

Часть 1

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

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Вариант 1

Умножим. Метод 1.

Задача 1.

дано: $t; g$

Искать: $h_{\max}; h_{\text{всп}}; \frac{s_1}{s_2}$

Решение:

$$1) \begin{cases} h_{\max} = \frac{v_0^2}{2g} \\ s_1 = \frac{gt^2}{2} \end{cases}$$

s_1 - путь первого мяча от h_{\max} до $h_{\text{всп}}$
 s_2 - полный путь первого мяча

$$\begin{cases} s_2 = h_{\max} - s_1 \\ s_2 = v_0 t - \frac{gt^2}{2} \end{cases}$$

$$\begin{cases} h_{\max} = \frac{v_0^2}{2g} \\ s_1 = \frac{gt^2}{2} \\ s_2 = \frac{v_0^2}{2g} - \frac{gt^2}{2} \\ \frac{v_0^2}{2g} - \frac{gt^2}{2} = v_0 t - \frac{gt^2}{2} \end{cases}$$

$$\begin{cases} h_{\max} = \frac{v_0^2}{2g} \\ s_1 = \frac{gt^2}{2} \\ s_2 = \frac{v_0^2}{2g} - \frac{gt^2}{2} \\ v_0 = 2gt \end{cases}$$

$$\left\{ \begin{array}{l} h_{\max} = 2gt^2 \\ S_1 = \frac{gt^2}{2} \\ S_2 = 1,5gt^2 \\ v_0 = 2gt \end{array} \right.$$

Microbook. Auct nr.

$$2) h_{\text{comp}} = S_2 = 1,5gt^2$$

$$3) \frac{S_1'}{S_2} = \frac{2gt^2 + 0,5gt^2}{1,5gt^2} = \frac{5}{3}$$

$$\boxed{\text{Ombem: } 2gt^2; 1,5gt^2; \frac{5}{3}}$$

Мановик. лист №3.

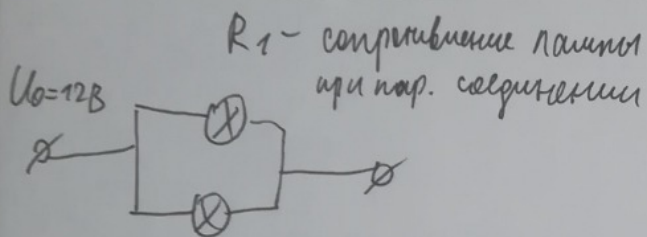
Задача №3.

Дано: $U_0 = 12\text{В}$; $P_1 = 20\text{Вт}$; $P_2 = 6,6\text{Вт}$

Найти: I_1 ; I_2 ; P_3 при ~~2~~ $2U_0$

Решение:

Параллельное соединение

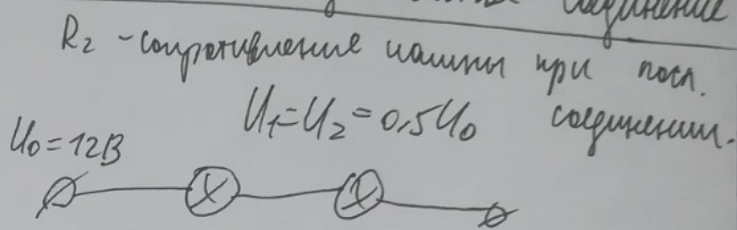


$$\begin{cases} P_1 = \frac{U_0^2}{R_1} \\ I_1 = \frac{U_0}{R_1} \end{cases}$$

$$\begin{cases} R_1 = \frac{U_0^2}{P_1} \\ I_1 = \frac{U_0 \cdot P_1}{U_0^2} \end{cases}$$

$$\begin{cases} R_1 = 7,2\text{Ом} \\ I_1 = 1,67\text{А} \end{cases}$$

Последовательное соединение



$$\begin{cases} P_2 = \frac{U_1^2}{R_2} \\ I_2 = \frac{U_1}{R_2} \end{cases}$$

$$\begin{cases} R_2 = \frac{(0,5U_0)^2}{P_2} \\ I_2 = \frac{0,5U_0 \cdot P_2}{(0,5U_0)^2} \end{cases}$$

$$\begin{cases} R_2 = 5,45\text{Ом} \\ I_2 = 1,1\text{А} \end{cases}$$

~~Решение~~

$$P_3 = \frac{(0,5(2U_0))^2}{R_2} = 26,42\text{Вт}$$

Ответ: $1,67\text{А}$; $1,1\text{А}$; $26,42\text{Вт}$

Условие. см. п. 4.

