Часть 1

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

Шифр: **21206223**

ID профиля: **866609**

Вариант 1

Чистовик

№1

Решение:

Дано:
$v_{01} = v_{02}$
H

$\tau_2 - ?$
$v_0 - ?$
$L_1 - ?$

$$\frac{mv_1^2}{2} = \frac{mv_2^2}{2} - mgH$$

$$\begin{cases} \frac{mv_2^2}{2} = \frac{mv_1^2}{2} + mgH, \\ mgH + \frac{mv_1^2}{2} = \frac{mv_0^2}{2}; \end{cases} \Rightarrow v_1 = v_2$$

$$\begin{cases} v_1 = v_0 - g\tau_2, \\ v_2 = g\tau_2; \end{cases}$$

$$v_0 - g\tau_2 = g\tau_2$$

$$v_0 = 2g\tau_2$$

$$\tau_2 = \frac{v_0}{2g}$$

$$\frac{mv_1^2}{2} + mgH = \frac{mv_0^2}{2}$$

$$v_1 = v_0 - g\tau_2 = 2g\tau_2 - g\tau_2 = g\tau_2$$

$$\frac{mg^2\tau_2^2}{2} + mgH = \frac{4mg^2\tau_2^2}{2}$$

$$mgH = 1{,}5mg^2\tau_2^2$$

$$\tau_2 = \sqrt{\frac{mgH}{1{,}5mg^2}} = \sqrt{\frac{H}{1{,}5g}} = \sqrt{\frac{2H}{3g}}$$

$$v_0 = 2g\tau_2 = 2g\sqrt{\frac{2H}{3g}} = \sqrt{\frac{8g^2H}{3g}} = \sqrt{\frac{8gH}{3}}$$

$mgh = \frac{mv_0^2}{2}$ (h – максимальная высота подъема)

$$h = \frac{mv_0^2}{2mg} = \frac{v_0^2}{2g} = \frac{8gH}{3 \cdot 2g} = \frac{4H}{3}$$

$$L_1 = h + (h - H) = \frac{4H}{3} + \left(\frac{4H}{3} - H\right) = \frac{5H}{3}$$

Ответ: $\tau_2 = \sqrt{\frac{2H}{3g}}$; $v_0 = \sqrt{\frac{8gH}{3}}$; $L_1 = \frac{5H}{3}$.

1

№3 Чистовик

Дано:

$m = 3$ г

$T = const$

$t_0 = 81°C$

$3{,}5 V_1 = V_0$

$P_1 = 1{,}8 P_0$

$P_{н.п.} = 0{,}5 \cdot 10^5$ Па

$\mu = 18 \frac{г}{моль}$

$P_0 - ?$

$V_1 - ?$

СИ

$= 3 \cdot 10^{-3}$ кг

$= 18 \cdot 10^{-3} \frac{кг}{моль}$

Решение:

$T = 354°K$

$$\begin{cases} P_0 V_0 = \nu_0 RT, \\ P_1 V_1 = \nu_1 RT; \end{cases}$$

$$\frac{P_0 V_0}{P_1 V_1} = \frac{\nu_0}{\nu_1}$$

$$\frac{P_0 \cdot 3{,}5 V_1}{1{,}8 P_0 \cdot V_1} = \frac{35}{18} = \frac{\nu_0}{\nu_1}$$

$\nu_1 = \frac{18}{35}\nu_0$ ($\nu_0 \neq \nu_0 \Rightarrow$ происходит конденсация $\Rightarrow P_1 = P_{н.п.} = 0{,}5 \cdot 10^5$ Па)

$$P_0 = \frac{P_1}{1{,}8} = \frac{0{,}5 \cdot 10^5}{1{,}8} \approx 2{,}8 \cdot 10^4 \text{ Па}$$

$$P_1 V_1 = \nu_1 RT = \frac{18 \nu_0 RT}{35}$$

$$V_1 = \frac{18 \nu_0 RT}{35 P_1} = \frac{18 mRT}{35 \mu P_1} = \frac{18 \cdot 3 \cdot 10^{-3} \cdot 8{,}31 \cdot 354}{35 \cdot 18 \cdot 10^{-3} \cdot 0{,}5 \cdot 10^5} \approx 5 \cdot 10^{-3} \text{ м}^3 \approx$$

≈ 5 дм^3 $= 5 \cdot 10^3$ см^3

Ответ: $P_0 \approx 2{,}8 \cdot 10^4$ Па; $V_1 \approx 5 \cdot 10^{-3}$ м^3 $= 5$ дм^3 $\approx 5 \cdot 10^3$ см^3.

2

Чистовик

№2.

