Часть 1

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

Шифр: **21206438**

ID профиля: **845673**

Вариант 1

Чистовик Физика, 9 кл

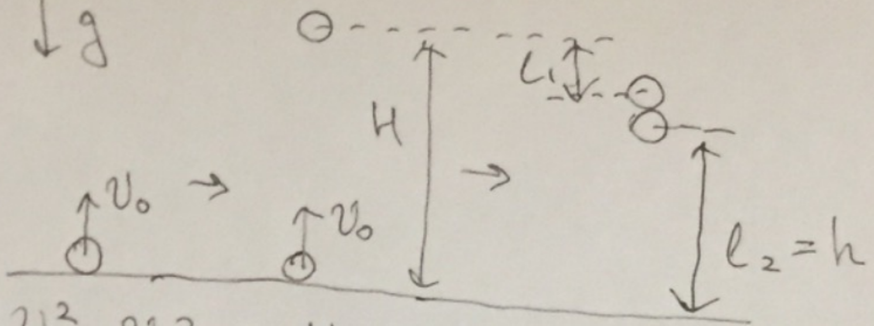
Задача 1.

Дано: τ

$H - ?$

$h - ?$

$l_1/l_2 - ?$



$v^2 = v_0^2 - 2gH \quad v = 0 \qquad \boxed{H = \frac{v_0^2}{2g}}$

$H = l_1 + l_2 \qquad \boxed{l_1 = \frac{g\tau^2}{2}} \qquad \boxed{l_2 = v_0\tau - \frac{g\tau^2}{2}}$

$H = v_0\tau - \frac{g\tau^2}{2} + \frac{g\tau^2}{2} \qquad \boxed{H = v_0\tau}$

$v_0\tau = \frac{v_0^2}{2g} \qquad v_0 = 2g\tau \qquad \boxed{H = 2g\tau^2}$

$h = l_2 = v_0\tau - \frac{g\tau^2}{2} = 2g\tau^2 - \frac{g\tau^2}{2} = \frac{3g\tau^2}{2}$

$\boxed{h = \frac{3}{2}g\tau^2} \qquad l_1 = \frac{g\tau^2}{2}, \ l_2 = \frac{3}{2}g\tau^2$

$\frac{l_1}{l_2} = \frac{g\cancel{\tau^2}}{\cancel{2}\cdot\frac{3}{\cancel{2}}g\cancel{\tau^2}} = \frac{1}{3} \qquad \boxed{l_1/l_2 = 1/3}$

Ответ: $H = 2g\tau^2$, $h = \frac{3}{2}g\tau^2$, $l_1/l_2 = 1/3$

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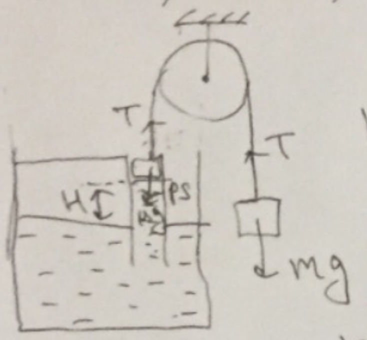
Задача 2.

Дано:

$S = 8\ см^2$, $M = 50\ г$, $H = 10\ см$

$p - ?$, $m - ?$, $h - ? \to \Delta m = 120\ г$



$$\boxed{p = p_0 + \rho g H = 101000\ Па = 1{,}01 \cdot 10^5\ Па}$$

$$T = mg$$

$$T = pS + Mg \quad mg = pS + Mg$$

$$\boxed{m = M + \frac{p_0 S}{g} + \rho S H = 8{,}13\ кг}$$

$$T = p'S + M'g \quad M' = M + \Delta m \quad p' = p_0 + \rho g h$$

$$mg = (p_0 + \rho g h)S + (M + \Delta m)g$$

$$p_0 + \rho g h = \frac{m - M - \Delta m}{S} g$$

$$h = \frac{m - M - \Delta m}{\rho S} - \frac{p_0}{\rho g} = -0{,}05\ м$$

Ответ: $p = p_0 + \rho g H = 101\ кПа$,

$$m = M + \frac{p_0 S}{g} + \rho S H = 8{,}13\ кг$$

$$h = \frac{m - M - \Delta m}{\rho S} - \frac{p_0}{\rho g} = -0{,}05\ м = -5\ см$$

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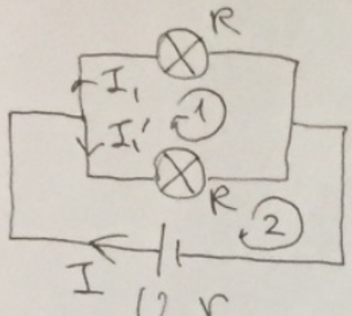
Задача 3.

Дано:

$U_0 = 12$ В, $P_1 = 20$ Вт, $P_2 = 6{,}6$ Вт

$I_1 - ?$, $I_2 - ?$, $P - ? \to U = 2U_0$



(1) $I_1 R = I_1' R \quad I_1 = I_1'$

$\underbrace{I = I_1 + I_1' = 2I_1}$

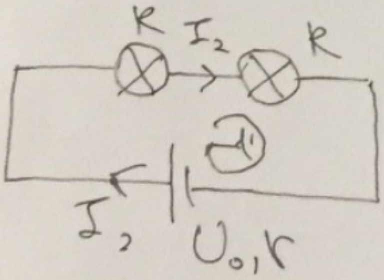
(2) $U_0 = Ir + I_1' R$

$U_0 = 2I_1 r + I_1 R$

$U_0 = I_1 (2r + R) \qquad I_1 = \dfrac{U_0}{2r + R}$

$P_1 = U_1 I_1 = I_1^2 R = \dfrac{U_0^2 R}{(2r+R)^2} \qquad P_1 = \dfrac{U_0^2 R}{(2r+R)^2}$

$2r + R = U_0 \sqrt{\dfrac{R}{P_1}} \qquad \underbrace{r = \dfrac{U_0 \sqrt{\frac{R}{P_1}} - R}{2}}$



(1') $U_0 = I_2 r + 2I_2 R$

$I_2 = \dfrac{U_0}{2R + r} \qquad P_2 = I_2 U_2 = I_2^2 R$

$P_2 = \dfrac{U_0^2 R}{(2R + r)^2} \qquad 2R + r = U_0 \sqrt{\dfrac{R}{P_2}} \qquad \underbrace{r = U_0 \sqrt{\dfrac{R}{P_2}} - 2R}$

