Часть 1

Олимпиада: **Физика, 9 класс (1 часть)**

Шифр: **21204181**

ID профиля: **360362**

Вариант 2

Чистовик Вариант Э9-02

Задача 1

Дано:

τ

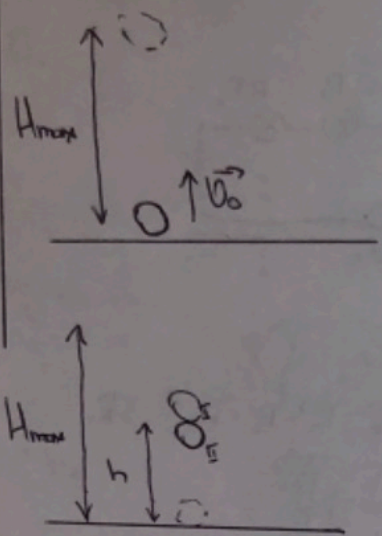
$v_{01} = v_{02}$

τ_1 - ?

H_{max} - ?

v_0 - ?

Анализ и решение:



ЗСЭ: $\frac{mv_0^2}{2} = mgh$

$\tau = \tau_1 + \tau_2$

где τ_1 - для мяча I на высоту H_{max}

τ_2 - для мяча II на высоту h

$h' = \frac{g\tau_1^2}{2} \Rightarrow$; $H = \frac{g\tau_1^2}{2}$

$H = \frac{v_0^2}{2g} \Rightarrow v_0 = \sqrt{2gH}$

$\frac{g\tau_2^2}{2} + (\underbrace{v_0\tau_2 - \frac{g\tau_2^2}{2}}_{h}) = H \Rightarrow \tau_2 = \frac{H}{v_0}$

$\tau_2^2 = \frac{H^2}{v_0^2} = \frac{H}{2g} = \frac{g\tau_1^2}{2} \cdot \frac{1}{2g} \Rightarrow 2\tau_2 = \tau_1$

$\tau = 3\tau_2 \Rightarrow \tau_2 = \frac{\tau}{3} \Rightarrow \tau_1 = \frac{2}{3}\tau \Rightarrow \tau_1^2 = \frac{4}{9}\tau^2$

$H = \frac{4}{9}\tau^2 \cdot \frac{g}{2} = \frac{2g\tau^2}{9}$

$v_0 = \sqrt{2 \cdot g \cdot H} = \sqrt{\frac{2g\tau^2}{9} \cdot 2g} = \sqrt{\frac{4g^2\tau^2}{9}} = \frac{2g\tau}{3}$

Ответ: $\tau_1 = \frac{2}{3}\tau$; $H = \frac{2}{9}g\tau^2$; $v_0 = \frac{2}{3}g\tau$

1

Чистовик Вариант 09-0,2

(2)

?
1 Дано:

$S = 9\cdot10^{-4}\,м^2$

$m = 0,25\,кг$

$H = 0,2\,м$

$M;\ p - ?$

$m_1 = \frac{m}{10}$

$h - ?$

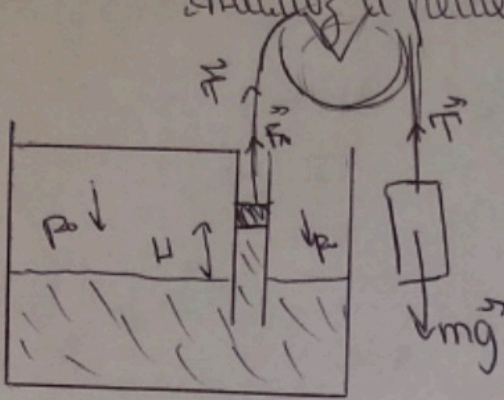
$p_0 = 1\cdot10^5\,Па$

$\rho = 1000\,\frac{кг}{м^3}$

$g = 10\,\frac{м}{с^2}$

Анализ и решение:

(I)



$p = \frac{F}{S}$

$p_1 = \rho g H = 2000\,(Па)$

$\rho g H + \frac{mg}{S} = p_0 + \frac{Mg}{S}$

$\rho g H S + mg = p_0 S + Mg$

$M = \frac{\rho g H S + mg - p_0 S}{g}$

$M = \frac{1000\cdot10\cdot0,2\cdot9\cdot10^{-4} + 0,25\cdot10 - 10^5\cdot9\cdot10^{-4}}{10}$

$M = 1,8 + 2,5$

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Чистовик Вариант 09-02 Част 1.

