

Часть 1

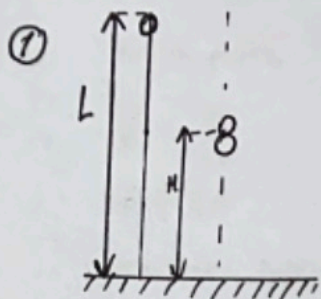
Олимпиада: **Физика, 10 класс (1 часть)**

Шифр: **21206624**

ID профиля: **177344**

Вариант 1

Ускорение



- 1 $L = v_0 T - \frac{gT^2}{2}$
- 2 $0 = v_0 - gT$
- 3 $H = L - \frac{gt^2}{2}$
- 4 $H = v_0 t - \frac{gt^2}{2}$

③ = ④ $L - \frac{gt^2}{2} = v_0 t - \frac{gt^2}{2}$
 $L = v_0 t$

② $\Rightarrow v_0 = gT$

① $\Rightarrow L = gT^2 - \frac{gT^2}{2} = \frac{gT^2}{2} \Rightarrow T = \sqrt{\frac{2L}{g}}$

$v_0 = gT = g\sqrt{\frac{2L}{g}} = \sqrt{2Lg}$

$v_0 = \frac{L}{t}$

$\frac{L}{t} = \sqrt{2Lg}$

$\sqrt{L} = t\sqrt{2g}$

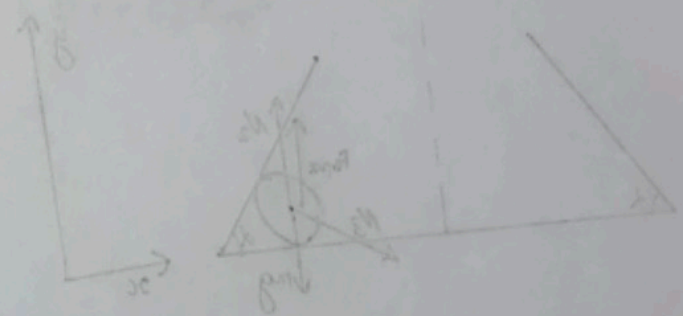
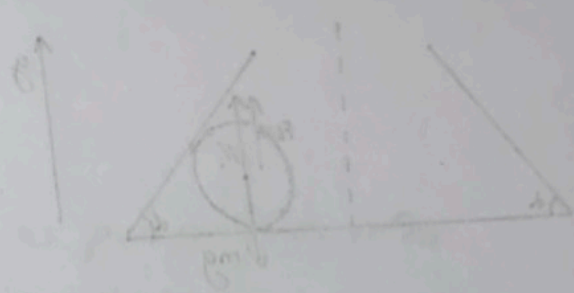
$L = 2gt^2$

1) ③ $\Rightarrow H = L - \frac{gt^2}{2} = 2gt^2 - \frac{gt^2}{2} = \frac{3gt^2}{2} \Rightarrow t = \sqrt{\frac{2H}{3g}}$

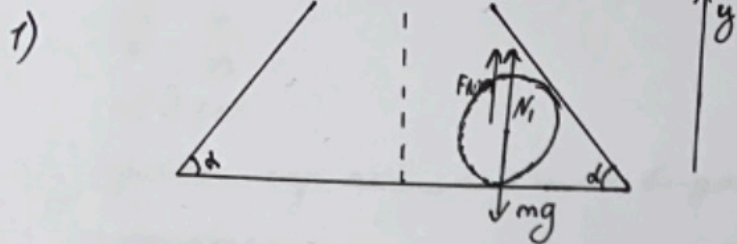
2) $v_0 = \sqrt{2Lg} = \sqrt{2g \cdot 2gt^2} = 2gt = 2g\sqrt{\frac{2H}{3g}} = 2\sqrt{\frac{2Hg}{3}}$

3) $s = L + (L - H) = 2gt^2 + 2gt^2 - \frac{3gt^2}{2} = 4gt^2 - \frac{3gt^2}{2} = \frac{5gt^2}{2} = \frac{5g \cdot \frac{2H}{3g}}{2} = \frac{5H}{3}$

