Часть 1

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

Шифр: **21204841**

ID профиля: **335531**

Вариант 2

Чистовик ②

$h = V_0 t_2 - \frac{g t_2^2}{2}$

$t_2 = \frac{V_0}{2g}$

$\underbrace{h = \frac{V_0 \cdot V_0}{2g} - \frac{g \cdot V_0^2}{2 \cdot 4g^2} = \frac{V_0^{2}}{2g} - \frac{V_0^2}{8g} = \frac{3V_0^2}{8g}}$

Ответ: $t_1 = \frac{3V_0}{2g}$; $\frac{t_1}{t_2} = 3$; $h = \frac{3V_0^2}{8g}$;

Задача 2.

Дано:

ω

ρ

6ρ

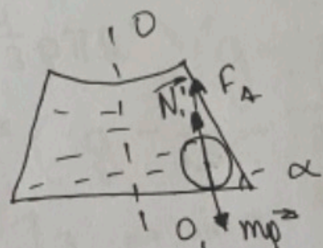
R

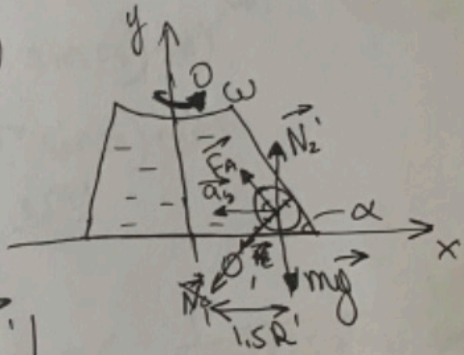
$1{,}5R$

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

1) N_1 - ?

2) N_2 - ?





I по III з-н Ньютона: $|\vec{N_1}| = |\vec{N_1'}|$

II з-н Ньютона для шара:

$mg = N_1' + F_A$

$mg = N_1 + F_A \Rightarrow N_1 = mg - F_A$

$m = 6\rho \cdot V = 8\rho\pi R^3$

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

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

$\underline{N_1 = 8\rho\pi R^3 g - \frac{4}{3}\rho g \pi R^3 = \frac{20}{3}\rho g \pi R^3}$

II $m\vec{a_y} = \vec{N_2'} + \vec{F_A} + m\vec{g}$; $|\vec{N_2'}| = |\vec{N_2}|$ (по III з-ну Ньютона)

$a_y = \omega^2 \cdot 1{,}5R$

$\vec{F_A} = \vec{F_{A1}} + \vec{F_{A2}}$

$F_{A1} = \rho g V$

$F_{A2} = \rho a_y V$ $\Bigg| \Rightarrow F_A = \sqrt{(\rho g V)^2 + (\rho a_y V)^2}$

21204841 (U335531 M1279135)

Чистовик 1

Задача 1.

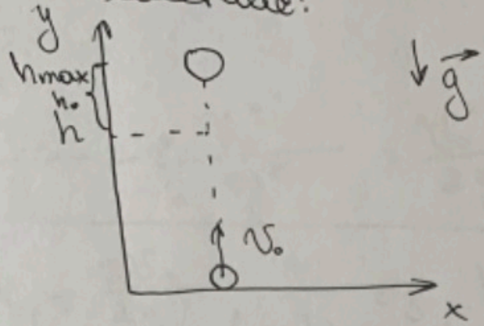
Дано:
v_0

$t_1 - ?$

$\frac{t_1}{t_2} - ?$

$h - ?$

Решение:



$t_1 = t_{11} + t_{12} = t_{11} + t_2$

t_{11} - время до max высоты

t_{12} - время от hmax до столкновения

$t_{12} = t_2$

$$h = v_0 t_2 - \frac{g t_2^2}{2}$$

$$h = h_{max} - h_0$$

$$h_{max} = v_0 t_{11} - \frac{g t_{11}^2}{2}$$

$$h_0 = \frac{g t_2^2}{2}$$

$$h = v_0 t_2 - \frac{g t_2^2}{2}$$

$$h = v_0 t_{11} - \frac{g t_{11}^2}{2} - \frac{g t_2^2}{2}$$

$$v_0 t_2 - \cancel{\frac{g t_2^2}{2}} = v_0 t_{11} - \frac{g t_{11}^2}{2} - \cancel{\frac{g t_2^2}{2}}$$

$$0 = v_0 - g t_{11} \Rightarrow t_{11} = \frac{v_0}{g}$$

$$\cancel{v_0} t_2 = \frac{v_0^{\cancel{2}}}{g} - \cancel{g} \cdot \frac{v_0^{\cancel{2}}}{2g^{\cancel{2}}}$$

$$t_2 = \frac{v_0}{g} - \frac{v_0}{2g} = \frac{v_0}{2g}$$

$$\underbrace{t_1 = t_{11} + t_2 = \frac{v_0}{g} + \frac{v_0}{2g} = \frac{3v_0}{2g}}$$

$$\underbrace{\frac{t_1}{t_2} = \frac{3\cancel{v_0} \cdot \cancel{2g}}{\cancel{2g} \cdot \cancel{v_0}} = 3}$$

