

# Часть 1

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

Шифр: **21205828**

ID профиля: **835820**

Вариант 2

Условие.

Лузана, 10 м.  
В10-02.

~3.

Дано:

$$V = \text{const}$$

$$T = 61^\circ \text{C}$$

$$V_k = \frac{V_n}{2}$$

$$V_k = 1,7 \text{ м}$$

$$p_{\text{нас}} = 0,5 \cdot 10^5 \text{ Па}$$

$$\mu = 18 \frac{\text{г}}{\text{моль}}$$

$$p_k = 3,6 p_n$$

1)  $p_n = ?$

2)  $m_{\text{нп}} = ?$

М.

$$274 \text{ K}$$

$$0,0017 \text{ м}^3$$

$$0,016 \frac{\text{кг}}{\text{моль}}$$

~~$p_k = p_n$~~

$pV = \text{const}$  при  $T = \text{const}$  если газ не конденсируется.

$$p_k V_k = \frac{V_n p_n \cdot 3,6}{7} = \frac{3,6}{7} V_n p_n \neq p_n V_n \Rightarrow$$

$\Rightarrow$  часть пара конденсируется.  $\Rightarrow p_k = p_{\text{нас}}$ .

$$p_n = \frac{p_k}{3,6} = \frac{p_{\text{нас}}}{3,6} \approx 13888,9 \text{ Па}$$

$$2) V_n = 7 V_k = 0,0119 \text{ м}^3;$$

$$p_n V_n = \frac{m_{\text{нп}}}{\mu} RT; \quad m_{\text{нп}} = \frac{p_n V_n \mu}{RT} \approx 0,001 \text{ кг}$$

Ответ:  $p_n \approx 13888,9 \text{ Па}$ ;  $m_{\text{нп}} = 0,001 \text{ кг}$ .

Лист 3



# Условие

Физика, 10 кл.  
13.10.02

№ 1.

Дано:

$V_0$ ;

$t_1 = t_{max 0}$

1)  $t_{cr 0} = t_{max 0} + t_{cr 1}$ , где  $t_{cr} =$  время броска.

$t_{max 0} = \frac{V_0}{g}$

$h_{max} = \frac{V_0^2}{2g}$

м.к. 2-го мяча бросили когда 1-й был на макс. высоте.

1)  $t_{cr 0} = ?$

2)  $\frac{t_{cr 0}}{t_{cr 1}} = ?$

3)  $h = ?$

$h = -\frac{g t_{cr 1}^2}{2} + V_0 t_{cr 1}$  для 2-го мяча

$h_{max} - h = \frac{g t_{cr 1}^2}{2}$

$h_{max} = V_0 t_{cr 1}$

$\frac{V_0^2}{2g} = V_0 t_{cr 1}; t_{cr 1} = \frac{V_0}{2g}$   
 $\frac{2g}{g} = \frac{V_0}{g} + \frac{V_0}{2g} = \frac{3V_0}{2g}$

для 1-го мяча, м.к. в момент броска 2-го мяча он был на максимальной высоте и его скорость равна нулю

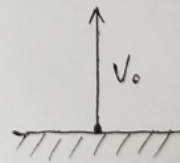
$t_{cr 0} = \frac{3V_0}{2g}$

2)  $\frac{t_{cr 0}}{t_{cr 1}} = \frac{\frac{3V_0}{2g}}{\frac{V_0}{2g}} = \frac{3V_0 \cdot 2g}{V_0 \cdot 2g} = 3$ ;  $\frac{t_{cr 0}}{t_{cr 1}} = 3$

3)  $h = V_0 t_{cr 1} - \frac{g t_{cr 1}^2}{2} = V_0 \cdot \frac{V_0}{2g} - \frac{g \cdot V_0^2}{2 \cdot 4g^2} = \frac{V_0^2}{2g} - \frac{V_0^2}{8g} = \frac{3V_0^2}{8g}$

$h = \frac{3V_0^2}{8g}$

Ответ:  $t_{cr 0} = \frac{3V_0}{2g}$ ;  $\frac{t_{cr 0}}{t_{cr 1}} = 3$ ;  $h = \frac{3V_0^2}{8g}$



Мет 1.

