Часть 1

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

Шифр: **21206314**

ID профиля: **321421**

Вариант 2

Чистовик. Лист 1.

№3.

После сжатия давление стало равно давлению насыщенного пара, т.к. при $V=const$ и $T=const$ $PV=const$, но $P_0V_0 \neq 3{,}6P_0 \cdot \frac{V_0}{7}$, следовательно $V \neq const$, значит часть пара превратилась в воду, т.е. пар стал насыщенным.

$P_{нас.} = 3{,}6\,P_0$.

$P_0 = \frac{P_{нас.}}{3{,}6} = \frac{0{,}5 \cdot 10^5\,Па}{3{,}6} = 13889\,Па$.

$P_0V_0 = \nu_0 RT$.

$V_0 = 7V_1$

$\nu_0 = \frac{P_0V_0}{RT} = \frac{P_{нас.} \cdot 7V_1}{3{,}6 \cdot R \cdot T}$

$T = 81°C = 354\,K$.

$m_0 = \mu\nu_0 = \frac{7\,P_{нас.}V_1}{3{,}6\,RT} \cdot \mu = \frac{7 \cdot 0{,}5 \cdot 10^5\,Па \cdot 0{,}0017\,м^3}{3{,}6 \cdot 8{,}31\,\frac{Дж}{моль \cdot K} \cdot 354\,K} \cdot 18\,г/моль = 1\,г$.

Ответ: 1) 13889 Па

2) 1 г.

Чистовик Лист 2

№1

$y_1(t) = V_0 t - \frac{gt^2}{2}$

$V_1(t) = V_0 - gt$

$V_1(t_1) = 0$

$V_0 = gt_1$

$t_1 = \frac{V_0}{g}$

$y_2(t) = V_0(t - t_1) - \frac{g(t-t_1)^2}{2}$

$y_1(t) = y_2(t)$

$V_0 t - \frac{gt^2}{2} = V_0(t - t_1) - \frac{g(t-t_1)^2}{2}$

$V_0 t - \frac{gt^2}{2} = V_0 t - V_0 t_1 - \frac{gt^2}{2} - \frac{gt_1^2}{2} + gtt_1$

$V_0 t_1 + \frac{gt_1^2}{2} = gtt_1$

$V_0 + \frac{gt_1}{2} = gt$

$t = \frac{V_0}{g} + \frac{t_1}{2} = \frac{V_0}{g} + \frac{V_0}{2g} = \frac{3V_0}{2g}$

$\frac{t}{t - t_1} = \frac{\frac{3V_0}{2g}}{\frac{3V_0}{2g} - \frac{V_0}{g}} = 3$

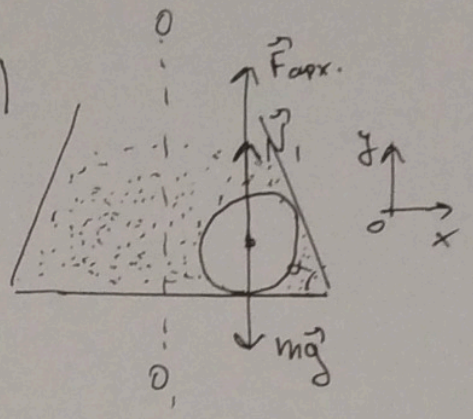
$h = y_1(t) = V_0 t - \frac{gt^2}{2} = \frac{3V_0^2}{2g} - \frac{g}{2} \cdot \frac{9V_0^2}{4g^2} = \frac{3V_0^2}{2g} - \frac{9V_0^2}{8g} = \frac{V_0^2}{g}\left(\frac{12-9}{8}\right) = \frac{3V_0^2}{8g}$

Ответ: 1) $\frac{3V_0}{2g}$; 2) 3; 3) $\frac{3V_0^2}{8g}$.

Чистовик. Лист 3.

№2.