$m = 8\rho\pi R^3$

$m\vec{a}_ц = \vec{N_2} + \vec{F_A} + m\vec{g}$

y: $\cancel{N_2} = 0 = N_2 - mg + F_A\cdot\sin\alpha - \cancel{N_c\cdot\cos\alpha}$; x: $-ma_{ц2} - N_c\cdot\sin\alpha - F_A\cdot\cos\alpha$

$\cancel{N_c = \frac{ma_ц - F_A\cdot\cos\alpha}{\sin\alpha}}$

$N_2 = mg - F_A\cdot\sin\alpha + \cancel{N_c\cos\alpha}$

$N_2 = 8\rho\pi R^3 - \sqrt{\rho^2 g^2 V^2 + \rho^2 a_ц^2 V^2}\cdot\sin\alpha + \cancel{(ma_ц - F_A\cdot\cos\alpha)\cdot ctg\alpha}$

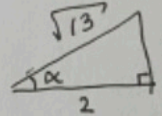
$N_2 = 8\rho\pi R^3 - \rho V\sqrt{g^2 - \frac{\omega^4}{2{,}25\cdot R^2}}\cdot\sin\alpha + \cancel{\left(\frac{m\cdot\omega^2}{2{,}25R} - \rho\frac{4}{3}\pi R^3\sqrt{g^2 - \frac{\omega^4}{2{,}25R^2}}\cdot\cos\alpha\right)\cdot ctg\alpha}$ $\cancel{(*)}$

$N_2 = 8\rho\pi R^3 g - \frac{4}{3}\pi R^3\rho\sqrt{g^2 - \frac{\omega^4}{2{,}25\cdot R^2}}\cdot\sin\alpha + \cancel{(*)}$

$N_2 = \left(8\rho\pi R^3 - \frac{4}{3}\rho\pi R^3\right)\left(g - \sqrt{g^2 - \frac{\omega^4}{2{,}25\cdot R^2}}\cdot\sin\alpha\right) + \cancel{(*)}$

$N_2 = \frac{20}{3}\rho\pi R^3\left(g - \frac{1}{1{,}5R}\sqrt{2{,}25g^2 - \omega^4}\cdot\sin\alpha\right) + \cancel{(*)}$

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



$\Rightarrow \sin\alpha = \frac{3}{\sqrt{13}} = \frac{3\sqrt{13}}{13}$

Ответ: $N_1 = \frac{20}{3}\rho g\pi R^3$; $N_2 = \frac{20}{3}\rho\pi R^3\left(g - \frac{1}{1{,}5R}\sqrt{2{,}25g^2 - \omega^4}\cdot\frac{3\sqrt{13}}{13}\right)$

Задача 3.

Дано:	СИ
$t = 81°C$	$354\ K$
$V_0 = 7V_1$	
$V_1 = 1{,}7\cdot 10^{-3}\ м^3$	
$p_1 = 3{,}6 p_0$	
$p_{н.п.} = 0{,}5\cdot 10^5$ Па	
$\mu = 18\cdot 10^{-3}\ \frac{кг}{моль}$	
$R = 8{,}31\ \frac{Дж}{моль\cdot K}$	

1) p_0 - ?
2) m_0 - ?

Решение:

$T = const$.

ур-ние Менделеева-Клапейрона:

в начале:

$p_0V_0 = \frac{m_0}{\mu}RT$

$p_1V_1 = \frac{m_1}{\mu}RT$

$\Big):\ \frac{p_0V_0}{p_1V_1} = \frac{m_0}{m_1}$

$\frac{p_0\cdot 7V_1}{3{,}6p_0\cdot V_1} = \frac{m_0}{m_1}$ => массы пара разные => выпала роса =>

$p_1 = 0{,}5\cdot 10^5$ Па

Чистовик ④

$p_0 V_0 = \frac{m_0}{\mu} RT \Rightarrow m_0 = \frac{p_0 V_0 \mu}{RT}$

$\underbrace{p_0 = \frac{p_1}{3,6} = \frac{p_{н.п.}}{3,6}}$

$\underbrace{m_0 = \frac{p_{н.п.} \cdot V_0 \cdot \mu}{3,6 RT} = \frac{p_{н.п.} \cdot 7V_1 \cdot \mu}{3,6 RT}}$

$p_0 = \frac{0,5 \cdot 10^5}{3,6} = 0,14 \cdot 10^5$ Па

$m_0 = \frac{0,5 \cdot 10^5 \cdot 7 \cdot 1,7 \cdot 10^{-3} \cdot 18 \cdot 10^{-3}}{8,31 \cdot 354 \cdot 3,6} = \cancel{0,0036 кг \approx 0,004 кг}$ 0,001 кг

Ответ: ~~0,14~~ $p_0 = 0,14 \cdot 10^5$ Па; $m_0 = \cancel{0,004 кг}$ 0,001 кг

$\boxed{\text{Черновик}}$ 2

№2.