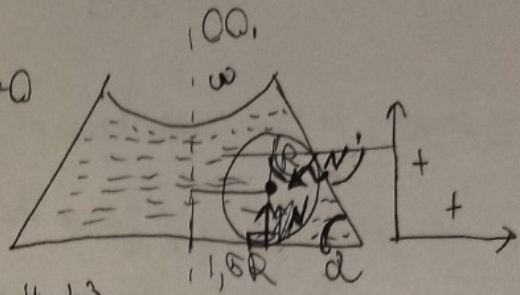


Учурдук.

Кезең, 10 нр.  
B10-02

~ 2.

Дано:  
 $\omega; R;$   
 $l = 1,5R;$   
 $\rho_s = \rho;$   
 $\rho_w = 6\rho.$   
 $\text{tg } \alpha = \frac{3}{2}$



1) 3 ш. Укорока:  $\vec{N} + m\vec{g} + \vec{F}_{A1} = 0$

$$F_{A1} + N - mg = 0$$

ay:  $N_1 = mg - F_{A1}$

$$F_{A1} = \rho V g; m = 6\rho V; V = \frac{4}{3}\pi R^3$$

$$N_1 = 6\rho V g - \rho V g = 5\rho V g = 5\rho \left(\frac{4}{3}\pi R^3\right) g = \frac{20\pi}{3} \rho R^3 g$$

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

1)  $N_1 = ?$

2)  $N_2 = ?$

2) 3 ш. Укорока:  $\vec{N}_2 + \vec{N}'_1 + m\vec{g} + \vec{F}_{A2} = 0$

ax:  $F_{Ax2} - N'_x = 0$

$$N'_x = F_{Ax2}; N'_x = N' \cdot \sin \alpha$$

$$F_{Ax2} = \rho V \cdot \omega^2 \cdot 1,5R; F_{Ax2} = \rho$$

$$N'_x = 1,5\rho V \omega^2 R$$

ay:  $-N'_y + F_{Ay2} - mg + N_2 = 0$

$$N_2 = mg - F_{Ay2} + N'_y$$

$$N'_y = N' \cdot \cos \alpha = N'_x \cdot \text{ctg } \alpha = \frac{2}{3} N'_x; F_{Ay2} = \rho V g; mg = 6\rho V g$$

$$N_2 = 6\rho V g - \rho V g + \frac{2}{3} \cdot 1,5\rho V \omega^2 R = \frac{20\pi}{3} R^3 \rho g + \frac{8\pi}{3} \rho R^3 \omega^2 R$$

$$= \frac{20\pi}{3} R^3 \rho g + \frac{4}{3} \pi R^3 \omega^2 \rho = \frac{4}{3} \pi R^3 \rho (5g + \omega^2 R)$$

Аукерн:  $N_1 = \frac{20\pi}{3} R^3 \rho g; N_2 = \frac{4}{3} \pi R^3 \rho (5g + \omega^2 R);$

Аукер 2

Черновик.

Дано:

$$V_0;$$

$$t_1 = t_{max 0};$$

$$t_{cr0} = ?$$

$$t_{max 0} = \frac{V_0}{g};$$

$$t_{cr0} = t_{cr} + t_{max 0}$$

$$t_{cr} = \sqrt{\frac{2h}{g}}$$

$$h = \frac{g t_{cr}^2}{2}$$

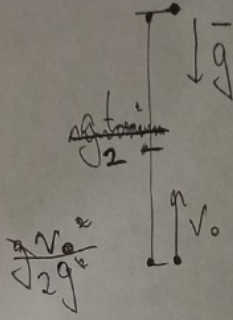
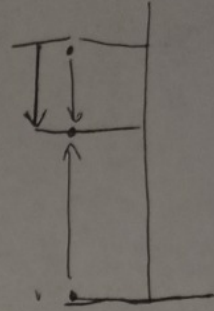
~~$$h = V_0 t_{cr} - \frac{g t_{cr}^2}{2}$$~~

$$t_{cr} = \sqrt{\frac{2h}{g}}$$

~~$$h = V_0 \sqrt{\frac{2h}{g}} - \frac{g \cdot \frac{2h}{g}}{2} = \frac{V_0 \sqrt{2h}}{\sqrt{g}} - \frac{2V_0^2}{g}$$~~

