

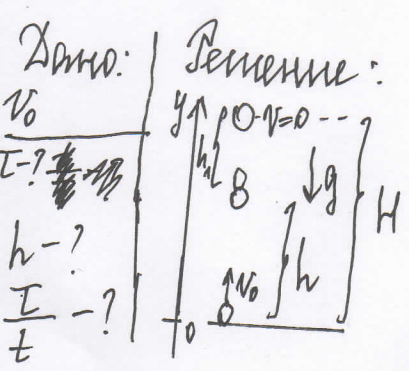
Часть 1

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

Шифр: **21204825**

ID профиля: **303869**

Вариант 2



№1

$$H = \frac{v^2 - v_0^2}{-2g} = \frac{v_0^2}{2g} = v_0 T - \frac{gT^2}{2} \Rightarrow gT^2 - 2v_0 T + \frac{v_0^2}{g} = 0 \quad (1)$$

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

$$h = H - h_1$$

$$h_1 = v_0 t + \frac{gt^2}{2} = \frac{gt^2}{2}$$

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

$$\frac{v_0^2}{2g} = v_0 t \Rightarrow t = \frac{v_0}{2g}$$

$$(1) \quad gT^2 - 2v_0 T + \frac{v_0^2}{g} = 0 \Leftrightarrow T^2 - \frac{2v_0}{g} T + \left(\frac{v_0}{g}\right)^2 = 0$$

$$\begin{cases} T_1 T_2 = + \frac{v_0^2}{g^2} \\ T_1 + T_2 = + \frac{2v_0}{g} \end{cases} \Rightarrow \begin{cases} T_1 = + \frac{v_0}{g} \\ T_2 = + \frac{v_0}{g} \end{cases} \Rightarrow T = \frac{v_0}{g}$$

$$T = T + t = \frac{v_0}{g} + \frac{v_0}{2g} = \frac{3v_0}{2g}$$

$$\frac{t}{T} = \frac{\frac{v_0}{2g}}{\frac{3v_0}{2g}} = \frac{1}{3} \Rightarrow \frac{T}{t} = 3$$

$$h = v_0 t - \frac{gt^2}{2} = v_0 \cdot \frac{v_0}{2g} - \frac{g \cdot \left(\frac{v_0}{2g}\right)^2}{2} = \frac{v_0^2}{2g} - \frac{v_0^2}{8g} = \frac{3v_0^2}{8g}$$

Ответ: $T = \frac{3v_0}{2g}$; $\frac{T}{t} = 3$; $h = \frac{3v_0^2}{8g}$

Условие. Страница 2

№3.

Дано:
 $T = 81^\circ\text{C}$
 $n_1 = 7$
 $V = 1,7 \text{ л}$
 $n_2 = 3,6$
 $p_H = 0,5 \cdot 10^5 \text{ Па}$
 $M = 18 \text{ г/моль}$

1) $p = ?$
 2) $m_0 = ?$

Решение

$7V, T, p$
 ненасыщ. пар

$V, T, 3,6p = p_H$
 насыщ. пар
 вода

$$\frac{7pV}{T} = \frac{m_0}{M} R$$

$$\frac{3,6pV}{T} = \frac{m}{M} R \Rightarrow \frac{7}{3,6} = \frac{m_0}{m} \Rightarrow m = \frac{3,6}{7} m_0 \Rightarrow \begin{cases} 3,6p = p_H \\ m < m_0 \Rightarrow \\ \Rightarrow m_0 = m + m_B \end{cases}$$

~~$p_H V = \frac{m}{M} R T \Rightarrow m = \dots$~~

$$3,6p = p_H \Rightarrow p = \frac{p_H}{3,6} = \frac{0,5 \cdot 10^5 \text{ Па}}{3,6} = 13,9 \text{ кПа} \approx 14 \text{ кПа}$$