Дано:

ω

ρ

6ρ

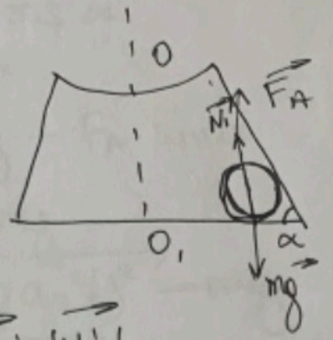
R

$1{,}5R$

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

$N_1 - ?$

$N_2 - ?$



$|\vec{N_1}| = |\vec{N_1'}|$

для шара:

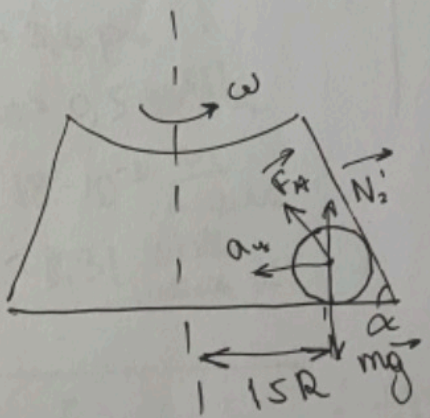
$mg = F_A + N_1 \Rightarrow N_1 = mg - F_A$

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

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

$m = 6\rho \cdot V = \cancel{6}\rho \cdot \frac{4}{\cancel{3}}\pi R^3 = 8\rho\pi R^3$

$\underbrace{N_1 = 8\rho\pi R^3 - \frac{4}{3}\rho g \pi R^3 = \frac{20}{3}\rho\pi R^3}$

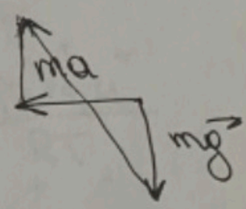


$m\vec{a_ц} = \vec{F_A} + \vec{N_2'} + m\vec{g}$

$\vec{F_A} = \vec{F_{A1}} + \vec{F_{A2}}$

$F_{A1} = \rho g V$

$F_{A2} = \rho a_ц V$



Черновик (1)

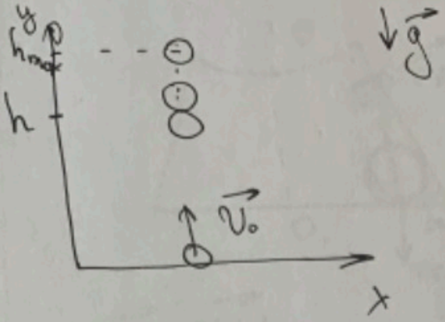
№1.

v_0

$t_1 - ?$

$\frac{t_1}{t_2} - ?$

$h - ?$



t_0 – время полета первого шара до max высоты

$\cancel{h_{max} = v_0 t_{max}}$

$t = t_{01} + t_{02}$

$v_{h_{max}} = v_0 - g t_{01}$, $v_{h_{max}} = 0$

$v_0 = g t_{01} \Rightarrow t_{01} = \frac{v_0}{g}$

$h = v_0 t_2 - \frac{g t_2^2}{2}$

$h = h_{max} - \frac{g t_{02}^2}{2}$

$h_{max} = v_0 t_{01} - \frac{g t_{01}^2}{2}$

$h = v_0 t_{01} - \frac{g t_{01}^2}{2} - \frac{g t_{02}^2}{2}$

$h = \frac{v_0 \cdot v_0}{g} - \frac{g \cdot v_0^2}{2 g^2} - \frac{g\, t_{02}}{2 g^2}$

$0 = v_0 -$

$v_0 = g t_{11}$

$\frac{м}{м} \cdot м^{2}$

$\frac{2{,}25 g^2 - \omega^4}{2{,}25 R^2}$

21204841 (U335531 M1279135)

Черновик ⑤

$$F_A = \sqrt{(\rho g V)^2 + (\rho a_ц V)^2}$$

~~x: = ma_ц =~~

$x: -ma_ц = -F_A \cdot \cos\alpha$

$ma_ц = F_A \cdot \cos\alpha$

$y: 0 = N_2 - mg + F_A \cdot \sin\alpha$

$N_2 = F_A \cdot \sin\alpha - mg$

$N_2 = \sqrt{(\rho g V)^2 + (\rho a_ц V)^2} \cancel{- mg} \cdot \sin\alpha - mg$

$N_2 = \rho V \sqrt{g^2 + \frac{\omega^4}{1{,}5^2 R^2}} \cdot \sin\alpha - mg$

$\sqrt{13}$, 3, 2, α

$\sqrt{9+4}$ $\sin\alpha = \frac{3}{\sqrt{13}}$

Задача 3.

Дано:

$t_1 = 81°C$ | СИ: 354 К

$V_0 = 7V_1$

$V_1 = 1{,}7 \cdot 10^{-3}$ м³

$\varphi_1 = 3{,}6\,\varphi_0$

$p_{н.п.} = 0{,}5 \cdot 10^5$ Па

$M = 18 \cdot 10^{-3}$ кг/моль

$R = 8{,}31$ Дж/(моль·К)

p_0 - ?

m_0 - ?