Задача 12.

Дано: $m_1 = 0,05 \text{ кг}$; $S = 0,0008 \text{ м}^2$; $M = 0,1 \text{ м}$; $\rho = 1000 \text{ кг/м}^3$; $p_0 = 100 \text{ кПа}$;

$g = 10 \text{ м/с}^2$; $m_2 = 0,12 \text{ кг}$

Найти: p_1 ; m_2 ; h

Решение:

$$1) \begin{cases} p_b = \rho g H + p_0 \\ p_n = \frac{m_1 g}{S} + p_0 \\ p_1 = p_b - p_n \\ m_2 g = p_1 \cdot S \end{cases}$$

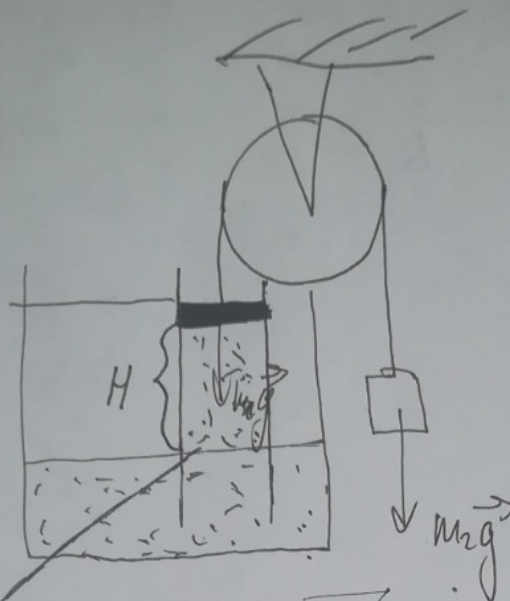
$$\begin{cases} p_b = \rho g H + p_0 \\ p_n = \frac{m_1 g}{S} + p_0 \\ p_1 = \rho g H - \frac{m_1 g}{S} \\ m_2 = \left(\rho g H - \frac{m_1 g}{S} \right) \cdot S \end{cases}$$

$$\begin{cases} p_b = 1000 \text{ Па} \\ p_n = 625 \text{ Па} \\ p_1 = 375 \text{ Па} \\ m_2 = 0,03 \text{ кг} \end{cases}$$

2) ~~$p_b = \rho g H + p_0$~~ ~~$p_n = \frac{m_1 g}{S} + p_0$~~ ~~$p_1 = p_b - p_n$~~ ~~$m_2 g = p_1 \cdot S$~~

~~$p_b = 1000 \text{ Па}$~~ ~~$p_n = 625 \text{ Па}$~~ ~~$p_1 = 375 \text{ Па}$~~ ~~$m_2 = 0,03 \text{ кг}$~~

Ответ: 375 Па ; $0,03 \text{ кг}$



Statische Gleichgewichte

$$S = 0,0008 \text{ m}^2$$

$$p = \rho g h = 10000 \text{ Pa}$$

$$p_a = \rho g h +$$

$$m_1 g : S$$

~~0,5 + 1,2~~

0,1

$$375 = \frac{1,4}{0,0008} - \rho g h$$

$$p = m_1 g : S - \rho g h = 625 \text{ Pa}$$

$$(m_1 g - m_2 g)$$

$$\frac{0,5 \cdot 10000}{8} =$$

$$625 = \rho g h_1$$

$$\frac{5000}{8} = \frac{2500}{4} =$$

$$h_1 =$$

$$\frac{1250}{2} = 625$$

$$100625 : 10000 = 10,0625$$

$$0,5 + 1,2 = 1,7$$

1,4

$$2125$$

$$2125 \cdot 1,4$$

$$1750$$

$$2125 - 375 = \rho g h \quad 1750 : 10000 =$$

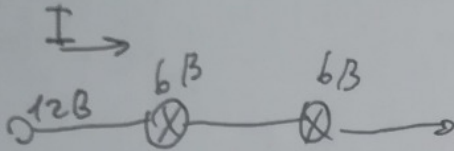
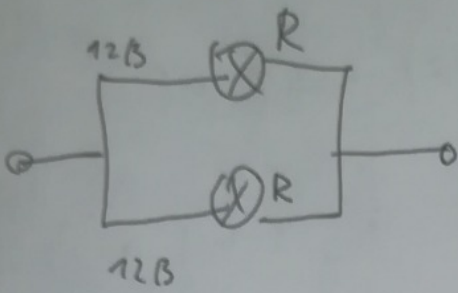
Чертюбух.