~~Ответ:~~

$$\frac{7pV}{T} = \frac{m_0}{M} R \Rightarrow m_0 = \frac{7pVM}{RT} = \frac{7p_H VM}{3,6RT} = \frac{7 \cdot 0,5 \cdot 10^5 \text{ Па} \cdot 1,7 \cdot 10^{-3} \text{ м}^3 \cdot \frac{18}{1000} \frac{\text{кг}}{\text{моль}}}{3,6 \cdot 8,31 \frac{\text{Дж}}{\text{моль} \cdot \text{К}} \cdot (81 + 273) \text{ К}} =$$

$$= 1,011312 \approx 1,2$$

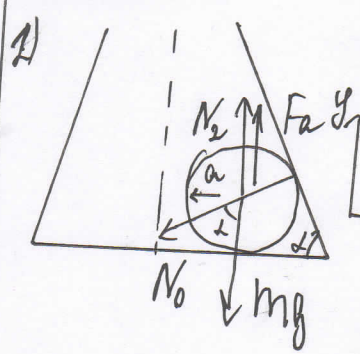
Ответ: $p = 14 \text{ кПа}; m \approx 1,2$.

Учетовик. Страница 3

N2.

Дано:
 w, ρ, ρ_f
 $R, 1,5R$
 $\text{tg } \alpha = \frac{3}{2}$
 1) N_1 - ? 2) N_2 - ?

Решение:



По второму закону Ньютона:

$$Oy: N_2 + F_a = mg + N_1 \cos \alpha$$

$$Ox: -N_1 \sin \alpha = -am \Rightarrow$$

$$\Rightarrow N_1 = \frac{N_2 + F_a - mg}{\cos \alpha}$$

$$am = (N_2 + F_a - mg) \text{tg } \alpha$$

$$N_2 = \frac{am}{\text{tg } \alpha} - F_a + mg$$

$$a = w^2 \cdot (1,5R)$$

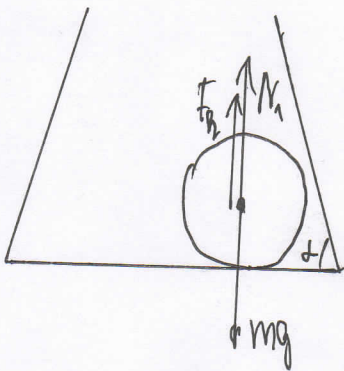
$$F_a = \rho_f g V = \rho_f g \cdot \frac{4}{3} \pi R^3$$

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

$$N_2 = \frac{8w^2 \pi R^3 \rho \cdot (1,5R)}{\frac{3}{2}} - \frac{4}{3} \rho_f g \pi R^3 + \frac{4}{3} \pi R^3 \rho g = 8w^2 \pi R^4 \rho - \frac{4}{3} \rho_f g \pi R^3 + \frac{4}{3} \pi R^3 \rho g =$$

$$= R^3 \rho g \pi \left(\frac{4}{3} \frac{\rho}{\rho} + 8w^2 R \right) = R^3 \rho g \pi \left(\frac{20}{3} + 8w^2 R \right) = R^3 \rho g \pi \left(\frac{20}{3} + 8w^2 R \right)$$

1)



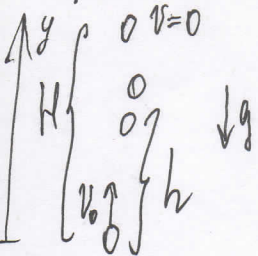
$$N_1 + F_a = mg$$

$$N_1 = mg - F_a = 6V \rho g - \rho_f g V = 5V \rho g = \frac{5 \cdot 4}{3} \pi R^3 \rho g = \frac{20}{3} \pi R^3 \rho g$$

Ответ: $N_1 = \frac{20}{3} \pi R^3 \rho g$; $N_2 = \pi R^3 \rho g \left(\frac{20}{3} + 8w^2 R \right)$

