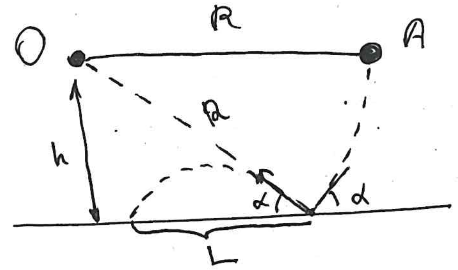
1	2	3	4	5	Σ
10	4	16	14	7	51

Шифр 08306

Открытая региональная межвузовская олимпиада вузов Томской области (ОРМО)

Общий балл	Дата	Ф.И.О. членов жюри	Подписи членов жюри
51	14.03	Абдрашитов СВ	[illegible]

1.



ЗСЭ: $mgh = \frac{mv^2}{2} \Rightarrow v^2 = 2gh$ К 1

$\sin\alpha = \frac{h}{R}$ К 2

$L = \frac{v^2 \cdot \sin 2\alpha}{g} = 2h \cdot \sin 2\alpha$ К 3

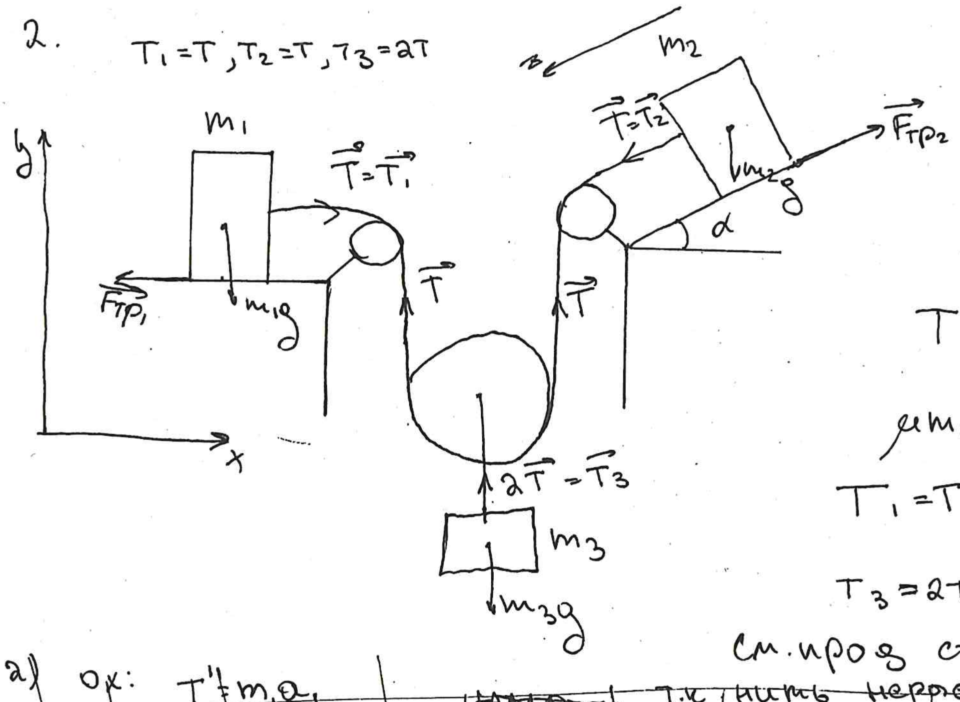
L_{max} при $\sin 2\alpha$ - max, то есть $\sin 2\alpha = 1 \Rightarrow 2\alpha = \frac{\pi}{2} \Rightarrow \alpha = \frac{\pi}{4}$

$\frac{h}{R} = \sin\alpha = \sin\frac{\pi}{4} = \frac{\sqrt{2}}{2}$

$L_m = 2h \cdot \sin 2\alpha = 2h \cdot 1 = 2h$

Ответ: $\frac{\sqrt{2}}{2}$; $2h$

2. $T_1 = T, T_2 = T, T_3 = 2T$



1) II ЗН:

Ox: $T - \mu m_1 g = 0$

$\mu m_2 g \cdot \cos\alpha - T = 0$

Oy: $2T - m_3 g = 0$

$T = \frac{m_3 g}{2}$ К3 2б

$\mu m_1 g = T = \frac{m_3 g}{2} \Rightarrow \mu = \frac{m_3}{2m_1}$

$T_1 = T_2 = \frac{m_3 g}{2}$

$T_3 = 2T = m_3 g$ К1,2 2б

см. прод стр. 4

а) Ox: $T' = m_1 a_1$ т.к. нить нерастяжима, то $a_1 = a_2$

$m_1 a_1 = m_2 a_1 - m_2 g \cdot \sin\alpha \Rightarrow a_1 = \frac{m_2 g \cdot \sin\alpha}{m_2 - m_1} = a_2$

Oz: $T' = m_2 a_2 - m_2 g \cdot \sin\alpha$

$T' = \frac{m_1 m_2 g \cdot \sin\alpha}{m_2 - m_1}$

Oy: $m_3 a_3 = 2T' + m_3 g$

$a_3 = \frac{m_3 g}{m_3} - \frac{2m_1 m_2 g \cdot \sin\alpha}{(m_2 - m_1) m_3} = g - \frac{2m_1 m_2 g \cdot \sin\alpha}{(m_2 - m_1) m_3}$

2 страница

08306

4.

$$V=\alpha\sqrt{T} \Rightarrow T=\frac{V^2}{\alpha^2}$$

$$pV=\nu RT$$

$$pV=\nu R\frac{V^2}{\alpha^2} \Rightarrow p(V)=\frac{\nu R}{\alpha^2}\cdot V$$

$$Q=A+\Delta U$$

$$A=\int_{V_1}^{V_2} p\,dV=\int_{V_1}^{V_2}\frac{\nu R}{\alpha^2}V\,dV=\frac{\nu R}{\alpha^2}\cdot\frac{V^2}{2}\Big|_{V_1}^{V_2}=\frac{\nu R}{2\alpha^2}(V_2^2-V_1^2)=$$

$$=\frac{\nu R}{2\alpha^2}(\alpha^2\cdot T_2-\alpha^2 T_1)=\frac{\nu R}{2}(T_2-T_1)\ \checkmark\ ;\ \Delta U=\frac{3}{2}\nu R(T_2-T_1)\ \checkmark$$

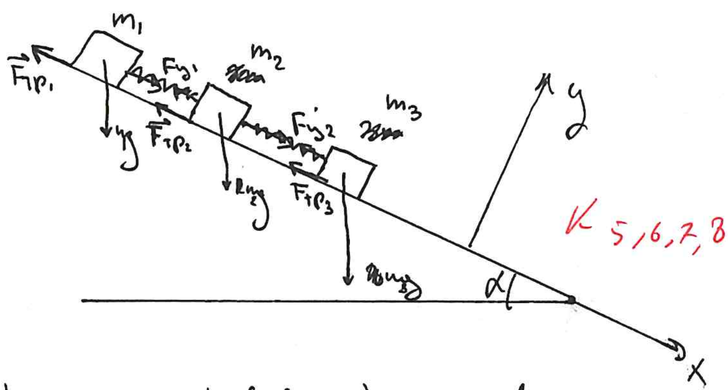
$$Q=\frac{\nu R}{2}(T_2-T_1)+\frac{3}{2}\nu R(T_2-T_1)=2\nu R(T_2-T_1)\ \checkmark$$

$$\eta=\frac{A}{Q}=\frac{\frac{\nu R}{2}(T_2-T_1)}{\frac{3}{2}\nu R(T_2-T_1)}=\frac{1}{3}\approx 33{,}3\%$$??? K_6 ✗

$$c=\frac{\Delta Q}{\nu\Delta T}=\frac{2\nu R\Delta T}{\nu\Delta T}=2R=const\ \checkmark$$ K_7 ✗

Ответ: $2\nu R(T_2-T_1)$; $\frac{1}{3}$; $2R$

5.