Решение:

Дано:
ω
ρ
3ρ
R
$L = 2R$
α
$tg\alpha = 2$

$N_1 - ?$
$N_2 - ?$

1) $\vec{N}_{K_1} + \vec{N} + m\vec{g} = 0$

$y: N_{K_1} + F_A - mg = 0$

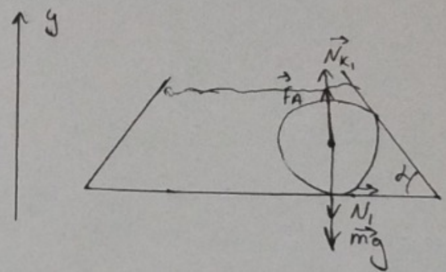
$N_{K_1} = mg - F_A = 3\rho g V - \rho g V =$

$= 2\rho g V = \frac{4 \cdot 2}{3} \pi R^3 \rho g = \frac{8\pi R^3 \rho g}{3}$

$\vec{N}_{K_1} + \vec{N}_1 = 0$

$N_{K_1} - N_1 = 0$

$N_1 = N_{K_1} = \frac{8\pi R^3 \rho g}{3}$



2) $\vec{N}_{K_2} + m\vec{g} + \vec{N}_3 + F_A = m\vec{a}$

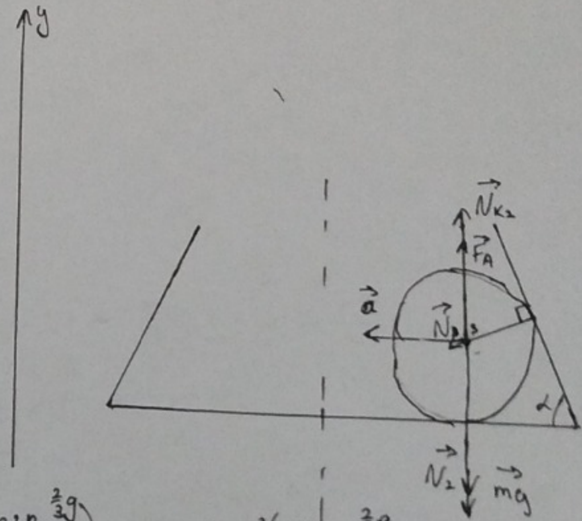
$y: N_{K_2} - mg - \frac{ma}{tg\alpha} + F_A = 0$

$N_{K_2} = mg + \frac{ma}{tg\alpha} - F_A =$

$= 3\rho g V + \frac{\omega^2 L m}{tg\alpha} - \rho g V =$

$= 2\rho g V = 3\rho V \frac{\omega^2 L}{tg\alpha} + 2\rho g V =$

$= 3\rho V \left(\frac{\omega^2 2R}{2} + \frac{2}{3} g \right) = 3\rho \frac{4}{3}\pi R^3 \left(\omega^2 R + \frac{2}{3}g\right) = 4\rho\pi R^3 \left(\omega^2 R + \frac{2}{3}g\right) = \frac{4}{3}\rho\pi R^3 (3\omega^2 R + 2g)$



$\vec{N}_2 + \vec{N}_{K_2} = 0$

$N_{K_2} - N_2 = 0$

$N_2 = N_{K_2} = \frac{4}{3}\rho\pi R^3 \left(\omega^2 R + \frac{2g}{3}\right) = \frac{4}{3}\rho\pi R^3 (3\omega^2 R + 2g)$

Ответ: $N_1 = \frac{8\pi R^3 \rho g}{3}$; $N_2 = \frac{4}{3}\rho\pi R^3 (3\omega^2 R + 2g)$.

Черновик

№1.

Решение:

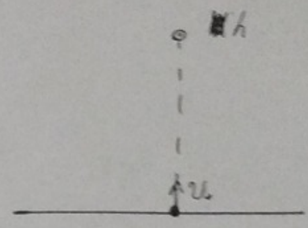
Дано:
H
$v_{01} = v_{02}$

$\tau_2 - ?$
$v_0 - ?$
$L_1 - ?$

$$\frac{mv_0^2}{2} = mgh$$

$$\frac{v_0^2}{2} = gh$$

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



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

$$H = \frac{g\tau_2^2}{2} = v_{01}\tau_2 - \frac{g\tau_2^2}{2} \quad \Big| : \tau$$

$$\frac{g\tau_2}{2} = v_{01} - \frac{g\tau_2}{2}$$

$$v_{01} = \frac{g\tau_2}{2} + \frac{g\tau_2}{2} = g\tau_2$$

$$\tau_2^2 = \frac{2H}{g}$$

$$\tau_2 = \sqrt{\frac{2H}{g}} \Rightarrow v_{01} = g\tau_2 = g\sqrt{\frac{2H}{g}} = \sqrt{2gH} \times$$