$U_0 \sqrt{\dfrac{R}{P_2}} - 2R = \dfrac{U_0 \sqrt{\frac{R}{P_1}} - R}{2}$

$2U_0 \sqrt{\dfrac{R}{P_2}} - 4R = U_0 \sqrt{\dfrac{R}{P_1}} - R$

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Задача 3.

$$2U_0\sqrt{\frac{R}{P_2}} - 4R = U_0\sqrt{\frac{R}{P_1}} - R$$

$$3R = U_0\sqrt{R}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right) \qquad \sqrt{R} = \frac{U_0}{3}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)$$

$$\boxed{R = \frac{U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)^2}$$

$$r = U_0\sqrt{\frac{R}{P_2}} - 2R = \frac{U_0^2}{3}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\frac{1}{\sqrt{P_2}} - \frac{2U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)^2$$

$$r = \frac{U_0^2}{3}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{1}{\sqrt{P_2}} - \frac{4}{3\sqrt{P_2}} + \frac{2}{3\sqrt{P_1}}\right)$$

$$\boxed{r = \frac{U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{2}{\sqrt{P_1}} - \frac{1}{\sqrt{P_2}}\right)}$$

$$I_1 = \frac{U_0}{2r+R} = \frac{\cancel{U_0}}{\frac{2U_0^{\cancel{2}}}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{2}{\sqrt{P_1}} - \frac{1}{\sqrt{P_2}}\right) + \frac{U_0^{\cancel{2}}}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)^2} =$$

$$= \frac{1}{\frac{U_0}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{4}{\sqrt{P_1}} - \frac{2}{\sqrt{P_2}} + \frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)} =$$

$$= \frac{1}{\frac{U_0}{\cancel{9}_3}\cdot\frac{\cancel{3}}{\sqrt{P_1}}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)} = \frac{3\sqrt{P_1}}{U_0\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)}$$

$$\boxed{I_1 = \frac{3\sqrt{P_1}}{U_0\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)} = \frac{3P_1}{U_0\left(2\sqrt{\frac{P_1}{P_2}} - 1\right)}}$$

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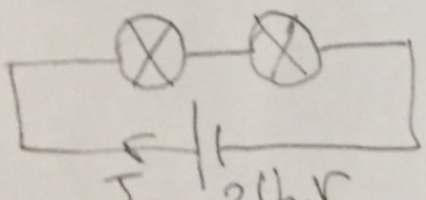
Задача 3.

$$I_2 = \frac{U_0}{r+2R} = \frac{U_0}{\frac{U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{2}{\sqrt{P_1}} - \frac{1}{\sqrt{P_2}}\right) + \frac{2U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)^2} =$$

$$= \frac{1}{\frac{U_0}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\cancel{\frac{2}{\sqrt{P_1}}} - \frac{1}{\sqrt{P_2}} + \frac{4}{\sqrt{P_2}} - \cancel{\frac{2}{\sqrt{P_1}}}\right)} =$$

$$= \frac{1}{\frac{U_0}{9} \frac{3}{\sqrt{P_2}}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)} = \frac{3\sqrt{P_2}}{U_0\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)}$$

$$\boxed{I_2 = \frac{3\sqrt{P_2}}{U_0\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)} = \frac{3P_2}{U_0\left(2 - \sqrt{\frac{P_2}{P_1}}\right)}}$$



$$P = I_0 U' = I_0^2 R$$

$$2U_0 = I_0 r + 2I_0 R \qquad I_0 = \frac{2U_0}{r+2R}$$

$$P = \frac{4U_0^2 R}{(r+2R)^2} \qquad P_2 = \frac{U_0^2 R}{(r+2R)^2}$$

$$\boxed{P = 4P_2}$$

Ответ: $I_1 = \frac{3P_1}{U_0\left(2\sqrt{\frac{P_1}{P_2}} - 1\right)} \approx 2A$,

$$\boxed{I_2 = \frac{3P_2}{U_0\left(2 - \sqrt{\frac{P_2}{P_1}}\right)} \approx 1{,}2 A}$$

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черновик

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

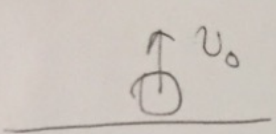
$v_0\tau = g\tau^2 \quad v_0 = g\tau \quad H = g\tau^2 - \frac{g\tau^2}{2} =$

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

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

O

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



$H = v_0\tau$

$P_1 = I_1^2 R \quad U_0 = I_1 R$

$I_1 = \frac{U_0}{R}$

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

$P_2 = I_2^2 R \quad U_0 = 2I_2R \quad I_2 = \frac{U_0}{2R}$

$P_2 = \frac{U_0^2}{4R} \quad R = \frac{U_0^2}{P_1}$

$P_2 = \frac{\cancel{U_0^2} P_1}{4\cancel{U_0^2}} = \frac{P_1}{4}$

$\rho g H + p_0 = Mg - T \quad T = mg \quad 9{,}75$

$S\rho g H + p_0 = Mg - mg \quad mg = M$

$m = M - \rho S H - \frac{p_0 S}{g}$

2 2 A

$U_0 = I_1 R \quad P_1 = I_1 U_1 \quad U_1 = U_0$

$P_1 = I_1 U_0 \quad I_1 = \frac{P_1}{U_0} = \frac{20}{12} = \frac{5}{3}$

$I_2 U_2 = P_2 \quad 2U_2 = U_0 \quad U_2 = \frac{U_0}{2}$

$\frac{I_2 U_0}{2} = P_2$

$I_2 = \frac{2P_2}{U_0} = \frac{\cancel{2}\cdot 6{,}6}{\cancel{20}\ \cancel{12}\ 6} = 1{,}1$

$\frac{3P_1\sqrt{P_2}}{U_0\left(2\sqrt{P_1} - \sqrt{P_2}\right)} =$

$2{,}2 \cdot R = 12$

$0{,}78 - 0{,}22$

$0{,}56$

$= \frac{3P_1}{U_0\left(2\sqrt{\frac{P_1}{P_2}} - 1\right)}$

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$U_0 = I_1(R+2r)$ $\quad P_1 = I_1 U_1 = I_1^2 R$ $\quad$ Черновик

