Часть 1

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

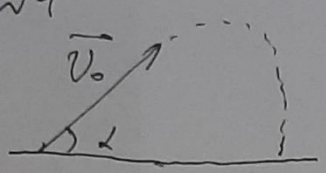
Шифр: **21206156**

ID профиля: **343389**

Вариант 3

Чистовик

№1



В верх. точке траектории $V_y = 0$ м/с, и проходит половина времени полёта, т.к. тракт – парабола.

тогда: $V_{к1y} = 0 = V_{0y} - g\frac{T_п}{2} \Rightarrow T_п = \frac{2V_0 \sin\alpha}{g}$

$S = V_{0x} T_п = \frac{2V_0^2 \cdot \cos\alpha \cdot \sin\alpha}{g} \Rightarrow V_0 = \sqrt{\frac{gS}{2 \cdot \cos\alpha \cdot \sin\alpha}} =$

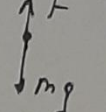
$= \sqrt{\frac{10 \cdot 17 \cdot 4}{2 \cdot \sqrt{3} \cdot 1}} = 14$ м/с.

2) 

$R_к$ – радиус кривизны траектории в верх. точке траектории у обоих тел одинаков, т.к. траектории одинаковы. Для камня:

$a = \frac{V_{0x}^2}{R_к} = g \Rightarrow R_к = \frac{V_0^2 \cos^2\alpha}{g}$

Для самолёта: II з. Ньютона:



oy: $a_y = \frac{mg - F}{m} = \frac{v^2}{R_к} = \frac{V_0^2}{16R_к} \Rightarrow \frac{mg - F}{m} = \frac{V_0^2 g}{16V_0^2 \cos^2\alpha} \Rightarrow$

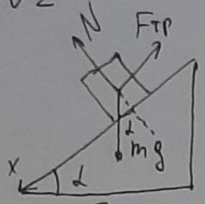
$\Rightarrow 16mg\cos^2\alpha - 16F\cos^2\alpha = mg \Rightarrow$

$\Rightarrow F = \frac{mg(16\cos^2\alpha - 1)}{16\cos^2\alpha} = \frac{1 \cdot 10 \cdot (16 \cdot 0{,}25 - 1)}{16 \cdot 0{,}25} = \frac{30}{4} = 7{,}5$ Н.

Ответ: $V_0 = 14$ м/с; $F = 7{,}5$ Н.

Чистовик

$\sqrt{2}$



1) Торможение: коробка начнёт тормозить на высоте h: $a_x < 0 \Rightarrow mg\sin\alpha < \mu mg\cos\alpha \Rightarrow$
$\Rightarrow \mu > \operatorname{tg}\alpha$, а $\mu > \operatorname{tg}\alpha$ только тогда, когда коробка ниже h.

По II з. Ньютона на ox:

$ma_1 = mg\sin\alpha - \mu_1 mg\cos\alpha \Rightarrow a_1 = g(\sin\alpha - \mu_1\cos\alpha) < 0$

2) Разгон: По II з Ньютона на ox:

$a_2 = g(\sin\alpha - \mu_2\cos\alpha) > 0$

$v_k = 0 = v_1 - |a_1|t_1$, где $t_1 = T$, v_1 - v на h. $\Rightarrow t_1 = \frac{v_1}{|a_1|}$

$v_1 = a_2 t_2$, t_2 - время до h от H, где $v = 0$ м/с $\Rightarrow t_2 = \frac{v_1}{a_2}$

$S_{торм} = \frac{h}{\sin\alpha} = v_1 t_1 - \frac{|a_1|t_1^2}{2} = \frac{v_1^2}{2|a_1|} \Rightarrow v_1^2 = \frac{2gh|(\sin\alpha - \mu_1\cos\alpha)|}{\sin\alpha}$

$t_1 = \frac{v_1}{|a_1|} = \sqrt{\frac{2h}{|a_1|\sin\alpha}} = \sqrt{\frac{2h}{g\sin\alpha(\mu_1\cos\alpha - \sin\alpha)}} = 2\text{с} = T$

$\frac{H-h}{\sin\alpha} = v_1 t_2 - \frac{a_2 t_2^2}{2} = \frac{v_1^2}{2a_2} \Rightarrow H = \frac{v_1^2 \cdot \sin\alpha}{2a_2} + h =$

$= \frac{gh(\sin\alpha - \mu_1\cos\alpha)}{g(\sin\alpha - \mu_2\cos\alpha)} + h = \frac{-h(\sin\alpha - \mu_1\cos\alpha)}{\sin\alpha - \mu_2\cos\alpha} + h =$

$= \frac{-2(1 - 0{,}81\cdot\sqrt{3})}{1 - 0{,}11\sqrt{3}} + 2 = 3\text{м}$

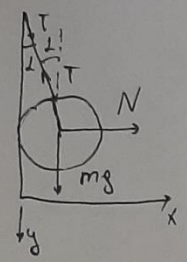
Ответ: $T = 2\text{с}$; $H = 3\text{м}$

(2)

В Ф-10-03

Чистовик

№3



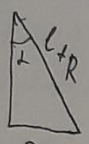
На стену со стороны шарика будет действовать N и T.

