

# Часть 1

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

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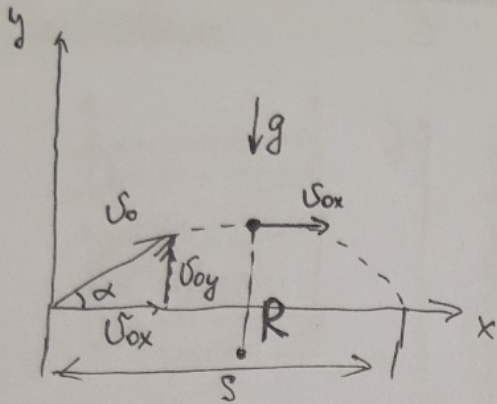
Вариант 3

Ущербук

Ризика 10 кл.

1.

$\alpha = 60^\circ$   
 $S = 17 \text{ м}$   
 $m = 1 \text{ кг}$   
 $v = \frac{v_0}{4}$   
 $F_y = ?$   
 $v_0 = ?$



$$S = v_{0x} \cdot t$$

$$v_{0x} = v_0 \cdot \cos \alpha = \frac{1}{2} v_0$$

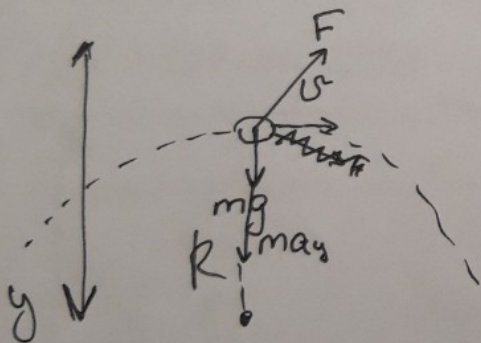
$$t = \frac{2v_{0y}}{g}; \quad v_{0y} = v_0 \cdot \sin \alpha = \frac{\sqrt{3}}{2} v_0$$

$$S = \frac{1}{2} v_0 \cdot \frac{2 \cdot \frac{\sqrt{3}}{2} v_0}{g} \quad 2gS = v_0^2 \sqrt{3}$$

$$S = \frac{1}{2} v_0 \cdot \frac{\sqrt{3}}{g} v_0 = \frac{v_0^2}{g} \cdot \frac{\sqrt{3}}{2}$$

$$\Rightarrow \left( v_0 = \sqrt{\frac{2gS}{\sqrt{3}}} = \sqrt{\frac{2 \cdot 10 \cdot 17}{\sqrt{3}}} \approx 14 \text{ м/с} \right)$$

$$g = \frac{v_{0x}^2}{R} \Rightarrow R = \frac{v_{0x}^2}{g} = 4,9 \text{ м}$$



$$-F_y + mg = \frac{mv^2}{R}$$

$$\Rightarrow F_y = m \left( \frac{v^2}{R} + g \right)$$

$$S = 4v_0 = 4 \cdot 14 = 56 \quad v = \frac{v_0}{4} = 3,5 \text{ м/с}$$

$$F_y = 1 \cdot \left( \frac{3,5^2}{4,9} + 10 \right) = 7,5 \text{ Н}$$

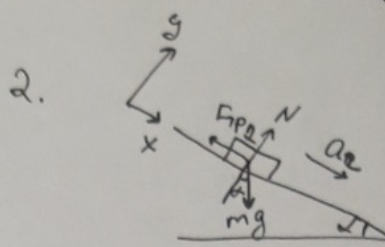
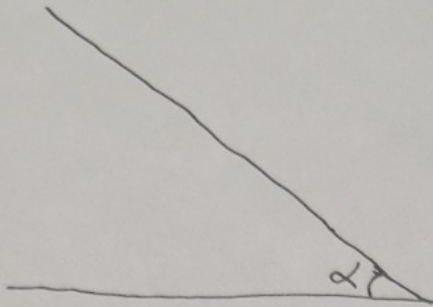
Отвеч:  $v_0 = 14 \text{ м/с}$ ;  $F_y = 7,5 \text{ Н}$

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# Циговик

Физика 10 кл.