$U_1 = I_1 R$ $\quad I_1 = \frac{U_0}{R+r}$ $\quad P_1 = \frac{U_0^2 R}{(R+r)^2}$

$P_2 = I_2^2 R$ $\quad U_0 = I_2(2R+r)$ $\quad P_2 = \frac{U_0 R}{(2R+r)^2}$

$$\sqrt{P_1}(R+r) = U_0\sqrt{R}$$

$$2r = U_0\sqrt{\frac{R}{P_1}} - R = U_0\sqrt{\frac{R}{P_2}} - 2R$$

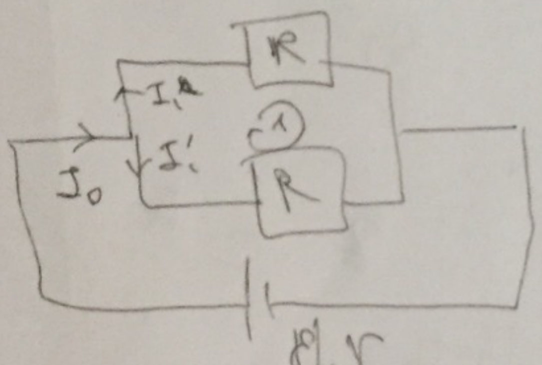
$$R = U_0\sqrt{R}\left(\frac{1}{\sqrt{P_1}} - \frac{1}{\sqrt{P_2}}\right)$$

$$\sqrt{R} = U_0\left(\frac{1}{\sqrt{P_1}} - \frac{1}{\sqrt{P_2}}\right)$$

$$U_0 = I_1(R+2r)$$

$$2U_0\sqrt{\frac{R}{P_2}} - 4R = U_0\sqrt{\frac{R}{P_1}} - R$$

$$3R = U_0\sqrt{R}\,($$



$I_1 R = I_1' R$

$I_1 = I_1'$

$I_0 = 2I_1$

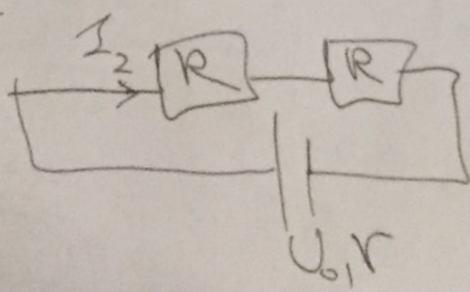
$U_0 = I_0 r + I_1 R$

$U_0 = I_1(R+2r)$

$I_1 = \frac{U_0}{R+2r}$

$$P_1 = U_1 I_1 = I_1^2 R = \frac{U_0^2 R}{(R+2r)^2}$$

$\mathcal{E}_2$



$U_0 = 2I_2R + I_2 r$

$U_0 = I_2(2R+r)$

$I_2 = \frac{U_0}{2R+r}$

Черновик

$H = v_0 t - \frac{gt^2}{2}$ $\quad v_0 - gt = 0 \quad v_0 = gt$

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

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

$Mg - T = S\rho g H + S p_0$

$T + \rho g H S + p_0 S = Mg$

$m = M - \rho H S - \frac{p_0 S}{2}$

$p_0 + \rho g H = p \quad pS = Mg - mg$

$m = M - \frac{pS}{g}$ $\quad T = p_0 S' + mg$

$Mg + p_0 S^L.$

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Черновик

$$P_2 = I_2^2 R = \frac{U_0^2 R}{(2R+r)^2} \qquad r = U_0\sqrt{\frac{R}{P_2}} - 2R$$

$$2r = U_0\sqrt{\frac{R}{P_1}} - R \qquad 2U_0\sqrt{\frac{R}{P_2}} - 4R = U_0\sqrt{\frac{R}{P_1}} - R$$

$$3R = U_0\sqrt{R}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)$$

$$\sqrt{R} = \frac{U_0}{3}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right) \qquad 0,79 - 0,22$$

$$R = \frac{U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)^2 \qquad 0,57$$

$\cancel{I_1}$ $r = U_0\sqrt{U_0}$

$$r = \frac{U_0^2}{3}$$

$$r = \frac{U_0^2}{3}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\frac{1}{\sqrt{P_2}} - \frac{2U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)^2$$

$\cancel{C1}$

$$r = \frac{U_0^2}{3}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{1}{\sqrt{P_2}} - \frac{4}{3\sqrt{P_2}} + \frac{2}{3\sqrt{P_1}}\right)$$

$$r = \frac{U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{2}{\sqrt{P_1}} - \frac{1}{\sqrt{P_2}}\right)$$

$$I_1 = \frac{U_0^2}{R + \frac{2U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{2}{\sqrt{P_1}} - \frac{1}{\sqrt{P_2}}\right)} =$$

$$= \frac{\cancel{U_0}}{\frac{U_0^{\cancel{2}}}{\cancel{9}\,3}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\cancel{\frac{2}{\sqrt{P_2}}} - \cancel{\frac{1}{\sqrt{P_1}}} + \frac{\cancel{4}\,3}{\sqrt{P_1}} - \cancel{\frac{2}{\sqrt{P_2}}}\right)}$$

$$I_1 = \frac{3\sqrt{P_1}}{U_0\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)}$$

Черновик

$$I_2 = \frac{U_0}{\frac{2U_0^2}{9}\left(\frac{2}{\sqrt{P_1}} - \frac{1}{\sqrt{P_1}}\right)^2 + \frac{U_0^2}{9}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{2}{\sqrt{P_1}} - \frac{1}{\sqrt{P_2}}\right)}$$

$$I_2 = \frac{}{\frac{U_0}{9_3}\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)\left(\frac{\cancel{8}}{\sqrt{P_2}} - \cancel{\frac{2}{\sqrt{P_1}}} + \cancel{\frac{2}{\sqrt{P_1}}} - \cancel{\frac{1}{\sqrt{P_2}}}\right)}$$

$$I_2 = \frac{3\sqrt{P_2}}{U_0\left(\frac{2}{\sqrt{P_2}} - \frac{1}{\sqrt{P_1}}\right)}$$

$$2U_0 = I(2R+r) \qquad I = \frac{2U_0}{2R+r}$$

$$P = I^2 R = \frac{4U_0^2}{(2R+r)^2} R$$

$$P_2 = \frac{U_0^2 R}{(2R+r)^2} \qquad P = 4P_2$$

$$\frac{g\tau^2}{2} + v_0\tau - \frac{g\tau^2}{2} = H \qquad H = v_0\tau$$

$$v_0\tau - \frac{g\tau^2}{2} = h \qquad v_0 = gt$$

$$v_0\tau = \frac{gt^2}{2} \qquad g\cancel{t}\tau = \frac{gt^{\cancel{2}}}{2}$$

$$\tau = \frac{t}{2}$$

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

$$t = 2\tau \qquad v_0 = 2g\tau$$

$$H = 2g\tau^2$$

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

$$\frac{h_1}{h_2} = \frac{\frac{g\tau^2}{\cancel{2}}}{\frac{3g\tau^2}{\cancel{2}}} = \frac{1}{3}$$