1)



$Oy: F_{apx.} + N_1 - mg = 0$

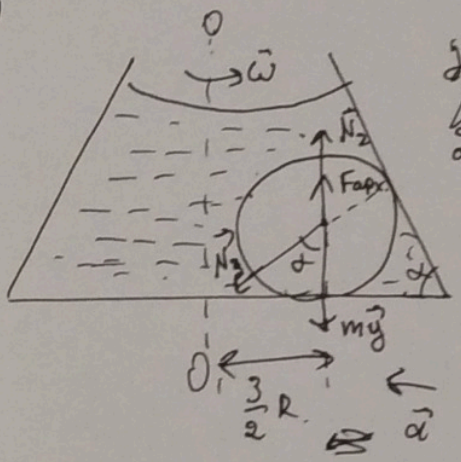
$\rho g V + N_1 - 6\rho V g = 0.$

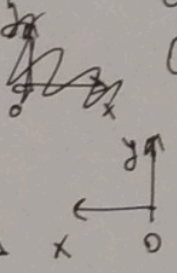
$N_1 = 5\rho g V = \frac{20}{3}\pi R^3 \rho g.$

$m = 6\rho V$

$V = \frac{4}{3}\pi R^3$

2)





$Ox: N_3 \sin\alpha = ma$

$Oy: N_2 + F_{apx.} - mg - N_3\cos\alpha = 0$

$a = \omega^2 \cdot \frac{3}{2}R$

$N_3 = \frac{ma}{\sin\alpha}.$

$N_2 + \rho g V = mg + \frac{ma}{tg\alpha}$

$N_2 + \rho g V = 6\rho g V + \frac{2}{3} \cdot 6\rho V \cdot \omega^2 \cdot \frac{3}{2}R.$

$N_2 = 5\rho g V + 6\rho V \cdot \omega^2 R = \rho V(5g + 6\omega^2 R) =$

$= \frac{4}{3}\pi R^3 \cdot \rho(5g + 6\omega^2 R)$

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

2) $\frac{4}{3}\pi R^3 \rho(5g + 6\omega^2 R)$

$t = 78°C$ $T = const.$ горловина V_0 $V_1 = \frac{V_0}{7}$.

1) $PV = \nu RT$. $p_{нас.}$ $p_0 = \frac{p_{нас.}}{3,6}$.

$p_0 V_0 = \nu_0 R T$.

$p_{нас.} V_1 = \nu_1 R T$. $\nu_0 = \frac{p_0 V_0}{RT} = \frac{p_{нас.} \cdot 7 V_1}{3,6 RT}$. $\mu = m$.

$3,6 p_0 \frac{V_0}{7} = \nu_1 R T$.

$\frac{3,6}{7} = \frac{V_1}{V_0}$ $V_1 = \frac{3,6 V_0}{7} = \frac{p_0 V_0}{RT} \cdot p_{нас.}$

$V_1 = 1,7 л. = 0,0017 м^3$.

2

#1 Уравнения:

① $y_1(t) = V_0 t - \frac{gt^2}{2}$ $\quad V(t) = V_0 - gt \quad V_0 = gt_1 \quad t_1 = \frac{V_0}{g}$

$y_2(t) = V_0(t - t_1) - \frac{g(t-t_1)^2}{2}$

② $V_{01} \neq V_{02}$?

$y_2(t) = V_{02}t - \frac{V_{02}^2}{g} - \frac{g}{2}\left(t^2 - 2\frac{V_{02}t}{g} + \frac{V_{02}^2}{g^2}\right) = V_{02}t - \frac{V_{02}^2}{g} - \frac{gt^2}{2} + V_{02}t - \frac{V_{02}^2}{2g} =$

$= 2V_{02}t - \frac{3V_{02}^2}{2g} - \frac{gt^2}{2}$

$2V_{02}t - \frac{gt^2}{2} = \frac{3V_{02}^2}{2g} = V_{02}t - \frac{gt^2}{2}$

$y_1(t) = y_2(t)$.

$V_{02}t = \frac{3V_{02}^2}{2g}$

$V_0 t - \frac{gt^2}{2} = V_0 t - V_0 t_1 - \frac{gt^2}{2} - \frac{gt_1^2}{2} + gtt_1$

$t = \frac{3V_0}{2g}$

$V_0 t_1 + \frac{gt_1^2}{2} = gtt_1$

$t - t_1 = \frac{3V_0}{2g} - \frac{V_0}{g} = \frac{V_0}{2g}$.

$V_0 + \frac{gt_1}{2} = gt$.

$\frac{t}{t-t_1} = 3$

$V_0 + \frac{V_0}{2} = gt$.