Черновик

273



$$H = \frac{v^2 - v_0^2}{-2g} = \frac{v_0^2}{2g}$$

$$h = H - h_1 = \frac{v_0^2}{2g} - \frac{gt^2}{2} = v_0 t - \frac{gt^2}{2}$$

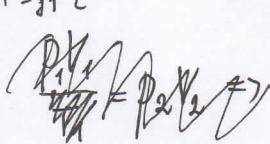
$$h_1 = v t + \frac{gt^2}{2}$$

$$\frac{v_0^2}{2g} = v_0 t \Rightarrow t = \frac{v_0}{g}$$

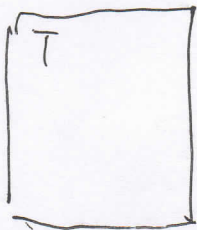


$$\frac{4}{3} \pi R^3$$

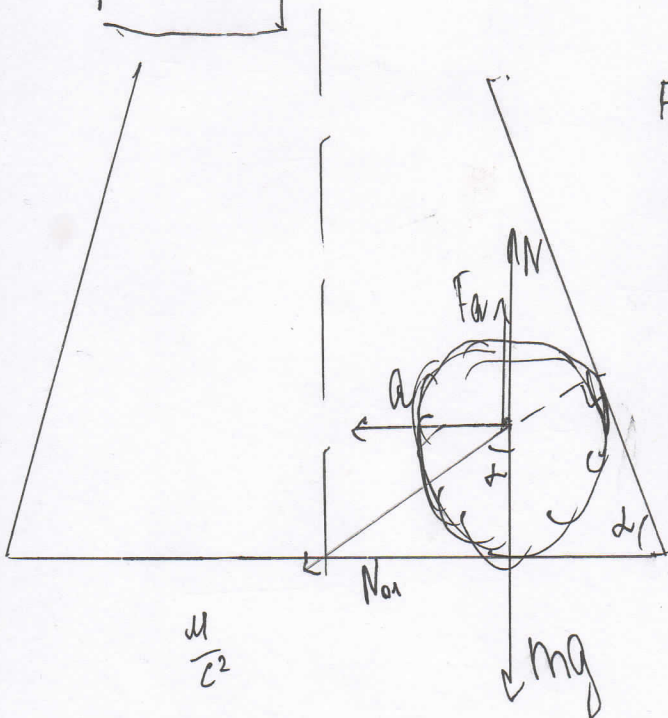
№3.
T = 11°C



$$\frac{P_1 V_1}{T_1} = \frac{m t}{T_2}$$



354



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

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

$$F_{av} + N_2 = mg + N_0 \cos \alpha \Rightarrow N_0 =$$

$$N_0 \sin \alpha = ma$$

$$(F_{av} + N_2 - mg) \tan \alpha = ma$$

$$a = \omega^2 R$$

ωR
v = ωR

Часть 2

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

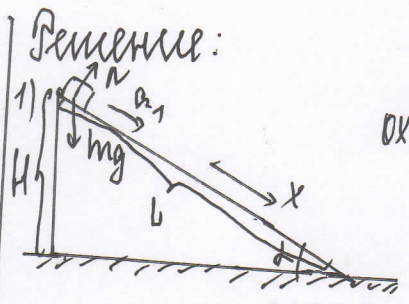
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Вариант 2

Чистовик. Справочка №1

Дано:
 $\cos \alpha = \frac{3}{5}$
 $m, 2m$
 $H, F = mg$



№4
 По второму закону Ньютона:

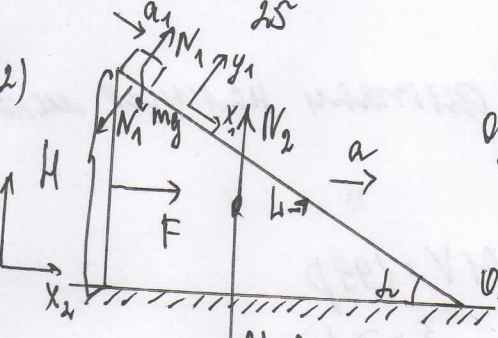
Ох: $mg \sin \alpha = ma_1 \Rightarrow a_1 = g \sin \alpha$
 $H = \frac{v^2}{2a_1} = \frac{a_1 t^2}{2} = \frac{g \sin \alpha t^2}{2}$

