0,125} =$

$= \sqrt{0,875} =$

$\sin\alpha = 0,25$

$\cos\alpha = \frac{\sqrt{15}}{4}$



$5 - 10$

$20 - x$

$\frac{5}{20} = \frac{15}{x}$

$x = 4\Pi.$

$\sim \frac{1}{c^2} \cdot M.$

$X: N = T\sin\alpha$

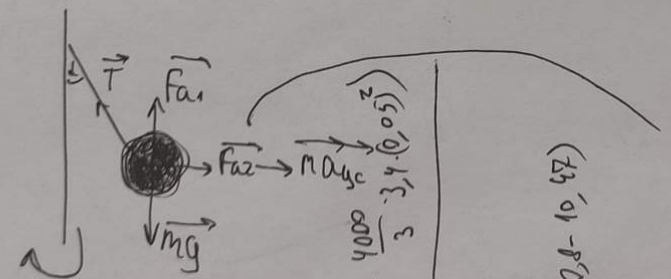
$y: T\cos\alpha = mg$

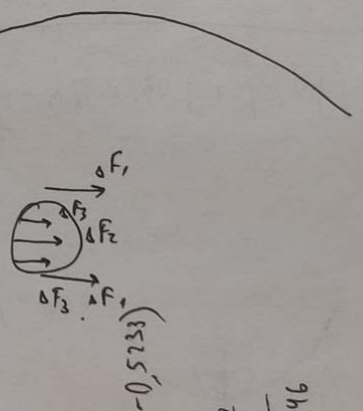
$\Rightarrow N = mg\frac{\sin\alpha}{\cos\alpha} = mg \cdot \frac{\frac{1}{4}}{\frac{1}{4}\cdot\sqrt{15}} = \frac{mg}{\sqrt{15}} = \frac{mg\sqrt{15}}{15}$

$a = \frac{v^2}{R} = \omega^2 R = \omega^2 R$

$y = ax^2 + bx + c$

$(y-y_0)^2 + (x-x_0)^2 = R^2$





$\rho_{пл} V_б = 10,47.$

$0,52.$

$\frac{3}{r}$

$10\left(0,1 - \frac{4000}{3} \cdot 3,4 \cdot (0,05)^2\right)$

$0,1($

$10 \cdot (0,1 - 10,47)$

$2,27$

$(0,1+5233) - 100\,(0,2)$

$10 - \rho g + 01$

$\frac{2,27}{2,46}$

Черновик.

$t = \frac{x}{V_0 \cos\alpha}$

$y = V_0 \sin\alpha \, t - \frac{gt^2}{2}$

$y = \frac{V_0 \sin\alpha \, x}{V_0 \cos\alpha} - g \frac{\frac{x^2}{V_0^2 \cos^2\alpha}}{2}$

$y = x \operatorname{tg}\alpha - \frac{10 x^2}{2 \cdot (4)^2 \cdot \frac{1}{4}}$

$y = \sqrt{3}\, x - \frac{10\, x^2}{2 (4)^2 \cdot \frac{1}{4}\, м}$

$y = 1{,}73x - 0{,}1 \frac{x^2}{м}$

$a_{цс} = \frac{V^2}{R} = \omega^2 R = \omega V$

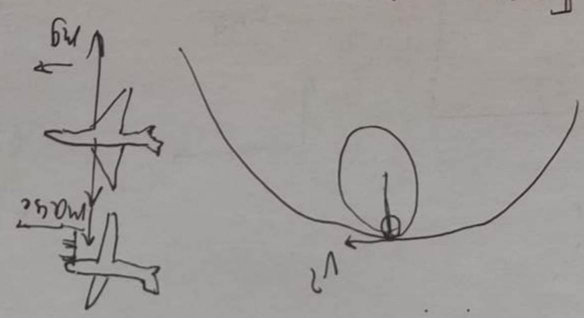
$\begin{cases} y = ax^2 + bx \\ (y - y_0)^2 + (x - x_0)^2 = R^2 \end{cases}$

⑧

$V \cdot \omega = м/с \cdot \frac{1}{с} = м/с^2$

$м/с^2$

$\frac{V^2}{R}$



$F + m a_{цс} = mg$

$F = m(g - a_{цс}) = 1кг \cdot \left(10 м/с^2 - \frac{12{,}25}{7{,}35}\right) = 8{,}33Н.$

$1{,}6666$

$5 - 5\sqrt{3} \cdot 0{,}81$

$\sqrt{4 \cdot 10}$

$\sqrt{40 \cdot (\sqrt{3} \cdot 0{,}81 - 1)}$

$V_м =$

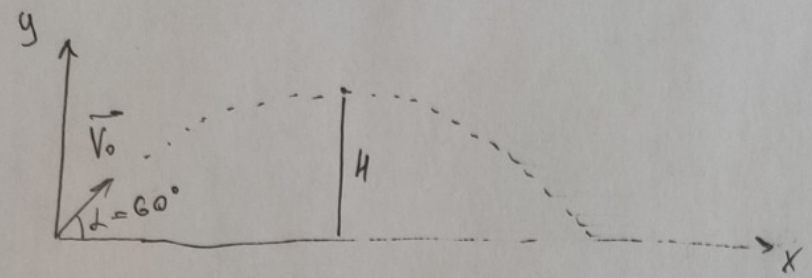
$mgH + \frac{A_{тр}}{m} = mgh + \frac{mV_1^2}{2}$

$gH - \mu_2 g \cos\alpha \cdot 2м = gh + \frac{V_1^2}{2}$

$V_1 = \sqrt{2 (gH - \mu_2 g \cos\alpha \cdot 2м - gh)} = \sqrt{2} \cdot \sqrt{g (H - h - \mu_2 \cdot 2м \cdot \cos\alpha)} = 4 м/с$

№1 Класс 10 Вариант 10-3

1) $V_0 = ?$



$S = 17$ м

1) $\begin{cases} \vec{a} = \text{const} \\ \vec{V} = \vec{V_0} + \vec{a}t \\ \vec{r} = \vec{r_0} + \vec{V_0}t + \frac{\vec{a}t^2}{2} \end{cases} \Rightarrow$ x: $\begin{cases} a_x = 0 \\ V_x = V_0\cos\alpha \\ x = V_0\cos\alpha t \end{cases}$ y: $\begin{cases} a_y = -g \\ V_y = V_0\sin\alpha - gt \\ y = V_0\sin\alpha t - \frac{gt^2}{2} \end{cases}$

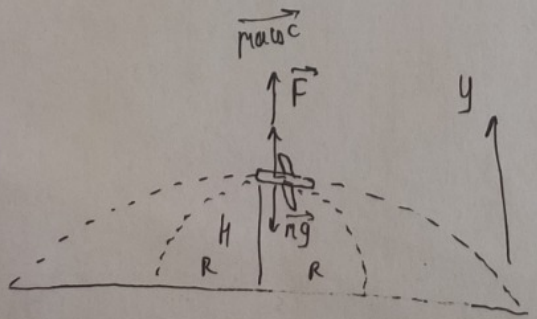
тело упало $\Rightarrow$ $y = 0 \Rightarrow$ $\begin{cases} \frac{gt^2}{2} - V_0\sin\alpha t = 0 \\ V_0\cos\alpha t = S \end{cases} \overset{t \neq 0}{\Rightarrow} \begin{cases} t = \frac{2V_0\sin\alpha}{g} \\ V_0\cos\alpha \cdot \frac{2V_0\sin\alpha}{g} = S \end{cases} \Rightarrow$

$V_0 = \sqrt{\frac{g \cdot S}{2\cos\alpha\sin\alpha}} = \sqrt{\frac{10\,\text{м/с}^2 \cdot 17\,\text{м}}{2 \cdot \frac{1}{2} \cdot \frac{\sqrt{3}}{2}}} = \sqrt{\frac{340\,\text{м}^2/\text{с}^2}{\sqrt{3}}} = \sqrt{\frac{340}{1{,}73}}\,\text{м/с} \approx 14{,}0\,\text{м/с} = 14\,\text{м/с}$

2) траектория наивысшая $\Rightarrow V_y = 0 \Rightarrow V_0\sin\alpha - gt_e = 0 \Rightarrow t_e = \frac{V_0\sin\alpha}{g}$

