Часть 1

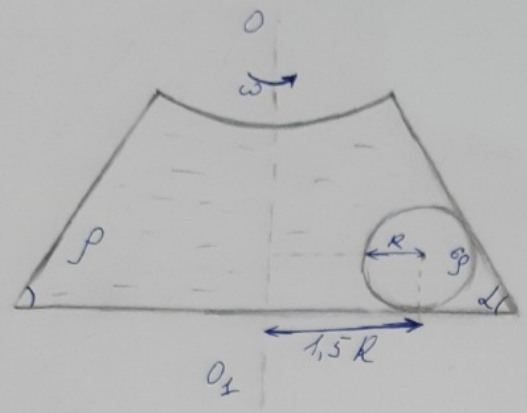
Олимпиада: **Физика, 10 класс (1 часть)**

Шифр: **21204986**

ID профиля: **283142**

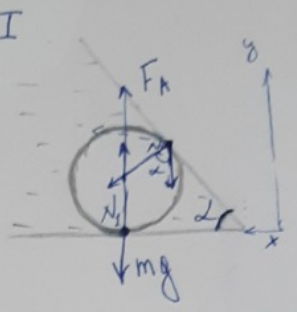
Вариант 2

Задача 2



$tg\alpha = \frac{3}{2}$

I



$$\text{I} \begin{cases} N_1 + F_A = mg + N_{2y} \\ F_A = \rho \cdot g \cdot v_{шар} \\ N_{2y} = N_2 \cos\alpha \\ v_{шар} = \frac{1}{3}\pi R^3 \\ N_2 \sin\alpha = 0 \Rightarrow N_2 = 0 \end{cases}$$

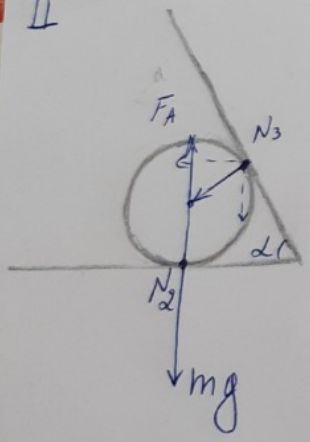
$$N_1 = mg - F_A = mg - \frac{1}{3}\rho g \cdot \pi R^3$$

$$m = 6\rho \cdot v_{шар}$$

$$N_1 = 6\rho g \cdot \pi R^3 \cdot \frac{1}{3} - \frac{1}{3}\rho g \pi R^3 =$$

$$= 1\frac{2}{3}\pi \rho g R^3$$

II



$$\begin{cases} N_2 + F_A = mg + N_{3y} \\ N_{3y} = N_3 \cos\alpha \\ N_{3x} = m a_1 \\ a_y = \omega^2 R \\ a_1 = 1{,}5\omega^2 R \\ N_{3x} = N_3 \cdot \sin\alpha \\ N_3 \sin\alpha = 1{,}5 m \omega^2 R \end{cases}$$

$$N_3 \cos\alpha = 1{,}5 m \omega^2 R \cdot ctg\alpha$$

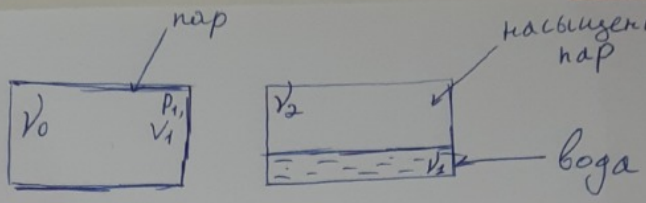
$$= \frac{3}{2} m \omega^2 R \cdot \frac{2}{3} = m\omega^2 R$$

$$N_2 = mg + m\omega^2 R - F_A = 6\rho v_{шар} \cdot g + 6\rho v_{шар} \omega^2 R - \rho g v_{шар} =$$

$$= \rho v_{шар}(6g + 6\omega^2 R - g) = \frac{1}{3}\pi R^3 \cdot \rho (5g - 6\omega^2 R)$$

Ответ: $N_1 = \frac{5}{3}\pi\rho g R^3$; $N_2 = \frac{1}{3}\pi R^3 \rho (5g - 6\omega^2 R)$

Задача 3



Дано:

$t = const$

$T = 81°C = 354 K$

$V_1 = 7 \cdot 1{,}7\,л$

$V_2 = 1{,}7\,л$

$3{,}6 P_1 = P_2$

$M = 18^2$ г/моль

~~$P_{нас}$~~ $P_{нас\ 81°C} = 10^5 \cdot 0{,}5$ Па

$P_1 = ?$

$\nu_0 = \nu_1 + \nu_2$

По з-ну Менделеева – Клапейрона:

$P_1 V_1 = \nu_0 R T$

$P_2 V_2 = \nu_2 R T$

$\frac{\nu_0}{\nu_2} = \frac{P_1 V_1}{P_2 V_2} = \frac{P_1 \cdot 7 V_2}{3{,}6 P_1 \cdot V_2} = \frac{70}{36} \Rightarrow \nu_1 = \frac{70-36}{70} = \frac{34}{70}\nu_0$

I $P_1 = \frac{P_2}{3{,}6} = \frac{P_{нас}(81°C)}{3{,}6} = \frac{0{,}5 \cdot 10^5}{36 \cdot 10^{-1}} =$

$= \frac{5 \cdot 10^5}{36} = 13{,}9$ кПа

II ~~$m_{пара\ 1} = \nu_1 M$~~

$m_{пара\ 1} = \nu_0 \cdot M$

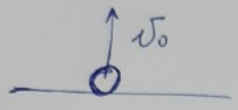
$\nu_0 = \frac{P_1 V_1}{RT} = \frac{13{,}9 \cdot 10^3 \cdot 7 \cdot 1{,}7 \cdot 10^{-3}}{8{,}31 \cdot 354} = 0{,}056$ моль

$m_{пара\ 1} = \nu_0 \cdot M = 0{,}056 \cdot 18 \approx 1{,}012 \approx 12$

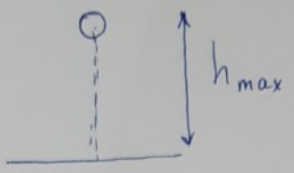
Ответ: 12

Задача 1

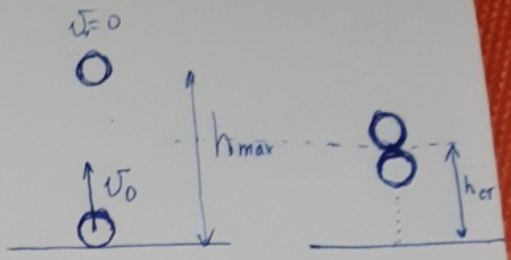
1.



2. $v_1 = 0$



3. $v_1 = 0$



I $h_{max} = \frac{v_0^2}{2g}$

$t_{1\uparrow} = \frac{v_0}{g}$

$h_{ст} = h_{max} - \frac{g t_{ст}^2}{2}$ (для 1-го тела)

$h_{ст} = v_0 t_{ст} - \frac{g t_{ст}^2}{2}$ (для 2-го тела)

$h_{max} = \frac{v_0^2}{2g}$

$\frac{v_0^2}{2g} - \frac{g t_{ст}^2}{2} = v_0 t_{ст} - \frac{g t_{ст}^2}{2}$

$\frac{v_0^2}{2g} = v_0 t_{ст} \Rightarrow t_{ст} = \frac{v_0}{2g}$

$t_1 = t_{1\uparrow} + t_{ст} = \frac{v_0}{g} + \frac{v_0}{2g} = \frac{3v_0}{2g}$

II $\frac{t_1}{t_2} = \frac{t_{1\uparrow} + t_{ст}}{t_{ст}} = 1 + \frac{t_{1\uparrow}}{t_{ст}} = 1 + \frac{v_0}{g} : \frac{v_0}{2g} = 1 + \frac{v_0}{g} \cdot \frac{2g}{v_0} = 3$

III $h_{ст} = h_{max} - \frac{g t_{ст}^2}{2} = \frac{v_0^2}{2g} - \frac{g}{2} \cdot \left(\frac{v_0}{2g}\right)^2 = \frac{v_0^2}{2g} - \frac{g \cdot v_0^2}{8g^2} =$

$= \frac{4v_0^2 - v_0^2}{8g} = \frac{3v_0^2}{8g}$

Ответ: $t_1 = \frac{3v_0}{2g}$; $\frac{t_1}{t_2} = 3$; $h_{ст} = \frac{3v_0^2}{8g}$

Часть 2

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

Шифр: **21204986**

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Вариант 2

Задача 5

Дано:

$0{,}99P_1 = P_2$

$1{,}02V_1 = V_2$

Т.К. и T и V и P практически не изменились, то пренебрежем изменением ν в течение данного процесса

1) $P_1V_1 = \nu RT_1$

$P_2V_2 = \nu RT_2$

$$\frac{P_1V_1}{0{,}99P_1 \cdot 1{,}02V_1} = \frac{T_1}{T_2}$$

$$\frac{T_1}{T_2} = \frac{10000}{99 \cdot 102} = \frac{10000}{10098}$$

$$\frac{T_2}{T_1} = \frac{10098}{10000} = \frac{100{,}98}{100} \Rightarrow$$ T увеличилась на 0,98 %.

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

2) $Q = \Delta U + A_2$

$$\frac{Q}{\Delta U} = \frac{\Delta U + A_2}{\Delta U} = 1 + \frac{A_2}{\Delta U}$$

$A_2 = P_2V_2 - P_1V_1$

$\Delta U = \frac{i}{2} \cdot (P_2V_2 - P_1V_1)$

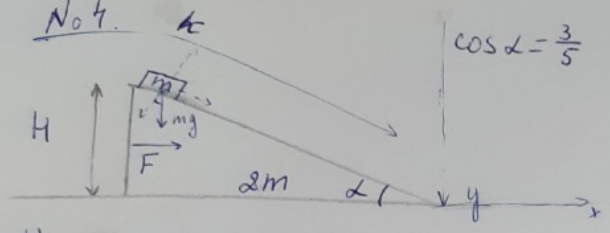
$i = 3$ для одноатомного газа

$$\frac{A_2}{\Delta U} = \frac{(P_2V_2 - P_1V_1)}{\frac{i}{2}(P_2V_2 - P_1V_1)} = \frac{1}{\frac{i}{2}} = \frac{2}{3}$$

$$\frac{Q}{\Delta U} = 1 + \frac{A_2}{\Delta U} = 1\frac{2}{3} = \frac{5}{3}$$

Ответ: 1) увеличилась; на 0,98 %.
2) 5:3

№4.



$\cos\alpha = \frac{3}{5}$

1) $mg\sin\alpha = ma_0$

$a_0 = g\sin\alpha$

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

$\frac{H}{\sin\alpha} = \frac{g\sin\alpha \cdot t^2}{2}$

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

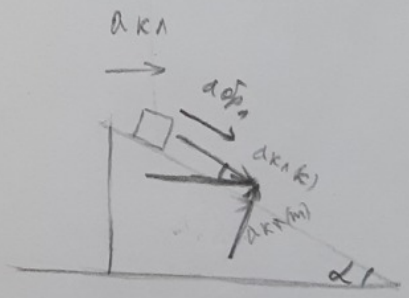
$t = \sqrt{\frac{2H}{g}} \cdot \frac{1}{\sin\alpha} = \sqrt{\frac{2H}{g}} \cdot \frac{1}{\sqrt{1-\cos^2\alpha}} = \sqrt{\frac{2H}{g}} \cdot \frac{1}{1} : \frac{4}{5} = \frac{5}{4}\sqrt{\frac{2H}{g}}$

2) $F = mg$

$3ma_{кл} = F$

$3ma_{кл} = mg$

$a_{кл} = \frac{mg}{3m} = \frac{g}{3}$



3) $\vec{a}_{отн_1} = \vec{a}_0 - \vec{a}_{кл}$ (на ось К)

$a_{отн_1} = g\sin\alpha - \frac{g}{3}\cdot\cos\alpha = g\left(\sin\alpha - \frac{\cos\alpha}{3}\right) = g\left(\frac{4}{5} - \frac{3}{5}\cdot\frac{1}{3}\right) = \frac{3}{5}g = 0{,}6g$

$\frac{H}{\sin\alpha} = \frac{0{,}6g \cdot t_1^2}{2}$

$t_1^2 = \frac{2H}{0{,}6g\sin\alpha} \approx 4{,}16\frac{H}{g}$

$t_1 \approx 2{,}03\sqrt{\frac{H}{g}} \approx 2\sqrt{\frac{H}{g}}$

Ответ:
1) $t = \frac{5}{4}\sqrt{\frac{2H}{g}}$
2) $\frac{g}{3}$
3) $2\sqrt{\frac{H}{g}}$