$a_x = a_y = 0$ м/с²

II з. Ньютона на ox и oy для шарика:

$$\begin{cases} ox: N = T\sin\alpha \\ oy: mg = T\cos\alpha \end{cases} \Rightarrow N = mg\,tg\,\alpha$$

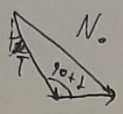
$$T = \frac{mg}{\cos\alpha}$$



$$tg\,\alpha = \frac{R}{\sqrt{l^2+2lR+R^2-R^2}} = \frac{R}{\sqrt{2Rl+l^2}}$$

$$N = \frac{mgR}{\sqrt{2Rl+l^2}} = \frac{0{,}8\cdot 10\cdot 0{,}05}{\sqrt{2\cdot 0{,}05\cdot 0{,}15+0{,}15^2}} = 2{,}42\text{ Н}$$

$$\vec{N_0} = \vec{N} + \vec{T}$$

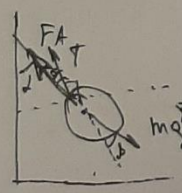


$$N_0 = \sqrt{N^2+T^2+2NT\sin\alpha}$$

$$N_0 = \sqrt{\frac{m^2g^2\sin^2\alpha}{\cos^2\alpha} + \frac{m^2g^2}{\cos^2\alpha} + \frac{2\cdot\sin^2\alpha\, m^2g^2}{\cos^2\alpha}} = mg\frac{\sin\alpha+1}{\cos\alpha} =$$

$$= \frac{0{,}8\cdot 10\cdot 0{,}25}{0{,}165} = 12{,}1\text{ Н}$$

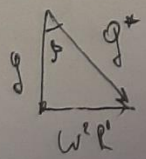
2)



$$g^* = \sqrt{g^2+\omega^2R'}$$

~~$\rho_ж g^* V_т + T = mg^*$~~

~~$\rho_ж g^* \frac{4}{3}\pi R^3 + T$~~



$$\Rightarrow \sin\beta = \frac{\omega^2R'}{g}$$

$$\overrightarrow{mg^*} = \overrightarrow{F_A} + \overrightarrow{T}$$

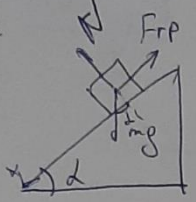
~~$T_{вес}$~~ $= mg^*\cos\beta$

3

Ответ: $N_0 = 12$ Н

Черновик

$\sqrt{2}$.



$S_{горки} = \frac{h}{\sin\alpha}$

1) Разгон: II з. Н. на ~~ox: $mg\sin\alpha$~~

$ma_2 = mg\sin\alpha - \mu_2 mg\cos\alpha$

$a_2 = g(\sin\alpha - \mu_2\cos\alpha)$ - ускорение разгона

2) Торможение: $ma_1 = mg\sin\alpha - \mu_1 mg\cos\alpha$

$a_1 = g(\sin\alpha - \mu_1\cos\alpha)$

$v_k = 0 = v_1 - a_1 t_1 \Rightarrow t_1 = \frac{v_1}{a_1}$

$v_1 = a_2 t_2 \Rightarrow t_2 = \frac{v_1}{a_2}$

$S_{горки} = \frac{h}{\sin\alpha} = v_1 t - \frac{a_1 t_1^2}{2} = \frac{2v_1^2}{2a_1} - \frac{a_1 v_1^2}{2a_1^2} =$

$= \frac{v_1^2}{2a_1} = \frac{h}{\sin\alpha}$ $v_1^2 = \frac{2ha_1}{\sin\alpha} = \frac{2hg(\sin\alpha - \mu_1\cos\alpha)}{\sin\alpha}$

$t_1 = \frac{v_1}{a_1} = \sqrt{\frac{2ha_1}{\sin\alpha \cdot a_1^2}} = \sqrt{\frac{2h}{a_1\sin\alpha}} = \frac{2\cdot 2}{\ldots} =$

$= \sqrt{\frac{2h}{\sin\alpha \cdot g(-\sin\alpha + \mu_1\cos\alpha)}} = \sqrt{\frac{2\cdot 2\cdot 2\cdot 2}{1\cdot 10\cdot(0{,}81\sqrt{3} - 1)}} =$

$= \sqrt{\frac{16}{4}} = 2$ с. $H = \frac{2\cdot 0{,}4\,0296}{0{,}80947} + 2 = 3$ м

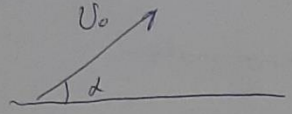
$-h$

$\frac{H^x}{\sin\alpha} = v_1 t_2 - \frac{a_2 t_2^2}{2} = \frac{v_1^2}{a_2} - \frac{a_2 v_1^2}{2a_2^2} = \frac{v_1^2}{2a_2}$

$H = \frac{v_1^2\cdot\sin\alpha}{2a_2} + h = \frac{2hg(\sin\alpha - \mu_1\cos\alpha)}{2\cdot g(\sin\alpha - \mu_2\cos\alpha)} + h = \frac{h(1 - 0{,}81\sqrt{3})}{(1 - 0{,}11\sqrt{3})} + 2$

черновик.

