Часть 1

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

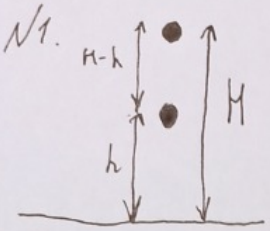
Шифр: **21205909**

ID профиля: **222510**

Вариант 1

Чистовик

№1.



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

$h = vt - \frac{gt^2}{2}$

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

$\frac{v^2}{2g} - vt + \frac{gt^2}{2} = \frac{gt^2}{2}$

$\frac{v^2}{2g} = vt \quad ; \quad v = 2gt$

1) $H = \frac{v^2}{2g} = \frac{4g^2t^2}{2g} = 2gt^2$

2) $h = vt - \frac{gt^2}{2} = 2gt^2 - \frac{gt^2}{2} = 1{,}5gt^2$

3) $H_1 = H + H - h = 2H - h = 4gt^2 - 1{,}5gt^2 = 2{,}5gt^2$

$\frac{H_1}{h} = \frac{2{,}5gt^2}{1{,}5gt^2} = \frac{5}{3}$

Ответ: 1) $2gt^2$

2) $1{,}5gt^2$

3) 5 к 3

(1)

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Чистовик

№2. Дано:

$S = 8\ см^2$

$m_1 = 50\ г$

$m_2 = 120\ г$

$H = 10\ см$

$g = 10\ м/с^2$

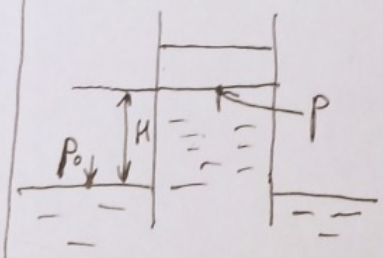
$p_0 = 100\ кПа$

$\rho = 1000\ \frac{кг}{м^3}$

1) $p - ?$

2) $m - ?$

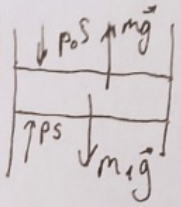
3) $h - ?$



1) $p = p_0 - \rho g H =$

$= 100000 - 1000 \cdot 10 \cdot 0{,}1 =$

$= 99000\ Па = 99\ кПа$



2) $p_0 S + m_1 g = mg + pS$

$m = \frac{S(p_0 - p)}{g} + m_1 = \rho S H + m_1 =$

$= 1\frac{г}{см^3} \cdot 8\ см^2 \cdot 10\ см + 50\ г = 130\ г$

3) $p_0 S + m_1 g + m_2 g = p' S + mg$

$p' = p_0 - \rho g h$

$p_0 S + m_1 g + m_2 g = p_0 S - \rho g h S + mg$

$\rho g h S = g(m - m_1 - m_2)$

$h = \frac{m - m_1 - m_2}{\rho S} = \frac{-40\ г}{1\frac{г}{см^3} \cdot 8\ см^2} = -5\ см$

поршень будет под водой

Ответ: 1) $p = 99\ кПа$

2) $m = 130\ г$

3) на 5 см ниже уровня воды

(2)

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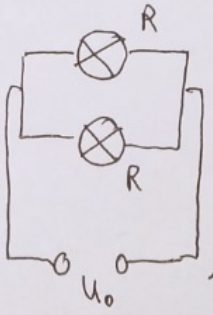
Чистовик

№3. Дано:
$U_0 = 12$ В
$P_1 = 20$ Вт
$P_2 = 6,6$ Вт
$U_2 = 2U_0$

1) I_1 – ?
2) I_2 – ?
3) P – ?