Решение:

T = const $\quad \varphi_1 = 3{,}6\,\varphi_0$

~~pV = const~~

~~$p_0V_0 = p_1V_1$~~

~~$p_0 = \frac{p_1V_1}{V_0} = \frac{1{,}7 \cdot 10^{-3}}{} \cdot 3{,}61$~~

~~$p_1 = \frac{p_0 V_0}{V_1} = \frac{p_0 \cdot 7V_1}{V_1} = 7p_0$~~

$p_0V_0 = \frac{m_0}{M}RT \Rightarrow m_0 = \frac{p_0 V_0 M}{RT}$

$p_1V_1 = \frac{m_0}{M}RT$

$\frac{p_0V_0}{p_1V_1} = \frac{m_0}{m_0}$

$\frac{p_0 \cdot 7V_1}{3{,}6p_0 \cdot V_1}$

$\frac{7}{3{,}6} \neq 1$

~~$p_0 \cdot 7V_1 = 3{,}6p_0 \cdot V_1$~~

$\varphi_1 = \frac{p_1}{p_{н.п.}} \cdot 100\%$

$p_1 = p_{н.п.} = 0{,}5 \cdot 10^5$ Па

$p_0 = \frac{p_1}{3{,}6} = \frac{0{,}5 \cdot 10^5}{3{,}6} = 13{,}9$ кПа

21204841 (U335531 M1279135)

$\boxed{\text{Черновик}}$ 4

$p_0 V_0 = \frac{m_0}{\mu} RT \Rightarrow m_0 = \cancel{p_0 V_0 \mu RT}$

$p_0 = \frac{\rho_0}{\mu} RT$

$p_1 = \frac{\rho_1}{\mu} RT$

$3{,}6 = \frac{\rho_1}{\rho_0}$

$\frac{V_0}{V_A} = 7$

$\cancel{\frac{\rho_1 V_1}{\rho_0 V_0} = 25{,}2}$

$\frac{m_0}{m_1} = 1{,}94$

$$\frac{0{,}5\cdot10^5\cdot7\cdot1{,}7\cdot10^{-3}\cdot18\cdot10^{-3}}{8{,}31\cdot354} =$$

$$= \frac{0{,}5\cdot7\cdot1{,}7\cdot18\cdot}{8{,}31\cdot354\cdot10} = 0{,}004\text{кг}$$

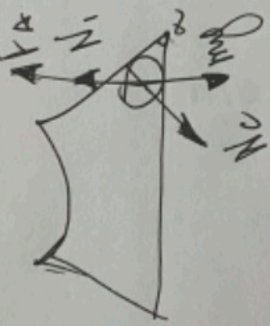
$h = v_0 t_2 - \frac{g t_2^2}{2}$

$t_1 = t_{11} + t_2$

$h = v_0 t_{11} - \frac{g t_{11}^2}{2} - \frac{g t_2^2}{2}$

$t_{11} = \frac{v_0}{g}$

$h = \frac{v_0^2}{g} - \frac{g v_0^2}{2g^2} - \frac{g t_2^2}{2}$



$h = \frac{v_0^2}{2g} - \frac{g t_2^2}{2}$

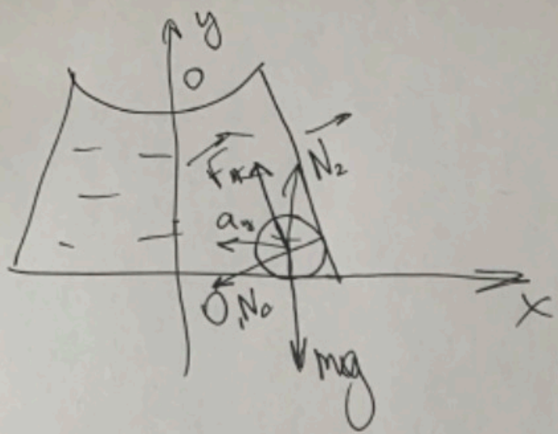
$v_0 t_2 - \cancel{\frac{g t_2^2}{2}} = \frac{v_0^2}{2g} - \cancel{\frac{g t_2^2}{2}}$

$t_2 = \frac{v_0}{2g}$

$t_1 = \frac{v_0}{g} + \frac{v_0}{2g} = \frac{3v_0}{2g}$

$h = \frac{v_0^2}{2g} - \frac{g\cdot v_0^2}{4g^2\cdot 2} = \frac{v_0^2}{2g}\left(1 - \frac{1}{4}\right) = \frac{3v_0^2}{8g}$

Черновик (5)



$x: -ma_x = -N_c \cdot \sin\alpha - F_A \cdot \cos\alpha$

$ma_x = N_c \cdot \sin\alpha + F_A \cdot \cos\alpha$

$N_c = \dfrac{ma_x - F_A \cdot \cos\alpha}{\sin\alpha}$

$y: 0 = N_2 - mg + F_A \cdot \sin\alpha - N_c \cdot \cos\alpha$

$N_2 = mg - F_A \cdot \sin\alpha + N_c \cdot \cos\alpha$

$N_2 = mg - F_A \cdot \sin\alpha + (ma_x - F_A\cos\alpha)\,ctg\alpha$

$N_2 = mg - \rho \cancel{g} \sqrt{g^2 + a_x^2} \cdot \sin\alpha$

$N_c = \dfrac{N_2 - mg + F_A \cdot \sin\alpha}{\cos\alpha}$

$ma_x = (N_2 - mg + F_A \cdot \sin\alpha)\,\cancel{ctg}\,tg\alpha + F_A \cdot \cos\alpha$