$$v_{01}\tau_2 - \frac{g\tau_2^2}{2} = H$$

$$v_{01} = \frac{H + \frac{g\tau_2^2}{2}}{\tau_2} = \frac{H + \frac{2H}{2}}{\sqrt{\frac{2H}{g}}} = \frac{2H\sqrt{g}}{\sqrt{2H}} = \sqrt{2gH}$$

$$v_{01} = \frac{g\tau_2^2}{\tau_2} = g\tau_2^2$$

$$h - H = \frac{g\tau_2}{2}$$

h_0

$$\frac{v_0^2}{2g} - H = \frac{g\tau_2^2}{2}$$

$$\tau_2^2 = \frac{\frac{v_0^2}{g} - 2H}{g} = v_0^2 - \frac{2H}{g}$$

$$\tau_2 = \sqrt{v_0^2 - \frac{2H}{g}} = \sqrt{4g^2\tau_2^2 - \frac{2H}{g}}$$

$$h_1 = h_2 \Rightarrow v_1 - v_2$$

$$v_1 = g\tau_2 = v_0 - g\tau_2$$

$$v_0 = 2g\tau_2$$

$$\tau_2^2 = 4g^2\tau_2^2 - \frac{2H}{g}$$

$$\tau_2(4g^2 - 1) = \frac{2H}{g}$$

$$\tau_2 = \frac{2H}{g(4g^2-1)}$$

Черновик

$h_1 = h_2 = H \Rightarrow v_1 = v_2$

$v_0 - g\tau_2 = g\tau_2$

$v_0 = 2g\tau_2$

$\tau_2 = \frac{2g}{v_0}$

$v_1 = v_2 = v_0 - g\tau_2 = g\tau_2 \Rightarrow$

$\frac{mv_1^2}{2} + mgH = \frac{mv_0^2}{2}$

$\frac{v_1^2}{2} + gH = \frac{v_0^2}{2}$

$\frac{g^2\tau_2^2}{2} + gH = \frac{4g^2\tau_2^2}{2}$

$gH = 1{,}5g^2\tau_2^2$

$\tau_2 = \sqrt{\frac{gH}{1{,}5g^2}} = \sqrt{\frac{H}{1{,}5g}} = ! \sqrt{\frac{2H}{3g}}$

$\frac{40}{15} = \frac{8}{3} = 2\frac{2}{3}$

$v_0 = 2g\tau_2 = 2g\sqrt{\frac{H}{1{,}5g}} = 2\sqrt{\frac{gH}{1{,}5}} = \sqrt{\frac{4gH}{1{,}5}} = \sqrt{\frac{8gH}{3}}$!

$mgh = \frac{mv_0^2}{2}$

$h = \frac{v_0^2}{2g} = \frac{8gH}{3 \cdot 2g} = \frac{8H}{6g} = \frac{4H}{3}$

~~$mgh = mgH$~~

$L_1 = h + (h - H) = \frac{4H}{3} + \left(\frac{4H}{3} - H\right) = \frac{5H}{3}$

Ответ: $\tau_2 = \sqrt{\frac{2H}{3g}}$; $v_0 = \sqrt{\frac{8gH}{3}}$; $L_1 = \frac{5H}{3}$

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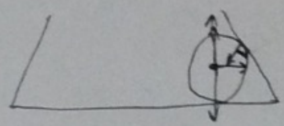
Чернодик.

$a = \frac{v^2}{R} = \omega^2 R$



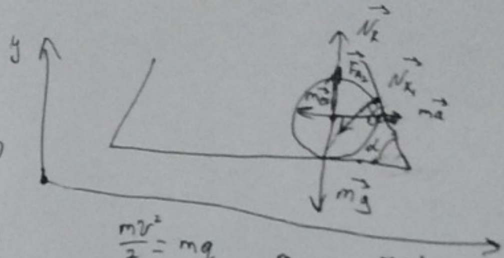
$x: \vec{N}_{K_1} = m\vec{a}$

$N_{K_1} \cdot tg\alpha = ma$

$N_{K_1} = \frac{ma}{tg\alpha} = \frac{m\omega^2 R}{tg\alpha}$

$\vec{N}_K + \vec{N}_{K_1} + \vec{F}_A + m\vec{g} = 0$

$N_K - N_{K_1} \cdot ctg\alpha + \rho g V - 3\rho g V = 0$



$tg\alpha = \frac{ma}{x}$

$\frac{mv^2}{2} = mq$

$m_1 q = \frac{mv^2}{2} = mgH$

$ma = x \cdot tg\alpha$

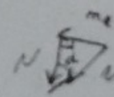
$H = \frac{m_1 q}{mg}$

$N_K = 3\rho g V - \rho g V + \frac{N_{K_1}}{tg\alpha} = 2\rho g V + \frac{m\omega^2 R}{tg^2\alpha} = \frac{4}{3} \cdot 2\pi R^3 \rho g \quad \frac{3\rho g \pi R^3 \omega^2 R}{4} =$