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

$$20 = \frac{12^2}{R}$$

$$R = 7,2 \text{ Ом}$$

$$I_1 = \frac{12}{7,2} = 1,67 \text{ А}$$



$$R_2 = \frac{U^2}{P_2} = \frac{6^2}{6,6} = 5,45 \text{ Ом}$$

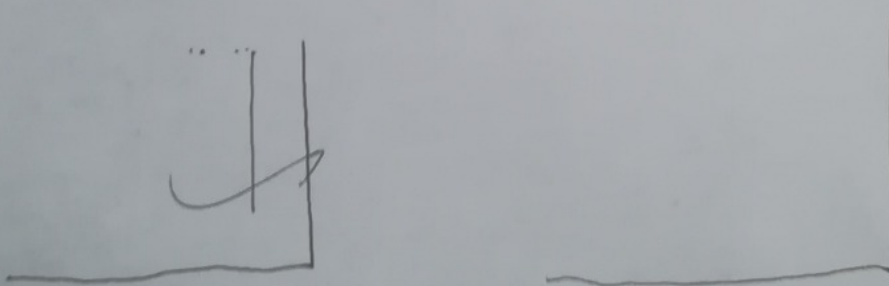
$$6 - 6,6$$

$$12 - 13,2$$

$$I_2 = \frac{6}{5,45} = 1,1 \text{ А}$$

$$3,6$$

~~scribble~~



~1. Measurement

$$\frac{\rho_0 V_0^2}{2} = \rho_0 g h$$

$$h =$$

$$V_0^2 = 2gh$$

~~scribbles~~

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

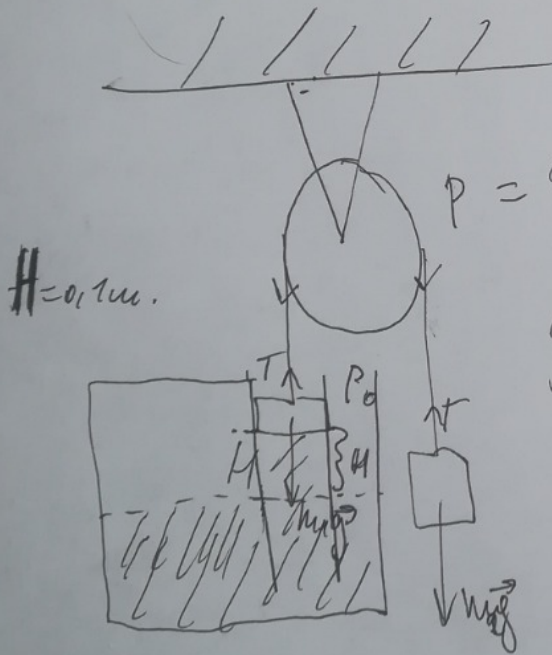
$$h = v_0 t_1 - \frac{g t_1^2}{2}$$

$$h = v_0 t_1 - \frac{g t_1^2}{2}$$

$$s_1 = \frac{g t^2}{2} ; t = \sqrt{\frac{2s_1}{g}}$$

$$s_2 = v_0 t - \frac{g t^2}{2}$$

~2.



$$T = m_1 g \quad T =$$

$$p = 0,05 \cdot 0,000008 = 62500 \text{ Pa}$$

$$H = 0,1 \text{ m}$$

$$p g h = 10000 \cdot 0,1 = 1000 \text{ Pa}$$

$$m_2 g = (62500 - 1000) \cdot 0,000008 \cdot 10$$

$$0,492$$

$$2gh = v_0^2$$

$$h = v_0 t_1 - \frac{gt_1^2}{2}$$

Упробина

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

$$\frac{v_0^2}{2g} = \frac{v_0 t_1 - \frac{gt_1^2}{2}}{2}$$

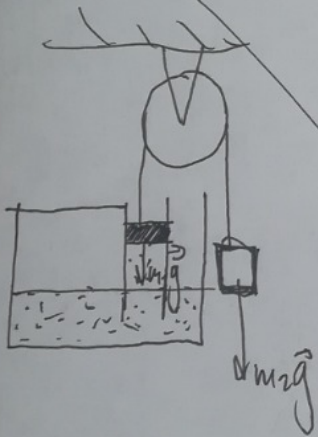
$$\cancel{v_0^2} = \cancel{v_0 t_1} - \cancel{gt_1^2}$$