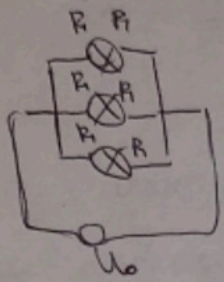
(3)

Дано:
$U_0 = 6В$
$P_1 = 2{,}4 Вт$
$P_2 = 0{,}5 Вт$

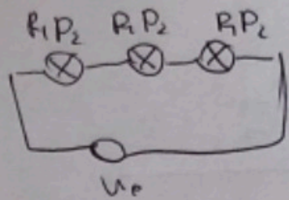
I - ?
$U_{02} = \frac{U_0}{3}$
P_1' - ?

Анализ и решение:

(I)



(II)



(I): $P_1 = \frac{U^2}{R_1} \Rightarrow R_1 = \frac{U^2}{P_1}$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$, $U = U_1 = U_2 = \dots$

$R = \frac{R_1}{3}$

$I_1 = \frac{U}{R_1} = \frac{U \cdot P_1}{U^2} = \frac{P_1}{U}$

$P = P_1 + P_2' + P_3' = 3P_1$

$I_1 = 0{,}4 A$

т.к. лампы одинак.

$R_1 = R_2 = R_3$

и $P_1 = P_2' = P_3$

$I_2 = \frac{U}{R_2}$; $P_2 = \frac{U^2}{R_2} \Rightarrow I_2 = \frac{U}{R_2} = \frac{P_2}{U}$

$I_3 = \frac{P_3}{U}$

$I_1 = I_2 = I_3 = 0{,}4 A \Rightarrow$

$\Rightarrow R_1 = \frac{U}{I_1} = 15 Ом$

(II) $P_2 = I^2 R_1$

$R = R_1 + R_2 + R_3 = 3R_1$

$I = \sqrt{\frac{P_2}{R_1}}$

$I_1 = I_2 = I_3 = \sqrt{\frac{P_2}{R_1}} = \sqrt{\frac{0{,}5}{15}} = 0{,}183 A$

(III) $P_1' = \frac{U_{02}}{R_1} = \frac{U_0}{3R_1}$

$P_1' = \frac{6В}{3 \cdot 15 Ом}$

$P_1' = 0{,}133 Вт$

Ответ: (I): $I = 0{,}4A$ (II): $I = 0{,}183A$; (III) $P_1' = 0{,}133 Вт$

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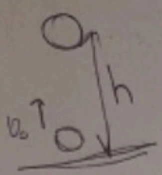
Вариант 09-02

①

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



$\tau = \tau_1 + \tau_2$

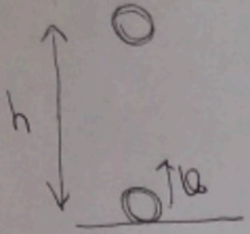
$v_{k_1} = v_0 - g\tau = 0 \Rightarrow v_0 = g\tau$

$\tau_2 = \tau - \tau_1$

$\boxed{h = \frac{v_0^2}{2g}}$ h $mgH = mgh + \frac{mv_1^2}{2}$

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

$v_0^2 = 2gh$



$h = \frac{g\tau_2^2}{2}$ $H = \frac{g\tau_1^2}{2}$

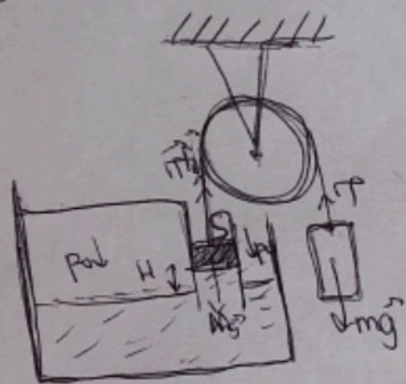
$v_0^2 = 2g\frac{g\tau_1^2}{2}$

$H = v_0\tau_2 \cdot 2 \frac{g\tau_1^2}{2}$

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

$v_0^2 = g^2\tau_1^2 \Rightarrow v = g\tau \Rightarrow \tau = \frac{v_0}{g}$

②



$p = \frac{F}{S} \Rightarrow F = p \cdot S$

$mg = F_1$

$10000 \cdot 0,2 = 2000$

$p_0 = \rho g H$ ~~...~~ $\frac{F}{S}$

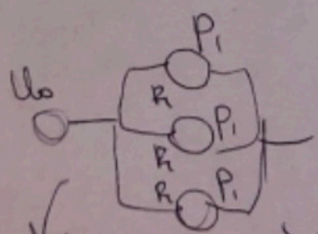
$p_0 + \frac{mg}{S} = \rho g H + \frac{Mg}{S}$