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

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

$\frac{g\tau^2}{2} = h$



$\frac{g\tau_1^2}{2} = \sqrt{2}h$

$N_K - N_{K_1} ctg\alpha + \rho g V - 3\rho g V = 0$

$\tau_1 = \sqrt{\frac{2\sqrt{2}h}{g}}$

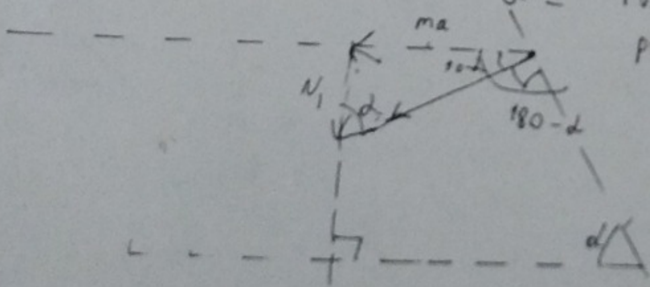
$N_K = 2\rho g V + N_{K_1} \cdot ctg\alpha =$

$PV = \nu RT \quad Pm = \nu RT\rho \quad \frac{ma}{V} = \alpha\, tg\alpha$

$\tau = \frac{2h}{g}$

$PV^{\frac{5}{3}} = const$

$N = \frac{ma}{tg\alpha}$



$ma = \sqrt{NK_1^2 + N^2}$

$\tau_1 = \sqrt{2}\,\tau.$

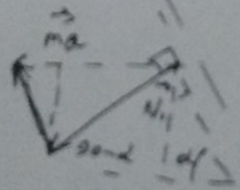
$N_{K_1} = ma \cdot \sin\alpha$

$\rho = \frac{Pm}{\nu RT} = \frac{P\mu}{RT}$

$\frac{\sin\alpha \cdot \cos\alpha}{\sin\alpha} = \cos\alpha$

$tg\alpha \quad \frac{ma}{N_1}$

$N_1 = \frac{ma}{tg\alpha} = \frac{1}{2} ma$



$\sin\alpha \cdot \cos\alpha = \frac{1}{2}\sin 2\alpha$

$\cos^2\alpha = \frac{1+\cos 2\alpha}{2}$

$\sin 5\alpha = \sin(3\alpha + 2\alpha) =$

$= \sin 3\alpha \cdot \cos 2\alpha + \sin 2\alpha \cdot \cos 3\alpha =$

$\frac{2}{3} \cdot 4 = \frac{8}{3} = 2 \cdot \frac{2}{3}$

$= (3\sin\alpha - 4\sin^3\alpha)(\cos^2\alpha - \sin^2\alpha) +$

$+ 2\sin\alpha \cdot \cos\alpha\,(4\cos^3\alpha - 3\cos\alpha) =$

$= 3\sin$

№3. Черновик.

Дано:

$m = 3\,г$

$T = const$

$t_0 = 81°C$

$3{,}5V_1 = V_0$

$P_1 = 1{,}8P_0$

$P_{н.п.} = 0{,}5 \cdot 10^5$

$\mu = 18\,г/моль$

$R = 8{,}31$

$P_0 - ?$

$V_1 - ?$

$pV = \nu RT$

$pm = \nu R T \rho$

$\rho = \frac{pm}{\nu RT} = \frac{p\mu}{RT}$

$T = 81 + 273 = 354$

$$\begin{cases} P_0V_0 = \nu_0 RT, \\ P_1V_1 = \nu_1 RT; \end{cases}$$

$$\frac{P_0V_0}{P_1V_1} = \frac{\nu_0 RT}{\nu_1 RT} = \frac{\nu_0}{\nu_1} = \frac{P_0\,3{,}5V_1}{1{,}8P_0\,V_1} = \frac{35}{18}$$

$$\nu_0 = \frac{35}{18}\nu_1 \left(\nu_0 \neq \nu_1,\ P_0 \neq P_1 \Rightarrow P_1 = P_{н.п.}\right) \Rightarrow P_1 = 0{,}5\cdot10^5\ Па.$$

$$P_0 = \frac{P_1}{1{,}8} = \frac{0{,}5\cdot10^5}{1{,}8} \approx$$

$$P_1V_1 = \nu_1 RT = \frac{18}{35}\nu_0 RT = \frac{18\, mRT}{35\mu}$$

$$V_1 = \frac{18\, mRT}{35\mu P_1} = \frac{18\cdot 0{,}003\cdot 8{,}31\cdot 354}{35\cdot 0{,}018\cdot 0{,}5\cdot10^5\ Па} \approx$$

$$\frac{3\cdot 8{,}31\cdot 354}{35\cdot 0{,}5\cdot 10^5} \approx 504{,}3\cdot10^{-5} \approx 5\cdot10^{-3}\ м^3 = 5\ дм^3 =$$

$$\frac{0{,}5\cdot10^5\cdot 5\cdot10^{-3}}{8{,}31\cdot 354}$$

$R = \varepsilon R$

$\varepsilon = \frac{1}{4\pi k}$ $\quad tg\,\alpha \in R$

$\alpha = arc\,tg\,2$

$\gamma = 90 - \alpha$

№2.