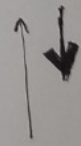
$$\begin{cases} h = V_0 t_{cr} - \frac{g t_{cr}^2}{2} \\ \frac{V_0^2}{2g} - h = \frac{g t_{cr}^2}{2} \end{cases}$$

$$t_{cr} = \frac{V_0}{2g};$$



$$\frac{V_0^2}{2g} = 0,5 = 1$$

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





$$T = 81 \text{ K}$$

$$Q = A;$$

$$T = 81 \text{ } ^\circ\text{C}.$$

$$V_k = \frac{V_1}{7}.$$

$$V_k = 1,7 \text{ u.}$$

$$p_k = 0,5 \cdot 10^5 \text{ Pa}$$

$$\mu = 18 \text{ g/mol}$$

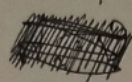
$$p_k = 3,6 p_0.$$


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$$p_0 = ?$$

$$m = ?$$

Черновик.



$$A = \Delta p \Delta V;$$

$$\Delta p \Delta V = \Delta \nu RT$$

$$V_k = V_k \cdot 7 = 7 + 4,9 = 11,9$$

$$pV = \nu RT$$

$$3,6 \cdot p_k V_k = \frac{V_k \cdot 3,6 p_0}{7} \Rightarrow \text{напр. скомпенсированная.}$$

$$\Rightarrow p_k = p_0$$

$$1 \cdot p_0 = \frac{p_k}{3,6} \approx 13889,9 \text{ Pa.}$$

$$V_k = 7 V_1 = 11,9 \text{ u.}$$

$$p_0 V_k = \frac{m \mu}{\mu} RT$$

$$m = \frac{p_0 V_k \mu}{RT}$$

$$\frac{Q_{\text{max}} \cdot \mu}{m \mu} = \mu.$$

$$V_k = 0,0119 \text{ m}^3.$$

$$\frac{18}{1000} \quad 0,019$$

$$T = 81 + 273 = 354 \text{ K.}$$

$$RT = 2541,74.$$

$$2,975 \cdot 81 + 273 = 2354$$

$$m_{\text{max}} \approx 1,2$$

$$\nu RT$$

$$m_{\text{max}} = \Delta \nu \mu. \quad p_{\text{max}} V_k = \nu RT$$

$$\frac{p_k V_k \mu}{RT} - \frac{p_{\text{max}} V_k \mu}{RT} = m_{\text{max}}$$



Угловая

2.

Дано:

$\omega, \rho, \rho_1$   
 $R, l = 1,5R$

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

$v_1$

~~$m\vec{g} + \vec{F}_A + \vec{N} = 0$~~  33M

$F_A + N - mg = 0$

$F_A + N = mg$

$\rho V g + N = 6\rho V g - \rho V g = 5\rho \left(\frac{4}{3}\pi R^3\right) g$

$a_c = \omega^2 1,5R$

$m\vec{g} + \vec{F}_A + \vec{N}_1 + \vec{N}_2 = 0$

$F_{Ax} = \rho V g \cdot \omega^2 \cdot l$

$F_{Ay} =$

$\vec{N}_1 + \vec{N}_2 = -\vec{F}_{Ax} - \vec{F}_{Ay} - m\vec{g} + m\vec{a}_c$

$N'_x = -N' \cdot \cos \alpha (90 - \alpha) = -N' \sin \alpha$

$-N' \sin \alpha + m\omega^2 \cdot 1,5R + \rho V \omega^2 \cdot 1,5R = 90 + \alpha + \beta = 180$