Часть 2

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

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Вариант 1

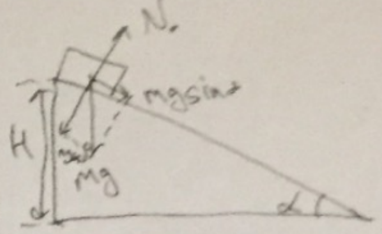
Чистовик Физика, 9 кл

Задача 4.

Дано:

$\cos\alpha = 4/5,\ H,\ m,\ M = 3m$

$t - ?,\ a_к - ?,\ \tau - ?$



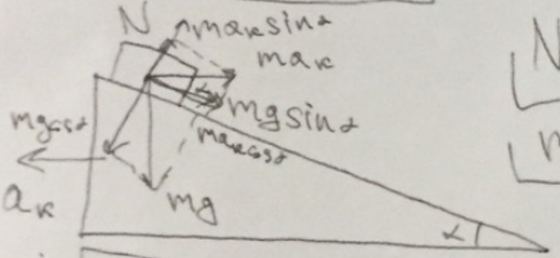
$mg\sin\alpha = ma$ $\quad \boxed{a = g\sin\alpha}$ $\quad \cos\alpha = \frac{4}{5}$

$\sin\alpha = \sqrt{1-\cos^2\alpha} = \sqrt{1-\frac{16}{25}} = \frac{3}{5}$ $\quad \boxed{\sin\alpha = 3/5}$

$\boxed{a = 3g/5}$ $\quad \frac{at^2}{2} = l$ $\quad \sin\alpha = \frac{H}{l}$ $\quad l = \frac{H}{\sin\alpha} = \frac{5H}{3}$

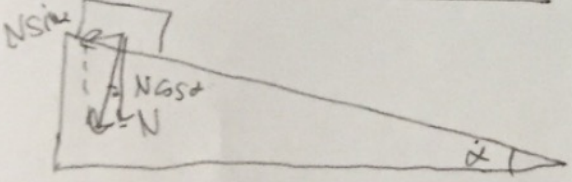
$\frac{5H}{3} = \frac{3gt^2}{2\cdot 5}$ $\quad t = \sqrt{\frac{2\cdot 5\cdot 5H}{3\cdot 3g}} = \frac{5}{3}\sqrt{\frac{2H}{g}}$

$\boxed{t = \frac{5}{3}\sqrt{\frac{2H}{g}}}$



$\boxed{N + ma_к\sin\alpha = mg\cos\alpha}$

$\boxed{mg\sin\alpha + ma_к\cos\alpha = ma_0}$



$\boxed{N\sin\alpha = Ma_к}$

$N = \frac{Ma_к}{\sin\alpha}$

$\frac{Ma_к}{\sin\alpha} + ma_к\sin\alpha = mg\cos\alpha$

$a_к = \frac{mg\cos\alpha\sin\alpha}{M + m\sin^2\alpha} = \frac{mg\,\frac{4}{5}\cdot\frac{3}{5}}{3m + m\frac{9}{25}} = \frac{\frac{12}{25}g}{\frac{84}{25}} = \frac{12}{84}g = \frac{g}{7}$

$\boxed{a_к = g/7}$ $\quad a_0 = g\sin\alpha + a_к\cos\alpha = \frac{3}{5}g + \frac{4}{5\cdot 7}g$

$a_0 = \frac{25}{35}g = \frac{5}{7}g$ $\quad \frac{a_0\tau^2}{2} = l = \frac{5H}{3}$ $\quad \tau = \sqrt{\frac{2\cdot 5H\cdot 7g}{3\cdot 5\,g}}$

$\tau = \sqrt{\frac{14H}{3g}}$

Ответ: $t = \frac{5}{3}\sqrt{\frac{2H}{g}},\ a_к = \frac{g}{7},\ \tau = \sqrt{\frac{14H}{g}}$

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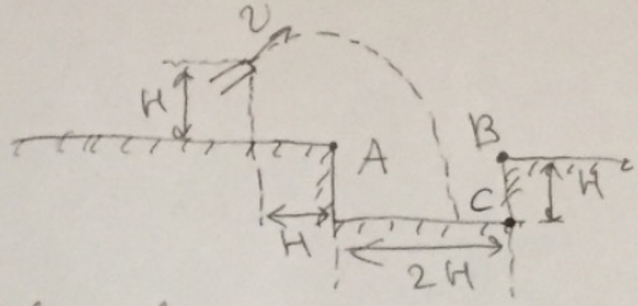
Задача 5.

Дано:

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

$\Delta t - ?,\ \alpha_A - ? \to A$

$tg\,\alpha - ?$



$$V=\pi R^2 h = \pi H^3 = Sl \qquad l = v\Delta t$$

$$\pi H^3 = Sv\Delta t \qquad \boxed{\Delta t = \frac{\pi H^3}{Sv} = \frac{\pi H^3}{S\sqrt{0{,}5gH}}}$$

$$v\cos\alpha\, t = H \qquad t = t_1+t_2+t_3 \qquad gt_1 = v\sin\alpha \qquad t_1 = \frac{v\sin\alpha}{g}$$

$$v\sin\alpha = gt_2 \qquad t_2 = \frac{v\sin\alpha}{g} \qquad v_y^2 = v^2\sin^2\alpha + 2gH$$

$$v_y = \sqrt{v^2\sin^2\alpha + 2gH} \qquad v_y = v\sin\alpha + gt_3$$

$$t_3 = \frac{\sqrt{v^2\sin^2\alpha + 2gH} - v\sin\alpha}{g} \qquad t = \frac{v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gH}}{g}$$

$$t = \frac{H}{v\cos\alpha} = \frac{v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gH}}{g}$$

$$\sqrt{v^2\sin^2\alpha + 2gH} = \frac{gH}{v\cos\alpha} - v\sin\alpha$$

$$v^2\sin^2\alpha + 2gH = \frac{g^2H^2}{v^2\cos^2\alpha} + v^2\sin^2\alpha - \frac{2gHv\sin\alpha}{v\cos\alpha}$$

$$0 = \frac{g^2H^2}{v^2}tg^2\alpha - 2gH\,tg\,\alpha + \frac{g^2H^2}{v^2} - 2gH$$

$$0 = \frac{gH}{v^2}tg^2\alpha - 2tg\,\alpha + \frac{gH}{v^2} - 2$$

$$tg\,\alpha = \frac{2 \pm \sqrt{4 - \frac{4gH}{v^2}\left(\frac{gH}{v^2} - 2\right)}}{\frac{2gH}{v^2}}$$