~~2017~~ ~~2017~~ ~~2017~~ ~~2017~~ ~~2017~~ ~~2017~~ ~~2017~~ ~~2017~~ ~~2017~~ ~~2017~~

$$s_1 = \frac{gt^2}{2}$$

$$s_2 = \frac{v_0^2}{2g} - \frac{gt^2}{2}$$

$$\frac{25}{15} = \frac{5}{3}$$



$$s_2 = v_0 t - \frac{gt^2}{2}$$

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

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

$$v_0 = 2gt \Rightarrow$$

$$h_{\max} = \frac{(2gt)^2}{2g} = \frac{4g^2 t^2}{2g} = 2gt^2$$

$$h_{\text{bep}} = h_{\max} - s_1 = 2gt^2 - \frac{gt^2}{2} = 1.5gt^2$$

$$\frac{s_1}{s_2} = \frac{1.5gt^2}{\frac{gt^2}{2}} = \frac{3gt^2}{gt^2} = 3$$

Часть 2

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

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Вариант 1

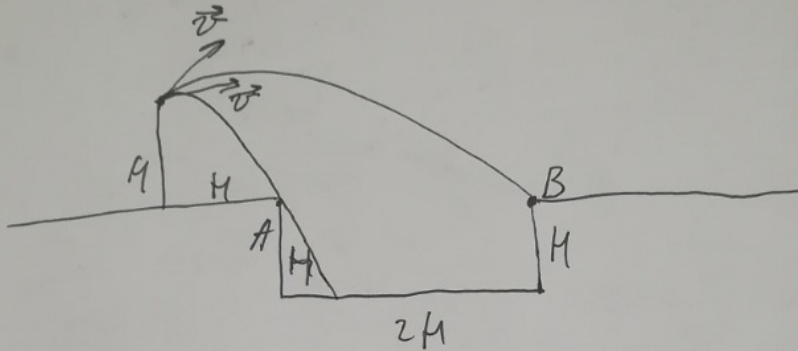
Числовик. лист N5.

Задача N5.

дано: H ; $v = \sqrt{0.5gH}$; S

найти: t ; d ; $\angle \beta$?

Решение!



$$1) \begin{cases} V_0 = \pi H^3 \\ v_{\text{затопление}} = v \cdot S \\ t = \frac{V_0}{v_{\text{затопление}}} \end{cases}$$

$$\begin{cases} V_0 = \pi H^3 \\ v_{\text{затопление}} = S \sqrt{0.5gH} \\ t = \frac{\pi H^3}{S \sqrt{0.5gH}} \end{cases}$$

$$\begin{cases} V_0 = \pi H^3 \\ v_{\text{затопление}} = S \sqrt{0.5gH} \\ t = \frac{\pi H^2 \sqrt{0.5gH}}{0.5gS} \end{cases}$$

~~Итого: $t = \frac{\pi H^2 \sqrt{0.5gH}}{0.5gS}$~~

~~Итого: $t = \frac{\pi H^2 \sqrt{0.5gH}}{0.5gS}$~~

~~$S \sin \alpha + \cos \alpha = \dots$~~

Умови . метр.

~~Важко~~

$$\begin{cases} M = v \cos \alpha t_1 \\ 0 = M + v \sin \alpha t_1 - \frac{g t_1^2}{2} \end{cases}$$
$$\begin{cases} t_1 = \frac{M}{v \cos \alpha} \quad (1) \\ 0 = M + \frac{v \sin \alpha \cdot M}{v \cos \alpha} - \frac{g \cdot M^2}{2 \cdot v^2 \cos^2 \alpha} \quad (2) \end{cases}$$

$$(2) \quad \frac{g M^2}{2 v^2 \cos^2 \alpha} = M + \operatorname{tg} \alpha M$$

$$\frac{g M}{2 v^2 \cos^2 \alpha} = \operatorname{tg} \alpha + 1 \quad (v = \sqrt{0,5 g M})$$