№1.



$v_y = v_{0y} - gt \Rightarrow t = \frac{v_{0y} - v_y}{g}$

$\frac{T_п}{2} = \frac{v_0 \sin\alpha}{g} \Rightarrow T_п = \frac{2v_0 \sin\alpha}{g}$

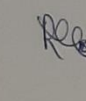
$S = v_{0x} T_п = v_0 \cos\alpha \cdot T_п = \frac{2v_0^2 \cos\alpha \sin\alpha}{g} \Rightarrow$

$\Rightarrow v_0 = \sqrt{\frac{gS}{2\cos\alpha\sin\alpha}} = \sqrt{\frac{10 \cdot 17 \cdot 4}{2 \cdot \sqrt{3}}} = \sqrt{\frac{10 \cdot 17 \cdot 2 \cdot \sqrt{3}}{3}} = 14 \text{ м/с}$

8

2) $R_{кр}$ траект: $g = \frac{v_{0x}^2}{R_{кр}} \Rightarrow R_{кр} = \frac{v_{0x}^2}{g} = \frac{v_0^2 \cos^2\alpha}{g}$

Для самолёта



$a = \frac{mg - F_y}{m}$

$a = \frac{v^2}{R_{кр}} = \frac{v_0^2}{16 R_{кр}} = \frac{v_0^2 \cdot g}{16 v_0^2 \cdot \cos^2\alpha}$

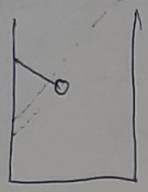
$\frac{mg - F_y}{m} = \frac{v_0^2 g}{16 v_0^2 \cos^2\alpha}$

$16 mg\cos^2\alpha - 16 F_y \cos^2\alpha = mg$

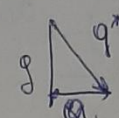
~~$16 mg\cos^2\alpha = mg \Rightarrow$~~

$F_y = \frac{(16\cos^2\alpha - 1)\, mg}{16\cos^2\alpha}$

$F_y = \frac{(16 \cdot 0{,}25 - 1) \cdot 10 \cdot 1}{16 \cdot 0{,}25} = \frac{30}{4} = \frac{15}{2} = 7{,}5 \text{ Н}.$



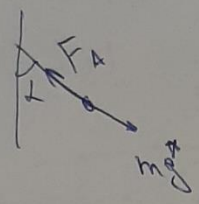
$$\vec{g^*} = \vec{a} + \vec{g}$$



$$g^* = \sqrt{a^2 + g^2}$$

$$a^2 = \omega^2 R$$

$$g^* = \sqrt{\omega^2 R + g^2}$$



$$\rho_n g V_T = m g^*$$

$$\rho_n g V_T = m\sqrt{\omega^2 R + g^2}$$

$$\rho_n^2 g^2 V_T^2 = m^2 \omega^2 R^2 + m^2 g^2$$

$$R^2 = \frac{\rho_n^2 g^2 V_T^2 - m^2 g^2}{m^2 \omega^2} = \frac{1000000 \cdot 100 \cdot \pi^2 R^4}{}$$

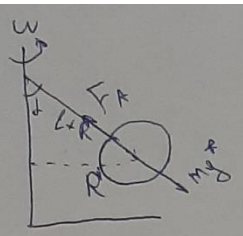
$$\rho_n^2 g^2 \frac{16}{9} \pi^2 R^6 = m^2 \omega^2 R^2 + m^2 g^2$$

$$R^2 = \frac{\rho_n^2 g^2 16 \pi^2 R^6 - 9 m^2 g^2}{9 m^2 \omega^2} =$$

$$= \frac{1000000 \cdot 100 \cdot 16 \cdot \pi^2 \cdot 0{,}05^6 - 9 \cdot 0{,}8^2 \cdot 100}{9 \cdot 0{,}8^2 \cdot 100} =$$

$$= \frac{16000000 \cdot 0{,}05^6 \pi^2 - 5{,}76}{5{,}76} =$$

$$= \frac{16 \cdot 10^6 \cdot (5 \cdot 10^{-2})^6 \cdot \pi^2}{5{,}76} - 1 = \frac{16 \cdot 5^6 \cdot 10^{-6} \cdot \pi^2}{5{,}76} - 1$$



