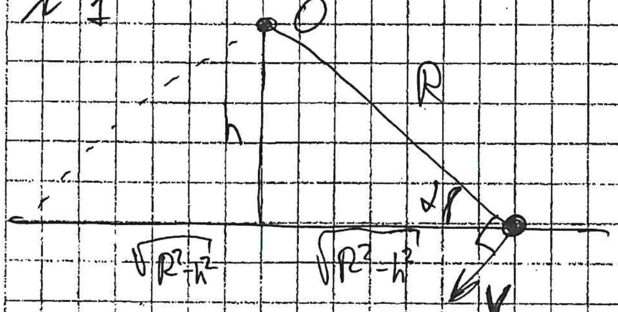
1/17, 2/16, 3/12, 4/11, 5/3, Σ/59

Шифр 09069

Открытая региональная межвузовская олимпиада вузов Томской области (ОРМО)

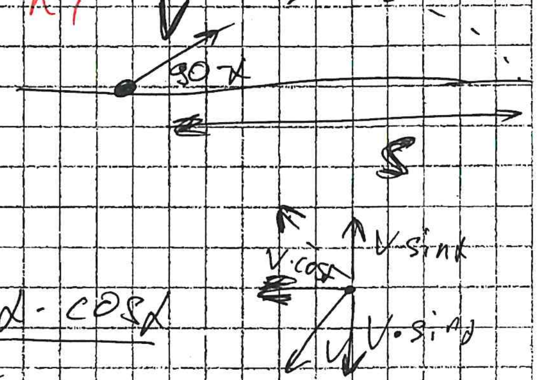
Общий балл	Дата	Ф.И.О. членов жюри	Подписи членов жюри
59	14.03	Абрамова С.В.	[illegible]

№ 1



$V = \sqrt{2gh}$, $\sin\alpha = \frac{h}{R}$; $\cos\alpha = \frac{\sqrt{R^2-h^2}}{R}$ К1 К2

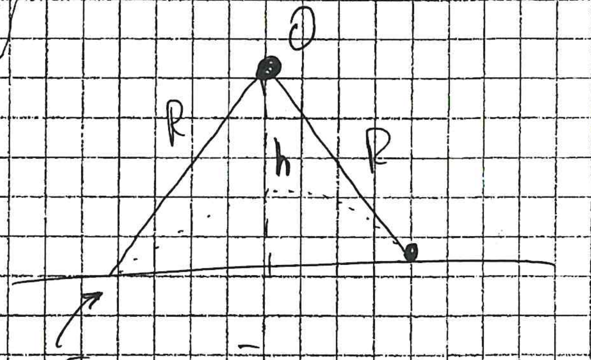
$\Rightarrow$ т.к. ЗСЧ



$$\begin{cases} V\sin\alpha\,t = S \\ V\cos\alpha\,t = g\frac{t^2}{2} \end{cases} \Rightarrow S = \frac{2V^2\sin\alpha\cdot\cos\alpha}{g}$$

$$S = \frac{2\cdot 2gh}{g}\cdot\frac{h}{R}\cdot\frac{\sqrt{R^2-h^2}}{R}$$

$$S = 4\frac{h^2}{R}\sqrt{R^2-h^2}$$ К3



$$2\sqrt{R^2-h^2} = 4\frac{h^2}{R^2}\sqrt{R^2-h^2}$$

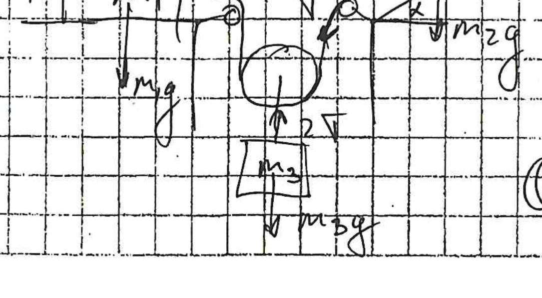
$$\frac{h^2}{R^2} = \frac{1}{2};\ \frac{h}{R} = \sqrt{0{,}5}$$

Это крайняя ситуация, т.к. должна шарик не сможет пролететь из-за того что нить нерастяжима, тогда $S = 2\sqrt{R^2-h^2}$ К4 К5

Ответ: $S = 2\sqrt{R^2-h^2}$; $\frac{h}{R} = \sqrt{0{,}5}$ К6

№ 2

1)