K 5,6,7,8 4б

K_1 3б

II ЗН:

$$\cancel{Ox: \begin{cases} 3mg\cdot\sin\alpha = F_{y_2}+F_{тр_3} \\ 2mg\cdot\sin\alpha + F_{y_2} = F_{y_1}+F_{тр_2} \\ mg\cdot\sin\alpha + F_{y_1} = F_{тр_1} \end{cases}}$$

$$L=l_1+l_2$$

Ox:

$$\cancel{\begin{cases} 3mg\cdot\sin\alpha = k(l_2-L_0)+3\mu mg\cos\alpha \\ 2mg\cdot\sin\alpha + k(l_2-L_0) = k(l_1-L_0)+2\mu mg\cos\alpha \\ mg\cdot\sin\alpha + k(l_1-L_0) = \mu mg\cos\alpha \end{cases}}$$

$$\cancel{\begin{cases} 3mg\cdot\sin\alpha = k(l_2-L_0)+6mg\sin\alpha \\ 2mg\sin\alpha + k(l_2-L_0) = k(l_1-L_0)+4mg\sin\alpha \Leftrightarrow \\ mg\sin\alpha + k(l_1-L_0) = 2mg\sin\alpha \end{cases}}$$

Ox: $m_3 g\cdot\sin\alpha = k(l_2-L_0)+\mu m_3 g\cos\alpha$

$m_2 g\sin\alpha + k(l_2-L_0) = k(l_1-L_0)+\mu m_2 g\cos\alpha$

$m_1 g\cdot\sin\alpha + k(l_1-L_0) = \mu m_1 g\cdot\cos\alpha$

$$\begin{cases} -m_3 g\cdot\sin\alpha = k(l_2-L_0) \\ -m_2 g\cdot\sin\alpha = k(l_1-l_2) \\ +m_1 g\cdot\sin\alpha = k(l_1-L_0) \end{cases}$$

$$l_1=\frac{m_1 g\cdot\sin\alpha}{k}+L_0\ ;\ l_2=\frac{-m_3 g\cdot\sin\alpha}{k}+L_0$$

$$\cancel{-m_2 g\sin\alpha = k\left(\frac{m_1 g\sin\alpha}{k}+\frac{m_3 g\sin\alpha}{k}\right)}\quad L=2L_0+\frac{g\sin\alpha}{k}(m_1-m_3)$$

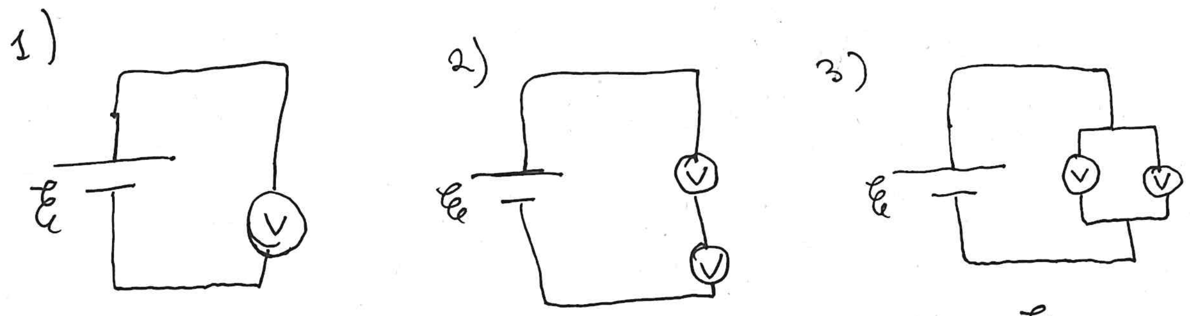
08306

L - max, при $(m_1 - m_3)$ - max

$$L = 2L_0 + \frac{g \cdot \sin\alpha}{k} \cdot 2m = 2\left(L_0 + \frac{mg \cdot \sin\alpha}{k}\right)$$

Ответ: $2\left(L_0 + \frac{mg \cdot \sin\alpha}{k}\right)$

3.



$I = \frac{\mathcal{E}}{R_V + r}$ $\qquad$ $I = \frac{\mathcal{E}}{2R_V + r}$ $\qquad$ $I = \frac{\mathcal{E}}{\frac{R}{2} + r}$