Задача 5. Чистовик Физика, 9 кл

$$tg\alpha = \frac{2 \pm \sqrt{4 - \frac{4gH}{v^2}\left(\frac{gH}{v^2} - 2\right)}}{\frac{2gH}{v^2}}$$

$$tg\alpha = \frac{2 \pm \sqrt{4 - \frac{4gH}{0{,}5gH}\left(\frac{gH}{0{,}5gH} - 2\right)}}{\frac{2gH}{0{,}5gH}}$$

$$tg\alpha = \frac{2 \pm \sqrt{4 - 8\cdot(2-2)}}{4} = \frac{2 \pm 2}{4}$$

$$tg\alpha_1 = \frac{2-2}{4} = 0 \qquad tg\alpha_2 = \frac{2+2}{4} = 1$$

$$\boxed{\alpha_{A_1} = 0^\circ,\ \alpha_{A_2} = 45^\circ}$$

$$v\cos\alpha_B t_B = 3H \qquad t_B = \frac{v\sin\alpha_B + \sqrt{v^2\sin^2\alpha_B + 2gH}}{g}$$

$$t_B = \frac{3H}{v\cos\alpha_B} = \frac{v\sin\alpha_B + \sqrt{v^2\sin^2\alpha_B + 2gH}}{g}$$

$$\sqrt{v^2\sin^2\alpha_B + 2gH} = \frac{3Hg}{v\cos\alpha_B} - v\sin\alpha_B$$

$$v^2\sin^2\alpha_B + 2gH = \frac{9H^2g^2}{v^2\cos^2\alpha_B} - \frac{6gHv\sin\alpha_B}{v\cos\alpha_B} + v^2\sin^2\alpha_B$$

$$0 = \frac{9H^2g^2}{v^2}tg^2\alpha_B - 6gH\,tg\alpha_B + \frac{9g^2H^2}{v^2} - 2gH$$

$$0 = \frac{9gH}{v^2}tg^2\alpha_B - 6\,tg\alpha_B + \frac{9gH}{v^2} - 2$$

$$\cancel{tg\alpha_B = 6 \pm \sqrt{36}}$$

$$tg\alpha_B = \frac{6 \pm \sqrt{36 - \frac{36gH}{v^2}\left(\frac{9gH}{v^2} - 2\right)}}{\frac{2\cdot 9gH}{v^2}} \cancel{= 6 \pm 6\sqrt{1 - \frac{gH}{0{,}5gH}\left(\frac{9gH}{0{,}5}\right)}}$$

2

Задача 5

$$tg\,\alpha_B = \frac{6 \pm \sqrt{36 - \frac{36gH}{v^2}\left(\frac{9gH}{v^2} - 2\right)}}{\frac{2\cdot 9gH}{v^2}}$$

$$tg\,\alpha_B = \frac{6 \pm \sqrt{36 - \frac{36gH}{0{,}5gH}\left(\frac{9gH}{0{,}5gH} - 2\right)}}{\frac{2\cdot 9gH}{0{,}5gH}}$$

$$tg\,\alpha_B = \frac{6 \pm \sqrt{36 - 16\cdot 36}}{36} = \frac{6 \pm \sqrt{-540}}{36}$$ невозможно!

~~Значит нужно рассмотреть случай когда вода проходит плоскость точки A через~~ $t = \frac{2v\sin\alpha}{g}$ ~~время.~~

~~Рассмотрим случай для C~~

$$v\cos\alpha\, t_c = 3H \qquad t_c = \frac{v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2g\cdot 2H}}{g}$$

$$t_c = \frac{v\sin\alpha + \sqrt{v^2\sin^2\alpha + 4gH}}{g} = \frac{3H}{v\cos\alpha}$$

$$v^2\sin^2\alpha + 4gH = \frac{9g^2H^2}{v^2\cos^2\alpha} - 6gH\,tg\,\alpha + v^2\sin^2\alpha$$

$$0 = \frac{9gH}{v^2}tg^2\alpha - 6\,tg\,\alpha + \frac{9gH}{v^2} - 4$$

$$tg\,\alpha = \frac{6 \pm \sqrt{36 - \frac{36gH}{v^2}\left(\frac{9gH}{v^2} - 4\right)}}{\frac{2\cdot 9gH}{v^2}}$$

$$tg\,\alpha = \frac{6 \pm \sqrt{36 - \frac{36gH}{0{,}5gH}\left(\frac{9gH}{0{,}5gH} - 4\right)}}{}$$

3

~~Ответ~~: $\cancel{\alpha = \pi H}$

Ответ: $\Delta t = \frac{\pi H 3}{5\sqrt{0{,}5gH}}$, $\alpha_{A_1} = 0°$; $\alpha_{A_2} = 45°$;

