Часть 1

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

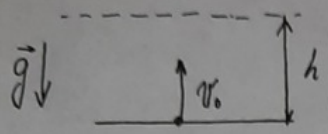
Шифр: **21204141**

ID профиля: **803437**

Вариант 2

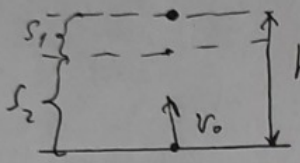
Чистовик ①

№1



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

$v_к = 0 = v_0 - g t_1 \quad t_1 = \frac{v_0}{g}$



$s_1 = \frac{g \Delta t^2}{2} \quad s_2 = v_0 \Delta t - \frac{g \Delta t^2}{2}$

$s_1 + s_2 = h$

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

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

1) $t_{общ1} = t_1 + \Delta t = \frac{v_0}{g} + \frac{v_0}{2g} = \frac{3}{2} \cdot \frac{v_0}{g}$

2) $\frac{t_{общ1}}{\Delta t} = \frac{\frac{3}{2} \frac{v_0}{g}}{\frac{v_0}{2g}} = \frac{3 v_0}{g} \cdot \frac{2g}{v_0} = 3$

3) $s_2 = v_0 \Delta t - \frac{g \Delta t^2}{2} = \frac{v_0^2}{2g} - \frac{g}{2} \cdot \frac{v_0^2}{4g^2} = \frac{v_0^2}{2g} - \frac{v_0^2}{8g} = \frac{4v_0^2}{8g} - \frac{v_0^2}{8g} =$

$= \frac{3 v_0^2}{8g}$

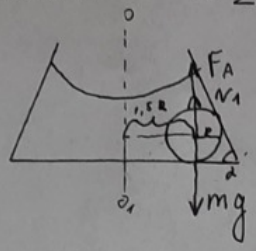
Ответ: 1) $\frac{3}{2} \cdot \frac{v_0}{g}$

2) 3

3) $\frac{3 v_0^2}{8g}$

Чистовик №2

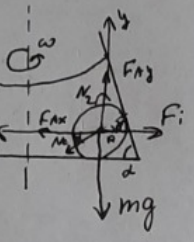
(2)



1) $F_A + N_1 = mg$ $N_1 = mg - F_A = 6\rho gV - \rho gV =$

$= 5\rho gV = 5\rho g \frac{4}{3}\pi R^3 = \frac{20\rho g\pi R^3}{3}$

2) Перейдем в НСО.

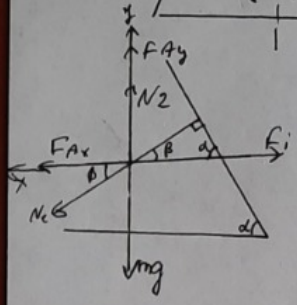


$a_ц = \omega^2 \cdot 1{,}5R$

По Ox:

$F_i = ma_y = 6\rho V\omega^2 \cdot 1{,}5R = \frac{2}{6}\rho\frac{4}{3}\pi R^3\omega^2 \cdot 1{,}5R =$

$= 12\pi R^4\rho\omega^2$,



$F_i = N_c\cos\beta + F_{Ax}$ $\beta = 90 - \alpha$

$F_i = N_c\cos(90-\alpha) + F_{Ax}$ $F_{Ax} = \rho a_x V = \rho\omega^2 1{,}5R \cdot \frac{4}{3}\pi R^3$

$= 2\pi R^4\rho\omega^2$

$N_c\sin\alpha = F_i - F_{Ax}$

$N_c = \frac{10\pi R^4\rho\omega^2}{\sin\alpha}$

По oy:

$mg + N_c\sin(90-\alpha) = N_2 + F_{Ay}$

$6\rho g\frac{4}{3}\pi R^3 + 10\pi R^4\rho\omega^2 ctg\alpha = N_2 + \rho g\frac{4}{3}\pi R^3$ $N_2 = \frac{20}{3}\rho g\pi R^3 + 10\pi R^4\rho\omega^2\frac{2}{3}$

$N_2 = \frac{20}{3}\rho\pi R^3(g + \omega^2 R)$

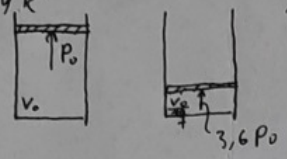
Ответ: 1) $\frac{20\rho g\pi R^3}{3}$

2) $\frac{20\rho\pi R^3(g+\omega^2 R)}{3}$

(3)

Чистовик №3

$T = 354\ K$



$P_н = P_0$

$P_к = 3{,}6\,P_0$

1) Предположим, что пар ненасыщенный на протяжении обоих состояний $\Rightarrow$ масса пара должна быть неизменна $\Rightarrow P_к = \dfrac{m_п R T}{M \frac{V_0}{4}} =$

$= \dfrac{4\, m_п R T}{M V_0}$, но по условию $P_к = \dfrac{3{,}6\, m_п R T}{M V_0} \Rightarrow$