$H = y(t_e) = V_0\sin\alpha \cdot \frac{V_0\sin\alpha}{g} - \frac{g}{2} \cdot \frac{V_0^2\sin^2\alpha}{g^2} = \frac{V_0^2\sin^2\alpha}{2g} = \frac{(14\,\text{м/с})^2 \cdot \frac{3}{4}}{2 \cdot 10\,\text{м/с}^2} = 7{,}35\,\text{м}$

$\vec{mg} + \vec{mg} + \vec{ma_{ус}} = 0.$ (1)



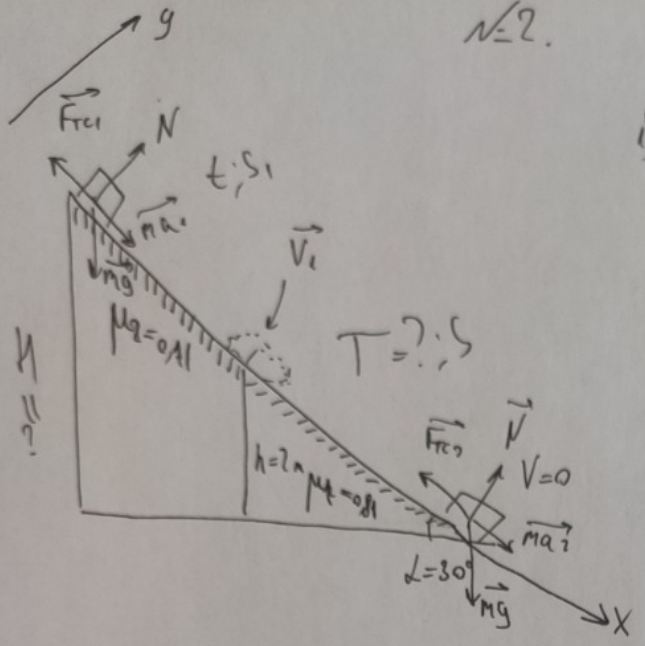
y: $mg = F + ma_{ус} \Rightarrow F = m(g - a_{ус}) =$

$= m\left(g - \frac{(V_0/4)^2}{R}\right) = m\left(m\left(g - \frac{(\frac{V_0}{4})^2}{H}\right)\right)$

$= 1\text{кг} \cdot \left(10\,\text{м/с}^2 - \frac{\left(\frac{14\,\text{м/с}}{4}\right)^2}{7{,}35\,\text{м}}\right) = 8{,}33\,\text{Н}$

Ответ: $V_0 = 14 м/с$; $F = 8,33 \Delta x$

№2.



1) $\vec{F}_{тс1} + \vec{N} + \vec{mg} = \vec{ma}_1$

X: $mg\cos(90-\alpha) - F_{тс1} = ma_{1x}$ ⇒

y: $N - mg\sin(90-\alpha) = 0$

$N = mg\cos\alpha$. $F_{тс1} = \mu_1 N = \mu_1 mg\cos\alpha$.

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

$a_{1x} = g(\sin\alpha - \mu_1\cos\alpha) = 10\,м/с^2 \cdot \left(\frac{1}{2} - 0{,}1\frac{\sqrt{3}}{2}\right)$

$= \frac{10 - 1{,}1\sqrt{3}}{2}\,м/с^2 = 4{,}05\,м/с^2$

$a_{1x} > 0$ ⇒ тело ускоряется на верхнем участке

2) $\vec{F}_{тс2} + \vec{N} + \vec{mg} = \vec{ma}_2$

X: $mg\sin\alpha - F_{тс2} = ma_{2x}$

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

$F_{тс2} = mg\cos\alpha\,\mu_1$

⇒ $mg\sin\alpha - mg\cos\alpha\,\mu_1 = ma_{2x}$

$a_{2x} = g(\sin\alpha - \cos\alpha\,\mu_1) = 10\,м/с^2 \cdot \left(\frac{1}{2} - \frac{\sqrt{3}}{2}\cdot 0{,}1\right) = -2{,}015\,м/с^2$ ⇒ тело тормозит.

3) $V_1 + a_{2x}t = 0$ ⇒ $T = \frac{-V_1}{a_{2x}}$

$A_{FTP} = (\vec{F}_T \cdot \vec{S}) = F_T \cdot S \cdot \cos 180° = -F_T S$

3) ЗСЭ: $\frac{mV_1^2}{2} + mgh = 0 + A_{FTP} + A_{FTP} = 0$.

$S = \frac{h}{\sin\alpha} = 2h$ ⇒ $A_{FT} = -2h \cdot mg\cos\alpha\,\mu_1$

$\frac{mV_1^2}{2} + mgh - 2hmg\cos\alpha\,\mu_1 = 0$

$\frac{V_1^2}{2} + gh - 2gh\cos\alpha\,\mu_1 = 0$ ⇒ $V_1 = \sqrt{2 \cdot (2gh\cos\alpha\,\mu_1 - gh)} = \sqrt{2 \cdot 10\,м/с^2 \cdot 2\,м \cdot (2\cos\alpha\,\mu_1 - 1)}$

$= \sqrt{4 \cdot 10\,м^2/с^2 \cdot \left(2\cdot\frac{\sqrt{3}}{2}\cdot 0{,}1 - 1\right)} = 4{,}015\,м/с$

(3)

4) из п. 2 и 3:

$S = 2h$

$V_1 = 4{,}015\ м/с$

$V_1 + a_{2x} T = 0 \Rightarrow T = \frac{V_1}{-a_{2x}} = \frac{4{,}015\ м/с}{2{,}015\ м/с^2} = 2с$

$\boxed{T = 2с}$

5) На верхнем участке:

~~$0 + V_1$~~

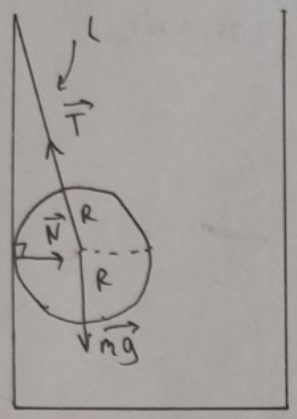
$0 + a_{1x} t = V_1 \Rightarrow t = \frac{V_1}{a_{1x}} = \frac{4{,}015\ м/с}{4{,}05\ м/с^2} = 1с$

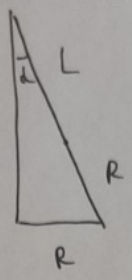
$S_1 = \underset{\downarrow 0}{V_0 t} + \frac{a_{1x} t^2}{2} = \frac{4{,}05\ м/с^2 \cdot 1с^2}{2} \approx 2м$

$H = (S_1 + S) \cdot \sin\alpha = \frac{1}{2} \cdot (2м + 4м) = 3м$

Ответ: $T = 2с$; $H = 3м$

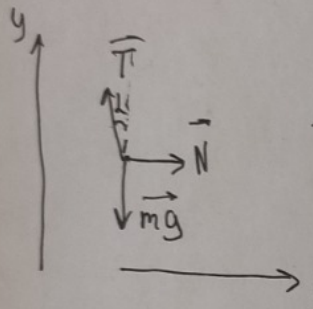
№3.





$$\sin\alpha = \frac{R}{L+R} = \frac{5}{15+5} = 0{,}25 = \frac{1}{4}$$

$$\cos\alpha = \frac{\sqrt{(L+R)^2 - R^2}}{L+R} = \frac{\sqrt{(20)^2 - 5^2}}{20} = \frac{\sqrt{15}}{4}$$



1) $\vec{mg} + \vec{T} + \vec{N} = 0$

$x: N = T\sin\alpha$

$y: \frac{mg}{\cos\alpha} = T\cos\alpha$

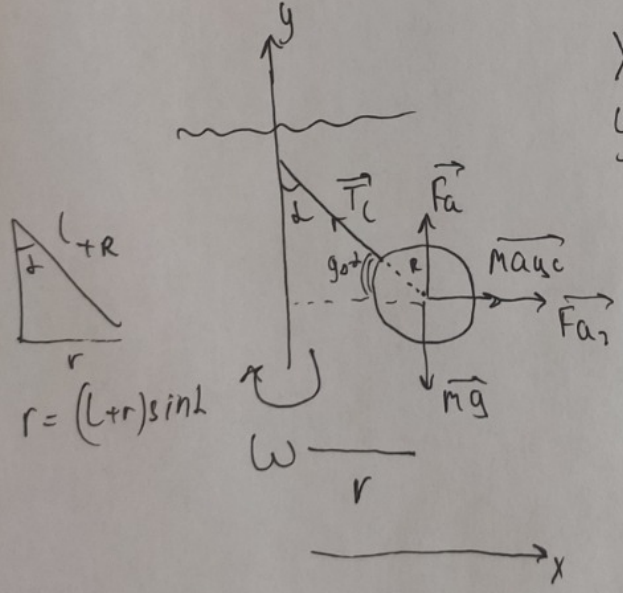
$$\Rightarrow N = mg\frac{\sin\alpha}{\cos\alpha} = mg \cdot \frac{1/4}{\sqrt{15}/4} = \frac{\sqrt{15}}{15} \cdot 0{,}2\,кг \cdot 10\,м/с^2 =$$