$$\frac{g M}{2 \cdot 0,5 g M \cdot \cos^2 \alpha} = \operatorname{tg} \alpha + 1$$

$$\frac{1}{\cos^2 \alpha} = \operatorname{tg} \alpha + 1 \quad (\cos^2 \alpha = \frac{1}{1 + \operatorname{tg}^2 \alpha})$$

$$1 + \operatorname{tg}^2 \alpha = \operatorname{tg} \alpha + 1$$

$$\operatorname{tg} \alpha = 1 \Rightarrow \alpha = 45^\circ$$

$$3) \quad \begin{cases} 3M = v \cos \beta t_2 & \text{дві точки B на прямих кривих бака} \\ 0 = M + v \sin \beta t_2 - \frac{g t_2^2}{2} \end{cases}$$

$$\begin{cases} t_2 = \frac{3M}{v \cos \beta} \quad (1) \end{cases}$$

$$\begin{cases} 0 = M + \frac{v \sin \beta \cdot 3M}{v \cos \beta} - \frac{g \cdot 9M^2}{2 \cdot v^2 \cdot \cos^2 \beta} \quad (2) \end{cases}$$

Умножим числ на 7.

(2)

$$\frac{9gM^2}{2v^2 \cos^2 \beta} = H + 3H \operatorname{tg} \beta$$

$$(v = \sqrt{0.5gH})$$

$$\frac{9gH}{2 \cdot 0.5gH \cdot \cos^2 \beta} = 3 \operatorname{tg} \beta + 1$$

$$\frac{9}{\cos^2 \beta} = 3 \operatorname{tg} \beta + 1 \quad \left(\cos^2 \beta = \frac{1}{1 + \operatorname{tg}^2 \beta} \right)$$

$$9 + 9 \operatorname{tg}^2 \beta = 3 \operatorname{tg} \beta + 1$$

$$9 \operatorname{tg}^2 \beta - 3 \operatorname{tg} \beta + 8 = 0$$

$$D = b^2 - 4ac = 9 - 4 \cdot 9 \cdot 8 < 0 \Rightarrow$$

только 45°

~~только 45° и 135° не подходит~~

~~только 45° и 135° не подходит~~

Ответ:

$$\frac{7H^3 \sqrt{0.5gH}}{0.5gS} ; 45^\circ$$

Умовник . метр

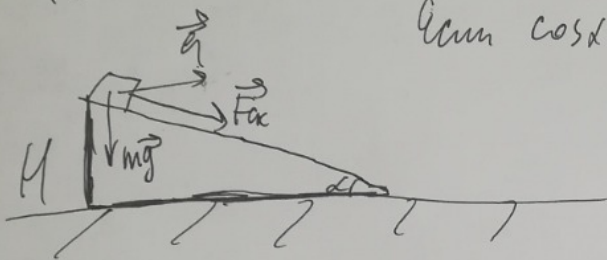
Задача 4.

дано: $\cos \alpha = 0.8$; M ; m ; $3m$.

найти: t_1 ; a_k ; t_2

Решение:

$$\text{так как } \cos \alpha = \frac{4}{5}, \text{ то } \sin \alpha = \frac{3}{5}$$



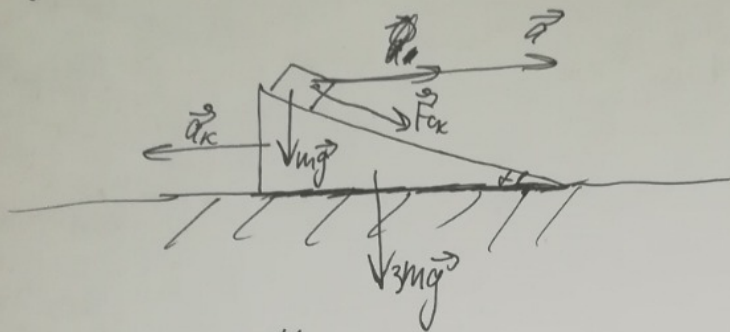
$$1) \begin{cases} F_{cx} = mg \cos \alpha \\ L = M \cdot \sin \alpha \\ \cancel{L} \quad L = \frac{at_1^2}{2} \\ ma = F_{cx} \end{cases}$$