$N' \sin \alpha = m\omega^2 \cdot 1,5R + \rho V \omega^2 \cdot 1,5R = \rho = 90 - \alpha$

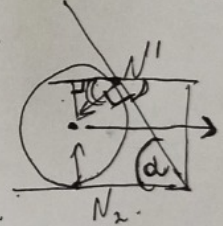
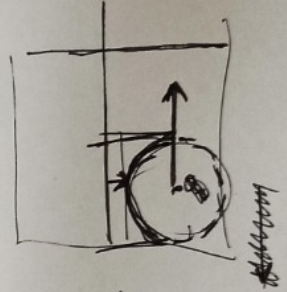
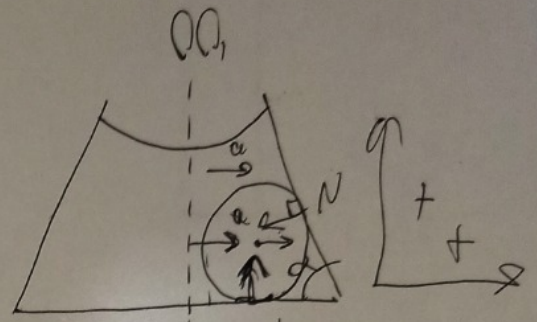
$= N' \sin \alpha = 9\rho V \omega^2 R + 1,5\rho V \omega^2 R = 10,5\rho V \omega^2 R$

$N'_y = N' \cos \alpha$

$N' \cos \alpha = N' \sin \alpha \cdot \operatorname{ctg} \alpha = \frac{2}{3} \cdot 10,5\rho V \omega^2 R$

$N_2 - N' \cos \alpha = mg - F_A = 6\rho V g - \rho V g = 5\rho V g$

$N_2 = 5\rho V g + N' \cos \alpha$



# Часть 2

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

Шифр: **21205828**

ID профиля: **835820**

Вариант 2



24.

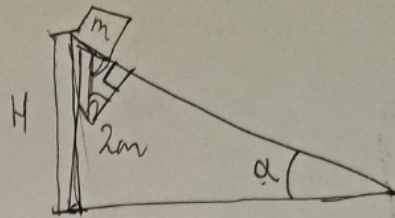
Упробун.

$\cos \alpha = \frac{3}{6}$

$\sin \alpha = 0,6$

~~$\frac{1}{0,64} = 0,56 = t$~~

m  
2m

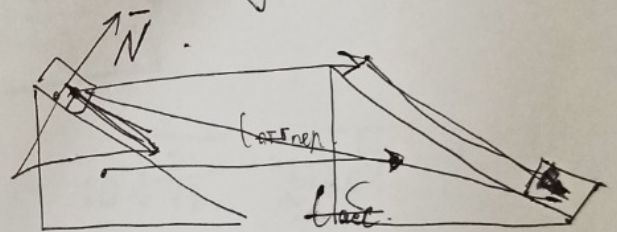
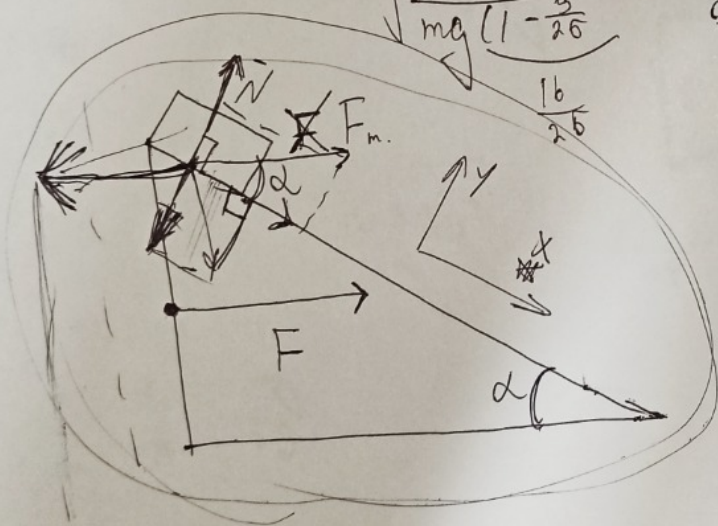