$\alpha = \arcsin \frac{R'}{L+R}$

$g^* = \sqrt{g^2 + \omega^2 R'}$

$F_A = m g^*$

$\rho_v g V_T = m \sqrt{g^2 + \omega^2 R'}$

$\rho_v g \frac{4}{5} \pi R^3 = m \sqrt{g^2 + \omega^2 R'}$

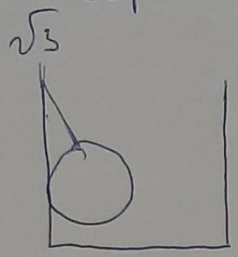
$16 \rho_v^2 g^2 \pi^2 R^6 = 9 m^2 g^2 + 9 m^2 \omega^2 R'$

$R' = \frac{16 \rho_v^2 g^2 \pi^2 R^6 - 9 m^2 g^2}{9 m^2 \omega^2} = \frac{16 \cdot 10^6 \cdot 10^2 \cdot \pi^2 (5 \cdot 10^{-2})^6 - 9 \cdot m^2 g^2}{9 \cdot m^2 \omega^2} =$

$= \frac{16 \cdot 10^6 \pi^2 \cdot 5^6 \cdot 10^{-12} - 9 \cdot 0{,}8^2 \cdot 10^6}{9 \cdot 0{,}8^2 \cdot 10^6} = \frac{16 \cdot 5^6 \cdot \pi^2 \cdot 10^{-6} - 9 \cdot 0{,}8^2}{9 \cdot 0{,}8^2} =$

$= \frac{16 \cdot 5^6 \cdot \pi^2 \cdot 10^{-6}}{9 \cdot 8^2 \cdot 10^{-4}} - 1 = \frac{16 \cdot 5^6 \cdot \pi^2 \cdot 10^{-2}}{9 \cdot 64} - 1 = 0{,}57$

Черновик



$a_x = a_y = 0$ для шара:

$mg = T\cos\alpha$

$N = T\sin\alpha$

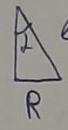
$T = \frac{mg}{\cos\alpha}$

$\sin\alpha = \frac{R}{\ell}$

$\cos\alpha = \sqrt{\frac{\ell^2 - R^2}{\ell^2}}$

$\frac{N}{mg} = tg\alpha \Rightarrow N = mg\,tg\alpha$

$\frac{0,4}{0,165}$



$tg\alpha = \frac{R}{\sqrt{\ell^2 - R^2}}$

$\vec{T} + \vec{N} =$

$N_0 = \sqrt{N^2 + T^2 - 2\cos(90+\alpha)NT} =$

$= \sqrt{N^2 + T^2 + 2\sin\alpha \cdot N t}$

$N_0 = \sqrt{m^2g^2 tg^2\alpha + \frac{m^2g^2}{\cos^2\alpha} + \frac{2\sin\alpha\, m^2g^2\sin\alpha}{\cos^2\alpha}}$

$N_0 = mg\sqrt{\frac{\sin^2\alpha}{\cos^2\alpha} + \frac{1}{\cos^2\alpha} + \frac{2\sin^2\alpha}{\cos^2\alpha}} = \sqrt{\frac{(\sin\alpha+1)^2}{\cos\alpha}}$

$N_0 = mg\frac{\sin\alpha+1}{\cos\alpha} = mg\frac{(R+\ell)\ell}{\ell\sqrt{\ell^2-R^2}} = mg\frac{R+\ell}{\sqrt{\ell^2-R^2}}$

$N_0 = 0,8\cdot 10\,\frac{0,05+0,15}{\sqrt{0,15^2 - 0,05^2}} = \frac{8\cdot 0,2}{0,05} = 32\text{ н.}$

$N = \frac{8\cdot 0,05}{0,05} = 8\text{ н.}$

$\sin\alpha = \frac{R}{\ell+R} = \frac{0,25}{0,165}$

$\frac{(R+\ell+R)(\ell+R)}{(\ell+R)\sqrt{\ell^2+2R\ell}} =$

$\cos\alpha = \sqrt{\frac{(\ell+R)^2 - R^2}{(\ell+R)^2}}$

$= \frac{R+\ell+R}{\sqrt{\ell^2+2R\ell}} = \frac{2\cdot 0,05+0,15}{\sqrt{0,15^2+2\cdot 0,05\cdot 0,15}}$

$\cos\alpha = \sqrt{\frac{\ell^2+2R\ell}{(\ell+R)^2}} = \frac{\sqrt{\ell^2+2R\ell}}{\ell+R}$

Часть 2

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

Шифр: **21206156**

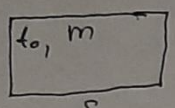
ID профиля: **343389**

Вариант 3

Числовик

В 10-03

№4



P_0 $Q_1 = C \cdot m \cdot t = cm(100-0) = 4180 \cdot 5{,}5 \cdot 100 \cdot 10^{-3} = 2299 Дж$.