Дано

ω

ρ

3ρ

R

$L_1 = 2R$

α

$tg\,\alpha = 2$

$N_1 - ?$

$N_2 - ?$

Решение:

1) $\vec{N} + \vec{F_A} + m\vec{g} = 0$

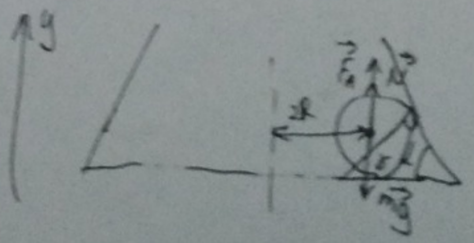
$N + F_A - mg = 0$

$F_A = mg - N$

$N = mg - F_A = 3\rho gV - \rho gV =$

$= 2g\rho V = \frac{4}{3}\cdot 2\pi R^3 \rho g =$

$= \frac{8\pi R^3 \rho g}{3}$



$\vec{N_1} + \vec{N} = 0$

$N - N_1 = 0$ $\quad N_1 = N = \frac{8\pi R^3 \rho g}{3}$

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Часть 2

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

Шифр: **21206223**

ID профиля: **866609**

Вариант 1

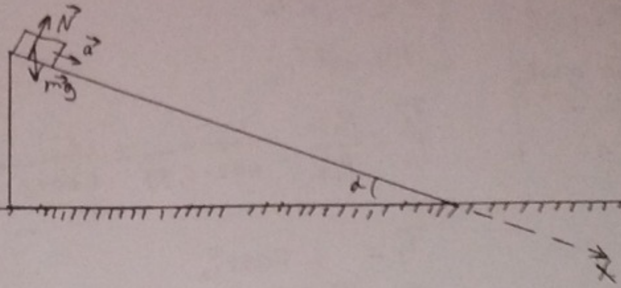
Чистовик

№4

Решение:

Дано:
H, $F = 2mg$
$m_1 = m$
$m_2 = 3m$
α
$\cos\alpha = \frac{4}{5}$

$\tau_1 - ?$
$a_1 - ?$
$\tau_2 - ?$



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

x: $mg \cdot \sin\alpha = ma$

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

$\sin\alpha = \sqrt{1 - \cos^2\alpha} = \sqrt{\frac{25}{25} - \frac{16}{25}} = \frac{3}{5}$

$L = \frac{H}{\sin\alpha} = \frac{5H}{3}$

$L = \frac{a\tau_1^2}{2}$

$\tau_1 = \sqrt{\frac{2L}{a}} = \sqrt{\frac{10H}{3a}}$

$g \cdot \sin\alpha = a$

$a = g \cdot \sin\alpha = \frac{3g}{5}$

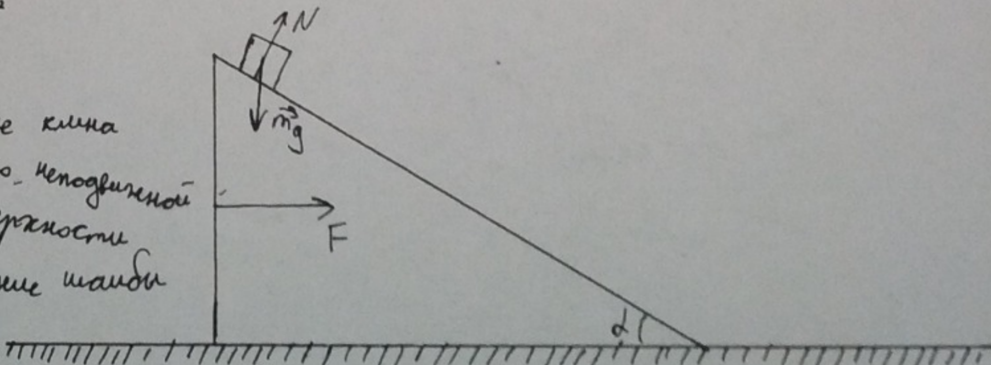
$\tau_1 = \sqrt{\frac{2L}{a}} = \sqrt{\frac{10H}{3a}} = \sqrt{\frac{10H \cdot 5}{3 \cdot 3g}} = \frac{5}{3} \cdot \sqrt{\frac{2H}{g}}$

$\vec F = 4m\vec a_2$ (a_2 – ускорение центра масс системы, создаваемое силой F)

z: $F = 4ma_2$

$2mg = 4ma_2$

$a_2 = \frac{g}{2}$



a_1 – ускорение клина относительно неподвижной точки поверхности

a_3 – ускорение шайбы относительно неподвижной точки поверхности.