$= 2{,}066\,Н$

F_{a2} - сила архимеда, действующая в box

$$\vec{mg} + \vec{F_a} + \vec{ma_{усс}} + \vec{F_{a2}} + \vec{T} = 0.$$

$$\begin{cases} X: F_{a2} + ma_{усс} = T\sin\alpha \\ y: F_a + T\cos\alpha = mg \end{cases} \Rightarrow$$



$$\begin{cases} (\rho_в V_ш + m)a_{усс} = T\sin\alpha \\ \cancel{\rho_в V_ш \cdot g - m)} \\ T\cos\alpha = g(m - \rho_в V_ш) \end{cases} \Rightarrow$$

$$tg\alpha = \frac{(\rho_в V_ш + m)\cdot\omega^2 r}{g(m - \rho_в V_ш)} = \quad (5)$$

$$\Rightarrow \frac{\sin\alpha}{\cos\alpha} = tg\alpha = \frac{(\rho_в V_ш + m)\cdot\omega^2(L+R)\sin\alpha}{g(m - \rho_в V_ш)} \Rightarrow \cos\alpha = \frac{g(m - \rho_в \cdot \frac{4}{3}\pi R^3)}{(m + \rho_б \cdot \frac{4}{3}\pi r^3)\cdot\omega^2(L+R)}$$

$$\cos\alpha = \frac{10\,м/с^2\left(0{,}8\,кг - 1000\,кг/м^3 \cdot \frac{4}{3} \cdot 3{,}14\,(0{,}05\,м)^3\right)}{\left(0{,}3\,кг + 1000\,кг/м^3 \cdot \frac{4}{3} \cdot 3{,}14 \cdot (0{,}05\,м)^2 \cdot \left(10\,рад/с\right)^2 (0{,}05 + 0{,}15)\,м\right)} =$$

$$= 0{,}1047 \Rightarrow \underline{\alpha \approx 84^\circ \approx 1{,}47\,рад}$$

Ответ: 2Н; $84^\circ = 1{,}47$ рад.

(6)

Черновик

$\frac{3}{4}\pi r^3$ $\left(\frac{4}{3}\pi r^3\right)''' = \left(\frac{4}{3}\pi \cdot 3(r^2)\right)'' = (4\pi r^2)' =$

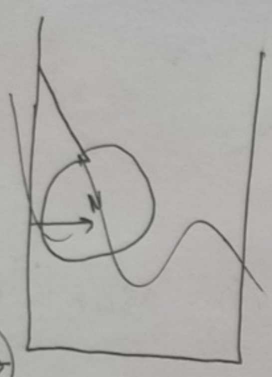
$375 = 5 \cdot 75 = 5 \cdot 25 \cdot 3$

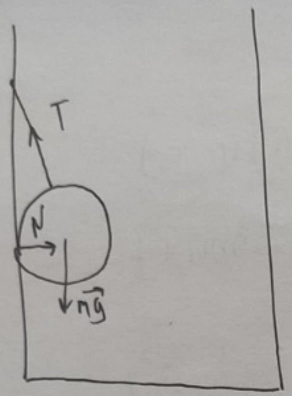
$\sqrt{1-0,1^2}$

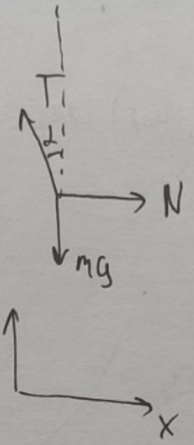
$\sin\alpha = 0,25$.

$\cos\alpha = \frac{\sqrt{15}}{4}$

(7)







$\sqrt{400-25} =$

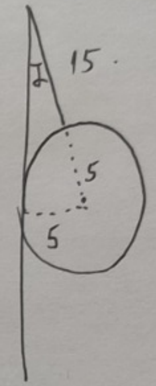
$= \sqrt{375} =$

$=$

$\frac{5\sqrt{15}}{20} = \frac{\sqrt{15}}{4}$

$\sqrt{1-0,125} =$

$= \sqrt{0,875} =$



5 – 10

20 – x

$\frac{5}{20} = \frac{10}{x}$

x = 40.

$\frac{1}{c^2} \cdot M$.

$x: N = T\sin\alpha$

$y: T\cos\alpha = mg$ $\frac{}{\cos\alpha}$

$\Rightarrow N = mg\frac{\sin\alpha}{\cos\alpha} = mg \cdot \frac{\frac{1}{4}}{\frac{1}{4}\cdot\sqrt{15}} = mg\frac{\sqrt{15}}{15} =$

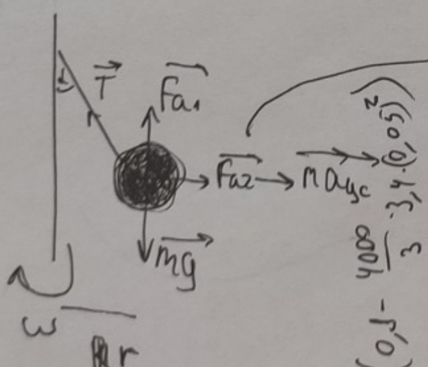
$a = \frac{v^2}{R} = \omega^2 R$

$y = ax^2 + bx + c$

$(y-y_0)^2 + (x-x_0)^2 = R^2$

$\rho_ж V_б = 10,47$.

0,52.

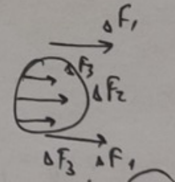


$10\left(0,8 - \frac{4000}{3}\cdot 3,14\cdot(0,05)^3\right)$

$0,8($

$10\cdot(0,8 - 10,47)$

$277 = (0,8 + 0,5233) - 100\cdot(0,2)$



$10 + (0,8 - 0,5233)$

$\frac{277}{26,46}$

21204518 (U383545 M1283564)

Черновик.

$t = \frac{x}{v_0 \cos\alpha}$

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

$y = \frac{v_0 \sin\alpha \cdot x}{v_0 \cos\alpha} - g\frac{x^2}{2 v_0^2 \cos^2\alpha}$

$y = x \operatorname{tg}\alpha - \frac{g x^2}{2 \cdot 2 v_0^2 \cos^2\alpha}$

$y = \sqrt{3}x - \frac{10 x^2}{2(14)^2 \cdot \frac{1}{4}}$

$y = 1{,}73x - 0{,}1\frac{x^2}{м}$

$a_{ц.с} = \frac{V^2}{R} = \omega^2 R = \omega V$

$\begin{cases} y = ax^2 + bx \\ (y - y_0)^2 + (x - x_0)^2 = R^2 \end{cases}$

$V \cdot \omega = \pi/с \cdot \frac{1}{2} = \pi/2с$

$\frac{1}{2}$

$\frac{V^2}{R}$

$V_1 = \sqrt{g(H - h - R) \cdot 2}$

$V_1 = \sqrt{(gH - mgh - 2mg\cos\alpha \cdot mR) \cdot 2}$

$\frac{mV_1^2}{2} = mgh + \frac{mV_2^2}{2}$

$mgH + A_{тр.с} = mgh + \frac{mV_2^2}{2}$

$h = h$

$F + ma_{ц.с} = mg$.

$F = m(g - a_{ц.с}) = 1кг \cdot \left(10м/с^2 - \frac{12{,}25}{7{,}35}\right) = 8{,}33Н.$

$\sqrt{2g \cdot (1 - 1{,}2 \cdot 0{,}33) \cdot 0{,}1}$

$5 - 5{,}33 \cdot 0{,}8$

Часть 2

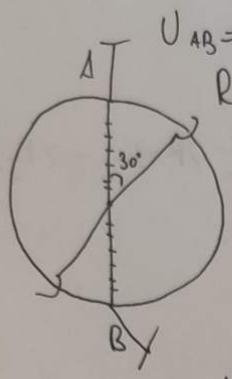
Олимпиада: **Физика, 10 класс (2 часть)**

Шифр: **21204518**

ID профиля: **383545**

Вариант 3

№5.