Чтобы вода испарилась:

$Q_{исп} = m \cdot r = 5{,}5 \cdot 10^{-3} \cdot 2{,}26 \cdot 10^6 = 12430 Дж < Q_2 \Rightarrow$

$\Rightarrow$ Вся вода испар. $Q = Q_2 - Q_{исп}$.

$Q = \Delta U + A' = 3 P_0 T + P_0 V = 4 P_0 V$, т.к. $P = const$.

$Q = 4PSH \Rightarrow H = \frac{Q}{4PS} = \frac{Q_2 - mr}{4PS} = \frac{17430 - 12430}{4 \cdot 5 \cdot 10^3} = 0{,}25 м$.

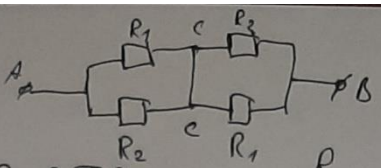
Ответ: $Q_1 = 2299 Дж$; $H = 0{,}25 м$.

Чистовик

В 10-03

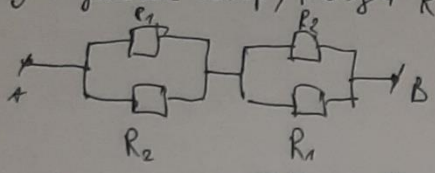
№5.

Перерис. эл. схему:



ρ - удельное сопр, тогда $R = 2\pi\rho \Rightarrow \pi\rho = \frac{R}{2}$.

1)

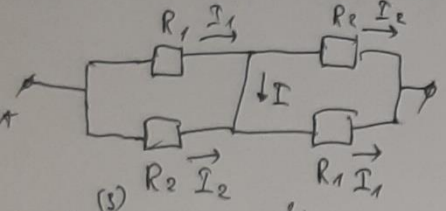


$P = \frac{U^2}{R_0}$ $R_0 = \frac{2R_1R_2}{R_1+R_2}$

$R_1 = \rho \cdot l = \frac{\pi\rho}{6} = \frac{R}{12}$ $R_2 = (180-\alpha)\rho = \frac{5R}{12}$

$R_0 = \frac{5R}{36}$ $P = \frac{U^2 \cdot 36}{5R} = \frac{36^2}{5 \cdot 24} = 10{,}8$ Вт.

2)



Расставим токи в соотв. с з. Ома и пр. Кирхгофа, заметим, что схема симметрична.

$U_{AB} = U = 2I_1R_1 = I_1R_1 + I_2R_2 \Rightarrow$

$\Rightarrow I_1R_1 = I_2R_2 = \frac{U}{2} \Rightarrow I_2 = \frac{U}{2R_2}$ (3) (2) $I_1 = I + I_2$ $\frac{R}{2} = R_1 + R_2 \Rightarrow$

$\Rightarrow R_2 = \frac{R - 2R_1}{2}$ (1) Из (1), (2) и (3) получим: $4IR_1^2 - R_1(U4 + 2IR) + UR = 0 \Rightarrow$

$\Rightarrow R_1 = \frac{2U + IR \pm \sqrt{I^2R^2 + 4U^2}}{4I} \Rightarrow R_{1.1} = 13$ Ом $\Rightarrow R_2 = \frac{24-26}{2} < 0 \Rightarrow$ не корень

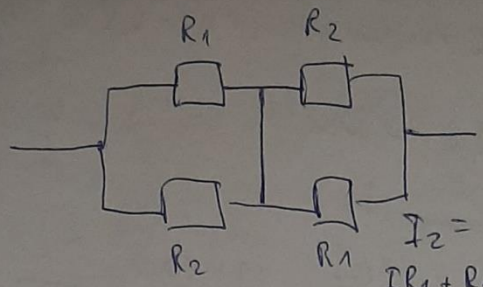
$R_{1.2} = 8$ Ом $\Rightarrow R_2 = 4$ Ом $\Rightarrow n = \frac{R_1}{R_2} = \frac{8}{4} = 2$.

$R_{0.2} = \frac{2 \cdot R_1 \cdot R_2}{R_1 + R_2} = \frac{2 \cdot 4 \cdot 8}{12} = \frac{16}{3}$ Ом

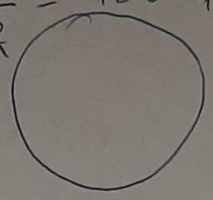
$P_2 = \frac{U^2 \cdot 3}{16} = \frac{18 \cdot 3}{8} = 6{,}75$ Вт.

Ответ: $P = 10{,}8$ Вт; $n = 2$; $P_2 = 6{,}75$ Вт.

№5 черн.