$3m a_1 = 3m a_2 - mg \cdot \sin\alpha$

$a_1 = a_2 - \frac{g \cdot \sin\alpha}{3} = \frac{1}{2}g - \frac{1}{5}g = 0,3g$

$ma_3 = ma_1 + mg \cdot \sin\alpha$

$a_3 = a_1 + g \cdot \sin\alpha = \frac{1}{2}g + \frac{3g}{5} = \frac{8g}{5} = 1,6g$

$a_{отн} = a_3 - a_1 = a_3 - a_1 = 1,6g - 0,3g = 1,4g$

1 $\tau_2 = \sqrt{\frac{2L}{a_{отн}}} = \sqrt{\frac{2L}{1,3g}} = \sqrt{\frac{20L}{13g}}$

Ответ: $\tau_1 = \frac{5}{3} \cdot \sqrt{\frac{2H}{g}}$; $a_1 = 0,3g$; $\leftarrow \tau_2 = \sqrt{\frac{20L}{13g}}$.

Чистовик

№5

Решение:

Дано:
$P_1 = 1{,}02 P_0$
$V_1 = 0{,}99 V_0$

ΔT - ?
η - ?

$$\begin{cases} P_0 V_0 = \nu R T_0, \\ P_1 V_1 = \nu R T_1; \end{cases}$$

$$\frac{T_0}{T_1} = \frac{P_0 V_0}{P_1 V_1} = \frac{1}{1{,}02 \cdot 0{,}99} = \frac{1}{1{,}0098}$$

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

$$\Delta T = \left(\frac{T_1 - T_0}{T_0}\right) \cdot 100\% = \frac{0{,}0098\, T_0}{T_0} \cdot 100\% = 0{,}98\%$$ ($T_1 > T_0 \Rightarrow$ температура увеличивается)

$V_1 < V_0 \Rightarrow A_2 < 0$

$$\Delta U = \frac{3}{2} k N \Delta T = \frac{3}{2} \nu R (T - T_0)$$

$$\Delta Q = \Delta A + \Delta U$$

$p \approx const$ $(\Delta p \to 0)$

$$P_{ср} = \frac{P_1 + P_0}{2} = 1{,}01 P_0$$

$$\Delta A = P_{ср}(V_1 - V_0) = -1{,}01 P_0 \cdot 0{,}01 V_0 = -0{,}0101 P_0 V_0 = -0{,}0101 \nu R T_0$$

$$\Delta Q = \Delta A + \Delta U = -0{,}0101 \nu R T_0 + \frac{3}{2} \nu R (T - T_0) = -0{,}0101 \nu R T_0 + 0{,}0147 \nu R T_0 =$$
$$= 0{,}0046 \nu R T_0$$

$$\eta = \frac{\Delta Q}{A} = \frac{0{,}0046 \nu R T_0}{-0{,}0101 \nu R T_0} \approx -0{,}46$$

Ответ: $\Delta T = 0{,}98\%$; $\eta \approx -0{,}46$.

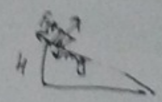
Чурилова

№1.

Дано:
H
$m_1 = m$
$m_2 = 3m$
α
$\cos\alpha = \frac{4}{5}$

$t_1 - ?$
$a_1 - ?$
$t_2 - ?$

$\sin\alpha = \sqrt{1-\cos^2\alpha} = \sqrt{\frac{25}{25} - \frac{16}{25}} = \frac{3}{5}$



~~$ma = mg\cdot\sin\alpha$ $F_{тр} = mg\sin\alpha$~~

$ma = mg\cdot\sin\alpha$

$a = g\cdot\sin\alpha = \frac{3}{5}g$

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

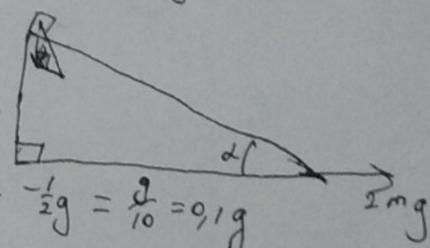
$L = \frac{at_1^2}{2}$ $\qquad L = \frac{H}{\sin\alpha} = \frac{5H}{3}$

$t_1 = \sqrt{\frac{2L}{a}} = \sqrt{\frac{10H}{3a}} = \sqrt{\frac{10H\cdot 5}{9g}} = \frac{5}{3}\sqrt{\frac{2H}{g}}$ $\qquad \sqrt{\frac{\mu\cdot c^2}{\mu}} = c$