Часть 2

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

Шифр: **21204841**

ID профиля: **335531**

Вариант 2

II) 2 з-н Ньютона для клина:

$$2m\vec{a_к} = \vec{F} + \vec{N'} + 2m\vec{g}$$

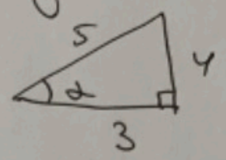
$F = mg$

$$x_1:\ 2ma_к \cdot \cos\alpha = F \cdot \cos\alpha + 2mg \cdot \sin\alpha$$

$$a_к = \frac{\cancel{m}g\cdot\cos\alpha + 2\cancel{m}g\cdot\sin\alpha}{2\cancel{m}\cos\alpha}$$

$$a_к = \frac{g + 2g\,tg\alpha}{2}$$

$$a_к = \frac{g}{2} + g\,tg\alpha = g(0{,}5 + tg\alpha)\ ;\ tg\alpha = \frac{4}{3}$$



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

$$\underbrace{a_к = g\left(0{,}5 + \frac{4}{3}\right) = \frac{11}{6}g}$$

Закон сохранения энергии для бруска:

$$\cancel{m}gH = \frac{\cancel{m}V_{абс}^2}{2}$$

$$\vec{V_{абс}} = \vec{V_{отн}} + \vec{V_к}\ ;\ V_{абс}^2 = V_{отн}^2 + V_к^2$$

p.144

$$V_{отн} = \frac{at^2}{2}\ ;\ V_к = \frac{a_к t^2}{2}$$

$$V_{абс}^2 = \left(\frac{at^2}{2}\right)^2 + \left(\frac{a_к t^2}{2}\right)^2$$

$$V_{абс}^2 = \left(\frac{\frac{4}{5}t^2}{2}\right)^2 + \left(\frac{\frac{11}{6}t^2}{2}\right)^2$$

$$gH = \frac{\left(\frac{4t^2}{10}\right)^2 + \left(\frac{11t^2}{12}\right)^2}{2} \Rightarrow 2gH = \frac{16t^4}{100} + \frac{121t^4}{144}$$

$$2gH = t^4$$

$$t = \sqrt[4]{2gH}$$

Чистовик (3)

$v_{отн} = at$; $v_к = a_к t$

$v_{абс}^2 = a^2 t^2 + a_к^2 t^2$

$v_{абс}^2 = \left(\frac{4}{5} g t\right)^2 + \left(\frac{11}{6} g t\right)^2$

$2gH = \frac{16}{25} g^2 t^2 + \frac{121}{36} g^2 t^2$

$2H = t^2 g \left(\frac{16}{25} + \frac{121}{36}\right) \Rightarrow t^2 = \frac{2H}{g\left(\frac{16}{25} + \frac{121}{36}\right)}$

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

$\underline{t = \sqrt{\frac{H}{2g}}}$

Ответ: 1) $\frac{5}{4}\sqrt{\frac{2H}{g}}$; 2) $\frac{11}{6} g$; 3) $\sqrt{\frac{H}{2g}}$

Задача 5.

Дано:

$i = 3$

$\frac{\Delta p}{p} = -0{,}01$

$\frac{\Delta V}{V} = 0{,}02$

1) $\frac{\Delta T}{T}$ - ?

2) $\frac{Q}{\Delta U}$ - ?

Решение:

Ур-ние Менделеева - Клапейрона:

$pV = \nu R T \Rightarrow$

$(p + \Delta p)(V + \Delta V) = \nu R (T + \Delta T)$

$pV + p\Delta V + \Delta p V + \cancel{\Delta p \Delta V} = \nu R T + \nu R \Delta T$

$\cancel{pV} + p\Delta V + \Delta p V = \cancel{pV} + \nu R \Delta T \quad |: pV$

$\frac{\Delta V}{V} + \frac{\Delta p}{p} = \frac{\nu R \Delta T}{pV = \nu R T}$

$\frac{\Delta V}{V} + \frac{\Delta p}{p} = \frac{\nu R \Delta T}{\nu R T}$

$\underline{\frac{\Delta V}{V} + \frac{\Delta p}{p} = \frac{\Delta T}{T}}$

$\frac{\Delta T}{T} = 0{,}02 - 0{,}01 = 0{,}01$ - температура газа увеличилась на 1%

Чистовик (4)

I начало термодинамики:

$Q = \Delta U + A$

$\Delta U = \frac{i}{2} \nu R \Delta T$

т.к. изменение ~~объема~~ давления очень мало, то возьмем $p = const$

$A = p\Delta V$

$Q = \frac{i}{2}\nu R\Delta T + p\Delta V \; | : pV$

$\frac{Q}{pV} = \frac{\frac{i}{2}\nu R\Delta T}{pV} + \frac{\Delta V}{V}$; $pV = \nu RT$