$\frac{5R^2 \cdot 24}{12^2 \cdot 6R} = \frac{5 \cdot R \cdot 2}{12 \cdot 6} = \frac{5R}{12 \cdot 3} = \frac{5R}{36}$

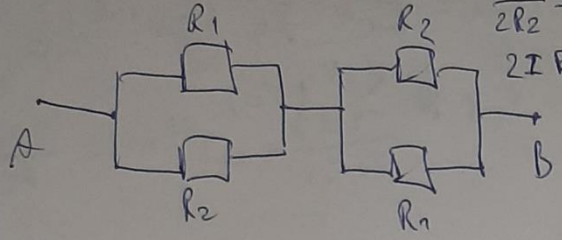


$\pi \rho = \frac{R}{2}$

$I_2 = \frac{U}{2R_2}$

$R = 24\,Om = \rho \cdot 2\pi$

$\frac{IR_1 + R_1 U}{2R_2} = \frac{R_2 U}{2R_2}$



$2IR_1 + UR_1 = UR_2$

$R_1 = \frac{\rho \pi}{6} = \frac{R}{12}$

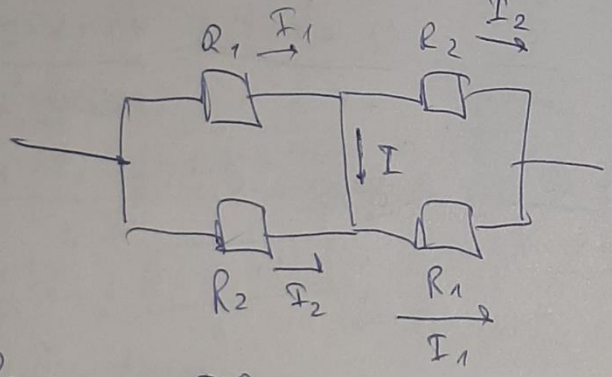
$R_2 = \frac{\rho \cdot 5\pi}{6} = \frac{R \cdot 5}{12}$

$P = \frac{U^2}{R_{01}}$ $\quad R_{01} = 2 \cdot \frac{R_1 \cdot R_2}{R_1 + R_2}$

$R_{01} = \frac{2 \cdot R \cdot 5R \cdot 2}{12 \cdot 12R} = \frac{20R}{144}$

$R_{01} = \frac{20 \cdot 24}{144} = \frac{10R}{72} = \frac{5R}{36}$

$P_1 = \frac{U^2 \cdot 36}{5R} = \frac{36^2}{5 \cdot 24} = 10{,}8\,Bt$



$I_1 R_1 + I_2 R_2 = U$

$2 I_1 R_1 = U$

$I_2 R_2 = I_1 R_1$

$\frac{R_2}{R_1} = \frac{I_1}{I_2} = \frac{I + I_2}{I_2} = 1 + \frac{I}{I_2} =$

$\frac{R_2}{R_1} = 1 + \frac{2IR_2}{U}$

$\frac{R_2}{R_1} = \frac{U + 2IR_2}{U}$

$I_1 = I + I_2$

$I_2 R_2 = \frac{U}{2}$

$I_2 = \frac{U}{2R_2}$

$UR_2 = UR_1 + 2R_1 R_2 I \quad | \cdot \frac{1}{R_1}$

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

$\frac{UR_2}{R_1} = U + \frac{2IR_2}{R_1}$

$U \cdot n = U + 2In$

$n = 1{,}3$ $\quad n = \frac{U}{U - 2I} = \frac{6 \cdot 3}{18 - 2 \cdot 2} = \frac{18}{14}$

$Q = \frac{5}{2} R \Delta T \qquad \Delta T = \frac{Q}{\frac{5}{2}R} = \frac{17430 \cdot 18}{4 \cdot 8{,}31 \cdot 5{,}5} =$

$\nu = \frac{m}{\mu} = \frac{5{,}5}{18}$

$\Delta T = \frac{Q_2 - mr}{c_p} = \frac{17430 - 12430}{2200} = \frac{5000}{2200} =$

$= 2{,}27) \qquad \Delta T = \frac{25}{11}$

$\frac{pV_1}{T_1} = \frac{pV_2}{T_2} \qquad V_1 T_2 = V_2 T_1$

$T_2 = T_1 + \Delta T$

$p_0 \cdot h_1 \cdot S = \nu R T_1 \qquad V_1 T_1 + V_2 \Delta T = V_2 T_1$

$h_1 = \frac{\nu R T_1}{p_0 S} \qquad Se = \qquad S h_1 T_1 + S h_2 \Delta T - S h_2 T_1 = 0$

$h_2 = \frac{S T_1 h_1}{S T_1 - S \Delta T} \Rightarrow$

$h_0 = \frac{mg}{g_e \cdot S}$

$\Rightarrow h_2 - h_0 =$

$h_0' = \frac{5{,}5}{1.500} = 0{,}011 \text{ cm}$

$\frac{\beta T_1 h_1 - \beta T_1 h_1 + \beta \Delta T h_1}{\beta T_1 - \beta \Delta T}$

