Часть 1

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

Шифр: **21204201**

ID профиля: **857982**

Вариант 2

чистовик

№1 стр 1

$h_в$ – выс. макс. 1-го мяча

$h_в = v_0 t_1 - \frac{g t_1^2}{2}$

$t_1: v = 0 \Rightarrow 0 = v_0 - g t \Rightarrow t = \frac{v_0}{g} \Rightarrow h_в = \frac{v_0^2}{g} - \frac{v_0^2}{2g} = \frac{v_0^2}{2g}.$

$\begin{cases} h_c = v_0 t_c - \frac{g t_c^2}{2} & \text{– 2-й мяч} \\ h_c = h_в - \frac{g t_c^2}{2} & \text{– 1-й мяч} \end{cases} \Rightarrow h_в - \frac{g t_c^2}{2} = v_0 t_c - \frac{g t_c^2}{2} \Rightarrow h_в = v_0 t_c \Rightarrow t_c = \frac{h_в}{v_0} \Rightarrow$

$\Rightarrow t_c = \frac{v_0}{2g} \Rightarrow t_{1c} = t_1 + t_c = \frac{v_0}{g} + \frac{v_0}{2g} = \frac{3}{2}\frac{v_0}{g}, \quad t_{2c} = t_c \Rightarrow \frac{t_{1c}}{t_{2c}} = \frac{3}{2}\frac{v_0}{g} : \frac{2g}{v_0} = 3$

$h_c - ?$ $\quad 2h_c = v_0 t_c + h_в - g t_c^2 = 2 v_0 t_c - g t_c^2 \Rightarrow h_c = v_0 t_c - \frac{g t_c^2}{2};$

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

Ответ: 1) $t_{1c} = \frac{3}{2}\frac{v_0}{g}$; 2) $\frac{t_{1c}}{t_{2c}} = 3$; 3) $h_c = \frac{3v_0^2}{8g}$.

21204201 (U857982 M1282292)

№2 чистовик стр 2

$F = mg - \rho_B V g$

$F = 6\rho V g - \rho V g = 5\rho V g = 5\rho g \frac{4}{3}\pi R^3 = \frac{20}{3}\pi \rho g R^3$

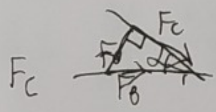
F – сила при отсутствии вращения

$F_0 = F + F'$

F_B – сила от вращ. на шар

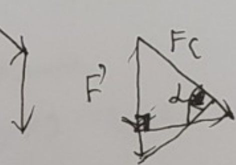
m, R

F_B №1, то центр можно брать как центр шара и счит. шар за мат. точку



$F_C = F_B \cos\alpha$

$F_B = w^2 \cdot 1{,}5R$



$F_C =$

$F' = F_C \sin\alpha$

$F' = F_B \sin\alpha \cos\alpha$

$F_0 = F + \frac{3}{2} w^2 R \sin\alpha \cos\alpha \cdot m$

$\frac{\sin\alpha}{\cos\alpha} = \frac{3}{2}$ $\sin\alpha = \frac{3}{2}\cos\alpha$

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

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

$\cos^2\alpha (tg^2\alpha + 1) = 1$

$\cos^2\alpha = \frac{1}{tg^2\alpha + 1} = \frac{1}{\frac{9}{4}+1} = \frac{1}{\frac{13}{4}} = \frac{4}{13}$

$F_0 = F + \frac{9}{4} w^2 R \cos^2\alpha \cdot m$

$F_0 = F + \frac{9}{13} w^2 R \cdot m$

$F_0 = \frac{20}{3}\pi \rho g R^3 + \frac{9}{13} w^2 R \cdot m$

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

$N_2 = R\left(\frac{20}{3}\pi \rho g R^2 + \frac{9}{13} w^2 m\right)$

$m = \frac{4}{3}\pi R^3 \cdot 6\rho = 8\pi R^3 \rho$; $N_2 = R^3\left(\frac{20}{3}\pi\rho g + \frac{9}{13} w^2 R \cdot 8\pi\rho\right) = \pi\rho R^3\left(\frac{20}{3}g + \frac{72}{13} w^2 R\right)$

$N_2 \approx \pi \rho R^3 (6{,}67 g + 5{,}54 w^2 R)$

$N_1 \approx 6{,}67 \pi \rho g R^3$

Ответ: 1) $N_1 = \frac{20}{3}\pi \rho g R^3$; 2) $N_2 = \pi \rho R^3 \left(\frac{20}{3} g + \frac{72}{13} w^2 R\right)$.