$\frac{Q}{\nu RT} = \frac{\frac{i}{2}\nu R\Delta T}{\nu RT} + \frac{\Delta V}{V}$

$Q = \left(\frac{i}{2} \cdot \frac{\Delta T}{T} + \frac{\Delta V}{V}\right)\nu RT$

$\Delta U = \frac{i}{2}\nu R\Delta T$

$$\frac{Q}{\Delta U} = \frac{\left(\frac{i}{2} \cdot \frac{\Delta T}{T} + \frac{\Delta pV}{pV}\right)\nu RT}{\frac{i}{2}\nu R\Delta T}$$

$$\frac{Q}{\Delta U} = \frac{i}{2} \cdot \frac{\Delta T}{T} \cdot \frac{T}{\Delta T} \cdot \frac{2}{i} + \frac{\Delta pV}{pV} \cdot \frac{T}{\Delta T} \cdot \frac{2}{i}$$

$$\frac{Q}{\Delta U} = 1 + \frac{\Delta pV}{pV}\left(\frac{\Delta T}{T}\right)^{-1} \cdot \frac{2}{i}$$

$$\frac{Q}{\Delta U} = 1 + (+0{,}02) \cdot 100 \cdot \frac{2}{3}$$

$$\frac{Q}{\Delta U} = 1 + \frac{4}{3}$$

$$\frac{Q}{\Delta U} = \frac{7}{3}$$

Ответ: 1) $\frac{\Delta T}{T} = 0{,}01$; 2) $\frac{Q}{\Delta U} = \frac{7}{3}$;

21204841 (U335531 M1279136)

Черновик (1)

№4.

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

H

m

$2m$

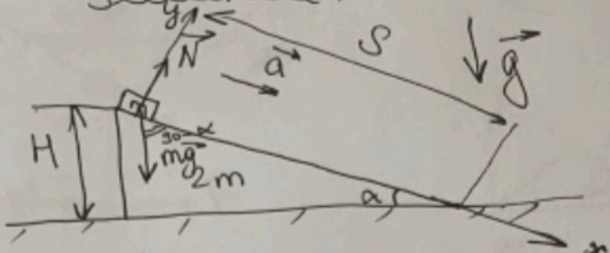
$F = mg$

$t_1 - ?$

$a_k - ?$

$t_2 - ?$

Решение:



2 з-н Ньютона для бруска:

$\vec{N} + m\vec{g} = m\vec{a}$

$x: ma = mg \cdot \sin\alpha \Rightarrow a = \frac{mg \cdot \sin\alpha}{m}$

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

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

$a = g \cdot \sin\alpha$

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

$S = \overset{=0}{V_{0x} t_1} + \frac{a_x t_1^2}{2}$

$S = \frac{g \cdot \sin\alpha \cdot t_1^2}{2}$

$\sin^2\alpha = 1 - \cos^2\alpha$

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

25

$t_1 = \sqrt{\frac{2H}{g \sin^2\alpha}}$

$t_1 = \sqrt{\frac{2H}{g(1-\cos^2\alpha)}} = \sqrt{\frac{2H}{g(1-\frac{9}{25})}} = \sqrt{\frac{2H}{\frac{16}{25} g}}$

$\frac{5}{4}\sqrt{\frac{2H}{g}}$

$S_{абс} = \sqrt{\frac{a_k^2 t^4}{4} + \frac{a^2 t^4}{4}} =$

$= \frac{t^2}{2}\sqrt{a_k^2 + a^2}$

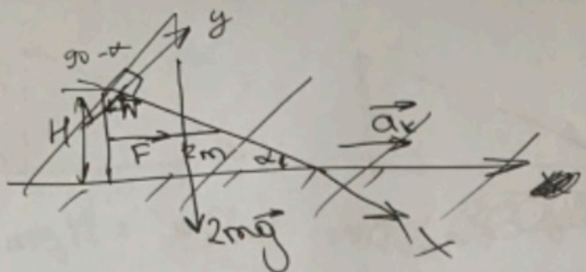
(б)

$S_k = \frac{a_k t^2}{2}$

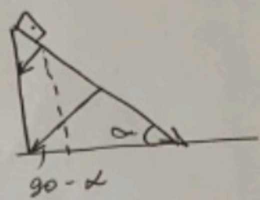
$S_б = \frac{a t^2}{2}$

21204841 (U335531 M1279136)