1) 

$U_{AB} = 6B$

$R_{пер} = 0$

$R_к = 240 м$

пусть $AB = d$

(линейное, т.к. площади сечения кольца одинаковая)

1) пусть удельное сопротивление материала кольца – ρ

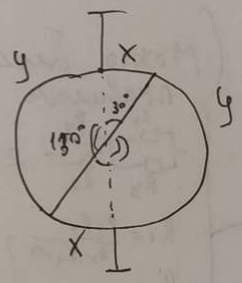
$\rho = \frac{R_к}{\pi d}$ ← сопр. к.

↑ длина к.

$\rho = \frac{\Delta R}{\Delta L}$

тогда при угле 30°:

$L_X = \frac{30°}{360°} \cdot \pi d = \frac{\pi d}{12}$.



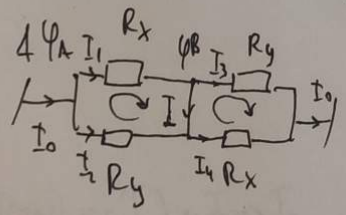
$R_x = \rho \cdot L_x = \frac{\pi d}{12} \cdot \frac{R_к}{\pi d} = \frac{240 м}{12} = 20 м$.

$L_y = \frac{150°}{360°} \cdot \pi d = \frac{5\pi d}{12}$

$R_y = L_y \cdot \rho = \frac{5\pi d}{12} \cdot \frac{R_к}{\pi d} = \frac{5 \cdot 240 м}{12} = 100 м$.

или $R_y = \frac{R_к}{2} - R_x = 120 м - 20 м = 100 м$.

≡



2) Воспользуемся 2 П. Кирхгофа:

$$\begin{cases} \cancel{\varphi_A} + I_1 R_x - I_2 R_y = \cancel{\varphi_A} \\ \cancel{\varphi_B} + I_3 R_y - I_4 R_x = \cancel{\varphi_B} \end{cases} \Rightarrow \begin{cases} I_1 R_x = I_2 R_y \\ I_3 R_y = I_4 R_x \end{cases}$$

$$\Rightarrow \begin{cases} \cancel{2} I_1 = I_2 \cdot \cancel{5} \\ \cancel{10} I_3 = \cancel{8} I_4 \end{cases}$$

5

По 1. П. Кирхгофа.

$$\begin{cases} I_0 = I_1 + I_2 \\ I_0 = I_3 + I_4 \\ I_2 + I = I_4 \\ I_1 = I + I_3 \end{cases} \Rightarrow$$

$I_1 = 5 I_2 \Rightarrow I_0 = 6 I_2 = \frac{6}{5} I_1$

$I_4 = 5 I_3 \Rightarrow I_0 = 6 I_3 = \frac{6}{5} I_4$

$I = I_1 - I_3 = \frac{5}{6} I_0 - \frac{1}{6} I_0 \Rightarrow I =$

(1)

$I_0 = 6I_2 = \frac{6}{5} I_1$
$I_0 = 6I_3 = \frac{6}{5} I_4$
$\Rightarrow$ $I_1 = I_4 = \frac{5}{6} I_0$
$I_2 = I_3 = \frac{I_0}{6}$ $\Rightarrow$

$P_0 = \sum_i P_i = I_1^2 R_x + I_4^2 R_x + I_2^2 R_y + I_3^2 R_y = 2R_x I_1^2 + 2R_y I_2^2$

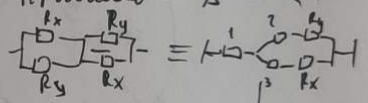
$= R_0 I_0^2$

$R_0 I_0^2 = 2 \cdot 20\,\text{Ом} \cdot \frac{25}{36} I_0^2 + 2 \cdot 10\,\text{Ом} \cdot \frac{1}{36} I_0^2$

$R_0 = \frac{120}{36}\,\text{Ом} = \frac{10}{3}\,\text{Ом}.$

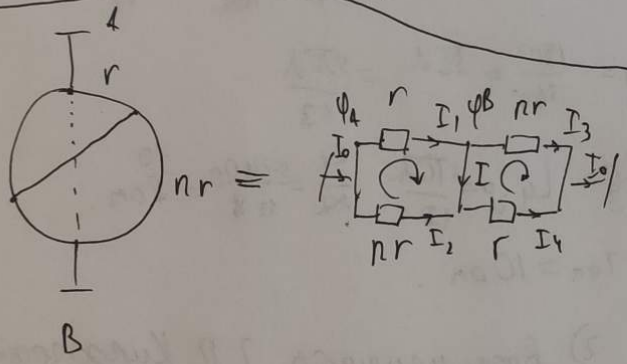
$P_0 = U^2 \cdot R = (6\,\text{В})^2 \cdot \frac{10}{3}\,\text{Ом} = \frac{36 \cdot 10}{3_1}\,\text{Вт} = 120\,\text{Вт}$

(Можно было всп. правилом $\Delta \to Y$:



$R_1 = \frac{R_x R_y}{R_x + R_y + 0}$
$R_2 = 0$
$R_3 = 0.$
$\Rightarrow R_0 = \frac{10}{3}\,\text{Ом}$

2)



по 2.В. Курск.

$\begin{cases} \varphi_A + rI_1 - nrI_2 = \varphi_A \\ \varphi_B + I_3 rn - I_4 r = \varphi_B \end{cases} \Rightarrow \begin{cases} I_1 = nI_2 \\ nI_3 = I_4 \end{cases} \Rightarrow$

по 1п. Кирх $\begin{cases} I_1 + I_2 = I_0 \\ I_3 + I_4 = I_0 \\ I_1 = I_3 + I_4 \\ I_2 + I = I_4 \end{cases}$

$I_1 = I_4 \begin{cases} I_0 = (1+n) I_2 = (1+n) I_3 \\ I_0 = I_1 \left(1 + \frac{1}{n}\right) = I_4 \left(1 + \frac{1}{n}\right) \end{cases}$

$\Downarrow$

$I = I_4 - I_2 = \frac{I_0}{1 + \frac{1}{n}} - \frac{I_0}{(1+n)} =$

$= I_0 \left(\frac{n-1}{n+1}\right) = \frac{2}{3}\,\text{А}$

(2)

аналогично

$$P_0 = \sum_i P_i$$

$$I_0^2 R_0 = 2 \cdot r I_1^2 + 2 \cdot r \cdot n \cdot I_3^2$$

$$I_0^2 R_0 = 2 \cdot r \cdot \frac{I_0^2}{\left(1+\frac{1}{n}\right)^2} + 2rn \cdot \frac{I_0^2}{(1+n)^2}$$

$$\begin{cases} R_0 = \dfrac{2r \cdot n^2}{(n+1)^2} + \dfrac{2rn}{(n+1)^2} \Rightarrow R_0 = \dfrac{2rn}{(n+1)^2} \cdot (n+1) = \dfrac{2rn}{n+1} \quad I_0 = \dfrac{U}{R_0} = \dfrac{6B(n+1)}{2rn} \\ r + r \cdot n = 24 + \dfrac{R_k}{2} \Rightarrow r(1+n) = 120\,Om \end{cases}$$

$$\begin{cases} I_0 = \dfrac{6B\,(n+1)}{2rn} \\ I_0 = \dfrac{?}{3} A (n+1) \end{cases} \Rightarrow \begin{cases} \dfrac{6B \cdot (n+1)}{2rn} = \dfrac{?}{3} A (n+1) \\ r + rn = 120\,Om \\ r = \dfrac{120\,Om}{1+n} \end{cases} \Rightarrow \frac{6B}{2 \cdot n \cdot \frac{120\,Om}{1+n}} = \frac{\frac{?}{3} A}{n-1}$$

$$\frac{1B \cdot (1+n)}{4n\,Om} = \frac{2A}{3(n-1)} \Rightarrow 3B(n^2-1) = 8n \cdot A \Rightarrow 3n^2 B - 8n \cdot A - 3B = 0.$$

$$D = 64A^2 + 36B^2 = 100 \Rightarrow \quad n = \frac{8 \pm 10}{6} \Rightarrow \begin{cases} n = 3 \\ n = -\frac{1}{3} \end{cases} \Rightarrow \boxed{n = 3}$$

---

3) $\begin{cases} R_0 = \dfrac{2rn}{n+1} \\ r(1+n) = 120\,Om \\ n = 3 \end{cases} \Rightarrow$ $R_0 = \dfrac{6r}{4} = \dfrac{3}{2} r = \dfrac{3 \cdot 30}{2} Om = 45 Om.$

$r = \dfrac{120\,Om}{1+3} = 30\,Om$

$P_0 = U^2 \cdot R_0 = 36B^2 \cdot 45\,Om = \boxed{1620\,Вт}$

Ответ: 120 Вт; 3; 1620 Вт.

