Часть 1

Олимпиада: **Физика, 9 класс (1 часть)**

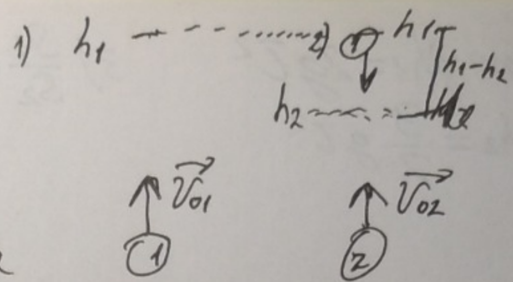
Шифр: **21205518**

ID профиля: **878263**

Вариант 1

$\boxed{1}$ $\boxed{\text{Чистовик}}$

$v_{01} = v_{02} = v_0$



$\boxed{\text{Дано: } \tau}$

t – время подъёма первого мяча

2)
$$h_1 - h_2 = v_0 t - \frac{gt^2}{2} - v_0\tau + \frac{g\tau^2}{2} = \frac{g\tau^2}{2}$$

1) $h_1 = v_0 t - \frac{gt^2}{2}$

$h_2 = v_0\tau - \frac{g\tau^2}{2}$

$h_1 - h_2 = \frac{g\tau^2}{2}$ → свободное падение 1ого мяча до столкновения

$$v_0 t - \frac{gt^2}{2} = v_0\tau$$

$h_1 = v_0\tau$

3) $\underbrace{v_к^2}_{=0} - v_н^2 = -2gh_1$

$v_0^2 = 2gh_1$

$h_1 = \frac{v_0^2}{2g}$

4) $v_0\tau = \frac{v_0^2}{2g}$

$\tau = \frac{v_0}{2g}$ | $v_0 = 2g\tau$

⇓

$$h_2 = v_0\tau - \frac{g\tau^2}{2} = 2g\tau^2 - \frac{g\tau^2}{2} = \frac{4g\tau^2 - g\tau^2}{2} = \frac{3}{2}g\tau^2$$

$$h_1 = \frac{(2g\tau)^2}{2g} = \frac{4g^2\tau^2}{2g} = 2g\tau^2$$

5) $S_1 = h_1 + (h_1 - h_2)$

$S_2 = h_2$

$$\frac{S_1}{S_2} = \frac{2h_1 - h_2}{h_2} = \frac{4g\tau^2 - \frac{3}{2}g\tau^2}{\frac{3}{2}g\tau^2} = \frac{4 - \frac{3}{2}}{\frac{3}{2}} = \frac{2,5}{1,5} = 1,667$$

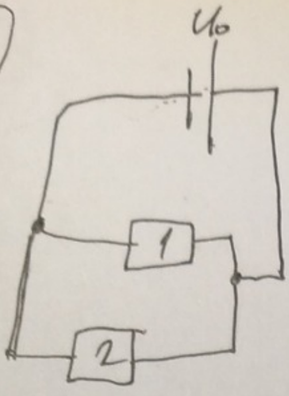
Ответ: 1) $h_1 = 2g\tau^2$ 2) $h_2 = \frac{3}{2}g\tau^2$

3) $\frac{S_1}{S_2} = 1,667$

Чистовик

3

1)



$R_{12}^{-1} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R}$

$R_{1,2} = \frac{R}{2}$

$U_1 = U_2 = U_0$

$I = I_1 + I_2$

$P_1 = \frac{U_0^2}{R}$

$R = \frac{U_0^2}{P_1} = \frac{12^2\,В^2}{20\,Вт} = \frac{144}{20} = 7,2\,Ом$

$R_{1,2} = 3,6\,Ом = \frac{R}{2}$

$I_0 = \frac{U_0}{R_{1,2}}$

$= \frac{12\,В}{3,6\,Ом} = 3,33\,A$

$R_1 = R_2$

$\Downarrow$

$I_1 = I_2 = \frac{I_0}{2}$

$\boxed{I_1 = I_2 = 1,667\,A}$

1) Ответ: 1,667А

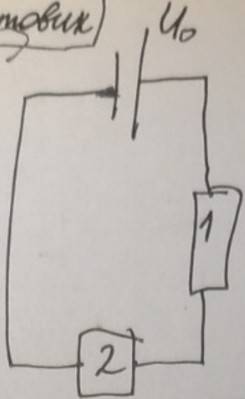
сопротивление каждой лампочки — R

$U_0 = 12\,В$

$P_1 = 20\,Вт$

$P_2 = 6,6\,Вт$

2)