Черновик ②



$2m\vec{a}_k = \vec{N}' + \vec{F} + 2m\vec{g}$



~~$x: 2ma_k = N'\sin\alpha + F$~~

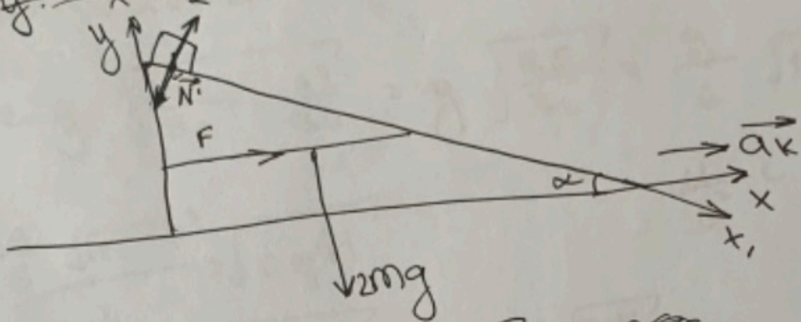
~~$y: x: 2ma_k = F\cdot\cos\alpha$~~

$\sin\alpha = \sqrt{1-\cos^2\alpha}$

$\sqrt{1-\frac{9}{25}}$

$\frac{16}{25}$

$\frac{4}{5}$



$x: 2ma_k = N'\cdot\sin\alpha + F \Rightarrow$

~~$N = 2mg\cdot\cos\alpha$~~

~~$N = \frac{3}{5}mg$~~

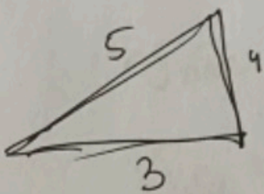
$y: 0 = N'\cdot\cos\alpha - 2mg$

$2mg = N'\cdot\cos\alpha$

$N' = \frac{2mg}{\cos\alpha} =$

$\frac{g(2tg\alpha+1)}{2}$

$\frac{2g\cdot tg\alpha + g}{2}$



$a_k = \frac{N'\cdot\sin\alpha + F}{2m}$

$a_k = \frac{\frac{2mg}{\cos\alpha}\cdot\sin\alpha + mg}{2m} = g\cdot tg\alpha + g = g(tg\alpha + 1)$

$\frac{1}{2} + \frac{4}{3}$

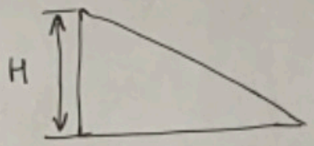
$\frac{3+8}{6} = \frac{11}{6}$

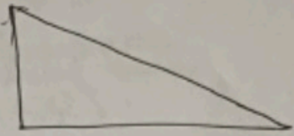
$x_1: 2ma_k\cdot\cos\alpha = F\cdot\cos\alpha + 2mg\cdot\sin\alpha$

$a_k = \frac{F\cdot\cos\alpha + 2mg\cdot\sin\alpha}{2m\cdot\cos\alpha} = \frac{mg\cdot\cos\alpha + 2mg\cdot\sin\alpha}{2m\cdot\cos\alpha}$

$\frac{g + 2g\,tg\alpha}{2}$

Черновик 3





$$mgH = \frac{m v_{абс}^2}{2}$$

$$v_к = \sqrt{\frac{a_{абс} t^2}{2}} =$$

$$a_{абс} = \sqrt{a_к^2 + a^2} = \sqrt{\frac{121}{36} g^2 + \frac{16}{9} g^2} =$$

$$= g \sqrt{\frac{121}{36} + \frac{64}{36}} = g \sqrt{\frac{185}{36}} = \frac{g}{6} \sqrt{185}$$

$$\frac{\frac{g}{6}\sqrt{185}\, t^2}{2} = \sqrt{2gH}$$

$$t^2 = \frac{12\sqrt{2gH}}{\sqrt{185}\, g} = \frac{12\sqrt{2gH}}{13{,}6\, g}$$

$$=$$

$$v_{абс} = \sqrt{v_к^2 + v_{отн}^2}$$

$$v_{абс} = \sqrt{\left(\frac{a_к t^2}{2}\right)^2 + \left(\frac{a t^2}{2}\right)^2}$$

$$g^2 H^2 = \left(\frac{a_к t^2}{2}\right)^2 + \left(\frac{a t^2}{2}\right)^2$$

$$g^2 H^2 = \left(\frac{\frac{11}{6} g t^2}{2}\right)^2 + \left(\frac{\frac{4}{3} g t^2}{2}\right)^2$$

$\frac{м}{с^2} \cdot с^2$

$\frac{м}{с^2} \cdot с$

$\frac{м}{с^2} \cdot$

$\frac{\frac{м}{с} \cdot с}{\frac{м}{с}}$

$\frac{м}{с^2} \cdot м \quad \frac{м}{с}$

$\frac{9}{25} + \frac{16}{25}$

$\frac{м}{с^2} \cdot м$

Черновик (4)

№5.

$\frac{\Delta p}{p} = -0{,}01$

$\frac{\Delta V}{V} = 0{,}02$

$i = 2$

$\frac{\Delta T}{T}$ - ?

$\frac{Q}{\Delta U}$ -?