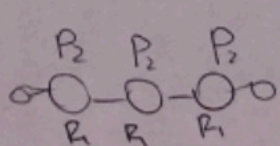
$p_0 S + mg = \rho g H S + Mg$

$M = \frac{p_0 S + mg - \rho g H S}{g}$

p_0 $9 \cdot 10^4 \cdot 1 \cdot 10^{-5}$

③





$3P_2 = I^2 \cdot R$ $\frac{5}{150} = \frac{1}{30}$

$P_2 = I^2 R$ (т.к. посл.)

$P_1 = \frac{U^2}{R}$ (т.к. пар.)

$I = \frac{U}{R}$ $2\frac{4}{10} = 2\frac{2}{5} = \frac{12}{5}$ $\frac{5}{12}$

$R = \frac{U}{I}$ $R = \frac{5}{36}$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_1} + \frac{1}{R_1} \Rightarrow R = \frac{R_1}{3}$ $R = \frac{U^2}{P_1}$

$\frac{3}{R_1}$ $I_1 = \frac{U}{R_1}$

$\frac{U P_1}{U^2} \Rightarrow I_1 = U P_1 = 6 \cdot 2,4$

$\frac{6}{14,4}$ $\frac{6}{14,4} = \frac{1}{2,4}$

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③ $P = \frac{U^2}{R} = \frac{3U^2}{R_1}$ $\quad I = I_1 + I_2 + I_3$

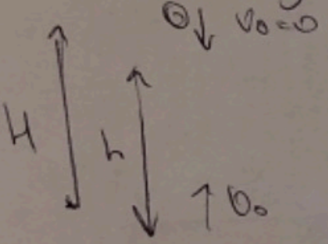
$\to \cancel{R_1 = \frac{P}{3U^2}} \quad \frac{3R}{U^2}$ $\quad P = I^2 R$ $\quad 3P_1 = I^2 R$

$R_1 = \frac{U^2}{R}$ $\quad 916 \cdot 15$ $\quad I \quad 9I_1^2$

$3I_1^2 \cdot R = P_1$

① $\tau_2^2 = \frac{H}{2g} = \frac{g\tau_1^2}{2g \cdot 2}$ $\to 4\tau_2^2 = \tau_1^2$

$2\tau_2 = \tau_1$



$$\left.\begin{aligned} v_0\tau_2 - g\frac{\tau_2^2}{2} &= h \\ g\frac{\tau_2^2}{2} &= H - h \end{aligned}\right\} \Rightarrow (I) + (II) = H$$

$v_0\tau_2 = H = g\frac{\tau_1^2}{2}$

$2v_0\tau_2 = g\tau_1^2$

$\tau_2^2 = \frac{H^2}{v_0^2} = \frac{H^2}{2gH} = \frac{H}{2g} = g\frac{\tau_1^2}{2} \cdot \frac{1}{2g}$

$4\tau_2^2 = \tau_1^2 \Rightarrow \tau_1 = 2\tau_2$

Часть 2

Олимпиада: **Физика, 9 класс (2 часть)**

Шифр: **21204181**

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Вариант 2

(IV) Чистовик 09.02

(1) Дано:

$m = m$

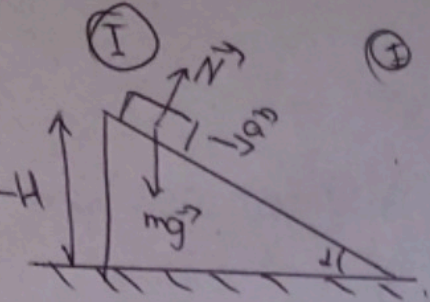
$M = 2m$

$\alpha; H$

$\tau_1 - ?$

$a_1; t - ?$

(I)



Анализ и решение:

(1) $\sin\alpha = \sqrt{1-\cos^2\alpha} = \frac{4}{5}$; $l = \frac{H}{\sin\alpha}$

II закон Ньютона:

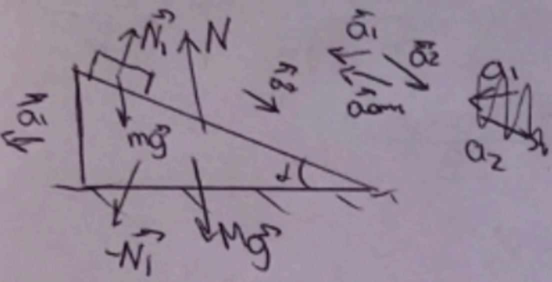
$mg\sin\alpha = ma \to a = g\sin\alpha$

ЗСЭ: $v^2 = 2gH$

$\sqrt{2gH} = a\tau = g\sin\alpha\cdot\tau \Rightarrow \tau = \sqrt{\frac{2H}{g}}\cdot\frac{1}{\sin\alpha}$

$\tau = \sqrt{\frac{5H}{4}}$ (с)

(II)



$N\sin\alpha = Ma_1 \Rightarrow N = \frac{Ma_1}{\sin\alpha}$ (I)

$m\vec{a_2} = m_2\vec{g} + \vec{N}$

$-\vec{N_1} = \vec{N_1}$

$\vec{a_2} = \vec{a}_{отн} + \vec{a_1}$

$mg\sin\alpha = m(a_{отн} - a_1\cos\alpha)$

$N - mg\cos\alpha = -ma_1\sin\alpha$

$Ma_1 - mg\cos\alpha\sin\alpha + ma_1\sin^2\alpha$

$a_1 = \frac{mg\cos\alpha\sin\alpha}{M+m\sin^2\alpha} = \frac{mg\cos\alpha\sin\alpha}{m(2+\sin^2\alpha)}$

$a_1 = g\frac{\cos\alpha\sin\alpha}{2+\sin^2\alpha} \Rightarrow$

$\Rightarrow a_{отн.} = \frac{(m+M)\sin\alpha}{M+m\sin^2\alpha}\cdot g \Rightarrow$

$\Rightarrow$ т.к. $\frac{a_{отн}\tau^2}{2} = \frac{H}{\sin\alpha}$

$\tau = \sqrt{\frac{2H}{a_{отн}\sin\alpha}}$

$\tau = \sqrt{\frac{2H(M+m\sin^2\alpha)}{\sin^2\alpha\, g\,(M+m)}} = \frac{2H\cdot m\,(2+\sin^2\alpha)}{m\sin^2\alpha\cdot g\,(2+1)} = \sqrt{\frac{2H(\sin^2\alpha+2)}{\sin^2\alpha\cdot g\cdot 3}}$

$a_1 = \frac{10\cdot\frac{3}{5}\cdot\frac{4}{5}}{2+\frac{16}{25}} = \frac{\frac{120}{25}}{\frac{66}{25}} = \frac{120}{66} = \frac{20}{11} \approx 1,(81)$ м/с²

$\tau = \sqrt{\frac{2H\left(\frac{16}{25}+2\right)}{\frac{16}{25}\cdot 10\cdot 3}} = \sqrt{\frac{2H\cdot\frac{66}{25}}{19,2}} = \sqrt{0,275H} \approx 0,5244\sqrt{H}$ (с)

Ответ: (I) $\tau = \sqrt{\frac{5H}{4}}$ с; (II) $a_1 \approx 1,(81)$ м/с²; $\tau \approx 0,5244\sqrt{H}$ с

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Чистовик 09-02

(V)

(2)

1) Дано:

H ; S

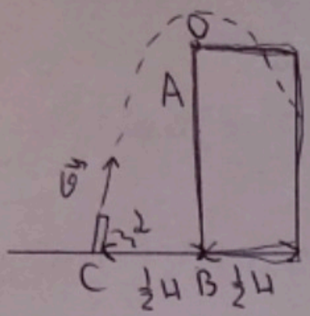
$\upsilon = \sqrt{2,5gH}$

τ - ?

α - ?