$h_1 = \frac{m R T_1}{M p_0 S}$

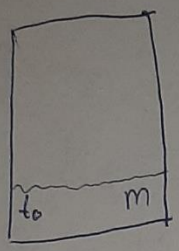
$h_1 = \frac{5{,}5 \cdot 8{,}31 \cdot 373 \cdot 10000}{18 \cdot 10^5 \cdot 500} \qquad \Delta h = \frac{T_1 = T_1 + \Delta T}{T_1 - \Delta T} h_1 = \frac{\Delta T}{T_1 - \Delta T} h_1$

$h_1 = \frac{5{,}5 \cdot 8{,}31 \cdot 373}{18 \cdot 10^3} = 0{,}95 \text{ m}. \qquad \Delta h_2 = \frac{25}{(100 \cdot 11 - 25)} = \frac{25}{1100 - 25}$

$\Delta h_2 = \frac{25}{1075}$

черновик

№4. P_0



$Q_1 = c m_в t_1 = cm \cdot (100-0) = 4180 \cdot 5{,}5 \cdot 10^{-3} \cdot 100 =$

$= 418 \cdot 5{,}5 = 2299$ Дж.

Чтобы вода испар.:

$Q_2 = m \cdot x \cdot r \Rightarrow x = \frac{Q_2}{mr} = \frac{17430000}{5{,}5 \cdot 2{,}26 \cdot 10^6} =$

$= \frac{17{,}43}{5{,}5 \cdot 2{,}26} = 1{,}4 > 1 \Rightarrow$

$\Rightarrow$ вся вода испарилась.

$Q = Q_2 - mr$ ~~= 17400~~

$Q = \Delta U + A' = \frac{6}{2} \nu R \Delta T + P \Delta V = \frac{6}{2} \nu R \Delta T + PHS$

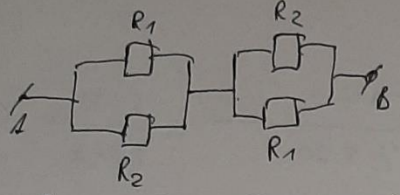
$Q = 4PHS \Rightarrow H = \frac{Q}{4PS} = \frac{Q_2 - mr}{4PS} = \frac{17430 - 5{,}5 \cdot 2{,}26 \cdot 10^3}{4 \cdot 500 \cdot 10^{-4} \cdot 1 \cdot 10^5} =$

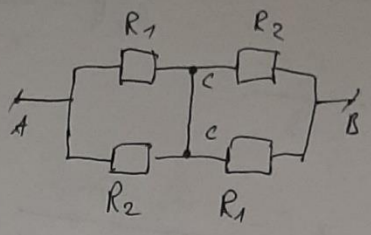
$H = \frac{17430 - 5{,}5 \cdot 2{,}26 \cdot 10^3}{2 \cdot 10^4} =$ ~~0,55~~ $= 0{,}25$ м.

~~Чистовик~~ черновик

№5.

Перересуем эквив. схему:





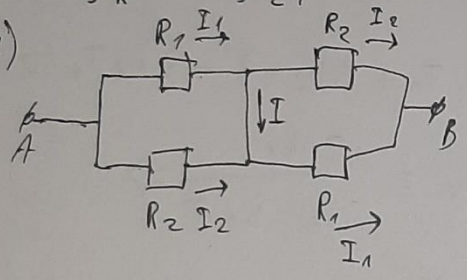
ρ - удельное сопротивление, тогда: $R = 2\pi\rho \Rightarrow \pi\rho = \frac{R}{2}$

1) $R_1 = \frac{\rho\pi}{6} = \frac{R}{12}$ $R_2 = \frac{5\rho\pi}{6} = \frac{5R}{12}$

$P = \frac{U^2}{R_0}$ $R_0 = \frac{R_1 \cdot R_2}{R_1 + R_2} \cdot 2 = \frac{5R \cdot R \cdot 2 \cdot 12}{12^2 \cdot 6R} = \frac{5R}{36}$

$P = \frac{U^2 \cdot 36}{5R} = \frac{36^2}{5 \cdot 24} = 10{,}8$ Вт.

2)



Расставим токи в соотв. с пр. Кирхгофа и з. Ома:

$U_{AB} = U = 2I_1R_1 = I_1R_1 + I_2R_2 \Rightarrow$

$\Rightarrow I_1R_1 = I_2R_2 = \frac{U}{2} \Rightarrow I_2 = \frac{U}{2R_2}$

$I_1 = I + I_2$

~~$R_1I + R_1I_2 = R_2I_2 \Rightarrow$~~

~~$\frac{R_2}{R_1} = \frac{I_1}{I_2} = 1 + \frac{I}{I_2} = 1 + \frac{2IR_2}{U} \Rightarrow$~~

~~$\Rightarrow IR_1 \cdot 2R_2 + R_1 \cdot U - UR_2 = 0 \mid \cdot \frac{1}{R_1}$~~