чистовик
№ 3 стр 3

$T = const$

$T = 81^0 C$

$V = \frac{1}{7} V_0$ $V = 1{,}7$ л

$P = 3{,}6 P_0$

$P_H (81^\circ C) = 0{,}5 \cdot 10^5$ па

$\mu = 78 \frac{г}{моль}$ $R = 8{,}31$

$PV = \nu RT$

$P_0 V_0 = \nu_0 RT$

$\frac{P}{P_0} \frac{V}{V_0} = \frac{\nu}{\nu_0}$

~~4·3~~ $\frac{3{,}6}{7} = \frac{\nu}{\nu_0}$

$P = P_H$

т.к иначе
это бы выразили
в 7 раз

$\nu \approx 0{,}5143 \nu_0$

$\nu = \frac{P_H V}{RT} = \frac{0{,}5 \cdot 10^5 \cdot 1{,}7 \cdot 10^{-3}}{8{,}31 \cdot 354} = \frac{0{,}5 \cdot 1{,}7}{8{,}31 \cdot 3{,}54}$

$P_0 \approx 1{,}389 \cdot 10^4$ па

$\nu \approx 0{,}02889$ моль

$m = \mu \nu$

$m_0 = \mu \nu_0 \approx 1{,}011292$

$\approx 10^{-3}$ кг

$\nu_0 = \frac{7\nu}{3{,}6} \approx 0{,}05618$ моль

Ответ: 1) $P_0 \approx 1{,}389 \cdot 10^4$ па; 2) $m_0 \approx 10^{-3}$ кг.

черновик стр 4

N1

$h_c = v_0 t - \frac{gt^2}{2}$ 1й корень – 1й мяч; 2й корень – 2й мяч

$\Delta t = t_1 - t_2$

h_{max} $v = 0$

$v_0 - gt$

$t_B = \frac{v_0}{g}$

$h_B = v_0 t_B - \frac{g t_B^2}{2}$

$h_B = \frac{v_0^2}{g} - \frac{v_0^2}{2g} = \frac{v_0^2}{2g}$

$h = 0$

$v_0 t = gt^2$

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

$2h_c = h_B + v_0 t_c - gt_c^2$

$h_2 = v_0 t_c - \frac{g t_c^2}{2}$

$h_1 = \frac{h_B\, g t_c^2}{2}$

$t = \frac{3}{2} \frac{t_1}{t_2}$

$h_B - \frac{gt_c^2}{2} = v_0 t_c - \frac{gt_c^2}{2}$

$h_1 = h_2$

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

$h_B = v_0 t_c$? $h_B = \frac{v_0^2}{2g}$

$t_c = t_2$

$t_c = \frac{h_B}{v_0} = \frac{v_0}{2g}$

$2h_c = 2v_0 t_c - gt_c^2$

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

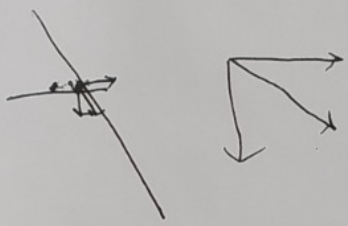
$t_1 = t_B + t_c = \frac{v_0}{g} + \frac{v_0}{2g} = \frac{3}{2}\frac{v_0}{g}$

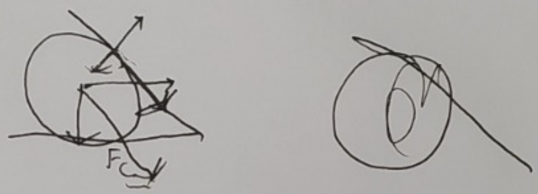
$h_c = v_0 t_c - \frac{g t_c^2}{2}$

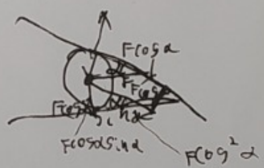
$h_c = \frac{v_0^2}{2g} - \frac{g v_0^2}{8g^2} = \frac{v_0^2}{2g} - \frac{v_0^2}{8g} = \frac{3v_0^2}{8g}$