$$\begin{cases} F_{cx} = mg \cos \alpha \\ L = \frac{5M}{3} \\ a = g \cos \alpha \\ \frac{5M}{3} = \frac{g \cos \alpha t_1^2}{2} \end{cases}$$

$$\begin{cases} F_{cx} = mg \cos \alpha \\ L = \frac{5M}{3} \\ a = g \cos \alpha \\ t_1 = \sqrt{\frac{10M}{3g \cos \alpha}} \end{cases}$$

$$t_1 = \sqrt{\frac{10M \cdot 5}{3g \cdot 4}} = \sqrt{\frac{25M}{6g}} = 5\sqrt{\frac{M}{6g}}$$

2)

Ускорение. мет g .

$$\begin{cases} L = \frac{5H}{3} \\ F_{ck} = mg \cos \alpha \\ 3 \mu a_k = F_{ck} \\ L = \frac{a_1 t_2^2}{2} \end{cases}$$

$$\begin{cases} L = \frac{5H}{3} \\ F_{ck} = mg \cos \alpha \\ a_k = \frac{g \cos \alpha}{3} = \frac{4g}{15} \end{cases}$$

~~$$\frac{5H}{3} = \frac{a_1 t_2^2}{2}$$~~

~~Положительно~~ Стокновение ~~и~~ ~~к~~ ~~ни~~ ~~ж~~ ~~е~~ ~~г~~ ~~л~~ ~~о~~ ~~б~~ ~~у~~ ~~д~~ ~~е~~ ~~т~~ ~~с~~ ~~я~~,
но манера езды более быстрая. \Rightarrow

~~$$a$$~~
$$\Rightarrow a_1 = a + a_k$$

$$\frac{5H}{3} = \frac{(g \cos \alpha + \frac{g \cos \alpha}{3}) t_2^2}{2} \quad | \cdot 6$$

~~$$20H = 4g \cos \alpha t_2^2$$~~

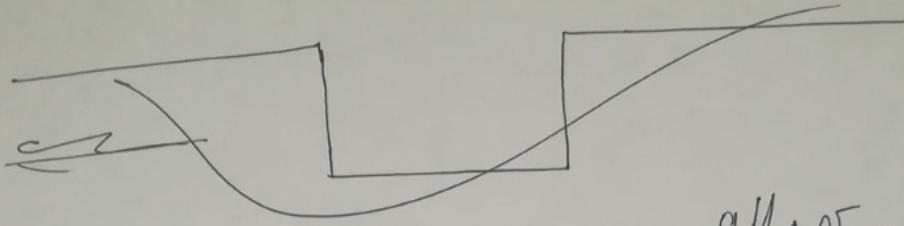
$$5H = \frac{2g \cdot 4 \cdot t_2^2}{5}$$

~~$$t_2 = \sqrt{\frac{5H}{8g}}$$~~

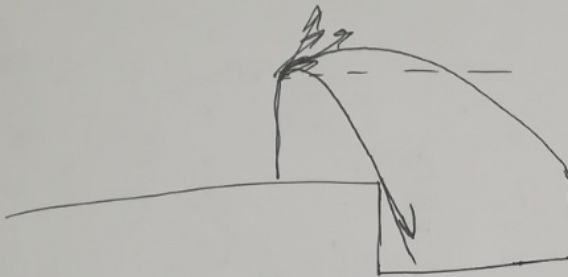
$$t_2 = 5 \sqrt{\frac{H}{8g}}$$

$$\text{Ответ: } 5 \sqrt{\frac{H}{6g}}; \frac{4g}{15}; 5 \sqrt{\frac{H}{8g}}$$

Упроблема.



$$gM + \frac{V \sin \alpha}{2} = \frac{V + g \cdot \frac{M}{2 \cos \alpha}}{2}$$



$$2gM + V \sin \alpha = V$$

$$M = V \cos \alpha t$$

$$0 = M + V \sin \beta t - \frac{gt^2}{2}$$

$$3M = V \cos \beta t$$

$$M = \frac{V \cos \beta t}{3}$$

$$\frac{gt}{2} = \frac{V \cos \beta}{3} + V \sin \beta$$

$$t_1 = \frac{M}{V \cos \alpha}$$

$$\frac{3gt}{2} = V (\cos \beta + \sin \beta)$$

$$\sin \beta + \cos \beta = \frac{3gt}{2V}$$

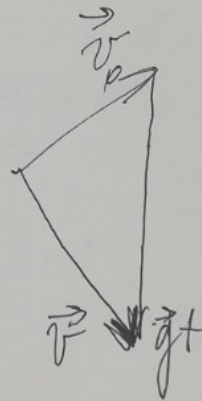
$$\sin^2 \beta + 2 \sin \beta \cos \beta + \cos^2 \beta = \frac{9g^2 t^2}{4V^2}$$