$\boxed{R_0 = R_1 + R_2 = 2R}$

$\cancel{I = \frac{U_0}{2R} = \frac{12\,В}{14,4\,Ом} = 0,833\,A}$

$\cancel{I_1 = I_2 = 0,833\,A}$

$I_1 = I_2 = I$

$P_2 = I^2 R$

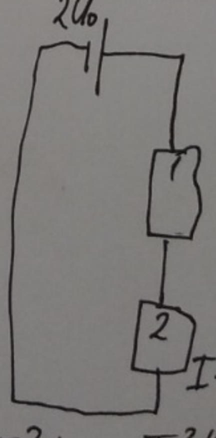
$\boxed{R = 7,2\,Ом}$ — из случая с параллельным соединением

$I = \sqrt{\frac{P_2}{R}} = \sqrt{\frac{6,6\,Вт}{7,2\,Ом}} =$

$= 0,957\,A = I_1 = I_2$

2) Ответ: 0,957А

3)



$R_1 = R_2 = R$

$R_0 = R_1 + R_2 = 2R$

$I = \frac{2U_0}{2R} = \frac{U_0}{R} = 1,667\,A$

$\boxed{R = 7,2\,Ом}$

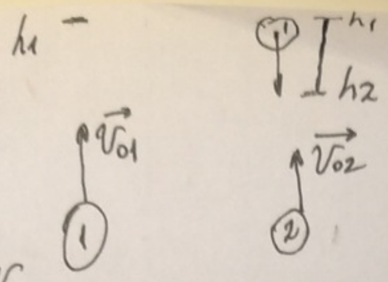
$I = I_1 = I_2 = 1,667\,A$

$P_1 = I_1^2 R_1 = I^2 R = 20\,Вт$

$P_2 = I_2^2 R_2 = I^2 R = 20\,Вт$

3) Ответ: $P_1 = 20\,Вт$, $P_2 = 20\,Вт$

1



черновик

$\cancel{v_{2\tau} = v_{02} - g\tau}$

$$h_2 = v_0\tau - \frac{g\tau^2}{2}$$

$v_{01} = v_{02} = v_0$

t – время подъема первого мяча

$$h_1 = v_0 t - \frac{gt^2}{2}$$

$$h_1 - h_2 = \frac{g\tau^2}{2} \qquad v_0^2 - 0^2 = 2gh_1$$

$$h_1 = \frac{v_0^2}{2g}$$

$$h_1 = \frac{v_0^2}{2g}$$

$$h_1 = v_0\tau$$

$$v_0\tau = \frac{v_0^2}{2g}$$

$$2g\tau = v_0$$

$$h_1 - h_2 = v_0 t - \frac{gt^2}{2} - v_0\tau + \frac{g\tau^2}{2} = \frac{g\tau^2}{2}$$

$$v_0 t - \frac{gt^2}{2} = v_0\tau$$

$$h_1 = v_0\tau$$

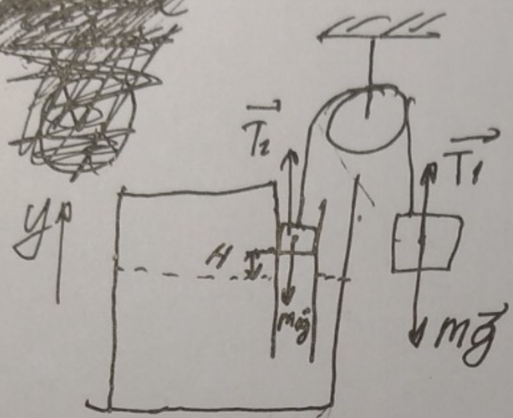
$$S_1 = h_1 + (h_1 - h_2) = v_0\tau + \frac{g\tau^2}{2}$$

$$S_2 = v_0\tau - \frac{g\tau^2}{2}$$

$$\frac{S_1}{S_2} = \frac{v_0\tau + \frac{g\tau^2}{2}}{v_0\tau - \frac{g\tau^2}{2}} = \frac{v_0 + \frac{g\tau}{2}}{v_0 - \frac{g\tau}{2}} = \frac{2v_0 + g\tau}{2v_0 - g\tau}$$