$g = 10$ м/с²

Анализ и решение



I) $m = \rho V$

$V = H \cdot S_1 = H \cdot \frac{\pi R^2}{2} \Rightarrow 0{,}03125\, H^3 \cdot \rho \cdot \pi = m$

$m = \rho \cdot \upsilon \cdot \tau \cdot S$

$0{,}03125\, H^3 \cdot \rho \cdot \pi = \rho \cdot \upsilon \cdot \tau \cdot S$

$\tau = \frac{0{,}03125 \cdot H^3 \cdot \pi}{\upsilon \cdot S} = \frac{0{,}03125 \cdot H^3 \cdot \pi}{S \cdot 5 \cdot \sqrt{H}} = \frac{0{,}00625 \cdot H^3 \cdot \pi}{S \cdot \sqrt{H}}$

$\tau = \frac{\sqrt{H} \cdot H^2 \cdot 0{,}00625 \cdot \pi}{S} = \frac{\sqrt{H^5} \cdot 0{,}00625 \cdot \pi}{S}$

II) струя попадёт в точку O при $\alpha = 60°$

в $\triangle ABC$; $\angle CBA = 90°$ и $OB = H$; $CB = \frac{1}{2}H \Rightarrow \angle CAB = 30° \Rightarrow$

$\Rightarrow$ при $\alpha = 60°$ струя попадёт в точку A. при $\upsilon = \sqrt{2,5gH}$

III) $2gH_1 = 2{,}5gH \Rightarrow H_1 = \frac{5}{4}H$

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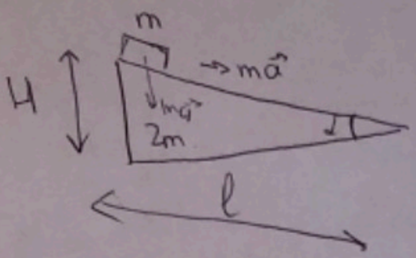
Черновик

VI



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

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

3,64 $\quad \frac{16\cdot 6}{5}$ $\quad$ 0,64

$\frac{16\cdot 30}{25}$

19,2

II

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

$mv = Mu \Rightarrow v = \frac{Mu}{m}$

$mgH = \frac{M^2 u^2}{2m} + \frac{Mu^2}{2}$

$2m^2 gH = M^2u^2 + mMu^2$

$u^2 = \frac{2m^2 gH}{M(m+M)} \Rightarrow u = m\sqrt{\frac{2gH}{M(m+M)}}$

$mg\cos\alpha = Ma$

$u = a\tau$

I

$mgH = \frac{mv^2}{2} \Rightarrow H = \frac{v^2}{2g}$

$mg\sin\alpha = ma \Rightarrow g\sin\alpha = a$

$v = a\tau = g\tau\sin\alpha = \frac{l}{\tau}$

$\sqrt{2gH} = \frac{H\sin\alpha}{\tau}$

$l = \frac{a\tau^2}{2}$

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

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

$\sqrt{2gH} = g\sin\alpha\cdot\tau$

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

$2gH = g^2\tau^2\sin^2\alpha$

$\sqrt{2gH} = \tau\sin\alpha\, g$

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

$g\tau^2\sin\alpha = H\sin\alpha$

$g\sin\alpha\,\tau = \frac{H\sin\alpha}{\tau}$

$\tau = \sqrt{\frac{H}{g}}$

$mgH = \frac{mv^2}{2} \Rightarrow v = \sqrt{2gH} = g\sin\alpha\cdot\tau$

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

$\tau\sqrt{2gH} = H\sin\alpha$

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

I

$v^2 = 2gH = \frac{H^2}{\sin^2\alpha\,\tau^2} = g\sin\alpha\cdot\tau$

$\tau = \frac{2H}{\sin\alpha}$

$2gH\sin\alpha\,\tau = H$

$\tau = \frac{1}{2g\sin\alpha}$; $H = g\sin^2\alpha\,\tau^2$

$\tau = \sqrt{\frac{H}{g}}\sin\alpha$

$v = \sqrt{2gH} = \frac{H}{\sin\alpha\,\tau} = g\sin\alpha\,\tau$

$\tau = \frac{\sqrt{2gH}\cdot\sin\alpha}{H}$

$\sqrt{2gH} = g\sin\alpha\,\tau \Rightarrow \tau = \frac{\sqrt{2gH}}{g\sin\alpha}$

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

~~Чертовы~~ Вариант 09-02

Черновик

(IV)

(1) Дано:

$m = m$

$M = 2m$

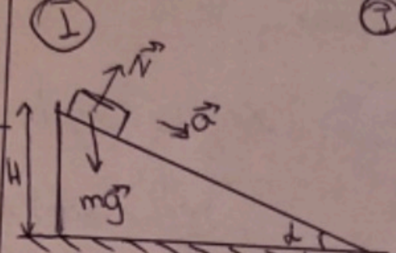
α ; H

τ_1 - ?

a_2; t - ?