- $\alpha = 30^\circ$
- $h = 2 \text{ м}$
- $\mu_1 = 0,81$
- $\mu_2 = 0,11$
- $v_0 = 0$
- $T = ?$
- $H = ?$



Рассмотрим движение на высоте  $> h$

$$O_x: mg \cdot \sin \alpha - F_{TP2} = ma_2$$

$$O_y: mg \cdot \cos \alpha = N$$

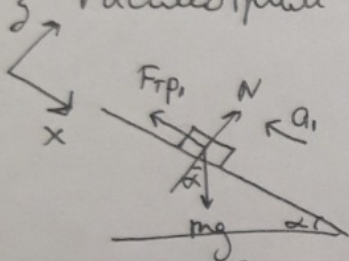
$$F_{TP2} = N \cdot \mu_2$$

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

$$a_2 = g(\sin \alpha - \mu_2 \cos \alpha) = 0,44g \approx 44\% \Rightarrow$$

$\Rightarrow$  при высоте  $> h$  коробка движется с ускорением вниз.

Рассмотрим движение на высоте  $< h$ :



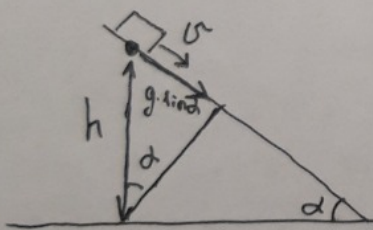
$$O_x: mg \cdot \sin \alpha - F_{TP1} = -ma_1$$

$$O_y: N = mg \cdot \cos \alpha; F_{TP1} = \mu_1 N$$

$$\mu_1 mg \cdot \cos \alpha - mg \cdot \sin \alpha = ma_1$$

$$\Rightarrow a_1 = g(\mu_1 \cos \alpha - \sin \alpha) = 24\% \Rightarrow$$

$\Rightarrow$  при высоте  $< h$  коробка движется с ускорением вверх (тормозит).



$$\frac{mv^2}{2} + mgh = F_{TP1} \cdot l; \quad F_{TP1} = \mu_1 mg \cdot \cos \alpha$$

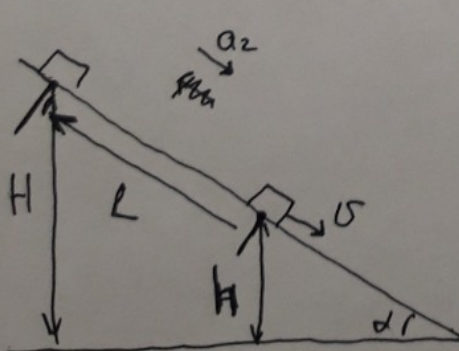
$$l = \frac{h}{\sin \alpha}$$

$$\frac{mv^2}{2} + mgh = \mu_1 mg \cdot \cos \alpha \cdot \frac{h}{\sin \alpha}$$

$$\Rightarrow v = \sqrt{2\mu_1 g \cdot h \cdot \frac{1}{\tan \alpha} - 2gh} = \sqrt{2gh(\mu_1 \cdot \frac{1}{\tan \alpha} - 1)} \approx 44\%$$

~~...~~

$$0 = v - a_1 T \Rightarrow T = \frac{v}{a_1} = \frac{4}{2} = 2 \text{ с}$$



$$L = \frac{H}{\sin \alpha} - \frac{h}{\sin \alpha} = 2H - 2h$$

$$L = \frac{v^2}{2a_2} \Leftrightarrow 2H - 2h = \frac{v^2}{2a_2}$$

$$4Ha_2 - 4ha_2 = v^2 \Rightarrow H = \frac{v^2 + 4ha_2}{4a_2} = 3 \text{ м}$$

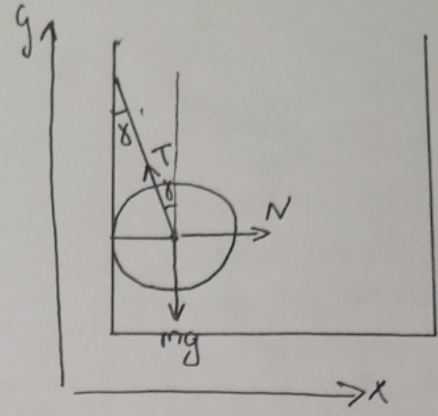
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Ответ:  $T = 2 \text{ с}; H = 3 \text{ м}$

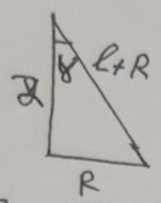
$R = 0,05 \text{ m}$   
 $l = 0,15 \text{ m}$   
 $m = 0,8 \text{ kg}$   
 $\omega = 10 \frac{\text{rad}}{\text{s}}$   
 $N, \alpha = ?$

Учуробук 3.

Физика 10 кл.