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

черновик стр 5
№2







$F\sin\alpha$

$F\cos\alpha$

$F\cos^2\alpha$ $F\sin\alpha\cos\alpha$

↙

$F\cos^3\alpha$

↓

$F\cos^2\alpha\sin\alpha$

Часть 2

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

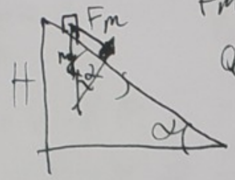
Шифр: **21204201**

ID профиля: **857982**

Вариант 2

чистовик стр 1

№4



$F_m = mg\sin\alpha$

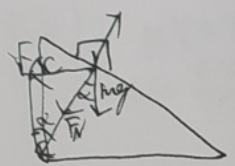
$a_m = g\sin\alpha$

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

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

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

$t = \sqrt{\frac{2S}{a}} = \frac{1}{\sin\alpha}\sqrt{\frac{2H}{g}} = \frac{5}{4}\sqrt{\frac{2H}{g}}$

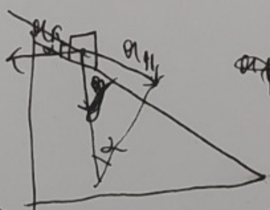


$F_K = F_N\sin\alpha = mg\cos\alpha\sin\alpha = mg\,\frac{4}{5}\cdot\frac{3}{5} = \frac{12}{25}mg$

$F_0 = F - F_K = mg - \frac{12}{25}mg = \frac{13}{25}mg$

$F_0 = 2ma_K \quad a_K = \frac{13}{50}g$

перейдем в с.о. клина, тогда брус получ-ет $a_K \perp mg$.



$a_{11} = g\sin\alpha - a_K\cos\alpha$

$a_{11} = \frac{4}{5}g - \frac{3}{5}\cdot\frac{13}{50}g$

$a_{11} = \frac{g}{5}\left(4 - \frac{39}{50}\right)$

$a_{11} = \frac{161g}{250}$

$S = \frac{a_{11}t^2}{2}$

$t = \sqrt{\frac{2S}{a_{11}}} = \sqrt{\frac{10H\cdot 250}{4\cdot 161\cdot g}} = 50\sqrt{\frac{H}{4\cdot 161\cdot g}} = 25\sqrt{\frac{H}{161g}}$

ответы: 1) $t = \frac{5}{4}\sqrt{\frac{2H}{g}}$; 2) $a_K = \frac{13}{50}g$; 3) $t = 25\sqrt{\frac{H}{161g}}$

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N 5 чистовик стр 2

$\frac{p}{p_0} = \alpha = 0{,}99$ $\frac{V}{V_0} = \beta = 1{,}02$

$pV = \nu R T$; $p_0 V_0 = \nu R T_0 \Rightarrow \frac{p}{p_0}\frac{V}{V_0} = \frac{T}{T_0} = \gamma$ $\gamma = \alpha\beta = 0{,}99 \cdot 1{,}02 = 1{,}0098$

$Q = A + \Delta U \Rightarrow \frac{Q}{\Delta U} = 1 + \frac{A}{\Delta U}$; $\frac{\Delta p}{p} << 1 \Rightarrow \Delta p << p$ $\Delta V << V$ $\Delta T << T$

т.к. $\Delta p << p$, $\Delta V << V$, то $p(V)$ — ≈ прямая

$p(V) = kV + b$

$k = \frac{p - p_0}{V - V_0} = \frac{p_0(\alpha - 1)}{V_0(\beta - 1)} = -\frac{p_0}{2V_0}$

$p_0 = kV_0 + b$
$p = kV + b$

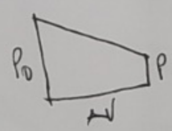
$\frac{(p_0 + p) - k(V_0 + V)}{2} = b$

$\frac{p_0(\alpha+1) - kV_0(\beta+1)}{2} = b$

$p_0 \frac{\alpha + 1 + \frac{\beta+1}{2}}{2} = b = \frac{3}{2} p_0$

$p = \frac{3}{2} p_0 - \frac{p_0}{2V_0} V$

$A = S_{трап}$



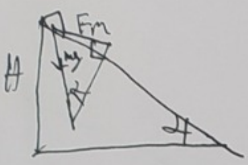
$A = S = \frac{p_0 + p}{2} \Delta V = p_0 \frac{\alpha+1}{2} \cdot V_0(\beta - 1) = p_0 V_0 \frac{\alpha+1}{2}(\beta-1)$

$\Delta U = \frac{3}{2}\nu R \Delta T = \frac{3}{2}(pV - p_0V_0) = \frac{3}{2} p_0 V_0 (\alpha\beta - 1)$