Ответ: $t = \sqrt{\frac{2H}{3g}}$; $v_0 = 2\sqrt{\frac{2Hg}{3}}$; $s = \frac{5H}{3}$



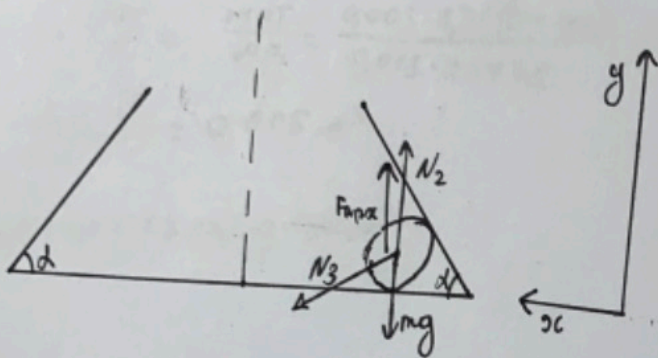
2)



$$\sum y: F_{Arch} + N_1 - mg = 0$$

$$N_1 = mg - F_{Arch} = 3\rho Vg - \rho gV = 2\rho gV = 2\rho g \frac{4}{3}\pi R^3$$

2)



$$\sum x: N_3 \cdot \sin \alpha = ma \Rightarrow N_3 = \frac{ma}{\sin \alpha}$$

$$\sum y: N_2 - mg - N_3 \cdot \cos \alpha = 0 \Rightarrow N_2 = mg + N_3 \cos \alpha = mg + ma \cdot \frac{1}{\tan \alpha} = m(g + \frac{1}{2}a) = \frac{4}{3}\pi R^3 \rho (g + \frac{1}{2}a)$$

~~Answers: $N_1 = \frac{8}{3}\rho g \pi R^3$; $N_2 = \frac{4}{3}\pi R^3 \rho (g + \frac{1}{2}a)$~~

$$= 3\rho V(g + \frac{1}{2}a) - \rho gV = \rho V(3g + \frac{3}{2}a - g) = \rho V(2g + \frac{3}{2}a) = \rho V(2g + 3\omega^2 R) = \frac{4}{3}\pi R^3 \rho (2g + 3\omega^2 R)$$

Answers: $N_1 = \frac{8}{3}\rho g \pi R^3$; $N_2 = \frac{4}{3}\pi R^3 \rho (2g + 3\omega^2 R)$

3

$$p_1 V_1 = p_2 V_2$$

$$\frac{p_2}{p_1} = \frac{V_1}{V_2}$$

$$1,8 \neq 3,5$$

значит пар газительно стал водой $\Rightarrow p_2 = p_{нас} = 0,5 \cdot 10^5 \text{ Па}$

пар начал становиться водой при $V_3 = \frac{V_1}{1,8}$ (в этот момент $p_2 = p_3 = 0,5 \cdot 10^5$)

~~$$p_1 = \frac{p_2}{1,8} = \frac{0,5 \cdot 10^5}{1,8} = 27778 \text{ Па}$$~~

$$2) p_1 V_1 = \nu RT$$

$$V_1 = \frac{\nu RT}{p_1} = \frac{m RT}{\mu p_1} = \frac{0,003 \cdot 8,31 (81 + 273)}{0,018 \cdot 27778} = 0,01765 \text{ м}^3$$

$$V_2 = \frac{V_1}{3,5} = 0,005 \text{ м}^3$$

Ответ: $p = 27778 \text{ Па}$; $V_2 = 0,005 \text{ м}^3$

3

Чернавик

$$p_1 V_1 = p_2 V_2$$

$$\frac{V_1}{V_2} = \frac{p_2}{p_1}$$

$$3,5 \neq 1,8$$

значит пар частично стал водоей

$$p_2 = 0,5 \cdot 10^5 \text{ Па} \Rightarrow p_1 = \frac{p_2}{3,5} = \frac{10^5}{7}$$