$\sin^2 \alpha = 1 - \cos^2 \alpha = 1 - \frac{9}{25} = \frac{16}{25}$

$t^2 = \frac{2H}{\sin^2 \alpha \cdot g} = \frac{2H}{\frac{16}{25} g}$

$t = \frac{5}{4} \sqrt{\frac{2H}{g}} = 1,25 \sqrt{\frac{2H}{g}} \approx 1,78 \sqrt{\frac{H}{g}}$

- 1) t - ?
- 2) a - ?
- 3) T - ?



Оу: $N_1 = \cos \alpha \cdot mg$

$N_2 = N_1 \cos \alpha + 2mg = 2mg + mg \cos^2 \alpha = mg(2 + \cos^2 \alpha)$

Ох: $F - N_1 \sin \alpha = 2ma$

$mg - mg \cos \alpha \cdot \sin \alpha = 2ma$

$a = \frac{g}{2} (1 - \cos \alpha \cdot \sin \alpha) = \frac{9,8 \frac{m}{c^2}}{2} (1 - \frac{4}{5} \cdot \frac{3}{5}) = 2,548 \frac{m}{c^2}$

$\sin \alpha = \sqrt{1 - \cos^2 \alpha} = \sqrt{1 - \frac{9}{25}} = \frac{4}{5}$

3) $a_2 = a_1 - a \cos \alpha = g \sin \alpha - \frac{g}{2} (1 - \cos \alpha \cdot \sin \alpha) \cos \alpha$

a_2 - ускорение бруска относительно клина

$L = \frac{H}{\sin \alpha} = \frac{a_2 T^2}{2} = \frac{T^2 (2g \sin \alpha - g \cos \alpha + g \sin \alpha \cdot \cos^2 \alpha)}{4}$

$T = \sqrt{\frac{4L}{2g \sin \alpha - g \cos \alpha + g \sin \alpha \cdot \cos^2 \alpha}} = 2 \sqrt{\frac{H}{2g \sin^2 \alpha - g \sin \alpha \cdot \cos \alpha + g \sin^2 \alpha \cdot \cos^2 \alpha}}$

$= 2 \sqrt{\frac{H}{g (2 \cdot \frac{16}{25} - \frac{4}{5} \cdot \frac{3}{5} + \frac{9}{25} \cdot \frac{16}{25})}} = 2 \sqrt{\frac{H \cdot 25^2}{g \cdot 644}} = 25 \sqrt{\frac{H}{161g}} \approx 1,97 \sqrt{\frac{H}{g}}$

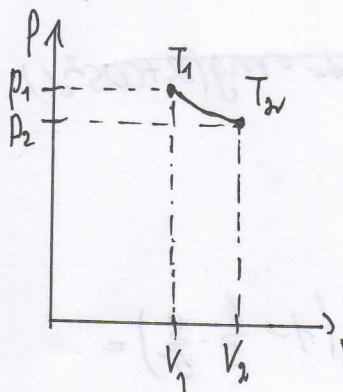
Ответ: 1) $t = 1,78 \sqrt{\frac{H}{g}}$; 2) $a = 2,548 \frac{m}{c^2}$; 3) $T = 1,97 \sqrt{\frac{H}{g}}$

Чистовик. Справочник №2

№5.