$\frac{Q}{\Delta U} = 1 + \frac{\frac{\alpha+1}{2}(\beta-1)}{\frac{3}{2}(\alpha\beta-1)} = 1 + \frac{(\alpha+1)(\beta-1)}{3(\alpha\beta-1)} = 1 + \frac{0{,}0398}{0{,}0294} \approx 2{,}354$

Ответ: 1) увеличится на 0,98%; 2) ≈ 2,354

№4 Черновик стр 3



$F_т = mg\sin\alpha$

$a = g\sin\alpha$

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

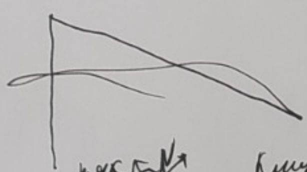
$\sin^2\alpha = 1 - \cos^2\alpha$

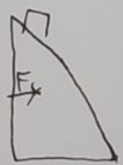
$\cos\alpha = \frac{3}{5}$ $\cos^2\alpha = \frac{9}{25}$

$\sin^2\alpha = \frac{16}{25}$

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

$\sqrt{\frac{2S}{a}} = t = \sqrt{\frac{2H}{g\sin^2\alpha}} = \frac{5}{4}\sqrt{\frac{2H}{g}}$ $\sin\alpha = \frac{4}{5}$





перейдем в СО ~~бруска~~ клина

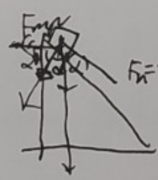
$m_i\vec{R}$ она нелинейна у всех одна (?) ... $a_к$

Клин не движется

$F_{\parallel} = m(g\sin\alpha - a_к\cos\alpha)$ $a_{\parallel} = g\sin\alpha - a_к\cos\alpha$

$F_{\perp} = m(a_к\sin\alpha + g\cos\alpha)$ $a_{\perp} = g\cos\alpha + a_к\sin\alpha$

$a_к \leq \frac{g}{2}$



$F_x = mg\cos\alpha \cdot \sin\alpha$

$\frac{F - F_т}{2m} = a_к$

$\frac{g}{2} - \frac{g}{2}\cos\alpha\sin\alpha = a_к$

$a_к = \frac{g}{2}(1 - \cos\alpha\sin\alpha)$

$\cos\alpha\sin\alpha = \frac{3}{5}\cdot\frac{4}{5} = \frac{12}{25}$

$a_к = \frac{g}{2}\left(\frac{13}{25}\right) = \frac{13g}{50}$

$F_{\parallel} =$

$a_{\parallel} = \frac{4}{5}g - \frac{3}{5}\cdot\frac{13}{50}g = \frac{1}{5}\left(4g - \frac{39}{50}g\right)$

$a_{\parallel} = \frac{161}{50}\cdot\frac{1}{5}g = \frac{161}{250}g$

~~$t =$~~ $S = \frac{a_{\parallel}t^2}{2}$

$\sqrt{\frac{2S}{a_{\parallel}}} = t$ $t = 5\sqrt{\frac{20H}{161g\sin\alpha}} = 10\sqrt{\frac{5H}{161g\sin\alpha}} = 50\sqrt{\frac{H}{161\cdot g\cdot 4}} = 25\sqrt{\frac{H}{161g}}$

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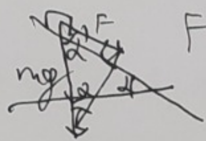
№4 черновик стр 4



$F = mg\sin\alpha$

$a = g\sin\alpha$

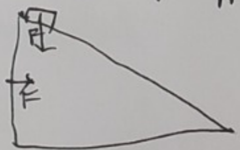
1) Клин держат

$S = \frac{at^2}{2}$ $t = \sqrt{\frac{2S}{a}}$

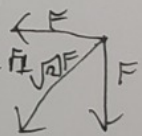
$S = \frac{H}{\sin\alpha}$ $\sin^2\alpha = 1 - \frac{9}{25} = \frac{16}{25}$ $t = \sqrt{\frac{2H}{\sin\alpha\, a}} = \sqrt{\frac{2H}{g\sin^2\alpha}}$

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

$F = mg$



перейдем в СО клина, на брусок действует сила $F = \sqrt{2}F$



$F_{\parallel} = F\sin\alpha - F\cos\alpha = F(\sin\alpha - \cos\alpha)$

$F_{\parallel} = \frac{mg}{5}$ $a_{\parallel} = \frac{g}{5}$

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

$\cos\alpha = \frac{3}{5}$ $\sin\alpha - \cos\alpha = \frac{1}{5}$

вы ищи

$F\cos\alpha\sin\alpha = \frac{-12}{25}mg$

$N = F_{\perp} = F(\cos\alpha + \sin\alpha) = F\frac{4}{5} = \frac{4}{3}mg$

$\frac{1}{25} + \frac{49}{25} = 2$

$F_m = N\sin\alpha$

$F_m = \frac{4?}{25}mg$

$F_m = \frac{-28}{25}mg$

$F_x = \frac{-3}{25}mg$?