1)

$t = \sqrt{\frac{2l}{a}}$   
 $l = \frac{H}{\sin \alpha}$

$a = mg \cos \alpha - d = mg \sin \alpha$

$t = \sqrt{\frac{2H}{\sin \alpha \cdot mg \sin \alpha}} = \sqrt{\frac{2H}{mg \sin^2 \alpha}} = \sqrt{\frac{2H}{mg(1 - \cos^2 \alpha)}} =$   
 $= \frac{25 \cdot 2}{876} = \frac{25H}{8mg} = \frac{5}{2} = 2,5 \sqrt{\frac{H}{mg}}$



$l_{acc} = \frac{a_{acc} t^2}{2}$

$l_{acc} = \frac{a_{op} t^2}{2}$

$a_{acc} + a_{op} = a_{op} (a_{acc})$

$a_{acc} = a_{op}$

$\frac{F_m}{F_{2m}} = \frac{1}{2}$

$\frac{H}{\sin \alpha} = \frac{a_{acc} t^2}{2} = \frac{gt}{2} \cdot t_1 = \sqrt{\frac{2H}{\sin \alpha g}}$

$F_m = \frac{1}{3} F = \frac{1}{3} mg$ ,  $ma_{acc} = F_m \cos \alpha + mg \sin \alpha$

$F_{2m} = \frac{2}{3} F = \frac{2}{3} mg = \frac{1}{3} mg \cos \alpha + mg \sin \alpha = 0,2mg + 0,6mg = mg$



~~$$a_{\text{orn}} = g$$~~

Упрощаем

~~2ml rep =~~

~~$$a_{\text{rep}} =$$~~

~~И~~

$\Delta m :$

$$\alpha : -F_m \cdot \cos \alpha + mg \sin \alpha = a_{\text{rep}} \cdot m$$

$$-\frac{1}{3} mg \cos \alpha + mg \sin \alpha = -0,2mg + 0,8mg = 0,6mg$$

$2 \cdot 2^2 \cdot 5^2$

$$t = \sqrt{\frac{2M}{g \sin \alpha \cdot 0,6g}} = \sqrt{\frac{2M}{9,48g}}$$

$$\frac{200}{48} = \frac{5 \cdot 2^2 \cdot 2^2 \cdot 5^2}{3 \cdot 2 \cdot 2^2} = \frac{25}{6}$$

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

~~и~~

~~и~~

$$a_{\text{rep}} = \frac{1}{3}g$$

$$10 \sqrt{\frac{2}{49}}$$

$$\frac{2 \cdot 100}{48} = 10 \sqrt{\frac{2}{48}} = \frac{10}{2} \sqrt{\frac{1}{24}} = 40 \sqrt{\frac{1}{6}}$$

$$F = mg$$

$$3ma_{\text{orn}} = mg$$

$$a_{\text{orn}} = \frac{1}{3}g$$

$$\frac{2 \cdot 2 \cdot 5 \cdot 2 \cdot 5}{3 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = \frac{25}{6}$$



Условие.

Газуна 10 м.

B10-02.

~5.