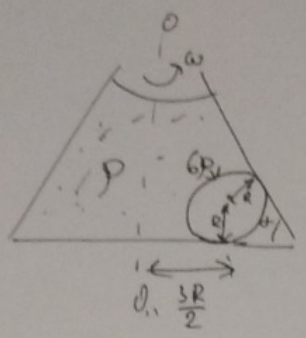
$y(t) = V_0 \cdot \frac{3V_0}{2g} - \frac{g}{2}\frac{9V_0^2}{4g^2} = \frac{3V_0^2}{2g} - \frac{9V_0^2}{8g} =$

$\frac{3V_0}{2} = gt$.

$t = \frac{3V_0}{2g}$.

$= \frac{(12-9)}{8}\frac{V_0^2}{g} = \frac{3V_0^2}{8g}$.

Черновик

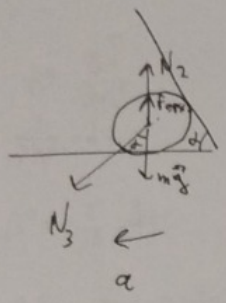


1) $mg = \rho g V + N_1$ $\quad m = 6\rho V$

$6\rho g V = \rho g V + N_1$ $\quad V = \frac{4}{3}\pi R^3$

$N_1 = 5\rho g V = 5\rho g \frac{4}{3}\pi R^3 = \frac{20\pi}{3}\rho g R^3$

$V = \omega R$.



$a = \omega^2 R$.

$Oy: N_2 + \rho g V = mg + N_3 \cos\alpha$.

$Ox: N_3 \sin\alpha = ma$.

$N_3 = \frac{ma}{\sin\alpha}$.

$N_2 + \rho g V = 6\rho g V + \frac{ma}{tg\alpha}$

$N_2 = 5\rho g V + \frac{6\rho V \cdot \omega^2 R}{tg\alpha} = 5\rho g V + \frac{8\pi \omega^2 R^4 \rho}{tg\alpha} =$

$= \frac{20}{3}\pi R^3 \rho g + \frac{16}{3}\pi R^4 \omega^2 \rho = \frac{4}{3}\pi R^3 \rho (5g + \omega^2 R)$

6

Часть 2

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

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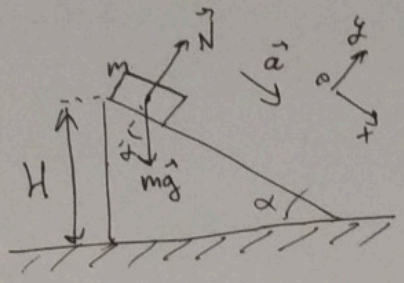
Вариант 2

Чистовик. Лист 1.

№4.

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

1)



$Ox: mg\sin\alpha = ma$

$a = g\sin\alpha = \frac{4}{5}g$

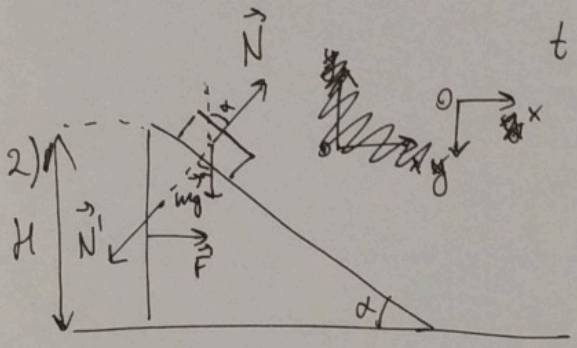
$L = \frac{H}{\sin\alpha} = \frac{5H}{4}$

$L = \frac{at^2}{2}$

$\frac{5H}{4} = \frac{4}{5}\frac{gt^2}{2}$

$t = \sqrt{\frac{25H}{8g}} = \frac{5}{2}\sqrt{\frac{H}{2g}}$

2)



$Ox: N\sin\alpha = ma_{1x}$

$F - N\sin\alpha = 2m \cdot a_2$

$Oy: mg - N\cos\alpha = ma_{1y}$

$tg\alpha = \frac{a_{1y}}{a_{1x} - a_2}$

$N = \frac{ma_{1x}}{\sin\alpha}$

$mg - ma_{1x} = 2ma_2$

$a_{1x} = g - 2a_2$.