$\cancel{0 \le 45}$: $0 \le tg\,\alpha \le 45°$

~~$v\cos\alpha\, t = 4h$~~

~~$t = v\sin\alpha + \sqrt{v^2\sin^2\alpha}$~~

Черновик

$$t = \frac{v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gh}}{} = \frac{\frac{\sqrt{0{,}5gh}}{2} + \sqrt{\frac{1}{4}\cdot\frac{1}{4}gh + 2gh}}{2} =$$

$$= \frac{\frac{\sqrt{0{,}5gh}}{2} + \frac{3}{4}\sqrt{gh}}{2} = \frac{\sqrt{gh}}{gh}\left(\sqrt{0{,}5} + \frac{3}{2}\right)$$

$$\frac{\sqrt{0{,}5gh}\cdot\sqrt{3}}{2}\sqrt{\frac{h}{g}}\frac{1}{4}\left(0{,}5 + \frac{3}{2}\right)) = l$$

$$\frac{h\cdot\sqrt{3\cdot 0{,}5}}{8}\left(0{,}5 + \frac{3}{2}\right)$$

$$\frac{h\cdot\sqrt{3\cdot 0{,}5}}{4}$$

$v\cos\alpha\, t = l$

$$t = \frac{2v\sin\alpha}{g} \qquad t = \frac{v\sin\alpha}{g} + \frac{\sqrt{v^2\sin^2\alpha + 2gh}}{g}$$

$$\frac{v^2\sin 2\alpha}{2g} + \frac{\sqrt{v^2\sin^2\alpha + 2gh}}{g} = l$$

$$l = \frac{0{,}5gh\cdot\sqrt{3}}{2\cdot 2g} + \frac{\sqrt{0{,}5gh\cdot\frac{1}{4} + 2gh}}{g}\sqrt{0{,}5gh}\cdot\frac{\sqrt{3}}{2}$$

$$l = \frac{\sqrt{3}h}{8} + \frac{\sqrt{\frac{17}{2}}}{2}\cdot\frac{\sqrt{3}}{2}\cdot\sqrt{0{,}5}$$

$$l = \frac{\sqrt{3}}{8}h + \frac{\sqrt{17}}{\sqrt{2}\cdot 4}\frac{\sqrt{3}\cdot 1}{\sqrt{2}}$$

$$l = \frac{\sqrt{3}}{8}\left(1 + \sqrt{17}\right)h$$

$0{,}6g$

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$v\cos\alpha\, t = 3H$ черновик

$$t = \frac{v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gH}}{g} = \frac{\sqrt{0{,}5gH}\sin\alpha + \sqrt{0{,}5gH\sin^2\alpha + 2gH}}{g}$$

$$\frac{v^2\sin\alpha\cos\alpha}{g} +$$

$$t = \frac{3H}{v\cos\alpha} \qquad \frac{v\sin\alpha}{g} + \sqrt{v^2\sin^2\alpha}$$

$$t = \sqrt{} \qquad t = \sqrt{\frac{H}{g}}\left(\sqrt{0{,}5}\sin\alpha + \cancel{\sqrt{0{,}5\sin\alpha/2}}\sqrt{0{,}5\sin^2\alpha + 2}\right)$$

$$t = \frac{3H}{v\cos\alpha} = \frac{3H}{\sqrt{0{,}5gH}\cos\alpha} = \sqrt{\frac{H}{g}}\frac{3\sqrt{2}}{\cos\alpha}$$

$$\frac{3\sqrt{2}}{\cos\alpha} = \sqrt{0{,}5}\ \frac{\sin\alpha}{\sqrt{2}} + \frac{\sqrt{4+\sin^2\alpha}}{\sqrt{2}}$$

$$\frac{3\cdot 2}{\cos\alpha} = \sin\alpha + \sqrt{4+\sin^2\alpha}$$

$$\frac{3\cdot 4}{\cos^2\alpha} - 4\,tg\,\alpha = 4 + \sin^2\alpha$$

$$4 + \quad -4 = 4 + \sin^2\alpha \qquad \sin^2\alpha = 0 \qquad \sin\alpha = 0 \quad \alpha = 0^\circ$$

$$v\cos\alpha \qquad \frac{v\sin\alpha}{g} \qquad v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gH} = \frac{3Hg}{v\cos\alpha}$$

$$v^2\sin^2\alpha + 2gH = \frac{9H^2g^2}{v^2\cos^2\alpha}$$

$$\cancel{12 + 8\,tg\,\alpha} = 4 + \sin^2\alpha$$

Черновик

$$tg\alpha = \frac{2 \pm \sqrt{4 - \frac{4gH}{v^2}\left(\frac{gH}{v^2} - 2\right)}}{\frac{2gH}{v^2}}$$

$$tg\alpha = \frac{v^2}{2gH}\left(2 \pm \sqrt{4 - \frac{4g^2H^2}{v^4} + \frac{8gH}{v^2}}\right)$$

$$tg\alpha = \frac{0,5}{2}\left(2 \pm \sqrt{4 - \frac{4}{0,25} + \frac{8}{0,5}}\right)$$

$$tg\alpha = \frac{1}{4}\left(2 \pm \sqrt{4 - \cancel{\frac{4\cdot 100}{4}}\cancel{16} + \cancel{16}}\right)$$

$$tg\alpha = \frac{1}{4}(2 \pm 2) \qquad tg\alpha_1 = 1 \quad tg\alpha_2 = 0$$

$vt = H$

$\frac{gt^2}{2} = H$

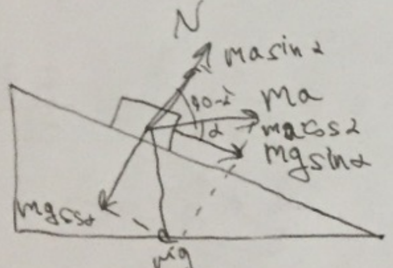
$$v\sqrt{\frac{2H}{g}} = H$$

$$\frac{v^2 \cdot 2}{g} = H$$

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

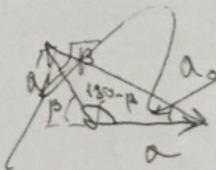
$N\cancel{\cos}$

$N\sin\alpha = Ma$



$mg\sin\alpha + ma\cos\alpha = ma_0$

$ma\sin\alpha + N = mg\cos\alpha$



$$\frac{a_0}{\sin\beta} = \frac{a'}{\sin\alpha}$$

$$ma\sin\alpha + \frac{Ma}{\sin\alpha} = mg\cos\alpha$$

$\cancel{ma\cos\beta\Delta t} =$

$ma\sin^2\alpha + Ma = mg\cos\alpha\sin\alpha$

$M v_x \cancel{\Delta t} = 3m v_x \cancel{\Delta t}$

$$a = \frac{mg\cos\alpha\sin\alpha}{M + m\sin^2\alpha}$$

$a'\cos\beta = 3a$

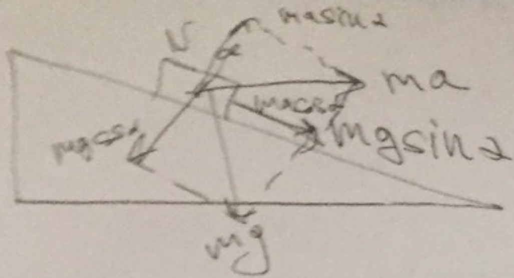
$ma'\cos\beta = Ma$

$$\frac{a_0}{\sin\beta} = \frac{Ma}{m\cos\beta\sin\alpha} \qquad a' = \frac{Ma}{m\cos\beta}$$

$$a_0 = \frac{Ma\,tg\beta}{m\sin\alpha}$$

$\cancel{\frac{Ma\,tg\beta}{m\sin\alpha}}$ $\cancel{tg\beta\sin\alpha\cos\alpha}$