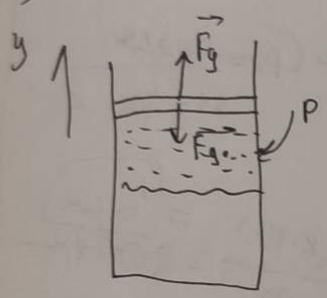
№4 при н.у.

$m = 5{,}5\,г$ $t_0 = 20°C$ $t_к = 100°C$ $S = 5000\,см^2$ $P_0 = 1{,}0 \cdot 10^5\,Па$

1) $Q_1 = Cm\Delta t = Cm(t_к - t_0) = 4180 \frac{Дж}{кг \cdot К} \cdot 5{,}5 \cdot 10^{-3}\,кг \cdot 100°К =$

$= 2299 Дж$

2)



$\vec{F_g} + \vec{F_{g_0}} = 0 \Rightarrow$ y: $F_{g_0} = F_g \Rightarrow p_0 S = S \cdot p \Rightarrow$ процесс изобарный.

$PV_1 = \nu RT_1$

$PV_2 = \nu RT_2$

$Q_2 = \lambda m_п \Rightarrow m_п = \frac{Q_2}{\lambda} = \frac{17430 Дж}{2{,}26 \cdot 10^6 Дж/кг} = 7{,}71 \cdot 10^{-3}\,кг$ — масса испарившейся воды. $\Rightarrow$ вся вода испарилась, пришли на испарение пошло.

$Q_3 = \lambda \cdot m = 2{,}26 \cdot 10^6 \frac{Дж}{кг} \cdot 5{,}5 \cdot 10^{-3}\,кг = 12430 Дж$

остальное тепло пошло в изм. вн. э. и работу газа.

$Q = Q_2 - Q_3 = 17430 Дж - 12430 Дж = 5000 Дж.$

~~ДО. П. Н. термодинамики.~~

изобарный

$Q = A + \Delta U = p_0 \Delta V + \frac{i}{2} \nu R \Delta T = 5000 Дж$

$\nu = \frac{m}{M_r} = \frac{5{,}5\,г}{18\,г/моль} = 0{,}306\,моль$

(4)

$\Delta Q = A + \Delta U$

$A = p_0 \Delta V = p_0 S \Delta H \Rightarrow H = \frac{A}{p_0 \cdot S}$

$A = \Delta Q - \Delta U$

$\Delta U = \frac{i}{2} \nu R \Delta T$ по условию $C_p = 2200 \frac{Дж}{кг \cdot К^\circ} \Rightarrow \left(1 + \frac{i}{2}\right) \nu R = C_p \nu$

~~$C_p = 2200 Дж$~~

$1 кг (H_2O) = \nu(H_2O) \cdot M \Rightarrow \nu = \frac{1 кг}{M} = \frac{1000 г}{18 г/моль} = 55\frac{5}{9}$ моль $\Rightarrow C_p \nu = \frac{2200 Дж}{55\frac{5}{9} моль \cdot К}$

$= 39,6 \frac{Дж}{моль \cdot К^\circ} \Rightarrow \frac{Дж}{моль К} 39,6 = \left(1 + \frac{i}{2}\right) \cdot 8,31 \frac{Дж}{моль К^\circ}$

$8,31 + \frac{8,31 i}{2} = 39,6 \Rightarrow i \approx 6 \Rightarrow$

$H = \frac{5000 Дж - 4 \cdot 0,305 моль \cdot 8,31 \frac{Дж}{моль К} \cdot 413,2^\circ}{1 \cdot 10^5 Па \cdot (500 см^2)} = 16 см$

~~$= 0,00 \ldots м =$~~ $= 0,$ ~~$\ldots$~~ $см.$

$\Delta t = \frac{\Delta Q}{C_p m} = \frac{5000 Дж}{2200 \frac{Дж}{кг \cdot К^\circ} \cdot 5,5 \cdot 10^{-3} кг} = 413,2^\circ К$; по Закону Менделеева-Клапейрона

$\begin{cases} p_0 V_1 = \nu R T_1 \\ p_0 V_2 = \nu R (T_1 + \Delta T) \end{cases} \Rightarrow \frac{V_1}{V_2} = \frac{T_1}{T_1 + \Delta T} = \frac{h_0}{h_0 + H} = \frac{T_1}{T_1 + \Delta T} \Rightarrow \frac{h_0 + H}{h_0} = \frac{T_1 + \Delta T}{T_1}$

h_0 – нач. высота поршня (когда вся вода испарилась). T_1 – начальная температура пара.

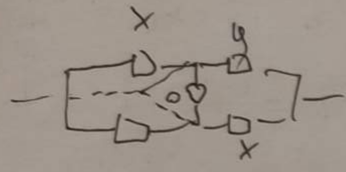
$1 + \frac{H}{h_0} = 1 + \frac{\Delta T}{T_1} \Rightarrow H = \frac{h_0 \Delta T}{T_1} = \frac{h_0 \cdot 413^\circ К}{373^\circ К} = 20,9 см$

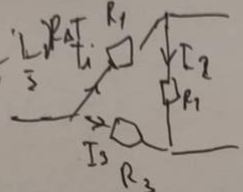
$h_0 = \frac{\nu R T_1}{p_0 S} = \frac{\frac{m}{M} \cdot R \cdot T_1}{p_0 S} = \frac{\frac{5,5 г}{18 г/моль} \cdot 8,31 \frac{Дж}{моль К^\circ} \cdot 100^\circ 373^\circ К}{1 \cdot 10^5 Па \cdot 500 \left(\frac{1}{100 м} \cdot \frac{1}{100 м}\right)} = 10,9 см.$

Ответ: ~~20,~~ 2299 Дж; 20,9 см ~~$= 0,0085$~~ $0,05 м^2$

$\frac{15}{36} = \frac{5}{12}$.

$\Delta V = \frac{L}{3}$





$\frac{150}{30} = 5 \quad n = 5$.

$\frac{h_0 \cdot 413{,}2}{100}$

$R_0 = \frac{2nr}{n+1}$

$nr + r = 12$

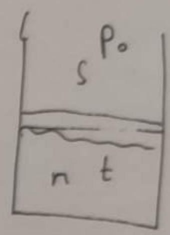
$6r = 12$

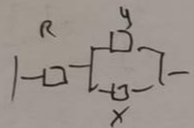
$r = 2$.

$\frac{2 \cdot 5 \cdot 2}{5+1} = \frac{20}{6} = \frac{10}{3}$

0,0055

CMΔt.





$R = \frac{R_x R_y}{R_x + R_y + 0}$ $\quad \frac{R_x 0}{0}$

$R_0 = \frac{R_x R_y}{R_x + R_y} + 1 : \left(\frac{1}{R_y} + \frac{1}{R_x}\right) = \frac{R_x R_y}{R_x + R_y} + \frac{R_x R_y}{R_x + R_y} = \frac{2 R_x R_y}{R_x + R_y} = \frac{2 \cdot 2 \cdot 10}{2 + 10}$ Ом $= \frac{20}{6} = \frac{10}{3}$ Ом.

$\frac{I^2}{R} = U^2 \cdot R$

$P = \frac{I^2}{}$ $\quad U \; P =$

$\Delta_{1,2,3}$

$I_2 =$

$P = U^2 \cdot R = 36\,В^2 \cdot \frac{10}{3}$ Ом. $= 120$ Вт

$I_1 = 5 I_2 \Rightarrow I_0 = 6 I_2 = \frac{6}{5} I_1$

$I_4 = 5 I_3 \Rightarrow I_0 = 6 I_3 = \frac{6}{5} I_4$.