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

(I)



Анализ и решение:

(1) $\upsilon_0 = 0 \Rightarrow \cancel{\upsilon \neq a t = \frac{l}{t}}$ $l = H \sin\alpha^{-1} = \frac{H}{\sin\alpha}$

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

II закон Ньютона:

$mg \sin\alpha = ma \Rightarrow a = g\sin\alpha$

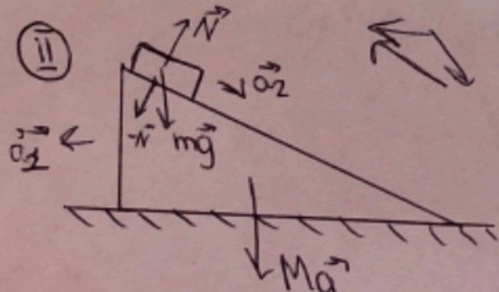
ЗСЭ: $mgH = \frac{m\upsilon^2}{2} \Rightarrow \upsilon^2 = 2gH$

$\cancel{l = \frac{\upsilon^2}{2g}}$ $\frac{H}{\sin\alpha} = g\frac{\sin\alpha \cdot \tau^2}{2}$; $\sqrt{2gH} = g\sin\alpha\,\tau$

$\tau = \sqrt{\frac{2H}{g}} \cdot \frac{1}{\sin\alpha}$

$\tau = \sqrt{\frac{H}{5}} \cdot \frac{5}{4} = \sqrt{\frac{5H}{4}}$ (c)

(II)



(II) $m\upsilon = Mu \Rightarrow \upsilon = \frac{Mu}{m}$

$mgH = \frac{Mu^2}{2} + \frac{m\upsilon^2}{2}$

$2m^2gH = M^2u^2 + mMu^2 \Rightarrow u = m\sqrt{\frac{2gH}{M(m+M)}} \Rightarrow \upsilon = M\sqrt{\frac{2gH}{M(m+M)}}$

~~$u = a_1 t$; $\upsilon = a_2 t$~~

~~$N = mg\cos\alpha \Rightarrow N_1 = mg\cos\alpha \cdot \sin\alpha = Ma_1 \Rightarrow a_1 = \frac{mg\cos\alpha\sin\alpha}{M}$~~

~~$a_1 = a_2 \sin\alpha$~~ ~~$a_1 = a_2 \sin\alpha$~~

~~$Ma_1 = N\sin\alpha$~~

~~$M\vec{a_2} = \vec{N} +$~~

$\vec{a_2} = \vec{a}_{отн} + \vec{a_1}$

(V) $\frac{m\upsilon^2}{2} = mgh$

$\upsilon = \sqrt{2gH}$

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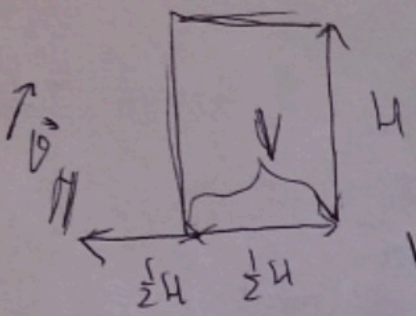
09-02



$\vartheta = \sqrt{2,5gH}$ $\quad$ $\Delta m = \rho \vartheta S$

$m = \rho V$

$V = HS$

$S = \frac{\pi R^2}{2} = \frac{0,0625 H^2 \pi}{2} = 0,03125 H^2 \cdot \pi$

$\frac{m\vartheta^2}{2} = mgH$ $\quad$ $\vartheta^2 = 2gH_1$

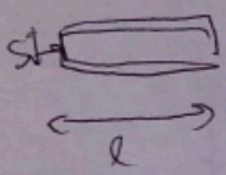
$2,5gH = 2gH_1$

$0,5H = 0,4H_1$

$5H = 4H_1$

$H_1 = 1\frac{1}{4}H$

$\vartheta \cdot S = \tau$



$m = \rho \cdot H^3 \cdot \pi \cdot 0,03125$

$l = \vartheta \cdot \tau \Rightarrow m = \vartheta \cdot \tau \cdot S \cdot \rho$

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