Дано:

$$\Delta p = -1\%$$

$$\Delta V = 2\%$$

$$\frac{\Delta p}{p_0} \ll 1;$$

$$\frac{\Delta V}{V_0} \ll 1;$$

$$\frac{\Delta V}{V_0} \approx 3$$

$$1) \Delta T = ?$$

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

~~Условие~~

$$1) p_0 V_0 = \nu R T_0$$

$$p_1 V_1 = \nu R T_1$$

$$p_1 = p_0 + \Delta p;$$

$$V_1 = V_0 + \Delta V;$$

$$T_1 = T_0 + \Delta T;$$

$$0,99 p_0 \cdot 1,02 V_0 = \nu R (T_0 + \Delta T);$$

$$1,0098 p_0 V_0 = \nu R (T_0 + \Delta T);$$

$$T_0 + \Delta T = 1,0098 T_0;$$

$$\Delta T = 0,0098 T_0;$$

$\Delta T > 0 \Rightarrow$  газуна таун. убавит.

$$\Delta T = 0,98\%$$

$$2) \Delta U = U_1 - U_0 = \frac{i}{2} p_1 V_1 - \frac{i}{2} p_0 V_0 = 0,0147 p_0 V_0$$

т.к.  $\frac{\Delta p}{p_0} \ll 1$  и  $\frac{\Delta V}{V_0} \ll 1$  можно приближенно что газуна отн. объема.

$$\text{мощь таунга: } A_2 = \Delta V \left( \frac{p_1 + p_0}{2} \right) = 0,0199 p_0 V_0$$

$$Q = \Delta U + A_2; \quad \frac{Q}{\Delta U} = \frac{\Delta U + A_2}{\Delta U} \approx 2,35.$$

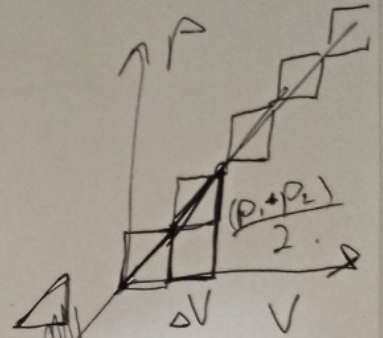
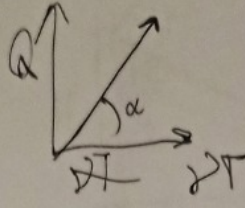
Ответ:  $\Delta T = 0,98\%$ ; таун. убавит.;  $\frac{Q}{\Delta U} = 2,35$

мет 2



Упручка

$\text{tg } \alpha = c$



нб.

$\Delta p = 1\%$

$\Delta V = 2\%$

$i = 3$

$\Delta T = ?$

$\frac{Q_{\text{max}}}{\text{масс} \cdot K} = C_{\text{и}}$

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

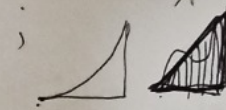
$Q = A + \Delta U$

ну вода работа

$\frac{Q}{\nu T}$

~~$\nu R \Delta T = \dots$~~

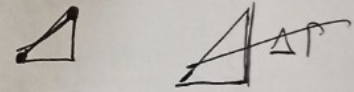
$Q = A$



~~$\Delta \nu \Delta T = \dots$~~

$C_{\text{и}} = \frac{Q}{\nu T}$

$Q = pV$



$0,9133 = A_{\text{и}}$

$(p + \Delta p)(V + \Delta V) = \nu R (T + \Delta T)$   
 $0,99 \cdot 1,02 = 1,0038 \nu R T$

$\Delta U = U_{\text{и}} - U_{\text{н}}$

$0,0147 = \Delta U$   
 $\approx 2,35$

$\Delta T = 0,0038 = 0,38\%$

$\frac{3}{2}$

$\frac{1}{2} \Delta p \Delta V$

~~$\nu R \Delta T$~~

$Q = \frac{1}{2} \Delta p \Delta V$   
 $\Delta U$

$\frac{3}{2} p_1 V_1$

1,5

$1,5 \cdot 1,01 \cdot 1,02 = 1,5$   
 $= 1,5 (1,01 \cdot 1,02 - 1)$



Ускорение.