Решение:
менд-клап:

$pV = \nu RT$

$(p+\Delta p)(V+\Delta V) = \nu R(T+\Delta T)$

$pV + p\Delta V + \Delta pV + \cancel{\Delta p\Delta V} = \nu RT + \nu R\Delta T$

$\cancel{pV} + p\Delta V + \Delta pV = \cancel{pV} + \nu R\Delta T$

$p\Delta V + \Delta pV = \nu R\Delta T \;|: pV$

$\frac{\Delta V}{V} + \frac{\Delta p}{p} = \frac{\nu R\Delta T}{pV}$

$\frac{\Delta V}{V} + \frac{\Delta p}{p} = \frac{\cancel{\nu R}\Delta T}{\cancel{\nu R}T}$

$\frac{\Delta V}{V} + \frac{\Delta p}{p} = \frac{\Delta T}{T}$

$\frac{\Delta T}{T} = -0{,}01 + 0{,}02 = +0{,}01$ - ~~тем~~ температура ~~увеличилась~~ на 1%

I нач. термодин.:

$Q = \Delta U + A$

$\Delta U = \frac{i}{2}\nu R\Delta T$

$A = \Delta pV$ (т.к. изменение мало возьмем $V = const$)

$Q = \frac{i}{2}\nu R\Delta T + \Delta pV \;|: pV$

$1 + (-0{,}01)\cdot(0{,}01)^{-1} : \frac{2}{3}$

$1 - \frac{2}{3}$

$\frac{Q}{pV} = \frac{\frac{i}{2}\cancel{\nu R}\Delta T}{\cancel{\nu R}T} + \frac{\Delta p}{p}$

$\frac{Q}{\nu RT} = \frac{1{,}5\Delta T}{T} + \frac{\Delta p}{p} \Big) : \frac{Q}{\nu RT\cdot\Delta U} = 1{,}5\Delta$

$\Delta U = \frac{i}{2}\nu R\Delta T$

$\frac{1}{100}$

21204841 (U335531 M1279136)

Черновик 5

$$Q = \left(\frac{1{,}5\Delta T}{T} + \frac{\Delta P}{P}\right) \nu R T$$

$$\Delta U = \frac{i}{2} \nu R \Delta T$$

$$\frac{Q}{\Delta U} = \frac{\left(1{,}5\frac{\Delta T}{T} + \frac{\Delta P}{P}\right)\nu R T}{1{,}5 \nu R \Delta T} = \frac{1{,}5 \frac{\Delta T}{T}\cdot\frac{T}{\Delta T} + \frac{\Delta P}{P}\cdot\frac{T}{\Delta T}}{1{,}5}$$

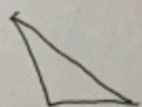
$$1 + \frac{\frac{\Delta P}{P}\cdot\frac{T}{\Delta T}}{1{,}5}$$

$$1 + \frac{-0{,}01 \cdot 100}{1{,}5} \quad 4gt \quad \frac{1}{100}$$

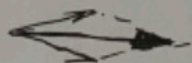
$$1 - \frac{1}{1{,}5}$$

$$\frac{4}{3} + 1^{13} = \frac{7}{3}$$

$$\sqrt{\frac{2H}{\frac{16}{25}g}} \quad \frac{5}{4}\sqrt{\frac{2H}{g}} \quad \frac{4}{3}$$



$$\frac{mc^2}{m} \quad \frac{10}{20}$$



$$\frac{5}{4}\sqrt{\frac{20}{10}}$$

$$(0{,}01)^{-1} \quad \frac{1}{100} \quad 100$$

$$\frac{7}{3}$$

21204841 (U335531 M1279136)

Чистовик (1)

Задача 4

Дано:

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

H

m

$2m$

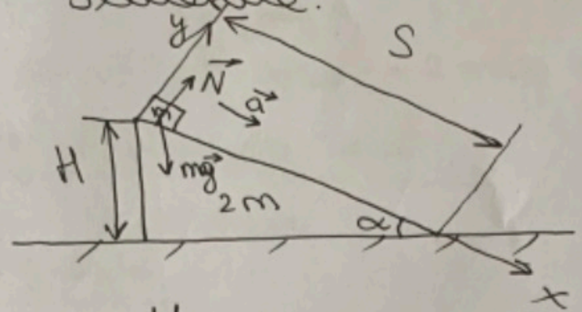
$F = mg$

1) t_1 - ?

2) $a_к$ - ?

3) t_2 - ?

Решение:



2 з-н Ньютона для бруска:

$\vec{N} + m\vec{g} = m\vec{a}$

x: $\cancel{m}a = \cancel{m}g \cdot \sin\alpha$

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

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

$N = mg \cdot \cos\alpha$

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

$S = \underbrace{v_{0x} t_1}_{=0} + \frac{a_x t_1^2}{2}$

$\frac{H}{\sin\alpha} = \frac{g \cdot \sin\alpha \, t_1^2}{2} \Rightarrow t_1 = \sqrt{\frac{2H}{g\sin^2\alpha}}$

$t_1 = \sqrt{\frac{2H}{g(1-\cos^2\alpha)}}$

$t_1 = \sqrt{\frac{2H}{g(1-\frac{9}{25})}} = \sqrt{\frac{2H}{g \cdot \frac{16}{25}}} = \sqrt{\frac{25 \cdot 2H}{16g}} = \frac{5}{4}\sqrt{\frac{2H}{g}}$

(II)