$S = \frac{g}{10}t^2$

$\sqrt{\frac{10S}{g}} = t$ $t = \sqrt{\frac{50 \cdot H}{4g}}$

$t = \sqrt{\frac{25H}{2}}$

$a_x - \frac{3}{50}g$?

(против сил)

№5

$\nu = const$?

$PV = \nu RT$ $\quad P = 0{,}99 P_0$ (α)

$P_0 V_0 = \nu R T_0$ $\quad V = 1{,}02 V_0$ (β)

$\frac{PV}{P_0V_0} = \frac{T}{T_0}$ $\quad \frac{T}{T_0} = 0{,}99 \cdot 1{,}02 = 1{,}0098 \approx 1{,}01 = +1\%$

$\Delta P << P_0$, $\Delta T << T_0$, $\Delta V << V_0$

$\frac{\Delta P}{P} << 1$ $\quad \frac{\Delta T}{T} << 1$ $\quad \frac{\Delta V}{V} << 1$

$Q = A + \Delta U$ $\quad \frac{Q}{\Delta U} = 1 + \frac{A}{\Delta U}$ $\quad \frac{\int P dV}{\frac{3}{2}\nu R \Delta T}$!

т.к. $\Delta V << V_0$ $dV \approx \Delta V$ по величине

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

$P(V) \approx const = P_0$ т.к. $\Delta V << V$

~~$\int P dV = \Delta P \Delta V$~~

$\Delta P, \Delta V$ - малы, или P - почти линейна

$P(V) \approx$ прямая

~~$P = kV + P_0$~~ $\quad$ ~~$\Delta P = kV$~~ $\quad k = \frac{\Delta P}{\Delta V}$

$P = kV + b$

$P_0 = kV_0 + b$ $\quad P + P_0 = k(V + V_0) + 2b$

$b = \frac{(P+P_0) - k(V+V_0)}{2}$

$P - P_0 = k(V - V_0)$

$\frac{\Delta P}{\Delta V} = k$ $\quad \frac{P}{P_0} = \beta$

$k = -\frac{P_0}{2V_0}$ $\quad P - P_0 = 0{,}99P_0 - P_0 = -0{,}01 P_0$

$\Delta V = 0{,}02 V_0$

• P, V $\quad$ • P_0, V_0

$\frac{P - P_i}{V} = \frac{P_0 - P_i}{V_0}$

$\alpha = \frac{V}{V_0} = \frac{P - P_i}{P_0 - P_i}$

$\alpha P_0 - P = \alpha P_i - P_i$

$\alpha P_0 - \beta P_0 = P_i(\alpha - 1)$

$P_0(\alpha - \beta) = P_i(\alpha - 1)$

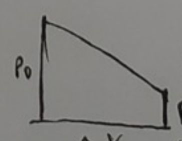
$P_i = P_0 \frac{\alpha - \beta}{\alpha - 1}$

$\nu R \Delta T = PV - P_0V_0 =$
$= P_0V_0(\alpha\beta - 1)$

$b = \frac{P_0(\alpha + 1) - kV_0(\beta + 1)}{2} = \frac{P_0 \cdot 1{,}99 + \frac{P_0}{2} \cdot 2{,}02}{2}$

~~$\frac{Q}{\Delta U} = 1 + \frac{\alpha\beta - 1}{0{,}0199}$~~

$b = P_0 \frac{1{,}99 + 1{,}01}{2} = P_0 \frac{3}{2}$



$P =$

$A = \frac{P + P_0}{2} \cdot \Delta V$

$A = P_0 \cdot \frac{\alpha + 1}{2} \cdot 0{,}02 V_0 = P_0V_0 \cdot$

$A = 0{,}0199 P_0V_0$?

$\frac{Q}{\Delta U} \approx 1{,}49$.

$P = \frac{3}{2}P_0 - \frac{P_0}{2V_0} V$