$$\sin \beta = \frac{9g^2 t^2}{4V^2} - 1$$

$$= \frac{\sqrt{9g^2 t^2 - 4V^2}}{2V}$$

$$0 = M + \frac{V \sin \alpha \cdot M}{V \cos \alpha} - \frac{g \left(\frac{M}{V \cos \alpha} \right)^2}{2}$$

$$\frac{gM^2}{2V^2 \cos^2 \alpha} = M + g d \quad \tan \alpha = \frac{gM}{2V^2 \cos^2 \alpha}$$



$$\frac{\sqrt{9g^2 t^2 - 4V^2}}{2V} = \frac{\sqrt{9g^2 t^2 - 4V^2}}{2V}$$

$$\frac{gM}{2 \cdot 0.5gH \cdot \cos^2 \alpha}$$

$$\cos^2 \alpha + \cos^2 \alpha \cdot \tan^2 \alpha = 1$$

$$g \cos \alpha = \frac{4}{5}g$$

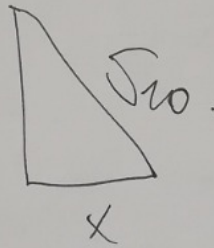
$$\cos^2 \alpha (1 + \tan^2 \alpha) = 1$$

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

$$\frac{3a}{m} = \frac{mg \cos \alpha}{m}$$

$$a = \frac{g \cos \alpha}{3} = 3x$$

$$= \frac{4g}{15}$$



$$\begin{array}{r} \times 72 \\ 4 \\ \hline 288 \\ + 288 \\ \hline 576 \end{array}$$

$$\frac{8}{15}g$$

$$9x^2 + x^2 = 10x^2$$

g

$$\sqrt{252}$$

$$\frac{10}{3}M = \frac{8gt^2}{15}$$

$$3ax = g \cos \alpha$$

$$50M = 8gt^2$$

$$\frac{10M}{3} = g \cos \alpha t_1^2$$

27g

$$t = \sqrt{\frac{50M}{8g}}$$

$$t_1 = \sqrt{\frac{10M}{3g \cos \alpha}}$$

$$\sqrt{\frac{25M}{4g}}$$

$$= 5 \sqrt{\frac{M}{4g}}$$

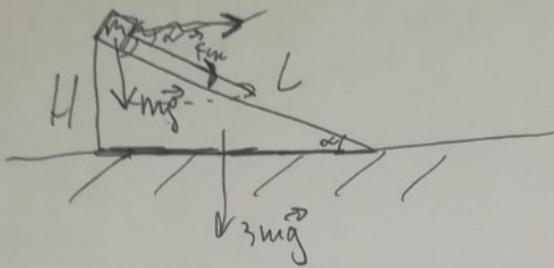
$$25M = 8gt^2$$

$$t_2 = \sqrt{\frac{25M}{8g}} = 5 \sqrt{\frac{M}{8g}}$$

Упробик.

24.

$$\cos \alpha = \frac{4}{5} \Rightarrow \sin \alpha = \frac{3}{5}$$



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

$$ma = \cancel{g} mg \cos \alpha = \frac{4}{5}g$$

$$\frac{5}{3}M = \frac{4g \cos \alpha t^2}{2}$$

$$\frac{10}{3}M = g \cos \alpha t^2$$

$$t^2 = \sqrt{\frac{\frac{10}{3}M}{g \cos \alpha}} = a_2$$

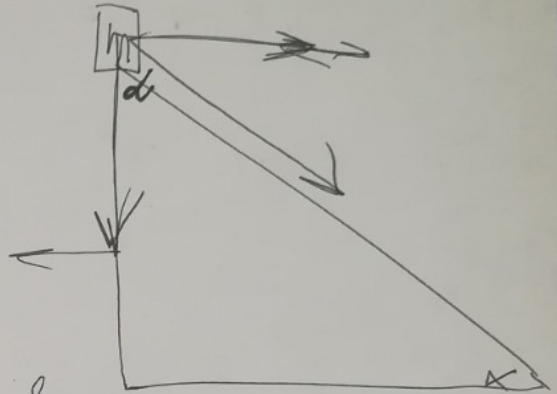
$$= \sqrt{\frac{10M \cdot 5}{3g \cdot 4}} =$$