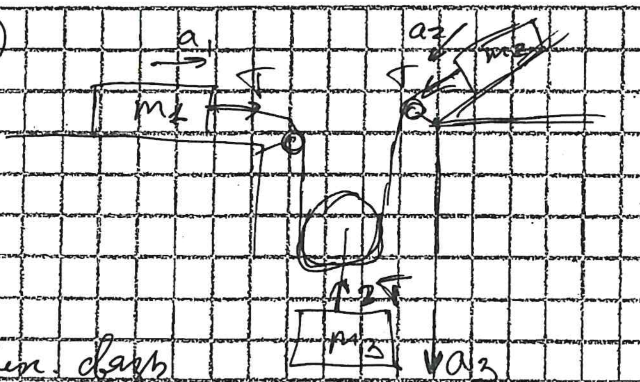
По II з.Н.:

m_3: $2T = m_3 g \Rightarrow T = \frac{m_3 g}{2}$ К1,2,3

m_1: $T = \mu m_1 g \Rightarrow \boxed{\mu = \frac{m_3}{2m_1}}$ 4б

Ответ: $T = \frac{m_3 g}{2}$; $\mu = \frac{m_3}{2m_1}$

2)



по II з. Н.

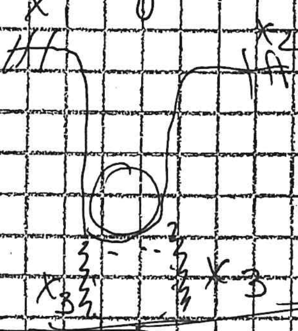
$$\begin{cases} m_3: m_3 g - 2T = m_3 a_3 \\ m_1: m_1 a_1 = T \\ m_2: m_2 a_2 = m_2 g \sin\alpha + T \end{cases}$$

$2a_3 = a_1 + a_2$

K 6,7,8,9,10

6б

Кин. связь



$2x_3 = x_1 + x_2$

$2a_3 = a_1 + a_2$

$m_2 a_2 = m_2 g \sin\alpha + m_1 a_1$

$\cancel{a_1 = m_2}$ $a_2 = \frac{m_2 g \sin\alpha + m_1 a_1}{m_2}$

~~подставим в кинематич. связь:~~

$2a_3 = a_1 + \frac{m_2 g \sin\alpha + m_1 a_1}{m_2}$

$2a_3 = a_1\left(1 + \frac{m_1}{m_2}\right) + g\sin\alpha$

Сложим ур для m_3 и m_1: (m_1 домножим на 2)

$m_3 g + 2m_1 a_1 = m_3 a_3 \mid 2$

$2m_3 g + 4m_1 a_1 = m_3\left(a_1\left(1 + \frac{m_1}{m_2}\right) + g\sin\alpha\right)$

$a_1\left(4m_1 - \frac{m_1}{m_2} - 1\right) = m_3(2g + g\sin\alpha)$

$$\boxed{a_1 = \frac{m_3(\cancel{2g+}\, g(2+\sin\alpha))}{4m_1 - \frac{m_1}{m_2} - 1}}, \quad 4m_1 - \frac{m_1}{m_2} - 1 > 0$$

$4m_1 > \frac{m_1}{m_2} + 1$

из 1) пункта:

$$\begin{cases} \mu m_1 g = m_2 g \cos\alpha\, \mu - m_2 g \sin\alpha \\ \mu = \frac{m_3}{2m_1} \end{cases}$$

$\frac{m_3}{2m_1}\left(-m_1 g + m_2 g \cos\alpha\right) = m_2 g \sin\alpha$

$\frac{m_3 \cdot m_2}{2m_1} g\cos\alpha - m_3 g = m_2 g \sin\alpha$

$$\boxed{a_3 = \frac{m_3 g(2+\sin\alpha)}{4m_1 - \frac{m_1}{m_2} - 1}\cdot\left(1 + \frac{m_1}{m_2}\right) + g\sin\alpha}$$

$$a_2 = \frac{m_2 g\sin\alpha + m_1 \cdot \frac{m_3 g(2+\sin\alpha)}{4m_1 - \frac{m_1}{m_2} - 1}}{m_2}$$

Ответ.

Место для скобы

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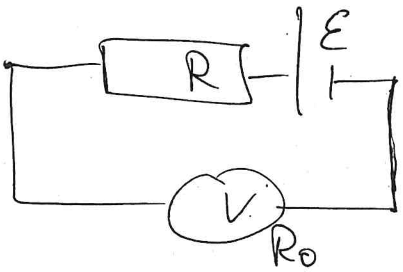
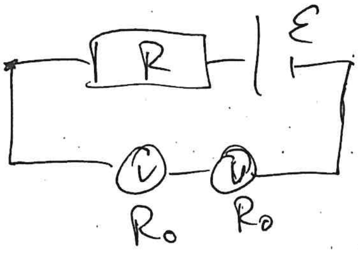
N3