$$p_1 V_1 = \nu R T$$

$$\nu = \frac{m}{M} N_A$$

N_2

$$p_2 V_2 = \nu_2 R T$$

$$\nu_2 = \frac{p_2 V_2}{3,5 R T}$$

$$p_3 V_3 = \nu_3 R T$$

при $V_3 = \frac{V_1}{1,8}$ $\nu_1 = \nu_3$ и $p_3 = p_2$

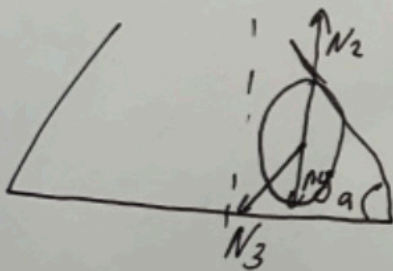
$$p_2 V_3 = \nu_1 R T$$

$$p_1 V_1 = p_2 V_2 \Rightarrow p_1 = p_2 / 1,8 =$$

$$p_1 V_1 = \frac{m}{M} R T \Rightarrow V_1 = \frac{m R T}{M p_1} \Rightarrow V_2 = \frac{V_1}{3,5} = \frac{m R T}{M p_1 \cdot 3,5}$$

$$N_1 = mg - F_{\text{арх}} = mg - \rho g V = mg - \frac{4}{3} \pi R^3 \cdot \rho g = 3 \rho g \cdot \frac{4}{3} \pi R^3 - \frac{4}{3} \pi R^3 \cdot \rho g =$$

$$= \frac{8}{3} \rho g \pi R^3$$



~~W^2 2R~~

$$N_3 \cdot \sin \alpha = \omega^2 2R$$

$$N_3 = \frac{\omega^2 2R}{\sin \alpha}$$

$$N_2 = mg - N_3 \cdot \cos \alpha = 0$$

$$N_2 = mg + N_3 \cdot \cos \alpha = 3 \rho g \frac{4}{3} \pi R^3 + \omega^2 2R \cdot \tan \alpha$$

$$\frac{d_y}{d_x} = \frac{v_3}{v_1}$$

Черновик

N1

$$\begin{cases} H = L - \frac{gt^2}{2} \\ H = v_0 t - \frac{gt^2}{2} \\ L = v_0 T - \frac{gT^2}{2} \\ 0 = v_0 - gT \Rightarrow v_0 = gT \end{cases}$$

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

$$L = v_0 t$$

$$L = gT^2 - \frac{gT^2}{2} = \frac{gT^2}{2} \Rightarrow T = \sqrt{\frac{2L}{g}}$$

$$v_0 = g \sqrt{\frac{2L}{g}} = \sqrt{2Lg}$$

$$L = \sqrt{2Lg} \cdot t$$

$$\sqrt{L} = \sqrt{2g} \cdot t$$

~~$\sqrt{L} = \sqrt{2g} \cdot t$~~

$$L = 2gt^2$$

$$v_0 = 2gt$$

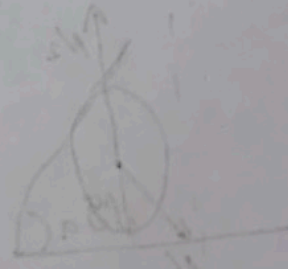
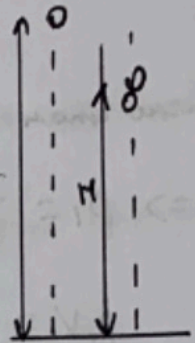
~~$v_0 = 2gt$~~

$$T = 2t$$

$$H = 2gt^2 - \frac{gt^2}{2} = \frac{3gt^2}{2} \Rightarrow t = \sqrt{\frac{4H}{3g}}$$