~4

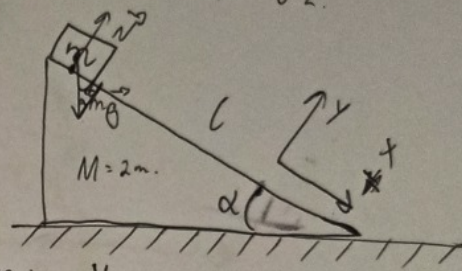
Дано:  
 $\cos \alpha = \frac{3}{5}$ ;  
 $m$ ;  $M = 2m$ ;  
 $M$ ;  $F = mg$ .

$$1) l = \frac{at_1^2}{2}; \sin \alpha = \sqrt{1 - \cos^2 \alpha} = \frac{4}{5}$$

$$t_1 = \sqrt{\frac{2l}{a}}$$

$$l = \frac{M}{\sin \alpha} = \frac{2m}{\frac{4}{5}} = \frac{5M}{4}$$

Физика 10 кл.  
 В10-02.



- 1)  $t_1 = ?$
- 2)  $a_{\text{вкл}} = ?$
- 3)  $t_2 = ?$

$$a = g_x = mg \cos(90 - \alpha) = mg \sin \alpha = \frac{4}{5} mg$$

$$t_1 = \sqrt{\frac{2 \cdot \frac{5M}{4} \cdot \frac{6}{5}}{4 \cdot \frac{4}{5} mg}} = 1,25 \sqrt{\frac{2M}{mg}}; \quad t_1 = 1,25 \sqrt{\frac{2M}{mg}}$$

2)  $\text{для } m+M$ :

$$(m+M) a_{\text{общ}} = F \quad \text{— 2-е и 3-е Ньютона}$$

$$\text{или: } (m+M) a_{\text{общ}} = F$$

$$\underline{a_{\text{вкл}} = a_{\text{общ}}}$$

$$(m+M) a_{\text{вкл}} = F$$

$$3m a_{\text{вкл}} = mg \quad | : 3m$$

$$\boxed{a_{\text{вкл}} = \frac{1}{3}g}$$

3)  $\text{для } m$ :

$$m a_{\text{общ}} = -m a_{\text{вкл}} + mg + N, \quad \text{— 2-е и 3-е Ньютона}$$

$$\text{или: } m a_{\text{общ}} = -m a_{\text{вкл}} + mg_x$$

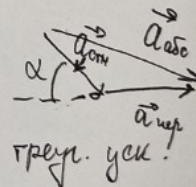
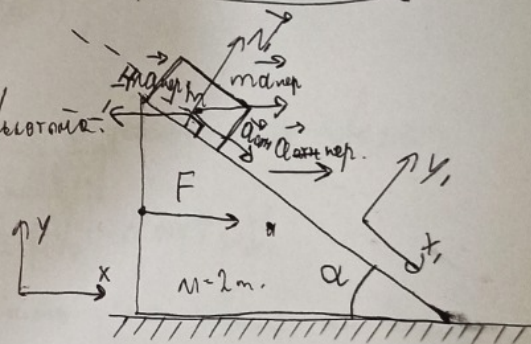
$$a_{\text{вкл}} = a_{\text{общ}} \cos \alpha = a_{\text{вкл}} \cdot \frac{3}{5} = \frac{1}{3}g \cdot \frac{3}{5} = 0,2g$$

$$g_x = g \sin \alpha = 0,8g$$

$$m a_{\text{общ}} = -0,2mg + 0,8mg = 0,6mg; \quad a_{\text{общ}} = 0,6g$$

$$l = \frac{a_{\text{общ}} t_2^2}{2}; \quad t_2 = \sqrt{\frac{2l}{a_{\text{общ}}}} = \sqrt{\frac{2M}{\sin \alpha \cdot 0,6g}} = \sqrt{\frac{2}{0,48} \frac{M}{g}} = 5 \sqrt{\frac{M}{6g}}$$

$$\text{Ответ: } t_1 = 1,25 \sqrt{\frac{2M}{mg}}; \quad a_{\text{вкл}} = \frac{1}{3}g; \quad t_2 = 5 \sqrt{\frac{M}{6g}}$$



Ует 1