$mg\cdot\cos\alpha = N$

$mg\cdot\sin\alpha = ma$ $\qquad 4ma_1 = 2mg$ $\qquad \rho g V$

$\vec{ma} + \vec{N} = \vec{mg}$ $\qquad a_1 = \frac{1}{2}g$

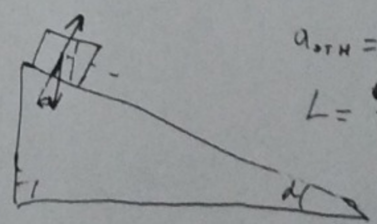


$a_2 = a_0 - a_1 = \frac{3g}{5} - \frac{1}{2}g = \frac{g}{10} = 0{,}1g$

$kv^2 = F$

$L = \frac{a_2 t_2^2}{2}$

$t_2 = \sqrt{\frac{2L}{a_2}} =$



$a_{отн} = 1{,}3g$

$L = \frac{a_{отн} t_2^2}{2} = \frac{1{,}3g\, t_2^2}{2}$

$t_2 = \sqrt{\frac{2L}{1{,}3g}} = \sqrt{\frac{20L}{13g}}$

$a_1 - \frac{mg\cdot\sin\alpha}{3m} =$

$= \frac{1}{2}g - \frac{g\cdot\sin\alpha}{3} = \frac{1}{2}g - \frac{1}{5}g =$

$= \frac{3g}{10} = 0{,}3g$

$mgH = \frac{mv^2}{2}$

$v = \sqrt{2gH}$

$mv = m_2 v_2 = 3m v_к$

$v_к = \frac{v}{3} = \frac{\sqrt{2gH}}{3}$

$a_{отн} = a - a_1 = \frac{3}{5}g - \frac{3}{10}g = 0{,}3g$

$L = \frac{a_{отн} t_2^2}{2}$

$t_2 = \sqrt{\frac{2L}{a_{отн}}} = \sqrt{\frac{10H}{3a_{отн}}} = \sqrt{\frac{10H}{3\cdot 0{,}3g}} = \sqrt{\frac{100H}{9g}} = \frac{10}{3}\sqrt{\frac{H}{g}}$

$P_0 V_0 = \nu R T_0$

$1{,}02 P \cdot 0{,}99 V = \nu R T$

$\frac{T}{T_0} = 1{,}02 \cdot 0{,}99$

$= \frac{3}{2}\nu R \Delta T$

$k = \nu R$

$- \nu R \Delta T$

$Q \to A$

$= Q$

$U + A$

№5. Черновик.

Решение:

Дано:

$i = 3$

$P_1 = 1{,}02 P_0$

$V_1 = 0{,}99 V_0$

$\Delta T - ?$

$\frac{\Delta Q}{\Delta A_0} - ?$

$P_1 V_1 = \nu R T_1$

$P_0 V_0 = \nu R T_0$

$\frac{T_1}{T_0} = \frac{P_1 V_1}{P_0 V_0} = \frac{1{,}02 P_0 \cdot 0{,}99 V_0}{P_0 V_0} = 1{,}02 \cdot 0{,}99$

$\Delta T = \left(\frac{T_1 - T_0}{T_0}\right) \cdot 100\% = 0{,}98\%$ увеличилась $(T_1 > T_0)$

$\Delta Q = \frac{5}{2}\nu R(T_1 - T_0) = \frac{5}{2}\nu R T_0 \cdot 0{,}0098$

$\Delta A < 0 \quad (V_1 < V_0)$

$\Delta U = \frac{3}{2}\nu R (T_1 - T_0)$

$A = \Delta Q - \Delta U = \nu R (T_1 - T_0)$

$1{,}02 \times 99$: $918 + 918 = 100{,}98$

$\varepsilon = \frac{3}{2} kT$

$\Delta A = \Delta Q - \Delta U$

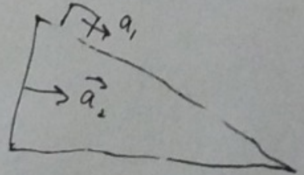
$Q = N \cdot \varepsilon = \frac{3}{2} NkT$