$$v_0 = 2gt = 2g \sqrt{\frac{4H}{3g}}$$

$$L + (L - H) = 2g \cdot \frac{4H}{3g} + (2g \cdot \frac{4H}{3g} - H)$$



Часть 2

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

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Вариант 1

5) $1,02 p_1 = p_2$

$0,99 V_1 = V_2$

1) $\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$

$\frac{p_1 V_1}{T_1} = \frac{1,02 \cdot 0,99 \cdot p_1 V_1}{T_2}$

$T_2 = T_1 \cdot 1,02 \cdot 0,99 = 1,0098$

температура увеличилась на 0,98%

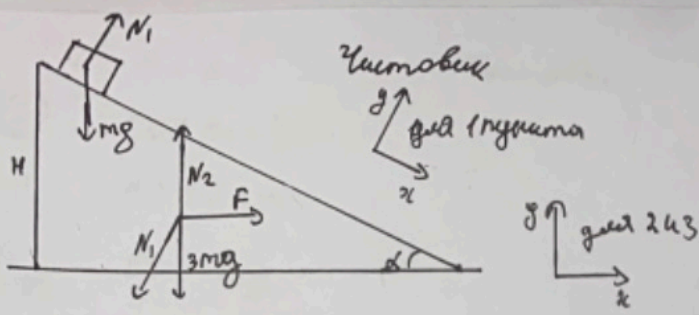
2) $A = \frac{p_1 + p_2}{2} \cdot (V_2 - V_1) = \frac{p_1 + 1,02 p_1}{2} (0,99 V_1 - V_1) = 1,01 p_1 (-0,01) V_1 = -0,0101 p_1 V_1$

$Q = A + \Delta U = -0,0101 p_1 V_1 + \frac{i}{2} 2 R \Delta t = -0,0101 p_1 V_1 + \frac{3}{2} \cdot (p_2 V_2 - p_1 V_1) = -0,0101 p_1 V_1 + 0,0098 p_1 V_1 \frac{3}{2}$
 $= 0,0046 p_1 V_1$

$\frac{Q}{A} = -0,455$

Ответ: увеличилась на 0,98%; -0,455

4



$\sin \alpha = \frac{3}{5}$
 $\operatorname{tg} \alpha = \frac{3}{4}$

1) $O_x: mg \cdot \sin \alpha = ma$

$s = \frac{H}{\sin \alpha}$

$s = \frac{gt^2}{2} \Rightarrow t = \sqrt{\frac{2s}{a}} = \sqrt{\frac{2H}{g \sin^2 \alpha}} = \frac{5}{3} \sqrt{\frac{2H}{g}}$

2) "m" $O_y: N_1 \cos \alpha - mg = -ma_1 \sin \alpha$

$O_x: N_1 \sin \alpha = m(a_1 \cos \alpha + a)$

"3m" $O_y: N_2 - 3mg - N_1 \cos \alpha = 0$

$O_x: -N_1 \sin \alpha + F = 3ma \Rightarrow N_1 = \frac{F - 3ma}{\sin \alpha}$

$N_1 \sin \alpha = ma_1 \cos \alpha + am$

$F - 3ma = ma_1 \cos \alpha + am$

$a_1 = \frac{F - 4ma}{m \cos \alpha} = \frac{2mg - 4ma}{m \cos \alpha} = \frac{2g - 4a}{\cos \alpha}$

$N_1 \cos \alpha - mg = -ma_1 \sin \alpha$

$(F - 3ma) \operatorname{tg} \alpha - mg = -m(2g - 4a) \operatorname{tg} \alpha$

$\frac{1}{3}(2g - 3a) \frac{4}{3} - mg = -m(2g - 4a) \cdot \frac{3}{4}$

$\frac{8}{3}g - 4a - g = -\frac{3}{2}g + 3a$

$16g - 24a - 6g = -9g + 18a$

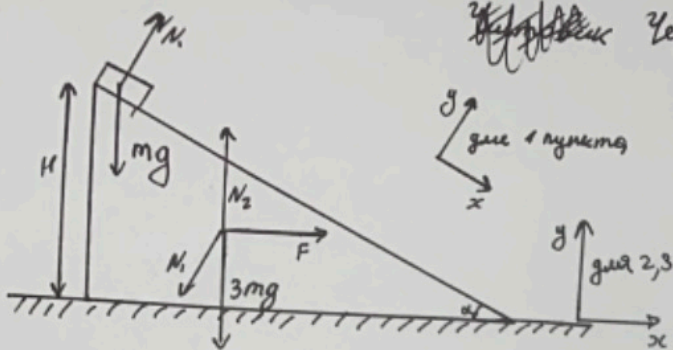
$19g = 42a$

$a = \frac{19}{42}g$

3) $a_1 = \frac{2g - 4a}{\cos \alpha} = \frac{2 \cdot 5(mg - 21a)}{4} = \frac{5(\frac{3}{21}g)}{2} = \frac{10g}{42} = \frac{5g}{21}$