$I = I_1 - I_3 = \frac{5}{6} I_0 - \frac{1}{6} I_0 = \frac{2}{3} I_0 \Rightarrow I_0 = 1{,}5 I$.

$I_1 = \frac{5}{6} I_0 = \frac{1}{2} I_0 \cdot \frac{5}{3} = \frac{5}{3} I$.

$I_2 = \frac{1}{3} I$

$I_1 = \frac{5}{3} I \quad I_3 = \frac{1}{3} I$

$I_2 = \frac{1}{3} I \quad I_4 = \frac{5}{3} I$

$I_1^2 R_x + I_4^2 R_x + I_3^2 R_y + I_2^2 R_y = 4 I^2 R_0$.

$2 \cdot 2 \left(\frac{25}{9} + \frac{25}{9}\right) + 10 \left(\frac{1}{9} + \frac{1}{9}\right) = 4 R_0$.

$\frac{100}{9} + \frac{20}{9} = 4 R_0 \Rightarrow R_0 = \frac{120}{4 \cdot 9} = \frac{10}{3}$ Ом.

⑥

$P_0 V_1 = \nu R T_1$ Черновик

$R_0 V_1 = \nu R T_1 + \frac{Q}{S}$

$m = 5{,}5$ г.

$cm\Delta t = Q$

500 см² $= 500 \cdot \frac{1}{100} \cdot \frac{1}{100} =$

$\frac{5}{100}$ м²

$pV = \nu R T_1$.

$p h_0 S = \nu R T_1$

$h_0 = \frac{\nu R T_1}{p_0 S}$.

$P = \frac{U^2}{R} = \frac{36}{10} \cdot 3$

$\frac{36 \cdot 10}{3} = 120$.

$I_0 = 5I_2 =$ $\Delta V = 5000 - \frac{i}{2}\Delta R$

$I_0 = 6I_2 = \frac{6}{5}I_1$ $\Rightarrow I_2 = I_3 = \frac{I_0}{6}$

$I_0 = 6I_3 = \frac{6}{5}I_4$ $I_1 = I_4 = \frac{5I_0}{6}$

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~~$I = I_1 + I_2 = \frac{5I_0}{6} - \frac{I_0}{6} = \frac{2}{3}I_0 \Rightarrow$~~ VI

$R_1 = \frac{nr^2}{r(n+1)}$

$R_0 = \frac{nr}{n+1} + 1 : \left(\frac{1}{r} + \frac{1}{rn}\right) = \frac{nr}{n+1} + 1 : \left(\frac{rn+r}{rrn}\right) =$

$= \frac{2nr}{n+1}$

$\frac{C_p}{C_v} = \frac{1+\frac{2}{i}}{\frac{i}{2}}$.

$P_0 = \sum_i P_i = I_1^2 \cdot R_x + I_4^2 \cdot R_x + I_3^2 \cdot R_y + I_2^2 \cdot R_y = R_x \cdot 2 \cdot (I_1^2) + R_y \cdot 2 I_2^2 = 2 \cdot 2 \cdot \frac{I_0^2}{36} + 2 \cdot 10 \cdot \frac{25 I_0^2}{36} = R_0 I_0^2$

$Q = cm\Delta t \quad \Delta t = \frac{Q}{cm}$.

$R_0 = 8\ \frac{4+500}{36} = \frac{504}{36} = \frac{252}{18} = \frac{126}{9}$

2 2.

$2 \cdot I_1^2 \cdot R_x + 2 \cdot I_3^2 R_y = I_0^2 R_0$.

(VI)

$2 \cdot \frac{25 I_0^2}{36} \cdot 2 +$ $I_2 = \frac{I_1}{n}$

$p_0 \Delta V$

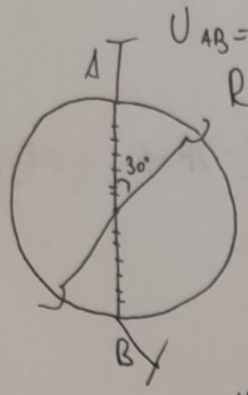
$I_0 = I_2 + nI_2 = I_3 + nI_3 = (1+n)I_2 = (1+n)I_3$.

$I_0 = I_1 + \frac{I_1}{n} = I_4 + \frac{I_4}{n} \Rightarrow I_1\left(1 + \frac{1}{n}\right)$

$\frac{I_0}{1+\frac{1}{n}}$

Чертёж.

№5.

1) 

$U_{AB} = 6B$

$R_{пер} = 0$

$R_к = 240 Ом$

пусть $AB = d$

(линейное, т.к. площадь сечения кольца одинаковая)

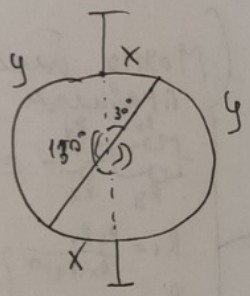
1) Пусть удельное сопротивление материала кольца — ρ.

$\rho = \frac{R_к}{\pi d}$ ← сопр. к.

$\rho = \frac{\Delta R}{\Delta l}$ ← длина к.

тогда при угле 30°:

$l_X = \frac{30°}{360°} \cdot \pi d = \frac{\pi d}{12}$.

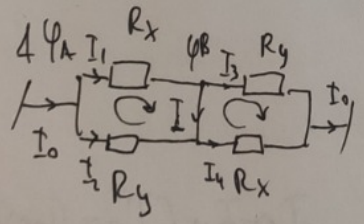


$R_x = \rho \cdot l_x = \frac{\pi d}{12} \cdot \frac{R_к}{\pi d} = \frac{240 Ом}{12} = 20 Ом$.

$l_y = \frac{150°}{360°} \cdot \pi d = \frac{5\pi d}{12}$

$R_y = l_y \cdot \rho = \frac{5\pi d}{12} \cdot \frac{R_к}{\pi d} = \frac{5 \cdot 240 Ом}{12 \cdot 8} = \frac{10}{8} Ом$.

или $R_y = \frac{R_к}{2} - R_x = 120 Ом - 20 Ом = 100 Ом$.

$\equiv$ 

2) Воспользуемся 2 З. Кирхгофа:

$$\begin{cases} \varphi_A + I_1 R_x - I_2 R_y = \varphi_A \\ \varphi_B + I_3 R_y - I_4 R_x = \varphi_B \end{cases} \Rightarrow \begin{cases} I_1 R_x = I_2 R_y \\ I_3 R_y = I_4 R_x \end{cases}$$

$\Rightarrow \begin{cases} 2 I_1 = I_2 \cdot 5 \\ 10 I_3 = 8 I_4 \end{cases}$

По 1 З. Кирхгофа.

$$\begin{cases} I_0 = I_1 + I_2 \\ I_0 = I_3 + I_4 \\ I_2 + I = I_4 \\ I_1 = I + I_3 \end{cases} \Rightarrow$$

$I_1 = 5 I_2 \Rightarrow I_0 = 6 I_2 = \frac{6}{5} I_1$

$I_4 = 5 I_3 \Rightarrow I_0 = 6 I_3 = \frac{6}{5} I_4$

$I = I_1 - I_3 = \frac{5}{6} I_0 - \frac{1}{6} I_0 \Rightarrow I =$

(1)

$$I_0 = 6I_2 = \frac{6}{5} I_1 \quad \Rightarrow \quad I_1 = I_4 = \frac{5}{6} I_0$$
$$I_0 = 6I_3 = \frac{6}{5} I_4 \quad \Rightarrow \quad I_2 = I_3 = \frac{I_0}{6} \Rightarrow$$

$$P_0 = \sum_i P_i = I_1^2 R_x + I_4^2 R_x + I_2^2 R_y + I_3^2 R_y = 2R_x(2R_x I_1^2 + 2R_y I_2^2$$