<p>Дано: $n_1 = 1\%$ $n_2 = 2\%$ $n = ?$</p>	<p>Решение: 1) $\frac{pV}{T} = \frac{0,99p \cdot 1,02V}{(1+n)T} \Rightarrow 1+n = 0,99 \cdot 1,02$ $n = 0,99 \cdot 1,02 - 1 = 0,0098$ $n = \del{0,98} 0,98\%$</p>
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2) Так как относительные изменения p, V и T считаем малыми мень-
 ше единицы $\Rightarrow A \approx \frac{1}{2} (p_1 + p_2) (V_2 - V_1)$



$$A = \frac{1}{2} (p + 0,99p) (1,02V - V) = 0,01V \cdot 0,99p$$

$$\Delta U = \frac{1}{2} R \Delta T \gamma = \frac{3}{2} R \gamma (T_2 - T_1) = \frac{3}{2} R \gamma n T$$

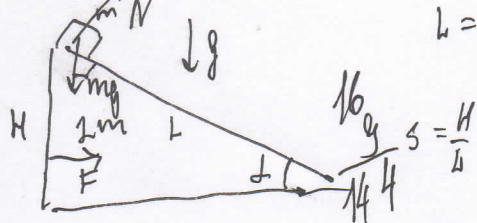
$$pV = \gamma RT \Rightarrow A = \del{0,0199} 0,0199 \gamma RT$$

$$Q = A + \Delta U = 0,0199 \gamma RT + \frac{3}{2} \gamma RT n = \gamma RT (0,0199 + \frac{3}{2} n) = \gamma RT \cdot 0,0346$$

$$\frac{Q}{\Delta U} = \frac{0,0346 \gamma RT}{\frac{3}{2} n \gamma RT} = \frac{0,0346}{0,0147} \approx 2,354$$

Ответ: 1) увеличилась на ~~0,98~~ 0,98%; 2) $\frac{Q}{\Delta U} = 2,354$.

Черновик



N5 $Q = A + \Delta H$
 $\Delta H = R \Delta T \cdot \frac{L}{2} =$

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

$$\frac{102}{1} = \frac{99}{1 + \Delta h}$$

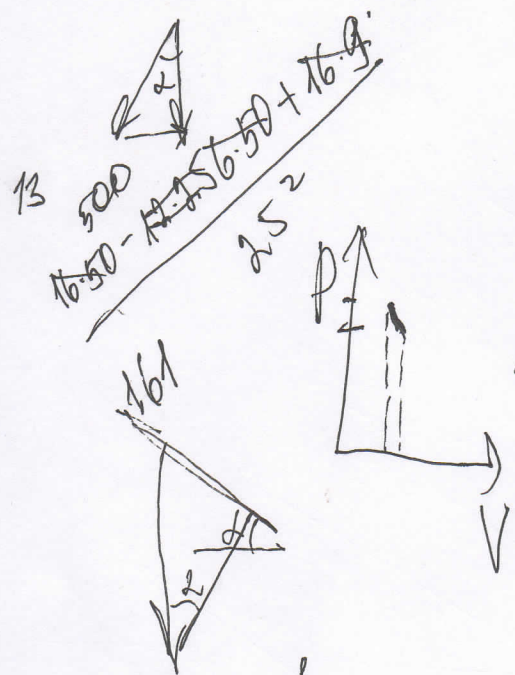
$$pV = \nu RT$$

$$102 + \frac{102 \Delta h}{1} = 99$$

$$-\frac{3}{34} = -\frac{3}{102} = \Delta h \approx -3\%$$

$$A = \frac{1}{2}(V_2 - V_1)(p_1 + p_2) = \frac{1}{2} \cdot \frac{99}{102} \cdot 1,99 \cdot 0,02 V p$$

$$Q = 1,99 \cdot 0,02 \cdot 1,5 R \Delta T \cdot \frac{1}{34} T$$



$$\sin \alpha = \frac{b}{c}$$

$$c = \frac{b}{\sin \alpha}$$

$$\frac{32}{25} - \frac{12}{25} = \frac{20}{25} = \frac{4}{5}$$