$t = \sqrt{\frac{2H}{a_1 \sin \alpha}} = \sqrt{\frac{2H \cdot 5}{a_1 \cdot 3}} = \sqrt{\frac{2H \cdot 5 \cdot 21}{5 \cdot 3 \cdot g}} = \sqrt{\frac{14H}{g}}$

Answers: $\frac{5}{3} \sqrt{\frac{2H}{g}}$, $\frac{5}{21}g$, $\sqrt{\frac{14H}{g}}$



Угол наклона

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

$$\tan \alpha = \frac{\sin \alpha}{\cos \alpha} = \frac{3 \cdot 5}{5 \cdot 4} = \frac{3}{4}$$

$$\cot \alpha = \frac{4}{3}$$

$$1) O_x: mg \cdot \sin \alpha = ma$$

$$S = \frac{H}{\sin \alpha}$$

$$S = \frac{at^2}{2} \Rightarrow t = \sqrt{\frac{2S}{a}} = \sqrt{\frac{2H}{g \sin \alpha}} = \frac{5}{3} \sqrt{\frac{2H}{g}}$$

$$2) \text{ " m " } O_y: N_1 \cos \alpha - mg = -ma \sin \alpha$$

$$O_x: N_1 \sin \alpha = m(a \cos \alpha + a)$$

$$\text{ " 3m " } O_y: N_2 - 3mg - N_1 \cos \alpha = 0$$

$$O_x: -N_1 \sin \alpha + F = 3ma \Rightarrow N_1 = \frac{F - 3ma}{\sin \alpha}$$

$$N_1 \sin \alpha = ma \cos \alpha + ma$$

$$F - 3ma = m a \cos \alpha + ma$$

$$\frac{F - 4ma}{m \cos \alpha} = a$$

$$N_1 \cos \alpha - mg = -ma \sin \alpha$$

$$(F - ma) \cot \alpha - mg = -(F - 4ma) \tan \alpha$$

$$\frac{4}{3} F - \frac{4}{3} ma - mg = -\frac{3}{4} F + 3ma$$

$$16F - 16ma - 12mg = 9F + 18ma$$

$$25F - 12mg = 34ma \Rightarrow a = \frac{25F - 12mg}{34m} = \frac{50mg - 12mg}{34m} = \frac{19g}{17}$$

~~Handwritten scribbles and crossed-out equations, including:~~

$$S = \frac{at^2}{2} \Rightarrow t = \sqrt{\frac{2S}{a}} = \sqrt{\frac{2H}{g \sin \alpha}} = \sqrt{\frac{2H \cdot 5}{g \cdot 3}} = \sqrt{\frac{10H}{3g}}$$

$$3) a_1 = \frac{F - 2ma}{m \cos \alpha} = \frac{2mg - 2 \cdot 17a}{m \cos \alpha} = \frac{2g - \frac{38}{17}g}{\frac{4}{5}} = \frac{34g - 38g}{17} = \frac{5(-4g)}{17} = -\frac{5g}{17}$$