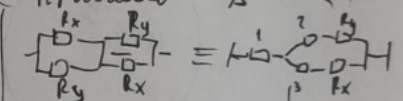
$$= R_0 I_0^2$$

$$R_0 I_0^2 = 2 \cdot 20\,\text{Ом} \cdot \frac{25}{36} I_0^2 + 2 \cdot 10\,\text{Ом} \cdot \frac{1}{36} I_0^2$$

$$R_0 = \frac{120}{36}\,\text{Ом} = \frac{10}{3}\,\text{Ом}.$$

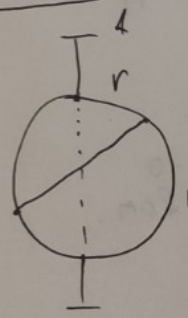
$$P_0 = U^2 \cdot R = (6\,\text{В})^2 \cdot \frac{10}{3}\,\text{Ом} = \frac{36 \cdot 10}{3_1}\,\text{Вт} = \boxed{120\,\text{Вт}}$$

(Можно было бы сразу правилом $\Delta \to Y$:

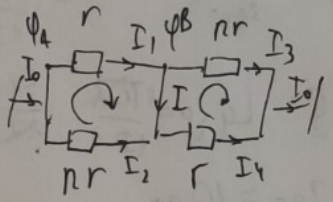


$R_1 = \frac{R_x R_y}{R_x + R_y + 0}$
$R_2 = 0$
$R_3 = 0.$
$\Rightarrow R_0 = \frac{10}{3}\,\text{Ом}$

2)



$\equiv$



по 2 з. Кирх.

$$\begin{cases} \varphi_A + rI_1 - nrI_2 = \varphi_A \\ \varphi_B + I_3 rn - I_4 r = \varphi_B \end{cases} \Rightarrow \begin{cases} I_1 = nI_2 \\ nI_3 = I_4 \end{cases} \Rightarrow$$

по 1 п. Кирх $\begin{cases} I_1 + I_2 = I_0 \\ I_3 + I_4 = I_0 \\ I_1 = I_3 + I \\ I_2 + I = I_4 \end{cases}$

$$\Rightarrow \begin{cases} I_0 = (1+n) I_2 = (1+n) I_3 \\ I_0 = I_1 \left(1 + \frac{1}{n}\right) = I_4 \left(1 + \frac{1}{n}\right) \end{cases}$$

$$\Downarrow$$

$$I = I_4 - I_2 = \frac{I_0}{1 + \frac{1}{n}} - \frac{I_0}{(1+n)} =$$

$$= I_0 \left(\frac{n-1}{n+1}\right) = \frac{2}{3}\,\text{А}$$

(2)

аналогично

$$P_0 = \sum_i P_i$$

$$I_0^2 R_0 = 2 \cdot r I_1^2 + 2 \cdot r \cdot n \cdot I_3^2$$

$$I_0^2 R_0 = 2 \cdot r \cdot \frac{I_0^2}{\left(1+\frac{1}{n}\right)^2} + 2rn \cdot \frac{I_0^2}{(1+n)^2}$$

$$\begin{cases} R_0 = \frac{2r \cdot n^2}{(n+1)^2} + \frac{2rn}{(n+1)^2} \Rightarrow R_0 = \frac{2rn}{(n+1)^2} \cdot (n+1) = \frac{2rn}{n+1} \quad I_0 = \frac{U}{R_0} = \frac{6B(n+1)}{2rn} \\ r + r \cdot n = 24 \frac{R_k}{2} \Rightarrow r(1+n) = 120 \text{ Ом} \end{cases}$$

$$\begin{cases} I_0 = \frac{6B(n+1)}{2rn} \\ I_0 = \frac{\frac{2}{3}A(n+1)}{(n-1)} \end{cases} \Rightarrow \begin{cases} \frac{6B \cdot (n+1)}{2rn} = \frac{\frac{2}{3}A(n+1)}{n-1} \\ r + rn = 120 \text{ Ом} \\ r = \frac{120 \text{ Ом}}{1+n} \end{cases} \Rightarrow \frac{6B}{2 \cdot n \cdot \frac{120 \text{ Ом}}{1+n}} = \frac{\frac{2}{3}A}{n-1}$$

$$\frac{1B \cdot (1+n)}{4n \text{ Ом}} = \frac{2A}{3(n-1)} \Rightarrow 3B(n^2-1) = 8n \cdot A \Rightarrow 3n^2 \cdot B - 8n \cdot A - 3B = 0.$$

$$D = 64A^2 + 36BA = 100 \Rightarrow \quad n = \frac{8 \pm 10}{6} \Rightarrow \begin{cases} n = 3 \\ n = -\frac{1}{3} \end{cases} \Rightarrow \boxed{n = 3}$$

---

3) $\begin{cases} R_0 = \frac{2rn}{n+1} \\ r(1+n) = 120 \text{ Ом} \\ n = 3 \end{cases} \Rightarrow$ $R_0 = \frac{6r}{4} = \frac{3}{2}r = \frac{3 \cdot 30}{2} \text{ Ом} = 45 \text{ Ом}.$

$r = \frac{120 \text{ Ом}}{1+3} = 30 \text{ Ом}$

$P_0 = U^2 \cdot R_0 = 36 \text{ В}^2 \cdot 45 \text{ Ом} = \boxed{1620 \text{ Вт}}$

Ответ: 120 Вт; 3; 1620 Вт.

(3)

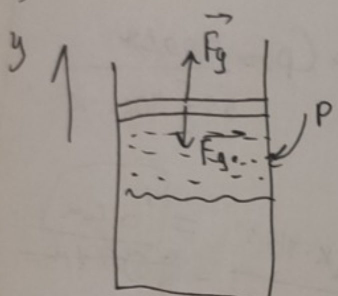
№ 4 при н.у.

$m = 5{,}5\,г \quad t_0 = 100°C \quad t_к = 100°C \quad S = 500\,см^2 \quad p_0 = 1{,}0 \cdot 10^5\,Па$

1) $Q_1 = cm\Delta t = cm(t_к - t_0) = 4180\,\frac{Дж}{кг \cdot K} \cdot 5{,}5 \cdot 10^{-3}\,кг \cdot 100°K =$

$= 2299\,Дж$

2)



$\vec{F_g} + \vec{F_{g0}} = 0 \Rightarrow \quad y: F_{g0} = F_g \Rightarrow p_0 S = S \cdot p \Rightarrow$ процесс изобарный.

$pV_1 = \nu RT_1$

$pV_2 = \nu RT_2$

$Q_2 = \lambda m_п \Rightarrow m_п = \frac{Q_2}{\lambda} = \frac{17430\,Дж}{2{,}26 \cdot 10^6\,Дж/кг} = 7{,}71 \cdot 10^{-3}\,кг > 5{,}5\,г$ –

масса испарившейся воды $\Rightarrow$ вся вода испарилась, причём на испарение пошло.

$Q_3 = \lambda \cdot m = 2{,}26 \cdot 10^6\,\frac{Дж}{кг} \cdot 5{,}5 \cdot 10^{-3}\,кг = 12430\,Дж$

остальное тепло пошло в изм. вн.э. и работу газа.

$\Delta Q = Q_2 - Q_3 = 17430\,Дж - 12430\,Дж = 5000\,Дж.$

~~По. п. н. термодинамики~~

~~изобарный~~

~~$\Delta Q = A + \Delta U = p_0 \Delta V + \frac{i}{2} \nu R T_{\Delta} = 5000\,Дж$~~

$\nu = \frac{m}{M_r} = \frac{5{,}5\,г}{18\,г/моль} = 0{,}306\,моль$

(4)

$\Delta Q = A + \Delta U$

$A = p_0 \Delta V = p_0 S \Delta H \Rightarrow H = \frac{A}{p_0 S}$

$A = \Delta Q - \Delta U$

$\Delta U = \frac{i}{2} \nu R \Delta T$ по условию $C_p = 2200 \frac{Дж}{кг \cdot К^\circ} \Rightarrow \left(1 + \frac{i}{2}\right) \nu R = C_p \nu$

~~$C_p = 2200 Дж$~~

$1 кг (H_2O) = \nu(H_2O) \cdot M \Rightarrow \nu = \frac{1 кг}{M} = \frac{1000 г}{18 г/моль} = 55\frac{5}{9}$ моль $\Rightarrow C_{p\nu} = \frac{2200 Дж}{55\frac{5}{9} моль \cdot К}$

$= 39{,}6 \frac{Дж}{моль \cdot К^\circ} \Rightarrow \frac{Дж}{моль К^\circ} 39{,}6 = \left(1 + \frac{i}{2}\right) \cdot 8{,}31 \frac{Дж}{моль К^\circ}$

$8{,}31 + \frac{8{,}31 i}{2} = 39{,}6 \Rightarrow i \approx 8 \Rightarrow$

$H = \frac{5000 Дж - 4 \cdot 0{,}306 моль \cdot 8{,}31 \frac{Дж}{моль К} \cdot 413{,}2^\circ}{1 \cdot 10^5 Па \cdot (500 см^2)} = 0{,}16 м = 16 см$

$\Delta t = \frac{\Delta Q}{C_p m} = \frac{5000 Дж}{2200 \frac{Дж}{кг \cdot К^\circ} \cdot 5{,}5 \cdot 10^{-3} кг} = 413{,}2^\circ К$; по Закону менделеева клапейрона

$\begin{cases} P_0 V_1 = \nu R T_1 \\ P_0 V_2 = \nu R (T_1 + \Delta T) \end{cases} \Rightarrow \frac{V_1}{V_2} = \frac{T_1}{T_1 + \Delta T} = \frac{h_0}{h_0 + H} = \frac{T_1}{T_1 + \Delta T} \Rightarrow \frac{h_0 + H}{h_0} = \frac{T_1 + \Delta T}{T_1}$

h_0 – нач. высота поршня. T_1 – начальная температура пара. когда вся вода испарилась.