$a_{1y} = tg\alpha(a_{1x} - a_2) = tg\alpha(g - 3a_2)$

$mg - \frac{m(g-2a_2)}{tg\alpha} = m \cdot tg\alpha(g - 3a_2)$

$g - \frac{3}{4}(g - 2a_2) = \frac{4}{3}(g - 3a_2)$

$\frac{g}{4} + \frac{3}{2}a_2 = \frac{4}{3}g - 4a_2$.

$\frac{11}{2}a_2 = \frac{13}{12}g$.

$a_2 = \frac{13}{66}g$

$a_{1y} = \frac{4}{3}(g - 3a_2) = \frac{4}{3}(g - \frac{13}{22}g) = \frac{4}{3} \cdot \frac{9}{22}g =$

$= \frac{6}{11}g$.

$H = \frac{a_{1y}t^2}{2} = \frac{6gt^2}{22} = \frac{3gt^2}{11}$

$t = \sqrt{\frac{11H}{3g}}$

Ответ: 1) $\frac{5}{2}\sqrt{\frac{H}{2g}}$; 2) $\frac{13}{66}g$; 3) $\sqrt{\frac{11H}{3g}}$

Чистовик. Лист 2.

№5.

$P_1 = 0{,}99\,P_0$

$V_1 = 1{,}02\,V_0$.

$P_0V_0 = \nu R T_0$.

$T_0 = \frac{P_0V_0}{\nu R}$.

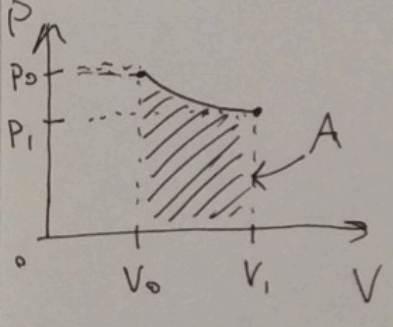
$P_1V_1 = \nu R T_1$

$0{,}99\,P_0 \cdot 1{,}02\,V_0 = \nu R T_1$

$T_1 = 1{,}0098\,T_0$

Температура увеличилась на 0,98%.

$\Delta U = \frac{3}{2}\nu R \Delta T = \frac{3}{2}(P_1V_1 - P_0V_0) = \frac{3}{2}P_0V_0(1{,}0098 - 1) = \frac{3}{2}P_0V_0 \cdot 0{,}0098 = 0{,}147\,P_0V_0$.



$A \approx \frac{(P_0+P_1)}{2}(V_1 - V_0) = P_0V_0\,\frac{(1+0{,}99)}{2}(1{,}02-1) = P_0V_0 \cdot 0{,}995 \cdot 0{,}02 =$

$= 0{,}0199\,P_0V_0$.

$Q = \Delta U + A = 0{,}147\,P_0V_0 + 0{,}0199\,P_0V_0 = 0{,}1669\,P_0V_0$

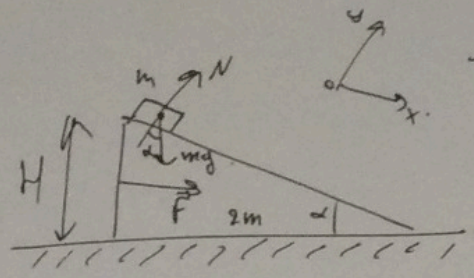
$\frac{Q}{\Delta U} = \frac{0{,}1669\,P_0V_0}{0{,}147\,P_0V_0} = 1{,}14$

Ответ: 1) увеличилась на 0,98%.

2) 1,14.

$\cos\alpha = \frac{3}{5}$ Черновик.

$\sin\alpha = \frac{4}{5}$.



1) $Ox: mg\sin\alpha = ma$.

$a = g\sin\alpha$.

$a = \frac{4}{5}g$.

$H = l\cdot\sin\alpha$.