~~$2R_2I + U - U\frac{R_2}{R_1} = 0$~~

~~$\Rightarrow UR_2 = UR_1 + 2IR_1R_2 \mid \cdot \frac{1}{R_1}$~~

~~$\frac{UR_2}{R_1} = U + \frac{2IR_2}{R_1}$~~ $\frac{R_2}{R_1} = 1 \Rightarrow$ ~~$R = \frac{U}{I}$~~

1) $R_1 + R_2 = \frac{R}{2} \Rightarrow$

$\Rightarrow R_2 = \frac{R - 2R_1}{2} \Rightarrow$

$\Rightarrow 4IR_1^2 - R_1(4U + 2IR) + 2UR = 0$

$R_1 = \frac{4U + 2IR \pm \sqrt{(4U + 2IR)^2 - 16URI}}{8I} = \frac{4U + 2IR \pm \sqrt{16U^2 + 4I^2R^2}}{8I}$

$R_{1,1} = 13$ Ом. $\Rightarrow R_2 = \frac{R - 2R_1}{2} = \frac{24 - 26}{2} < 0$ - не корень

$R_{1,2} = 8$ Ом. $\Rightarrow R_2 = \frac{24 - 16}{2} = 4$ Ом. $n = \frac{R_1}{R_2} = \frac{8}{4} = 2.$

$R_0 = \frac{2R_1 \cdot R_2}{R_1 + R_2} = \frac{2 \cdot 4 \cdot 8}{12} = \frac{32}{6} = \frac{16}{3}$ $P_2 = \frac{U^2}{R_0} = \frac{36 \cdot 6}{32} = 6{,}75$ Вт.

$\frac{36 \cdot 3}{16} = \frac{18 \cdot 3}{8} = \frac{27}{4}$

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

$\frac{R_2}{R_1} = \frac{18}{14} = \frac{9}{7} \Rightarrow 7R_2 = 9R_1 \quad R_2 = \frac{9R_1}{7}$

$R_1 + \frac{9R_1}{7} = \frac{R}{2} \quad (7R_1 + 9R_1)2 = 7R$

$R_1 = \frac{7R}{2 \cdot 16} = \frac{7R}{32}$

$P_2 = \frac{U^2 \cdot 32 \cdot 16}{63R} \quad R_{o2} = \frac{7R \cdot 9R \cdot 32}{32^2 \cdot 16R} \quad R_2 = \frac{9 \cdot 7R}{7 \cdot 32} = \frac{9R}{32}$

$P_2 = \frac{36 \cdot 32 \cdot 16}{63 \cdot 24} = 12{,}2\,\text{Вт} \quad R_{o2} = \frac{63R}{16 \cdot 32}$

$I_1 R_1 + I_2 R_2 = U$

$I_2 R_2 = I_1 R_1 = \frac{U}{2}$

$\frac{R_2}{R_1} = \frac{I_1}{I_2} = \frac{I_2 + I}{I_2} = 1 + \frac{I}{I_2} = 1 + \frac{2IR_2}{U} = \frac{U + 2IR_2}{U}$

$I_1 = I_2 + I \qquad I_2 = \frac{U}{2R_2}$

$UR_2 = UR_1 + 2IR_2R_1 \mid \cdot \frac{1}{R_1}$

$R_2 I_2 = R_1 I_1 + R_1 I.$

$\frac{UR_2}{R_1} = U + 2IR_2$

$R_1 = \frac{4U + 2IR \pm \sqrt{16U^2 + 4I^2R^2 + 16UIR}}{8I}$

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

$R_1 = \frac{(24 + 32)3}{16} \pm \frac{\sqrt{16 \cdot 36 + 4 \cdot 24^2 \cdot \frac{4}{9}}}{16} 3$

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

$UR_2 = UR_1 + \frac{2IR_1 \cdot (R - 2R_1)}{2}$

$R_1 = \frac{56 \cdot 3}{16} = \frac{7 \cdot 3}{2} \pm \frac{32 \cdot 6}{16}$

$UR_2 - UR_1 = IR_1R - 2IR_1^2$

$R_1 = \frac{21}{2} \pm \frac{30}{8}$

$\frac{U(R - 2R_1)}{2} = UR_1 + \frac{2IR_1(R - 2R_1)}{2}$

$R_{1.1} = 13\,\Omega$

$UR - 2UR_1 = 2UR_1 + 2IR_1R - 4IR_1^2$

$R_{1.2} = 8\,\Omega$

$4IR_1^2 - R_1(4U + 2IR) + UR = 0$

$R_{2.1} = \frac{24 - 26}{2}$

$R_1 = \frac{4U + 2IR \pm \sqrt{(4U + 2IR)^2 - 16URI}}{8I}$

$R_{2.2} = \frac{24 - 16}{2} = 4\,\Omega.$