$U_1 = I \cdot R_V = \frac{\mathcal{E} R_V}{R_V + r}$ $\qquad$ $U_2 = I \cdot R_V = \frac{\mathcal{E} R_V}{2R_V + r}$ $\qquad$ $U_3 = \frac{I}{2} R_V = \frac{\mathcal{E} R_V}{R_V + 2r}$

$$\begin{cases} U_1 = \frac{\mathcal{E} R_V}{R_V + r} \\ U_2 = \frac{\mathcal{E} R_V}{2R_V + r} \\ U_3 = \frac{\mathcal{E} R_V}{R_V + 2r} \end{cases} \qquad \begin{cases} \frac{U_1}{U_2} = \frac{2R_V + r}{R_V + r} \\ \frac{U_2}{U_3} = \frac{R_V + 2r}{2R_V + r} \end{cases}$$

$$\frac{U_1}{U_2}(R_V + r) = \frac{U_3}{U_2}(R_V + 2r)$$

$$U_1 R_V + U_1 r = U_3 R_V + 2U_3 r$$

$$r = \frac{(U_3 - U_1) R_V}{U_1 - 2U_3}$$

$$U_1 = \frac{\mathcal{E} \cdot R_V}{R_V + \frac{(U_3 - U_1) R_V}{U_1 - 2U_3}} = \frac{\mathcal{E} (U_1 - 2U_3)}{U_1 - 2U_3 + U_3 - U_1} = \frac{\mathcal{E}(U_1 - 2U_3)}{-U_3}$$

$\mathcal{E} = \frac{U_3 U_1}{2U_3 - U_1}$; при $R_V = 0$ $\quad \frac{U_1}{U_2} = \frac{r}{r} = 0$

$$\frac{U_2}{U_3} = 2$$

$U_1 : U_2 : U_3 = 2:2:1$ X К2

Ответ: $\frac{U_3 U_1}{2U_3 - U_1}$; 2:2:1

Место для скобы

Шифр 08306

2)
$$\begin{cases} Ox: T' = m_1 a_1 \\ Oz: T' = m_2 a_2 - m_2 g \cdot \sin\alpha \\ Oy: m_3 a_3 = m_3 g - 2T' \end{cases}$$

$$m_1 a_1 = m_2 a_2 - m_2 g \cdot \sin\alpha$$

допустим тело m_3 ~~опустилось~~ сместилось вниз на Δx_3, тогда

$$\Delta x_3 = \Delta x_2 + \Delta x_1 \quad \Big| : t^2$$

$$a_3 = a_2 + a_1$$

$$g - \frac{2T'}{m_3} = \frac{T'}{m_2} + g \cdot \sin\alpha + \frac{T'}{m_1}$$

$$T'\left(\frac{1}{m_2} + \frac{1}{m_1} + \frac{2}{m_3}\right) = g - g \cdot \sin\alpha \Rightarrow T' = \frac{g(1-\sin\alpha) \cdot m_1 m_2 \cdot m_3}{(m_1 m_3 + m_2 m_3 + 2m_1 m_2)}$$

$$a_1 = \frac{g(1-\sin\alpha) m_2 m_3}{m_1 m_3 + m_2 m_3 + 2m_1 m_2}$$

$$a_2 = g \cdot \sin\alpha + \frac{T'}{m_2} = g \cdot \sin\alpha + \frac{g(1-\sin\alpha) \cdot m_1 m_3}{m_1 m_3 + m_2 m_3 + 2m_1 m_2} = \frac{g \cdot \sin\alpha (m_2 m_3 + 2m_1 m_2) + m_1 m_3 g}{m_1 m_3 + m_2 m_3 + 2m_1 m_2}$$

$$a_3 = g - \frac{2T'}{m_3} = g - \frac{2g(1-\sin\alpha) \cdot m_1 m_2}{m_1 m_3 + m_2 m_3 + 2m_1 m_2} = \frac{g(m_1 m_3 + m_2 m_3) + 2g \cdot m_1 m_2 \cdot \sin\alpha}{m_1 m_3 + m_2 m_3 + 2m_1 m_2}$$

Ответ: 1) $\frac{m_3}{2m_1}$; $\frac{m_3 g}{2}$; $\frac{m_3 g}{2}$; $m_3 g$; 2) $\frac{g(1-\sin\alpha) m_2 m_3}{m_1 m_3 + m_2 m_3 + 2m_1 m_2}$, $\frac{g \cdot \sin\alpha (m_2 m_3 + 2m_1 m_2) + m_1 m_3 g}{m_1 m_3 + m_2 m_3 + 2m_1 m_2}$,

$$\frac{g(m_1 m_3 + m_2 m_3) + 2g \cdot m_1 m_2 \cdot \sin\alpha}{m_1 m_3 + m_2 m_3 + 2m_1 m_2}$$