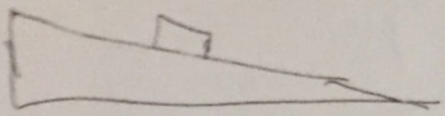
$\cancel{a_0 = g\sin\alpha + a\cos\alpha}$

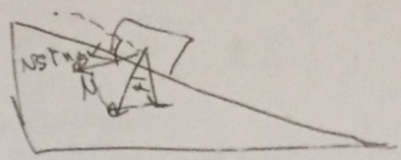


$$mg\sin\alpha + ma\cos\alpha = ma_0$$

$$ma\sin\alpha + N = mg\cos\alpha$$

$$N\sin\alpha = Ma$$





$$N = \frac{Ma}{\sin\alpha} \qquad ma\sin\alpha + \frac{Ma}{\sin\alpha} = mg\cos\alpha$$

$$a = \frac{mg\cos\alpha\sin\alpha}{m\sin^2\alpha + M} = \frac{g\,\frac{4}{5}\cdot\frac{3}{5}}{\frac{9}{25}+3}$$

$$a = \frac{12g}{84} = \frac{12}{84} = \frac{g}{7}$$

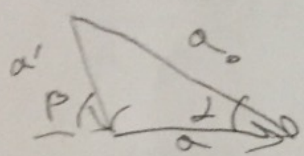
$$\boxed{a = \frac{g}{7}}$$

$$\cancel{a_0 = gs}$$

$$a_0 = g\sin\alpha + a\cos\alpha$$

$$a_0 = \frac{3g}{5} + \frac{4g}{7\cdot 5}$$

$$a' = \sqrt{a_0^2 + a^2 - 2a_0 a\cos\alpha}$$



$$a_0 = \frac{25g}{35} = \frac{5g}{7}$$

$$\frac{5g}{7}t^2 =$$

$$a' = \sqrt{\frac{25g^2}{49} + \frac{g^2}{49} - \frac{10g^2}{49}\cdot\frac{4}{5}}$$

$$a' = \sqrt{\frac{25+1-8}{49}}\,g = \frac{3}{7}\sqrt{2}\,g$$

$$\frac{a}{\sin\beta} = \frac{a'}{\sin\alpha} \qquad \sin\beta = \frac{a_0\sin\alpha}{a'} = \frac{\frac{5g}{7}\cdot\frac{3}{5}}{\frac{3}{7}\sqrt{2}\,g} = \frac{1}{\sqrt{2}}$$

$$\beta = 45^\circ$$

a'

$$\frac{\frac{1}{\sqrt{2}}\cdot\frac{3}{7}\sqrt{2}\,g\,\tau^2}{2} = H$$

Черновик

$$tg\alpha = \frac{6 \pm \sqrt{36 + \frac{72gH}{v^2} - \frac{324g^2H^2}{v^4}}}{\frac{18gH}{v^2}}$$

$$tg\alpha = 6 \pm \sqrt{36 + \frac{72}{0,5} - \frac{324}{0,25}}$$

$$\frac{v^2 \sin 2\alpha}{2g} + \frac{\sqrt{v^2\sin^2\alpha + 2gH}\, v\cos\alpha}{g} = l$$

$$\cancel{0,5} \cdot \frac{\sqrt{3}H}{8} + \frac{\sqrt{0,5gH \cdot \frac{3}{4} + 2gH} \cdot \sqrt{0,5gH}\, \frac{1}{2}}{g} = l$$

$$l = \frac{\sqrt{3}H}{8} + \frac{\sqrt{(\frac{3}{8} + 2)gH} \cdot \frac{1}{2}\sqrt{0,5}}{g} = l$$

$$l = \frac{\sqrt{3}H}{8} + \frac{\sqrt{19}}{8}$$

$$l = \frac{\sqrt{3}H}{8} + \frac{\sqrt{0,5 \cdot \frac{1}{4} + 2} \cdot \sqrt{0,5} \cdot \frac{1}{2}}{g} H$$

$$l = \frac{\sqrt{3}H}{8} + \frac{\sqrt{\frac{1}{8} + 2} \cdot \cancel{\sqrt{0,5}} \cdot \frac{1}{2}}{}$$

$$l = \frac{\sqrt{3}H}{8} + \frac{\sqrt{17}}{8}$$

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$v\cos\alpha\, t = H \qquad t = \frac{v\sin\alpha}{g} + \frac{\sqrt{v^2\sin^2\alpha + 2gH}}{g}$

$t = \frac{H}{v\cos\alpha} \qquad v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gH} = \frac{gH}{v\cos\alpha}$

$\cancel{v^2\sin^2\alpha - 2\,2\,4gH\,tg\alpha} =$

$v^2\sin^2\alpha + 2gH = \frac{g^2H^2}{v^2\cos^2\alpha} - 2gH\,tg\,\alpha + v^2\sin^2\alpha$

$2gH = \frac{g^2H^2}{v^2} + \frac{g^2H^2}{v^2}tg^2\alpha - 2gH\,tg\,\alpha$

$\cancel{tg\alpha = \frac{2gH \pm \sqrt{4g^2H^2}}{2}}$

$\frac{gH}{v^2}tg^2\alpha - 2tg\,\alpha + \frac{gH}{v^2} - 2 = 0$

$tg\alpha = \frac{2 \pm \sqrt{4 - \frac{4g^2H^2}{v^4} + \frac{8gH}{v^2}}}{\frac{2gH}{v^2}}$

$tg\alpha = \frac{2 \pm \sqrt{4 - \frac{4}{0{,}25} + \frac{8}{0{,}5}}}{\frac{2}{0{,}5}}$