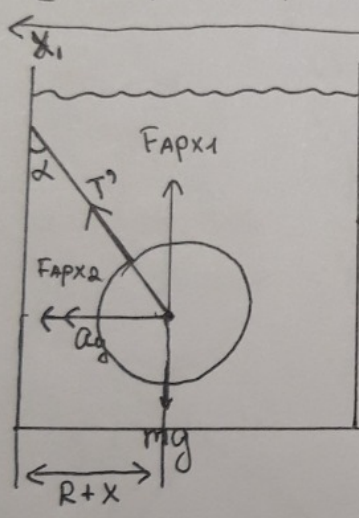


$O_x: N = T \cdot \sin \alpha$   
 $O_y: T \cdot \cos \alpha = mg$   
 $T = \frac{mg}{\cos \alpha}$   
 $N = mg \cdot \tan \alpha$



$x = \sqrt{(l+R)^2 - l^2} = \sqrt{0,2^2 - 0,05^2} \approx 0,19365 \text{ m} \Rightarrow \tan \alpha = \frac{R}{x} = \frac{0,05}{0,19...} = 0,258$   
 $\Rightarrow (N = 0,8 \cdot 10 \cdot 0,258 \approx 2 \text{ H})$

$v = \omega(R+x)$   
 $a_y = \frac{v^2}{R+x} = \omega^2(R+x)$

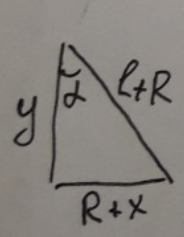


$O_{x1}: T' \cdot \sin \alpha = m \omega^2 (R+x)$   
 $\sin \alpha = \frac{R+x}{R+l}$   
 $O_{y1}: F_{apx1} + T' \cdot \cos \alpha = mg$   
 $\rho g V + T' \cdot \cos \alpha = \rho g V$

$T \cdot \cos \alpha = mg$   
 $F_{apx1} + T' \cdot \cos \alpha = T \cdot \cos \alpha$

$O_{x1}: T' \cdot \sin \alpha + \rho g a_y V = m \omega^2 (R+x)$   
 $O_{y1}: \rho g V + T' \cdot \cos \alpha = mg$   
 $T \cdot \sin \alpha = m \omega^2 (R+x) - \rho g \omega^2 (R+x) V$   
 $T' \cdot \cos \alpha = mg - \rho g V$

$\tan \alpha = \frac{\rho V \omega^2 (R+x) - \rho g \omega^2 (R+x) V}{\rho V g - \rho g V} = \frac{\omega^2 (R+x) (\rho V - \rho g V)}{g (\rho V - \rho g V)} = \frac{\omega^2 (R+x)}{g}$



$y = \sqrt{(l+R)^2 - (R+x)^2} = \sqrt{0,04 - (R+x)^2}$   
 $\frac{R+x}{\sqrt{0,04 - (R+x)^2}} = \frac{\omega^2 (R+x)}{g} \Leftrightarrow \frac{0,05+x}{\sqrt{0,04 - (0,05+x)^2}} = 10(0,05+x)$

$10 \sqrt{0,04 - (R+x)^2} = 1$   
 $0,04 - R^2 - 2Rx + x^2 = 0,01$

$x^2 + 0,1x - 0,0275 = 0$   
 $40x^2 + 4x - 1,1 = 0 \quad \frac{D}{4} = 4 + 40 \cdot 1,1 = 48$

$x = \frac{-2 \pm \sqrt{48}}{40} \Rightarrow x \approx 0,12 \text{ m}$

$\Rightarrow \alpha = \arcsin \frac{R+x}{R+l} = \arcsin \frac{0,17}{0,2} = \arcsin 0,85 \approx 58^\circ$

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# Часть 2

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

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Вариант 3

4.

$Q_2 = 17430 \text{ Дж}$   
 $m = 5,5 \cdot 10^{-3} \text{ кг}$   
 $t_0 = 0^\circ \Rightarrow T_0 = 273 \text{ К}$   
 $S = 500 \cdot 10^{-4} \text{ м}^2$   
 $p_0 = 10^5 \text{ Па}$

$Q_1 - ?$   
 $H - ?$

$(Q_1 = cm\Delta t = cm(100^\circ - t_0) = 4180 \cdot 5,5 \cdot 10^{-3} \cdot 100 = 22999 \text{ Дж.})$

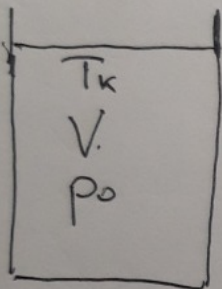
$Q_2 = m \cdot r + c_p m (t_k - 100^\circ)$