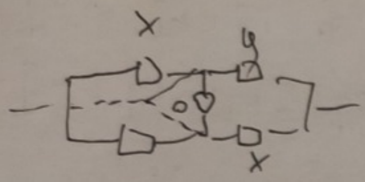
$1 + \frac{H}{h_0} = 1 + \frac{\Delta T}{T_1} \Rightarrow H = \frac{h_0 \Delta T}{T_1} = \frac{h_0 \cdot 413^\circ К}{373^\circ К} = 20{,}9 см$

$h_0 = \frac{\nu R T_1}{p_0 S} = \frac{\frac{m}{M} \cdot R \cdot T_1}{p_0 S} = \frac{\frac{5{,}5 г}{18 г/моль} \cdot 8{,}31 \frac{Дж}{моль К} \cdot 373^\circ К}{1 \cdot 10^5 Па \cdot 500 (\frac{1}{100} м \cdot \frac{1}{100} м)} = 12{,}9 см.$

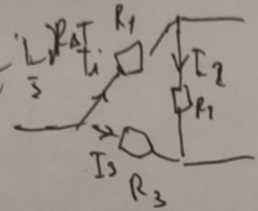
Ответ: ~~20,~~ 2299 Дж; 20,9 см (5)

$\frac{15}{36} = \frac{5}{12}$.

$\frac{39}{180}t$



$dV = \frac{L}{3}...$



$\frac{h_0 \cdot 413{,}2}{100}$

$R_0 = \frac{2nr}{n+1}$

$\frac{100}{...}$ $\frac{150}{30} = 5$ $n = 5$.

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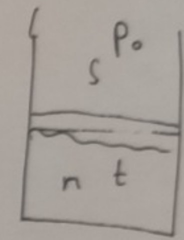
$\frac{7 \cdot 5 \cdot 7}{5+1} = \frac{70}{6} = \frac{10}{3}$.

CMΔt.



$p_0V_1 = \nu RT_1$ Черновик

$R_0\overline{V_1} = \nu RT_1 + \frac{Q}{S}$

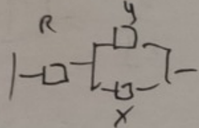
$m = 5{,}5$ г.

$cm\Delta t = Q$

$nr + r = 12$

$6r = 12$

$r = 2$.



500 см^2 $=$

$500 \cdot \frac{1}{100} \cdot \frac{1}{100} =$

$\frac{5}{100}$ м^2

$R = \frac{R_xR_y}{R_x+R_y+0}$ $\frac{R_x 0}{0}$

R_x $L4$

$R_0 = \frac{R_xR_y}{R_x+R_y} + 1 : \left(\frac{1}{R_y} + \frac{1}{R_x}\right) = \frac{R_xR_y}{R_x+R_y} + \frac{R_xR_y}{R_x+R_y} = \frac{2R_xR_y}{R_x+R_y} = \frac{2 \cdot 2 \cdot 10}{2+10}$ Ом $= \frac{20}{6} = \frac{10}{3}$ Ом.

$\frac{I^2}{R} = U^2 \cdot R$

$\Delta_{1,2,3}$

$P = \frac{I^2}{...}$ $UP =$

$I_x =$

$P = U^2 \cdot R = 36$ В$^2 \cdot \frac{10}{3}$ Ом $= 120$ Вт

$pV = \nu RT_1$.

$\rho h_0 S = \nu RT_1$

$h_0 = \frac{\nu RT_1}{\rho \cdot S}$.

$I_1 = 5I_2 \Rightarrow I_0 = 6I_2 = \frac{6}{5}I_1$

$I_4 = 5I_3 \Rightarrow I_0 = 6I_3 = \frac{6}{5}I_4$.

$I = I_1 - I_3 = \frac{5}{6}I_0 - \frac{1}{6}I = \frac{2}{3}I_0 \Rightarrow I_0 = 1{,}5I$.

$I_1^2R_x + I_4^2R_x + I_3^2R_y + I_2^2R_y = 4I^2R_0$.

$2I^2\left(\frac{25}{9} + \frac{25}{9}\right) + 10I^2\left(\frac{1}{9} + \frac{1}{9}\right) = 4I^2R_0$.

$P = \frac{U^2}{R} = \frac{36 \cdot 3}{10}$

$\frac{36 \cdot 810}{3} = 120$.

$I_1 = \frac{5}{6}I_0 = \frac{1}{2}I_0 \cdot \frac{5}{3} = \frac{5}{3}I$.

$I_2 = \frac{1}{3}I$

$I_1 = \frac{5}{3}I$ $I_3 = \frac{1}{3}I$

$I_2 = \frac{1}{3}I$ $I_4 = \frac{5}{3}I$

$\frac{100}{9} + \frac{20}{9} = 4R_0 \Rightarrow R_0 = \frac{120}{4 \cdot 9} = \frac{10}{3}$ Ом.

(6)

21204518 (U383545 M1283565)

$I_0 = 5I_2 =$

$I_0 = 6I_2 = \frac{6}{5} I_1$

$I_0 = 6I_3 = \frac{6}{5} I_4$

$\Rightarrow I_2 = I_3 = \frac{I_0}{6}$

$I_1 = I_4 = \frac{5I_0}{6}$

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$I = I_4 + I_2 = \frac{5I_0}{6} - \frac{I_0}{6} = \frac{2}{3} I_0 \Rightarrow$

$\Delta V = 5000 - \frac{i}{2} \Delta R$

$R_1 = \frac{nr^2}{r(n+1)}$

$R_0 = \frac{nr}{n+1} + 1 : \left(\frac{1}{r} + \frac{1}{rn}\right) = \frac{nr}{n+1} + 1 : \left(\frac{r_n + r}{rr_n}\right) =$

$= \frac{2nr}{n+1}$

$\frac{C_p}{C_v} = \frac{1 + \frac{2}{i}}{\frac{i}{2}}$.

$P_0 = \sum_i P_i = I_1^2 \cdot R_x + I_4^2 \cdot R_x + I_2^2 \cdot R_y + I_3^2 \cdot R_y = R_x \cdot 2 \cdot (I_1^2) + R_y \cdot 2 I_2^2 = 2 \cdot 2 \cdot \frac{I_0^2}{36} + 2 \cdot 10 \cdot \frac{25 I_0^2}{36} = R_0 I_0^2$

$Q = cm\Delta t \quad \Delta t = \frac{Q}{cm}$.

$R_0 = 2 \frac{4 + 500}{36} = \frac{504}{36} = \frac{252}{18} = \frac{126}{9}$

2 2.

$2 \cdot I_1^2 \cdot R_x + 2 \cdot I_3^2 R_y = I_0^2 R_0$.

(1)

$2 \cdot \frac{25 I_0^2}{36} \cdot 2 +$ $\quad I_2 = \frac{I_1}{n}$

$p_0 \Delta V$

$I_0 = I_2 + nI_2 = I_3 + nI_3 = (1+n) I_2 = (1+n) I_3$.

$I_0 = I_1 + \frac{I_1}{n} = I_4 + \frac{I_4}{n} \Rightarrow I_1 \left(1 + \frac{1}{n}\right)$

$\frac{I_0}{1 + \frac{1}{n}}$

Чернобик.