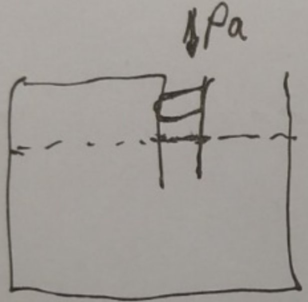
$$\boxed{\frac{S_1}{S_2} = \frac{2v_0 + g\tau}{2v_0 - g\tau}}$$

$\boxed{2}$



$T_1 = T_2 = T$

масса поршня — m_1



$F_{атм} = p_A \cdot S = 10^5\,Па \cdot 8 \cdot 10^{-4}\,м^2 =$

$= 80\,Н$

$m_1\vec{g} + \vec{F}_{атм} + \vec{F}_c + \vec{T}_2 = 0$

$M\vec{g} + \vec{T}_1 = 0$

$y: -m_1 g - F_{атм} + F_c + T = 0$

$-Mg + T = 0$

Часть 2

Олимпиада: **Физика, 9 класс (2 часть)**

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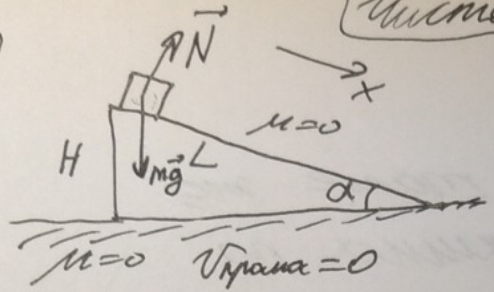
Вариант 1

(Чистовик)

$\boxed{4}$



$\cos\alpha = \frac{4}{5}$

$F_{тр_1} = 0$

$F_{тр_2} = 0$

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

$\sin\alpha = \sqrt{1-\frac{16}{25}} = \sqrt{\frac{9}{25}} = \frac{3}{5}$

$L = \frac{H}{\sin\alpha} = \frac{5H}{3}$

1) $\cancel{mg\sin\alpha}$ $m\vec{g} + \vec{N} = m\vec{a}$

y: $N = -mg$

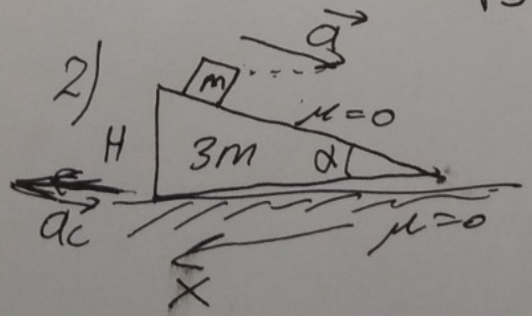
x: $mg\cdot\sin\alpha = ma$

$a = g\cdot\sin\alpha = \frac{10\,м/с^2\cdot 3}{5} = 6\,м/с^2$

$L = \overset{=0}{v_0}t + \frac{at^2}{2} = \frac{at^2}{2}$

$t = \sqrt{\frac{2L}{a}} = \sqrt{\frac{2\cdot 5H}{3\cdot 6\,м/с^2}} = \sqrt{\frac{5H}{9}} = \frac{\sqrt{5H}}{3}$ с.

2)



a – ускорение шайбы относительно клина (найдено в предыдущем пункте)

$a_x = a\cos\alpha = \frac{6\,м/с^2\cdot 4}{5} = \frac{24}{5}\,м/с^2$

$v_x = \overset{=0}{v_{0x}} + a_x t =$

$= a_x t = \frac{24\sqrt{5H}}{5\cdot 3} = \frac{8\sqrt{5H}}{5}$

Из закона сохранения импульса:

$\Delta p_ш = m v_x$

$\Delta p_с = 3m\Delta v$

$\Delta p_ш = \Delta p_с$

$m v_x = 3m\Delta v$

$\Delta v = \frac{v_x}{3} = \frac{8}{5}\,м/с$

$a_с = \frac{\Delta v}{\Delta t} = \frac{8\cdot\sqrt{5H}}{5\cdot 3} = \frac{8\sqrt{5H}}{15}$

Чистовик

(4) (продолжение)

3) время будет такое же, т.к. движение клина по горизонтали не влияет на свободное скольжение шайбы.