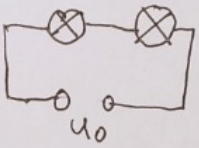


1) $P_1 = I_1 U_0$; $P_1 = \frac{U_0^2}{R} \Rightarrow R = 7,2$ Ом

$I_1 = \frac{P_1}{U_0} = \frac{20}{12} = \frac{5}{3} \approx 1,67$ А

2) $2P_2 = I_2 U_0$

$I_2 = \frac{2P_2}{U_0} = \frac{13,2}{12} = 1,1$ А



3) При последовательном соединении падение напряжения на лампочке будет U_0, и её сопротивление будет $R = 7,2$ Ом, и мощность будет $2P = \frac{(2U_0)^2}{2R}$; $P_2 = \frac{U_0^2}{R} = 20$ Вт

Ответ: 1) $I_1 = 1,67$ А
2) $I_2 = 1,1$ А
3) $P = 20$ Вт

(3)

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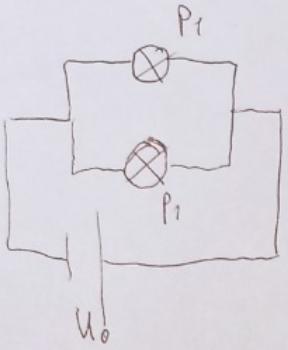
Черновик

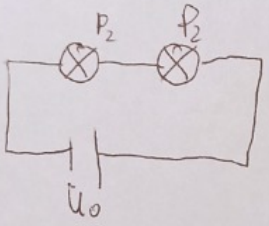


$U_0 = 12\,В$; $P_1 = 20\,Вт$; $P_2 = 6{,}6\,Вт$

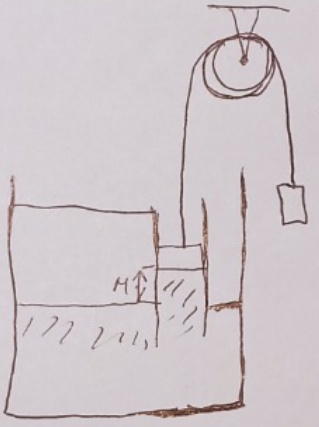
$P_1 = I_1 U_0$; $I_1 = \frac{P_1}{U_0} = \frac{20}{12} = \frac{5}{3} \approx 1{,}7\,А$

$R_1 = \frac{U_0}{I_1} = \frac{12 \cdot 3}{5} = \frac{36}{5} = 7{,}2\,Ом$

$P_2 = I_2^2 R_1$; $I_2 = \sqrt{\frac{P_2}{R_1}} = \sqrt{\frac{6{,}6}{7{,}2}} \approx 0{,}96\,А$