$Q_2 = mr + c_p m t_k - 100 c_p m$

$\Rightarrow t_k = \frac{Q_2 - mr + 100 c_p m}{c_p \cdot m} = \frac{17430 - 5,5 \cdot 10^{-3} \cdot 2,26 \cdot 10^6 + 100 \cdot 5,5 \cdot 10^{-3} \cdot 2200}{5,5 \cdot 10^{-3} \cdot 2200}$

$= \frac{17430 - 12430 + 1210}{12,1} \approx 513^\circ \Rightarrow T_k = 786 \text{ К}$

Т.к.  $m = 5,5 \cdot 10^{-3}$  (масса воды) очень маленькая  $\Rightarrow V_6$  (объем воды) прене-  
 брешно мал, тогда



$p_0 V = \frac{m}{\mu} R T_k \Leftrightarrow p_0 S H \mu = m R T_k$

$\Rightarrow H = \frac{m R T_k}{p_0 \cdot S \cdot \mu} = \frac{5,5 \cdot 10^{-3} \cdot 8,31 \cdot 786}{10^5 \cdot 500 \cdot 10^{-4} \cdot 18 \cdot 10^{-3}} = \frac{5,5 \cdot 8,31 \cdot 786}{18 \cdot 5000}$

$= 0,4 \text{ м.}$

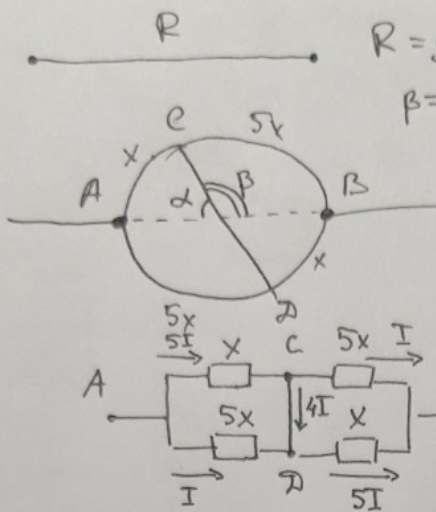
Ответ:  $Q_1 = 22999 \text{ Дж}$ ;  $H = 0,4 \text{ м}$

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Циркуит 5.

Радиус 10 см

$R = 24 \text{ Ом}$   
 $U = 6 \text{ В}$   
 $\alpha = 30^\circ$   
 $I = \frac{2}{3} \text{ А}$   
 $P_1 = ?$   
 $\eta = ?$   
 $P_2 = ?$



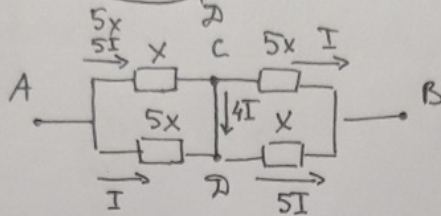
$$R = \rho \frac{l}{S}$$

$$\beta = 180 - \alpha = 180 - 30 = 150$$

$$\frac{AC}{CB} = \frac{30}{150} = \frac{1}{5}, \text{ тогда пусть } y = 10x$$

$$AC = x, \quad CB = 5x = AP$$

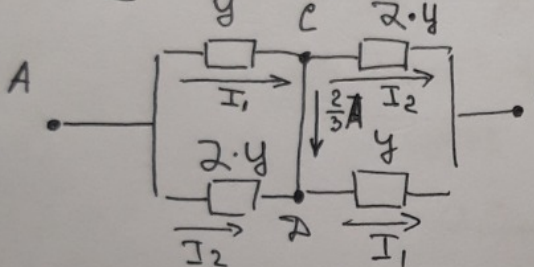
$$R = 12x \Rightarrow x = \frac{R}{12} = 2 \text{ Ом}$$



$$5Ix + 5Ix = U \Rightarrow I = \frac{U}{10 \cdot x} = \frac{6}{10 \cdot 2} = 0,3 \text{ А}$$

$$I_{\text{общ}} = 6I = 6 \cdot 0,3 = 1,8 \text{ А}$$

$$(P = U \cdot I_{\text{общ}} = 6 \cdot 1,8 = 10,8 \text{ Вт})$$



Пусть  $y < 2 \cdot y$

$$I_1 = I + I_2$$

$$I_1 \cdot y = I_2 \cdot 2 \cdot y$$

$$I_1 = I_2 \cdot 2$$

$$U = I_2 \cdot y \cdot 2 + I_1 \cdot y = 2I_2 \cdot y$$

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

$$R = 2y + 2 \cdot y = 24$$

$$2(y + 2y) = 24 \Rightarrow y + 2y = 12$$

$$\begin{cases} I_2 \cdot 2 = \frac{2}{3} + I_2 \\ U = 2I_2 \cdot y \\ y + 2y = 12 \end{cases}$$