$t'' = \frac{\sqrt{5H}}{3}$

Ответ: 1) $t = \frac{\sqrt{5H}}{3}$ 2) $a_c = \frac{8\sqrt{5H}}{15}$

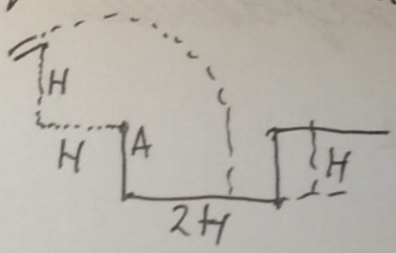
3) $t'' = \frac{\sqrt{5H}}{3}$

5

Чистовик

S – площадь сечения шланга v – скорость воды

t – время наполнения

1) 

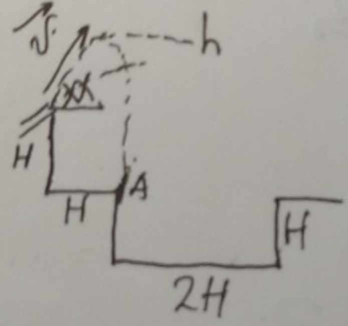
$R = H$

$S_g = \pi R^2 = \pi H^2$

$V = H \cdot S = \pi H^3$

$$v \cdot t \cdot S = \pi H^3$$

$$t = \frac{\pi H^3}{v \cdot S} = \frac{\pi H^3}{S\sqrt{0{,}5gH}}$$

2) 

τ – время падения струи.

h – высота подъема струи.

подъема

I $v_{0x} = v \cdot \cos\alpha$

$v_{0y} = v \cdot \sin\alpha$

$v_x \tau = H$

$\tau v \cos\alpha = H$

II $v\sin\alpha = -g t_1$ | III $(v\sin\alpha)^2 - \overset{=0}{v_k^2} = 2gh$

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

IV $H + h = \frac{g t_2^2}{2}$

$t_1 + t_2 = \tau$

V
$$\begin{cases} v \cdot \sin\alpha = -g t_1 \\ H + h = \frac{g t_2^2}{2} \\ t_1 + t_2 = \tau \\ v(\cos\alpha)\tau = H \end{cases}$$

$t_1 = \frac{v \cdot \sin\alpha}{g}$

~~$t_2 = $~~ $t_2 = \sqrt{\frac{2(H+h)}{g}}$

$\tau = \frac{H}{v\cos\alpha}$

$\tau = t_1 + t_2$

$$\frac{v \cdot \sin\alpha}{g} + \sqrt{\frac{2(H+h)}{g}} = \frac{H}{v\cos\alpha}$$

$\boxed{5}$ (продолжение) $\boxed{\text{Чистовик}}$

VI из закона сохранения энергии:

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

$$v_к = \sqrt{2gH + v^2}$$

$\cancel{v_к \cdot \sin\alpha = g t_2}$

$\cancel{v \cdot \sin\alpha =}$

$$v_к \cdot \cos\beta \cdot t_2 = \frac{H}{2} \qquad v_к \cdot \sin\beta = g t_2$$

$$v \sin\alpha = g t_1 \qquad \cancel{tg\beta t_2 =}$$

$\cancel{v_к \cos\beta = v_к \sin\beta t_2 = 2}$

3) аналогично пункту 2:

$$\begin{cases} v \cdot \sin\gamma = g t_3 \\ H + h_1 = \frac{g t_4^2}{2} \\ t_3 + t_4 = \tau_1 \\ v \tau_1 \cos\gamma = H + 2H = 3H \end{cases}$$

Из закона сохранения энергии:

$$mgH + \frac{mv^2}{2} = \frac{mv_{к_1}^2}{2}$$

$$v_{к_1} = \sqrt{2gH + v^2}$$

$$\boxed{\text{Ответ: 1) } t = \frac{\pi H^3}{S\sqrt{0{,}5gH}}}$$

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5 (продолжение) ~~[illegible]~~ Черновик

Из закона сохранения энергии:

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

$$v_к = \sqrt{2gH + v^2}$$

$v_к \cdot \sin\alpha = gt_2$ $\quad \frac{v_к}{v} = \frac{t_2}{t_1}$

$v \cdot \sin\alpha = gt_1$ $\quad vt_2 = v_к t_1$

$\sin\alpha (v_к + v) = \cancel{gt} \; g\tau$ $\quad t_2 = \frac{v_к t_1}{v}$

$\frac{\sin}{\cos} = tg$ $\quad \frac{\cos}{\sin} = ctg$ $\quad \sin$

$$\boxed{\sin\alpha (v_к + v) = \frac{gH}{v \cdot \cos\alpha}}$$ ~~$\cdot \cos\alpha$~~

ф-ла 2 угла:

~~$\sin\alpha \cdot \cos\alpha = \frac{gH}{v(v_к+v)} \cdot \cos\alpha$~~

$$\sin\alpha \cdot \cos\alpha = \frac{\sin 2\alpha}{2}$$

~~$\sin\alpha \cdot \sqrt{1 - \sin^2\alpha} = \frac{gH}{v(v_к+v)}$~~

~~$\sin 60 \cdot \cos 60 = \sin$~~

$$\sin 30 \cdot \cos 30 = \frac{\sin 60}{2}$$

~~$\sin\alpha (1 - \sin^2\alpha) = \frac{g^2H^2}{v^2(v_к+v)^2}$~~

~~$-\sin^3\alpha + \sin\alpha = \left(\frac{gH}{v(v_к+v)}\right)^2$~~

$$\sin 2\alpha = \frac{2gH}{v(v_к+v)} =$$

~~$tg\alpha (v_к + v) = \frac{gH}{v \cdot \cos^2\alpha}$~~

$$= \frac{2gH}{0{,}5gH + \sqrt{\cancel{2gH + 4\ldots}} \sqrt{3{,}5gH}\sqrt{0{,}5gH}} =$$

$$= \frac{2gH}{0{,}5gH \cdot \sqrt{2{,}5 \cdot 0{,}5 g^2H^2}} = \frac{2}{0{,}5\sqrt{2{,}5 \cdot 0{,}5}} =$$

$$= \frac{4}{\quad}$$

$$\sin\alpha = \frac{gt_1}{v}$$ Черновик.

$$t_1 = T - t_2 = \frac{H}{v\cos\alpha} - \sqrt{\frac{(H+h)2}{g}}$$

$$\sin\alpha = \frac{g\left(\frac{H}{v\cos\alpha} - \sqrt{\frac{(H+h)2}{g}}\right)}{v}$$

$$v = \sqrt{0{,}5gH}$$

$$\cos\alpha = \sqrt{1-\sin^2\alpha}$$

$$H = \frac{v^2}{0{,}5g}$$

$$\frac{gH}{v\cos\alpha} = g\sqrt{\frac{(H+h)2}{g}}$$

$$v\sin\alpha = \frac{gH - v\cos\alpha\, g\sqrt{\frac{(H+h)2}{g}}}{v\cos\alpha}$$

$$v^2\sin\alpha\cdot\cos\alpha = gH - v\cos\alpha\, g\left(\sqrt{\dots}\right)$$

$$\cancel{v^2\sin\alpha\cdot\cos\alpha + v\cdot\cos\alpha\, g\sqrt{\dots} = gH}$$

$$v\cdot\cos\alpha\cdot(t_1+t_2) = H$$

$$v\cos\alpha\cdot\left(\frac{v\sin\alpha}{g} + \sqrt{\frac{2(H+h)}{g}}\right)$$

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

$$v_k=\sqrt{2gH+v^2}$$

$$v_k=gt_2$$

$$\boxed{t_2=\frac{\sqrt{2gH+v^2}}{g}}$$

$$\tau-t_1=\frac{v_k t_1}{v}$$

$$v\tau-vt_1=v_k t_1$$

$$t_1=\frac{v\tau}{v+v_k}$$

$$v\cdot\sin\alpha=g\frac{v\tau}{v+v_k}$$

$$v\cdot\sin\alpha=\frac{gvH}{}$$

$$\frac{v_k+v}{tg}=\frac{gH\cdot\cancel{\cos^2\alpha}}{v\cdot\cancel{\cos\alpha}\cdot\sin^2\alpha}$$

$$\frac{8\sin^2\alpha}{\frac{\sin}{\cos}}$$

$$\frac{tg\,\alpha}{\tau}=\frac{gt_1}{H}$$

$$tg\,\alpha=\frac{g\tau t_1}{H}$$