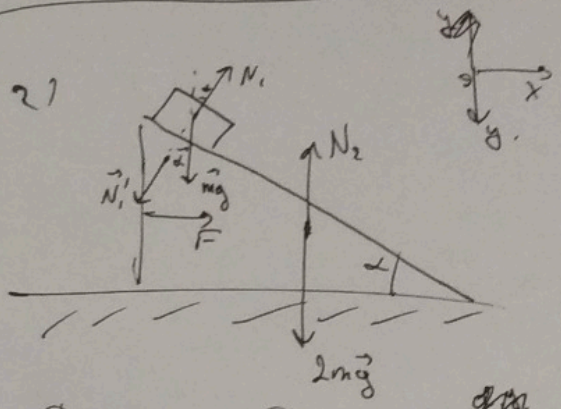
$l = \frac{H}{\sin\alpha} = \frac{5H}{4}$.

$l = \frac{at^2}{2}$.

$\frac{5H}{4} = \frac{4}{5}g\cdot\frac{t^2}{2}$.

$t = \sqrt{\frac{25H}{8g}} = \frac{5}{2}\sqrt{\frac{H}{2g}}$

2)



1) $Ox: N_1\sin\alpha = ma_{1x}$

$Oy: mg - N_1\cos\alpha = ma_{1y}$

2) $Ox: F - N_1\sin\alpha = 2ma_{2x}$

$\frac{a_{1y}t^2}{2} = H$. $\frac{a_{1x}t^2}{2} = L + l$. $\frac{a_{2x}t^2}{2} = L$.

$tg\alpha = \frac{H}{l}$. $l = \frac{H}{tg\alpha}$.

$N_1 = \frac{ma_{1x}}{\sin\alpha}$.

$\frac{a_{1x}t^2}{2} = \frac{a_{2x}t^2}{2} + l$. $l = \frac{H}{tg\alpha}$.

$N_1\sin\alpha = ma_{1x}$.

$mg - N_1\cos\alpha = ma_{1y}$. $mg - \frac{ma_{1x}}{tg\alpha} = ma_{1y}$

$\frac{(a_{1x}-a_{2x})t^2}{2} = \frac{H}{\sin\alpha}tg\alpha$.

$mg - N_1\sin\alpha = 2ma_{2x}$. $mg - ma_{1x} = 2ma_{2x}$.

$a_{1x} - a_{2x} = \frac{a_{1y}}{tg\alpha}$.

$g = a_{1x} + 2a_{2x}$.

$g = a_{1x} + \frac{a_{1x}}{tg\alpha}$.

$a_{1x} = g - 2a_{2x}$.

$a_{1y} = (g - 3a_{2x})tg\alpha$.

$a_{1x} = g - 2a_{2x}$.

$g - 3a_{2x} = \frac{a_{1y}}{tg\alpha}$.

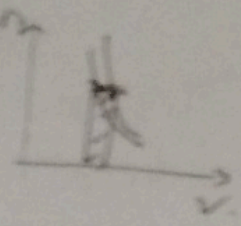
$a_{1y} = (a_{1x} - a_{2x})tg\alpha$.

$g = (g - 3a_{2x})tg\alpha + \frac{g - 2a_{1x}}{tg\alpha}$.

reproduction
N5.

$P_1 = 0{,}99\,P_0$ $\quad P_0V_0 = \nu R T_0 \quad T_0 = \frac{P_0V_0}{\nu R}$

$V_1 = 1{,}02\,V_0$ $\quad P_1V_1 = \nu R T_1$

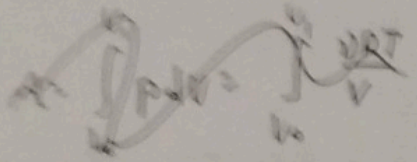


$0{,}99P_0 \cdot 1{,}02\,V_0 = \nu R T_1$

$T_1 = 0{,}99 \cdot 1{,}02\,T_0 = 1{,}0098\,T_0 \approx 0{,}93\% \approx 1\%$

$\frac{\Delta Q}{\Delta U}$ $\quad \Delta Q = \Delta U + A$

$\Delta U = \frac{3}{2}\nu R \Delta T = \frac{3}{2}(P_1V_1 - P_0V_0) = \frac{3}{2}P_0V_0 \cdot 0{,}038$



$A \approx \frac{(P_0+P_1)}{2}(V_1 - V_0) = 0{,}995P_0 \cdot 0{,}02V_0 = 0{,}0199P_0V_0$

$\Delta Q = 0{,}147\,P_0V_0 + 0{,}0199P_0V_0 = 0{,}1669\,P_0V_0$

$\frac{\Delta Q}{\Delta U} = 1{,}14$