$Q_0 = \frac{3}{2} P_0 V_0$

$Q_1 = \frac{3}{2} P_1 V_1 = \frac{3}{2} P_0 V_0 \cdot 1{,}0098$

$\Delta Q = \frac{3}{2} \cdot 0{,}0098\, P_0 V_0$

ΔU



$\Delta a = \frac{7g}{5}$

$m a_1 + 3m a_2 = F + mg \sin\alpha - mg \sin\alpha$

$m a_1 + 3 m a_2 = 2mg$

$a_1 + 3a_2 = 2g$

$a_1 + 3a_2 = 4a = 2g$

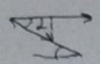
$a = \frac{g}{2}$

$a_1 = \frac{g}{2} + \frac{3g}{5} = \frac{4g}{5}$

$a_1 = a + \frac{mg \sin\alpha}{m} = a + \frac{3g}{5}$

$a_2 = \frac{2g}{5}$

$a_2 = a - \frac{mg\sin\alpha}{3m} = a - \frac{g}{5}$



$P_0 V_0 = \nu R T_0$

$1{,}02 P \cdot 0{,}99 V = \nu R T$

$a_2 \cos\alpha +$

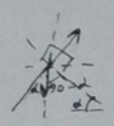
$\frac{T}{T_0} = 1{,}02 \cdot 0{,}99$

$m a_2 \cdot \cos\alpha + 3 m a_1 = F = 2mg$

$0{,}8 a_2 + 3 a_1 = 2g$

$\Delta U = \frac{3}{2} \nu R \Delta T$

$\Delta Q =$



$NK = \nu R$

$A = -\nu R \Delta T$

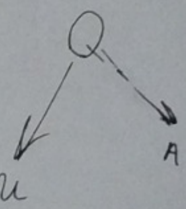
$mg - N \cdot \cos\alpha = m_2 a \cdot \sin\alpha$

$\eta - ?$

$\eta = \frac{Q_H}{Q_H - Q_X}$

$mg - mg \cdot \cos^2\alpha = m a_2 \sin\alpha$

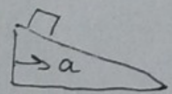
$\frac{9}{25} mg = ma \cdot \sin\alpha$



$a = \frac{9}{25} \frac{g}{\sin\alpha} = \frac{9g \cdot 5g}{25 \cdot 3} = \frac{3}{5} g$

$a_2 = \frac{1}{2} g + \frac{3}{5} g$

$A + U = Q$



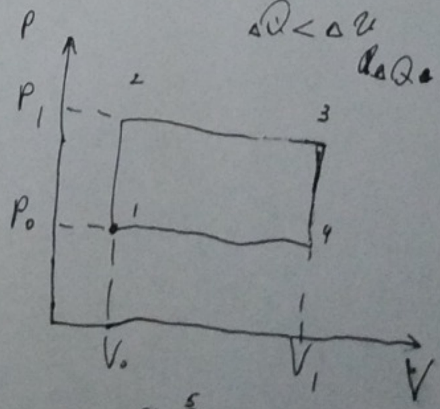
$\Delta U = \frac{3}{2} K \Delta T$

$\Delta Q < \Delta U$

$\Delta Q = \Delta U + \Delta A$

$Q_1 = \frac{5}{2}$

$Q_2 =$



$U_1 = \frac{3}{2} P_0 V_0$

$U_2 = \frac{3}{2} P_1 V_0$

$U_3 = \frac{3}{2} P_1 V_1$

$A_3 = P_1 (V_1 - V_0)$

$U_4 = \frac{3}{2} P_0 V_1$

При адиабате

$PV^{\frac{5}{3}}$

$P_0 V_0^{\frac{5}{3}} ? = 1{,}02 P \cdot 0{,}99^{\frac{5}{3}} V$

$P_0 V_0^{\frac{5}{3}} = P_1 V_1^{\frac{5}{3}}$

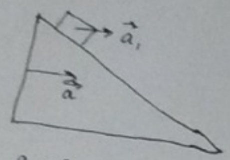
$1{,}02^3 \cdot 0{,}99^5$

$P \approx const$

$P_{cp} = 1{,}01 P_0$

$A = P_{cp}(V_1 - V_0) = -1{,}01 P_0 \cdot 0{,}01 V_0 =$

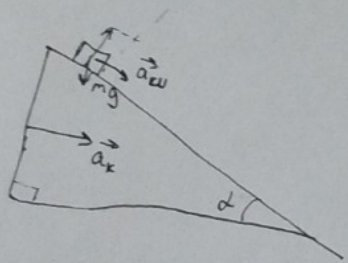
$= -0{,}0101 P_0 V_0$



$a_1 - a$

$$mgH = \frac{mv_1^2}{2} + \frac{3m \frac{1}{9} v_1^2}{2} = \frac{\frac{4}{3} m v_1^2}{2} = \frac{2}{3} m v_1^2$$

$$v_1 = \sqrt{\frac{3gH}{2}}$$



$a_1 - a = a_б$

$\frac{g\tau^2}{2} -$

$F l \cdot \cos\alpha = \frac{mv^2}{2}$

$F \cdot \cos\alpha = \frac{mv^2}{2l} = \frac{mv^2 \cdot 5}{2 \cdot 3H} = \frac{5mv^2}{6H}$

$R = NK = 6{,}02 \cdot 10^{23} \cdot 1{,}38 \cdot 10^{-23}$