$$1,02 p_1 = p_2$$

$$V_1 = 1,01 V_2$$

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

$$\frac{p_1 V_1}{T_1} = \frac{1,02 p_1 \cdot V_1}{1,01 T_2}$$

$$\frac{p_1 V_1}{T_1} = \frac{1,02 p_1 V_1}{1,01 T_2}$$

$$T_2 = \frac{1,02}{1,01} T_1$$

$$T_2 = 1,0099 T_1$$

$$1,02 p_1 = p_2$$

$$0,99 V_1 = V_2$$

$$\frac{p_1 V_1}{T_1} = \frac{1,02 p_1 \cdot 0,99 V_1}{T_2}$$

$$T_2 = T_1 \cdot 1,02 \cdot 0,99$$

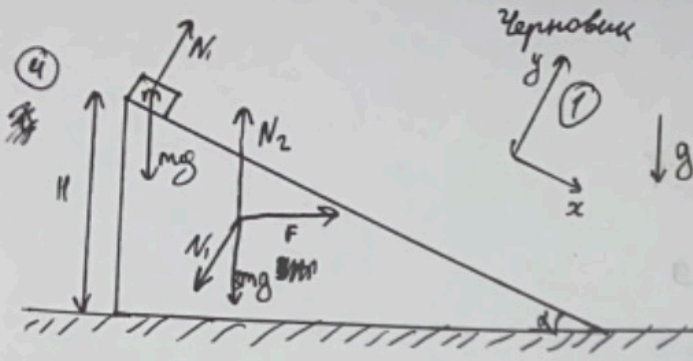
$$T_2 = T_1 \cdot 1,0098$$

температура увеличилась на 0,99%

$$A = \frac{p_1 + p_2}{2} (V_2 - V_1) = \frac{1,02 p_1}{2} (V_1 \cdot 0,99 - V_1) = -1,01 p_1 \cdot 0,01 V_1 = -0,0101 p_1 V_1$$

$$Q = \Delta U + A = \nu R \Delta T + A = p_2 V_2 - p_1 V_1 + A = 1,0098 p_1 V_1 + A = 0,0098 p_1 V_1 - 1,01 \cdot 0,01 p_1 V_1 = 0,0003 p_1 V_1$$

$$\frac{Q}{A} = 0,0297$$



"m" $O_x: mg \sin \alpha = ma$
 $a = g \cdot \sin \alpha$

"3m" $O_x: F - N_1 \sin \alpha = a \cdot 3m$

$S = \frac{H}{\sin \alpha}$

$O_y: N - mg \cdot \cos \alpha = 0$
 $N = mg \cos \alpha$

1) $S = \frac{gt^2}{2}$

$t = \sqrt{\frac{2S}{a}} = \sqrt{\frac{2H}{a \cdot \sin \alpha}} = \sqrt{\frac{2H}{g \sin^2 \alpha}} = \sqrt{\frac{2H}{g(1 - \cos^2 \alpha)}} = \sqrt{\frac{2H}{g \cdot \frac{9}{25}}} = \frac{5}{3} \sqrt{\frac{2H}{g}}$

~~2) $O_x: mg \sin \alpha = m a$~~

~~"m" $O_y: N_1 - mg \cos \alpha = a \cdot \sin \alpha$
 $N_1 = mg \cos \alpha + a \sin \alpha$~~

~~$O_y: N_1 \cos \alpha - mg = 0$~~

~~"3m" $O_x: N_1 \sin \alpha$~~

~~$O_y: N_1 \cos \alpha - mg = m a \sin \alpha$
 $N_1 = \frac{mg + m a \cos \alpha}{\cos \alpha}$~~

~~$mgH = \frac{3m v_1^2}{2} + \frac{m v_2^2}{2}$~~

"3m" $O_x: -N_1 \sin \alpha + F = m a$

~~$O_x: 0 = -2m v_1 + m v_2 \cos \alpha + F$~~

~~$(O_y: N_2 - 3mg - N_1 \cos \alpha = 0)$~~

~~$3v_1 = v_2 \cos \alpha$~~

~~$3v_1 = v_2$~~

$O_x: N_1 \sin \alpha = m(a \cos \alpha + a)$

"m" $O_y: N_1 \cos \alpha - mg = m a \sin \alpha$

$F - ma = m(a \cos \alpha + a)$

$O_x: N_1 \sin \alpha = m(a \cos \alpha + a)$

$F = m a \cos \alpha + 2m a \rightarrow a_1 = \frac{F - 2m a}{m \cos \alpha}$

$N_1 \sin \alpha + F = m a \rightarrow N_1 \sin \alpha = F - m a$