$$\frac{S(p_0 - p) + m_1 g = mg}{g}$$



$p_0 S + m_1 g + m_2 g = p_0 S - \rho g h S + mg$

$\rho g h S = g(m - m_1 - m_2)$

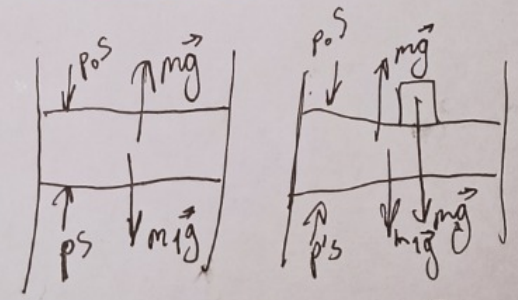
$h = \frac{m - m_1 - m_2}{\rho S}$

$\frac{U_0^2}{4R}$

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

$I_2 = \frac{2P_2}{U_0} = \frac{13{,}2}{12} = 1{,}1\,А$

$\frac{2P_2}{U_0}$



$P_2 = I_2^2$

$\frac{24^2}{14{,}4}$

$2P_2 = \frac{\chi U_0^2}{R}$

P_2

$mg + pS = m_1 g + p_0 S$

$m = \frac{S(p_0 - p) + m_1 g}{g} = \frac{S(p_0 - p)}{g} + m_1$

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Черновик

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

$H = \frac{v}{2} \cdot t$

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

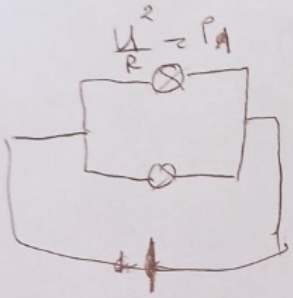
$H - h = \frac{g t^2}{2}$

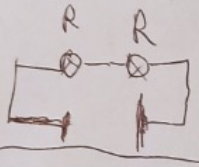
$I = \frac{U}{R}$

$P = I U_2$

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

$P = I^2 R$





$U_0 = 12 В$; $P_1 = 20 Вт$

$P_2 = 6,6 Вт$

$P = IU$

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

$\frac{5}{25}$ 3

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

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

$v = 2g\tau$

$H = \frac{4g^2\tau^2}{2g} = 2g\tau^2$

$h = 2g\tau^2 - \frac{g\tau^2}{2} = g\tau^2(2 - \frac{1}{2}) =$

$= 1,5 g\tau^2$

$H_1 = 2g\tau^2 + \frac{g\tau^2}{2} =$

$= g\tau^2(2 + \frac{1}{2}) = 2,5 g\tau^2$

$\frac{H_1}{h} = \frac{2,5 g\tau^2}{1,5 g\tau^2} = \frac{5}{3}$

$P = \frac{U_0^2}{R_{12}}$ $R_{12} = \frac{U_0^2}{P_1} = 7,2 Ом$

$I = \frac{U_0}{R} = \frac{12}{7,2} \approx 1,7 А$

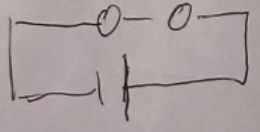
$R_0 = 7,2 Ом$

$\frac{20}{12}$ $\frac{20}{12}$ 1,3

$\frac{5}{3}$

$P_1 = I_1 U$; $I_1 = \frac{P_1}{U} \approx 1,7 А$

$P_2 = I_2^2 R$; $I_2 = \sqrt{\frac{P_2}{R}} \approx 0,96 А$



$P = \frac{U_0^2}{R} = 20 Вт$

$4g\tau^2 - 1,5$

2,5

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Часть 2

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

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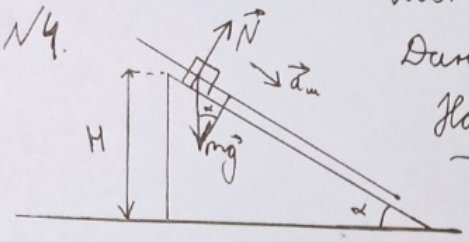
Вариант 1

Чистовик

№4.



Дано: $\cos\alpha = \frac{4}{5}$; m, $3m$; H

Найти: 1) t_1 - ? 2) a' - ? 3) t_2 - ?

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

$\frac{H}{l} = \frac{3}{5}$; $l = \frac{5}{3}H$

$mg\sin\alpha = ma_m$; $a_m = g\sin\alpha$

$l = \frac{a_m t_1^2}{2}$; $t_1 = \sqrt{\frac{2l}{a_m}} = \sqrt{\frac{10H}{3g\sin\alpha}}$

3) $mgH = \frac{mv^2}{2} + \frac{3mv^2}{2}$, где v - скор. клина

по ЗСИ: $mv = 3mv' \Rightarrow v' = \frac{v}{3}$ И тогда

$gH = \frac{v^2}{2}\left(1+\frac{1}{3}\right) = \frac{2}{3}v^2 \Rightarrow v = \sqrt{\frac{3gH}{2}}$

$t_2 = \frac{2S}{v} = \frac{2H\sqrt{2}}{\sin\alpha\sqrt{3gH}} = \sqrt{\frac{8H}{(1-\cos^2\alpha)3g}} = \frac{5}{3}\sqrt{\frac{8H}{3g}}$

2) Ускор. клина по ЗСИ: $v' = \frac{v}{3}$ в 3 р. меньше ускорения шайбы $a' = \frac{a_m}{3}$

$a_m = \frac{v_m}{t_m}$; м.к. $v_m = \sqrt{\frac{3gH}{2}}$; а $t_m = \frac{5}{3}\sqrt{\frac{8H}{3g}}$, то

$a_m = \frac{3}{5}\sqrt{\frac{3gH\cdot 3g}{2\cdot 8H}} = \frac{9}{20}g$

$a' = \frac{a_m}{2} = \frac{3}{20}g$

(1)