$\Rightarrow$ противоречие $\Rightarrow$ во втором состоянии пар насыщенный и

$P_к = 0{,}5 \cdot 10^5$ Па $= 3{,}6\, P_н \Rightarrow P_н = \dfrac{0{,}5 \cdot 10^5}{3{,}6} \approx 0{,}139 \cdot 10^5$ Па

г) $P_н = 0{,}139 \cdot 10^5 = \dfrac{m_п R T}{M V_н}$ $\quad m_п = \dfrac{P_н M \cdot 4 V_0}{RT} = \dfrac{0{,}139 \cdot 10^5 \cdot 18 \cdot 10^{-3} \cdot 4 \cdot 1{,}7 \cdot 10^{-3}}{8{,}31 \cdot 354}$

$= \dfrac{2{,}502 \cdot 11{,}9 \cdot 10^{-7}}{2941{,}74} \approx 0{,}00101$ кг

Ответ: 1) $0{,}139 \cdot 10^5$ Па

г) $0{,}00101$ кг

Часть 2

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

Шифр: **21204141**

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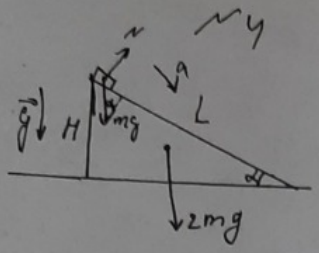
Вариант 2

Чистовик

(2)



$\sin\alpha = \sqrt{1 - \frac{9}{25}} = \frac{4}{5}$

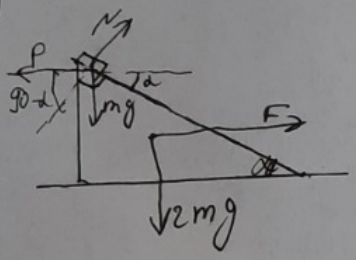
1) $\frac{H}{L} = \sin\alpha = \frac{4}{5}$ $\quad L = \frac{H}{\sin\alpha} = \frac{5H}{4}$

$mg\sin\alpha = ma_1$ $\quad a_1 = g\sin\alpha$

$L = \frac{g\sin\alpha\, t^2}{2}$ $\quad \frac{10H}{4} = g\sin\alpha\, t^2$

$t = \sqrt{\frac{10H}{4g\frac{4}{5}}} = \sqrt{\frac{50H}{16g}} = \sqrt{\frac{25H}{8g}}$

2)



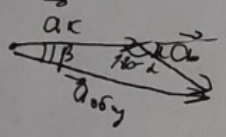
$N = mg\cos\alpha$

$P = N\cos(90-\alpha) = mg\cos\alpha\sin\alpha = \frac{12}{25}mg$

$F - \frac{12}{25}mg = 2ma_к$

$\frac{13}{25}g = 2a_к$ $\quad a_к = \frac{13g}{50}$

3)



$\frac{a_{отн}}{\sin\alpha} = \frac{a_1}{\sin\beta}$

Ответ: 1) $\sqrt{\frac{25H}{8g}}$

2) $\frac{13g}{50}$

Чистовик

1) $P_н = \frac{\nu R T_1}{V_н}$ (№5) $\quad P_к = 0{,}99\, P_н = \frac{\nu R T_2}{1{,}02 V_н} \Rightarrow P_н = \frac{\nu R T_2}{0{,}99 \cdot 1{,}02 V_н} \Rightarrow$

$\Rightarrow \frac{\nu R T_1}{V_н} = \frac{\nu R T_2}{1{,}0098 V_н} \quad \frac{T_2}{T_1} = 1{,}0098 = 100{,}98\,\% \Rightarrow$ Увеличилась на $0{,}98\,\%$

2) $\Delta U = \frac{3}{2}\nu R \Delta T = \frac{3}{2}\nu R T_1 (1{,}0098 - 1) = \frac{3}{2}\nu R T_1 \cdot 0{,}0098 = 0{,}0147\, \nu R T_1$

$Q = \frac{3}{2}\nu R \Delta T + A \qquad A = \Delta P \cdot \Delta V = (0{,}99 P_н - P_н)(1{,}02 V_н - V_н) =$

$= -0{,}01 P_н \cdot 0{,}02 V_н = -0{,}0002\, P_н V_н$

$P_н = \frac{\nu R T_1}{V_н} \Rightarrow A = -0{,}0002 \frac{\nu R T_1}{V_н} \cdot V_н = -0{,}0002\, \nu R T_1$

$Q = \frac{3}{2}\nu R \cdot 0{,}0098 T_1 - 0{,}0002\, \nu R T_1 = 0{,}0145\, \nu R T_1$

$\frac{Q}{\Delta U} = \frac{0{,}0145\, \nu R T_1}{0{,}0147\, \nu R T_1} = \frac{145}{147}$

Ответ:

1) • увеличится на $0{,}98\,\%$

2) $\frac{145}{147}$