$$\begin{cases} I_2 \cdot 2 = \frac{2}{3} + I_2 \\ y = \frac{U}{2I_2} \\ \frac{U}{2I_2} + 2 \frac{U}{2I_2} = 12 \end{cases}$$

$$\begin{cases} I_2 \cdot 2 = \frac{2}{3} + I_2 \\ y = \frac{U}{2I_2} \\ U + 2U = 24I_2 \Rightarrow I_2 = \frac{U(1+2)}{24} \end{cases}$$

$$\Rightarrow \frac{U(1+2)}{24} \cdot 2 = \frac{2}{3} + \frac{U(1+2)}{24}$$

$$\frac{2(1+2)}{4} = \frac{2}{3} + \frac{(1+2)}{4} \cdot 12$$

$$3 \cdot 2(1+2) = 8 + 3 + 3 \cdot 2$$

$$3 \cdot 2 + 3 \cdot 2 = 8 + 3 + 3 \cdot 2$$

$$3 \cdot 2^2 = 11 \Rightarrow 2 = \sqrt{\frac{11}{3}} \approx 1,915$$

$$\Rightarrow \eta = \frac{2 \cdot y}{y} = 2 = 1,915$$

$$\Rightarrow I_2 = 0,73 \text{ А}; \quad I_1 = I_2 \cdot 2 = 0,73 \cdot 1,915 = 1,4 \text{ А}$$

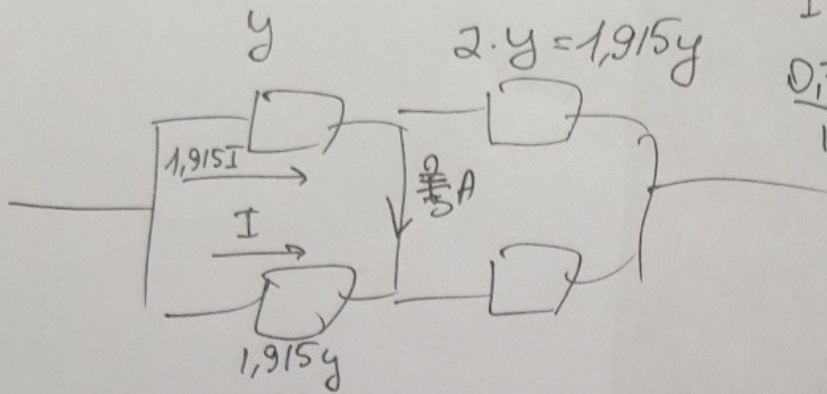
$$I_{\text{общ}2} = I_1 + I_2 = 2,13 \text{ А}$$

2

$$(P_2 = I_{\text{общ}2} \cdot U = 2,13 \cdot 6 = 12,78 \text{ Вт})$$

Ответ:  $P = 10,8 \text{ Вт}$ ;  $\eta = 1,915$ ;  $P_2 = 12,78 \text{ Вт}$

Черновик

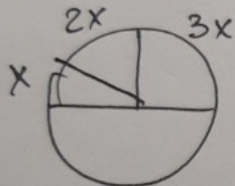


$$I = 0,73A$$

$$\frac{0,73 + \frac{2}{3}}{1,39666} = \frac{0,73 \cdot 1,915}{1,39666} \approx 1,39795$$

$$R = \frac{U}{I}$$

$$P = \frac{U^2}{R} = \frac{U^2}{\frac{U}{I}} = UI$$



$$V_B = \frac{m_B}{g_B} = \frac{5,5 \cdot 10^{-3}}{10^3} \approx 0$$

$$\frac{473 \cdot 5,5 \cdot 10^{-3} \cdot 2200 + 5,5 \cdot 10^{-3} \cdot 2,26 \cdot 10^6}{49973}$$

18 <sup>2</sup> мкс

$$0,5 \cdot 10^7$$

$$50000$$

$$p_0 g h = 2,5 \cdot 0,4$$

$$50000 \cdot 0,4$$

$$500 \cdot 10^{-4} \cdot 10^5 \cdot 0,4 = \frac{15}{18} 8151 \cdot 786$$

$$0,04$$