Ответ: 1) $\sqrt{\frac{10H}{3g\sin\alpha}}$

2) $\frac{3}{20}g$

3) $\frac{5}{3}\sqrt{\frac{8H}{3g}}$

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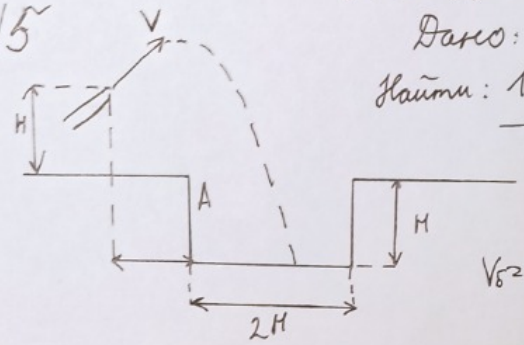
Чистовик

№5



Дано: S, H; $V = \sqrt{0{,}5gH}$

Найти: 1) t – ?; 2) α – ? 3) α_{min} и α_{max} – ?

1) $V_б = \pi H^2 \cdot H = \pi H^3$

$\alpha = \frac{\Delta V}{\Delta t} = VS$ – расход воды за ед. вр.

$V_б = \frac{\Delta V}{\Delta t}\ t \Rightarrow t = \frac{V_б}{\alpha} = \frac{\pi H^3}{VS} = \frac{\pi H^3}{S}\sqrt{\frac{2}{gH}}$

2) $H = V\cos\alpha t$, $0 = H + V\sin\alpha t - \frac{gt^2}{2}$; $t = \frac{H}{V\cos\alpha}$

$H + H\cdot tg\alpha - \frac{gH^2}{2V^2\cos\alpha} = 0 \quad |:H$

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

$1 + tg\alpha - \frac{gH}{2V^2}(1 + tg^2\alpha) = 0$; $V^2 = \frac{gH}{2} \Rightarrow$

$\Rightarrow tg\alpha - tg^2\alpha = 0 \Rightarrow tg\alpha = 0;\ tg\alpha = 1$

$\alpha = 0°$ и $\alpha = 45°$

3) Чтобы попасть в бак вода должна вылетать из шланга под углом в 0° и в 45°. Под другими углами она не долетит до бака. Потому что $V_{45°}$ – максимальная дальность полёта.

Ответ: 1) $\frac{\pi H^3}{S}\sqrt{\frac{2}{gH}}$

2) 0° или 45°

3) 0° и 45°

2

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$2v^2 + 6v^2 tg\alpha - ggH - ggH tg^2\alpha = 0$ Черновик

$ggH tg^2\alpha - 6v^2 tg\alpha + (ggH - 2v^2) = 0$

$D_1 = 9v^4 - ggH(ggH - 2v^2) =$

$= 9v^4 - 81g^2H^2 + 18gHv^2 =$

$= 2{,}25 g^2H^2 - 81g^2H^2 + 18 \cdot gH \cdot 0{,}5 gH =$

$= 9g^2H^2 + 2{,}25g^2H^2$

$3H = v \cdot \cos\alpha t$; $0 = H + v\sin\alpha t - \frac{gt^2}{2}$

$t = \frac{3H}{v\cos\alpha}$; $H + \frac{v\sin\alpha \cdot 3H}{v\cos\alpha} - \frac{g \cdot 9H^2}{2v^2\cos^2\alpha} = 0$

$1 + 3tg\alpha - \frac{9gH(1 + tg^2\alpha)}{2v^2} = 0$

$2v^2 + 6v^2 tg\alpha - 9gH - 9gH tg^2\alpha = 0$

$D = 9v^4 + 9gH(2v^2 - 9gH) = 9v^4 + 18gHv^2 - 81g^2H^2 =$

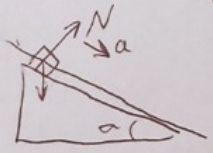
$= 2{,}25 g^2H^2 + 9g^2H^2 - 81g^2H^2$

$x = v_0 t$; $0 = H - \frac{gt^2}{2}$ $t = \sqrt{\frac{2H}{g}}$

$t = \frac{x}{v_0}$; $H + \frac{gx^2}{2v_0^2} = 0$

x_2

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



$mg \cdot \sin\alpha = ma$ $a = g\sin\alpha$

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

$\frac{H}{l} = \frac{3}{5}$; $l = \frac{5}{3}H$

$l = \frac{gt^2}{2}$ $v = \sqrt{2gH}$ $S = \frac{H}{\sin\alpha}$

$t = \sqrt{\frac{2l}{g\sin\alpha}} = \sqrt{\frac{10H}{3g\sin\alpha}}$ $S = \frac{v}{2}t$ $t = \frac{2S}{v}$