$tg\alpha = 2 \pm \sqrt{4 - 16 + 16}$

$tg\alpha = \frac{(2 \pm 2)\cancel{4}}{4} \qquad tg\alpha = 0 \quad \alpha = 0$

$v\cos\alpha\, t = 3H \qquad \frac{3Hg}{v\cos\alpha} = v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gH}$

$2gH = \frac{9H^2g^2}{v^2\cos^2\alpha} - 6gH\,tg\alpha$

$0 = \frac{9g^2H^2}{v^2}tg^2\alpha - 6gH\,tg\alpha + \frac{9H^2g^2}{v^2} - 2gH$

$0 = \frac{9gH}{v^2}tg^2\alpha - 6tg\alpha + \frac{9Hg}{v^2} - 2$

$tg\alpha = \frac{6 \pm \sqrt{36 + \frac{72gH}{v^2} - \frac{324gH}{v^4}}}{\frac{18gH}{v^2}} \qquad 6 \pm \sqrt{36 + 72\cdot 4 - 324\cdot 4^2}$

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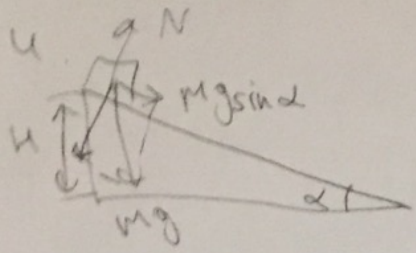
Черновик



$mg\cos\alpha = N$

$mg\sin\alpha = ma$

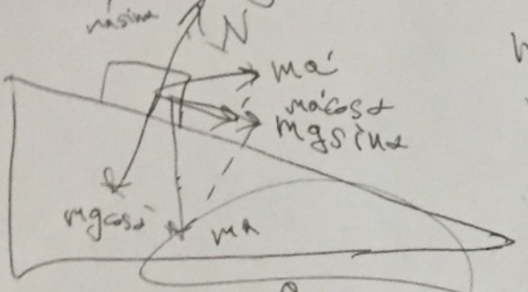
$a = g\sin\alpha$

$\frac{at^2}{2} = L = \frac{H}{\sin\alpha}$

$t = \sqrt{\frac{2H}{g\sin^2\alpha}}$ $\quad t = \sqrt{\frac{2H}{g}}\frac{1}{\sin\alpha}$

$\cos\alpha = \frac{4}{5}$ $\quad \sin\alpha = \sqrt{1-\frac{16}{25}} = \frac{3}{5}$

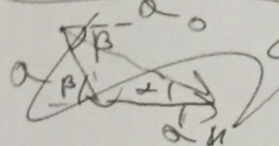
$t = \sqrt{\frac{2H}{g}}\frac{3}{5}$



$ma'\cos\alpha + mg\sin\alpha = ma_0$

$ma'\sin\alpha + N = mg\cos\alpha$

$N\cos\alpha$



$\cancel{a^2 = a_0^2 + a}$

$\cancel{a_0\cos\alpha = a}$

$\cancel{p_{0x} = p_x \quad 0 = ma}$

$a = \frac{a}{\sin\alpha} = \frac{a_0}{\sin\beta}$ $\quad a = \sqrt{a_0^2 + a'^2 - 2a_0a'\cos\alpha}$

$\sin\beta = \frac{a_0\sin\alpha}{a}$

$a\cos\beta = a'$

$\left(a_0^2 + a'^2 - 2a_0a'\cos\alpha\right)\left(1 - \frac{a_0^2\sin^2\alpha}{a^2}\right) =$

$= a'^2$

$\cancel{a_0^2 + a'^2 - 2a_0a'\cos\alpha - \frac{a_0^4\sin^2\alpha}{a^2}} -$

$\sqrt{a^2 - a_0^2\sin^2\alpha} = a'$

$a_0^2 + \cancel{a'^2} - 2a_0a'\cos\alpha - a_0^2\sin^2\alpha = \cancel{a'^2}$

$a \quad \cancel{2}\cancel{a_0}a'\cos\alpha = \cancel{2}a_0^{\cancel{2}}\cos^2\alpha$

$a' = a_0\cos\alpha$

$\cancel{v\Delta t}$

$\cancel{v\Delta t S g}$ Черновик

$$v\Delta t S = \pi H^2 \cdot H = \pi H^3$$

$$\Delta t = \frac{\pi H^3}{vS} \qquad H = v\sin\alpha\, t + \frac{gt^2}{2}$$

$$t = \frac{-v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gH}}{g}$$

$$v\cos\alpha\, t = H \qquad t = \frac{2v\sin\alpha}{g} + \sqrt{v^2}$$

$$t = \frac{v\sin\alpha + \sqrt{v^2\sin^2\alpha + 2gH}}{g}$$

$$\frac{v^2\cos\alpha\sin\alpha + v\sqrt{v^2\sin^2\alpha + 2gH}\cos\alpha}{g} = H$$

$\cancel{v^2\cos^2\alpha}$ $\cancel{\cos^2\alpha}$ $\cancel{v^2\sin^2\alpha}$

$$\cancel{v\cos} \quad gH - v\cos\alpha\sin\alpha = \sqrt{v^2\sin^2\alpha + 2gH}\cos\alpha$$

$$\frac{gH}{\cos\alpha} - v\sin\alpha = \sqrt{v^2\sin^2\alpha + 2gH}$$

$$\frac{g^2H^2}{\cancel{\cos^2\alpha}} - 2gHv\,tg\,\alpha + \cancel{v^2\sin^2\alpha} = \cancel{v^2\sin^2\alpha} + 2gH$$

$$\cancel{0 = g^2H^2}$$

$$\sqrt{v^2\sin^2\alpha + 2gH} = \frac{gH}{v\cos\alpha} - v\sin\alpha$$

$$\cancel{v^2\sin^2\alpha} + 2\cancel{g}\cancel{H} = \frac{g^2H^2}{v^2}(1 + tg^2\alpha) - 2\cancel{g}\cancel{H}\,tg\,\alpha + \cancel{v^2\sin^2\alpha}$$

$$\cancel{0 = g^2 H}$$

$$0 = \frac{gH}{v^2} + \frac{gH}{v^2}tg^2\alpha - 2\cancel{g}\,tg\,\cancel{\alpha} - 2$$

$$\cancel{tg\,\alpha = \frac{2 \pm \sqrt{4 + 8 - \frac{4gH}{v^2}}}{}}$$