$$\sqrt{\frac{25M}{6g}} = 5\sqrt{\frac{M}{6g}}$$

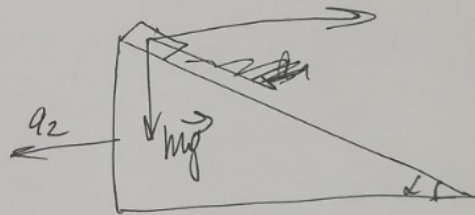
$$\frac{10}{3}M = \frac{8g t^2}{15}$$

$$50M = 8g t^2$$

$$t = \sqrt{\frac{50M}{8g}} = \sqrt{\frac{25M}{4g}} =$$



$$\frac{8}{15}g$$



а2

Упробик

$$3ma_2 = mg \cos \alpha$$

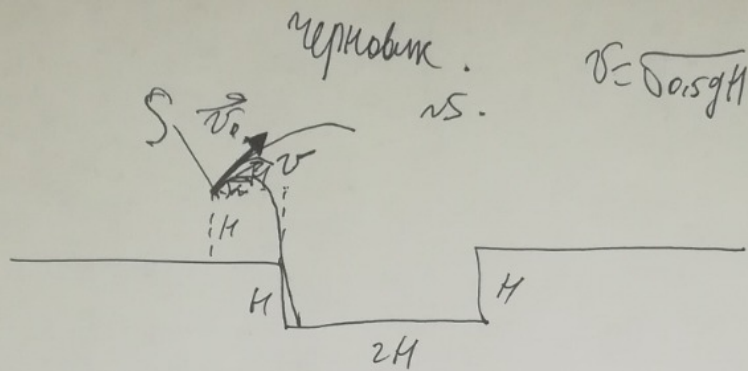
$$a_2 = \frac{4g}{15}$$

$$\frac{16}{15}g$$

$$\frac{5}{3}M = \frac{16}{15}g t^2$$

$$5\sqrt{\frac{M}{4g}}$$

$$t = \sqrt{\frac{10M \cdot 15}{16 \cdot 3g}} = \frac{5\sqrt{M}}{4g}$$



$$\pi R^2 h$$

$$\mu/c \cdot m^2$$

$$v \cdot S = \sqrt{0.5gH} \cdot S$$

$$V = \pi H^2 \cdot H = \pi H^3$$

$$t = \frac{V}{vS} = \frac{\pi H^3}{\sqrt{0.5gH} \cdot S} = \frac{\pi H^2 \sqrt{0.5gH}}{0.5gH \cdot S}$$

or

$$H = v \sin \alpha t - \frac{gt^2}{2}$$

$$H = v \cos \alpha t$$

$$v \cos \alpha t = v \sin \alpha t - \frac{gt^2}{2}$$

~~or~~

$$\frac{gt}{2} = v (\sin \alpha - \cos \alpha)$$

$$\sin \alpha - \cos \alpha = \frac{gt}{2v}$$

sin

$$0 = H + v \sin \alpha t - \frac{gt^2}{2}$$

$$H = v \cos \alpha t$$

$$\frac{gt}{2} = v (\sin \alpha + \cos \alpha)$$

$$\sin \alpha \cos \alpha = \frac{gt}{2v}$$



$$0 = H + v \sin \alpha t - \frac{gt^2}{2}$$

$$H = v \cos \alpha t$$

$$\frac{gt}{2} = v (\sin \alpha + \cos \alpha)$$

$$\sin \alpha + \cos \alpha = \frac{gt}{2v}$$

$$\sin^2 \alpha + 2 \sin \alpha \cos \alpha + \cos^2 \alpha = \frac{g^2 t^2}{4v^2}$$

$$2 \sin \alpha \cos \alpha = \frac{g^2 t^2}{4v^2} - 1$$

$$\sin 2\alpha = \frac{g^2 t^2}{4v^2} - 1$$