$t = \frac{5}{3}\frac{\sqrt{2gH}}{3\sqrt{2gH}} = \frac{2H}{\sin\alpha \cdot \sqrt{2gH}}$ $\frac{2S}{v} = \frac{10H}{3\sqrt{2gH}}$

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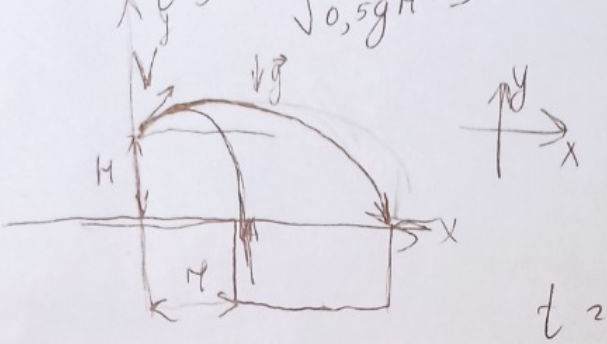
Черновик

$V_б = H \cdot \pi H^2 = \pi H^3$

$\frac{м^3}{м/с \cdot м^2} = с$

$t = \frac{V_б}{\vartheta S} = \frac{\pi H^3}{\sqrt{0{,}5gH}\, S} = \frac{\pi H^3}{S}\sqrt{\frac{2}{gH}}$



$H = \vartheta \cdot \cos\alpha \, t$

$0 = H + \vartheta \sin\alpha \, t - \frac{gt^2}{2}$

$t = \frac{H}{\vartheta \cdot \cos\alpha}$

$H + \frac{\vartheta \sin\alpha \cdot H}{\vartheta \cos\alpha} - \frac{gH^2}{2\vartheta^2 \cos^2\alpha} = 0$

$H + tg\alpha H - \frac{gH^2}{2\vartheta^2 \cos^2\alpha} = 0$

$1 + tg\alpha - \frac{gH(1+tg^2\alpha)}{2\vartheta^2} = 0$

$2\vartheta^2 + tg\alpha \cdot 2\vartheta^2 - gH - gH \cdot tg^2\alpha = 0$

$gH\,tg^2\alpha - 2\vartheta^2 tg\alpha + (gH - 2\vartheta^2) = 0$

$D/4 = \vartheta^4 - gH(gH - 2\vartheta^2) = \vartheta^4 - g^2H^2 + 2\vartheta^2 gH =$

$= 0{,}25\,g^2H^2 - g^2H^2 + g^2H^2 = 0{,}5\,gH$

$tg\alpha = \frac{\vartheta^2 + 0{,}5gH}{gH} = \frac{gH}{gH} = 1$ $\quad tg = 0$

$3H = \vartheta \cdot \cos\alpha \, t$ $\quad t = \frac{3H}{\vartheta \cos\alpha}$

$0 = H + \vartheta \sin\alpha \, t - \frac{gt^2}{2}$

$H + \frac{\vartheta \sin\alpha \cdot 3H}{\vartheta \cos\alpha} - \frac{g 9 H^2}{2\vartheta^2 \cos^2\alpha} = 0$

$1 + 3tg\alpha - \frac{9gH(1+tg^2\alpha)}{2\vartheta^2} = 0$

$H = \frac{\vartheta^2}{2g}$ $\quad \vartheta^2 = 2gH$ $\quad \frac{2}{gH}$

$\frac{2 \cdot gH}{2 g^2 H^2}$ $\quad \frac{gH}{8 g^2 H^2}$

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