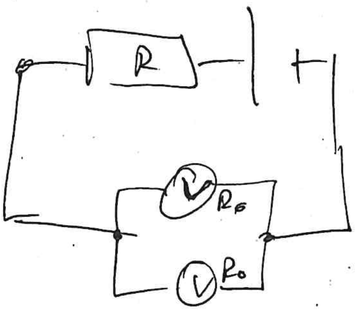
$$\mathcal{E} = (R+R_0)I_1$$
$$RI_1 = U_1$$
$$\Rightarrow 1)\ \mathcal{E} = \frac{(R+R_0)U_1}{R}$$

К1, 6 б



2) ~~$\mathcal{E} = \frac{(R+2R_0)U_2}{R}$~~

$$(R+2R_0)I_2 = \mathcal{E}$$
$$R_0 I_2 = U_2$$
$$\mathcal{E} = \frac{(R+2R_0)\cdot U_2}{R_0}$$



3) $$\mathcal{E} = \frac{\left(\frac{R_0}{2}+R\right)U_3}{R_0}$$

К3,4,5 6 б

$$\mathcal{E} = \frac{\left(\frac{R_0}{2} + \frac{2U_2-U_1}{U_1-U_2}R_0\right)2U_3}{R_0}$$

$$\mathcal{E} = \left(\frac{(U_1-U_2) + 2(U_2-U_1/2)}{U_1-U_2}\right)U_3$$

1) и 2):

$$(U_1-U_2)R = (2U_2-U_1)R_0$$

$$R = \frac{2U_2-U_1}{U_1-U_2}R_0$$

$$\boxed{\mathcal{E} = \frac{U_1\cdot U_3}{2(U_1-U_2)}}$$

Если $R_0 = 0$.

~~$U_1 = U_2 = U_3$~~

$$\mathcal{E} = U_1$$
$$2U_2 = \mathcal{E};\ U_2$$

1) и 2) $$\frac{(R+R_0)U_1}{R} = \frac{(R+2R_0)U_2}{R_0}$$

Место для скобы

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$$R(R+2R_0)u_2 = R_0(R+R_0)u_1$$

$$R^2u_2 + 2R_0Ru_2 = R_0Ru_1 + R_0^2u_1$$

$$R^2u_2 + R_0R(2u_2-u_1) - R_0^2u_1 = 0$$

$$D = R_0^2(2u_2-u_1)^2 + 4u_2\cdot R_0^2u_1 =$$

$$= R_0^2(4u_2^2+u_1^2+4u_2u_1-4u_2u_1) =$$

$$= R_0^2(4u_2^2+u_1^2)$$

$$R = \frac{(2u_2-u_1)R_0 \pm R_0\sqrt{4u_2^2+u_1^2}}{2u_2}$$

$$2(u_2-u_1) > \sqrt{4u_2^2+u_1^2}$$

из 3)

$$\varepsilon = \frac{\left(\frac{R_0}{2} + R_0\left(\frac{2u_2-u_1\pm\sqrt{4u_2^2+u_1^2}}{2u_2}\right)\right)2u_3}{R_0}$$

$$\varepsilon = \frac{3u_2-u_1\pm\sqrt{4u_2^2+u_1^2}}{2u_2}u_3$$ X

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

№4

K_1 3б

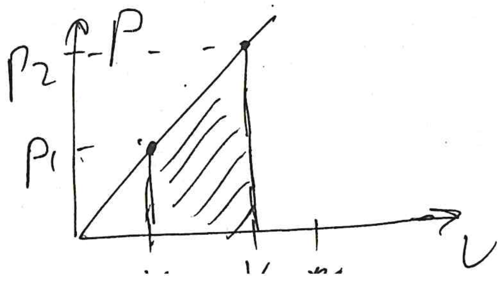
$$Q = \frac{3}{2}\nu R(T_2-T_1) + A \; ; \quad \cancel{p_1\cdot\alpha\sqrt{T_1} = \nu RT_1}$$

$$\cancel{p_2\cdot\alpha\sqrt{T_2} = \nu RT_2}$$

$$p_1\cdot V_1 = \frac{V_1^2\nu R}{\alpha^2} \Rightarrow p_1 = \frac{V_1\nu R}{\alpha^2}$$

K_2 2б

$$p_2V_2 = \frac{V_2^2\nu R}{\alpha^2} \qquad p_2 = \frac{V_2\nu R}{\alpha^2}$$



$$A = \frac{p_1 + p_2}{2} \cdot (V_2 - V_1) = (V_1 + V_2) \cdot (V_2 - V_1) \cdot \frac{\nu R}{\alpha^2 2}$$

$$A = (V_2^2 - V_1^2) \cdot \frac{\nu R}{\alpha^2 2} = (\alpha^2 \cdot T_2 - \alpha^2 \cdot T_1) \frac{\nu R}{\alpha^2 2} =$$

$$= \frac{(T_2 - T_1)\nu R}{2}$$

К 3

$$\boxed{Q = 2\nu R (T_2 - T_1)}$$

К4

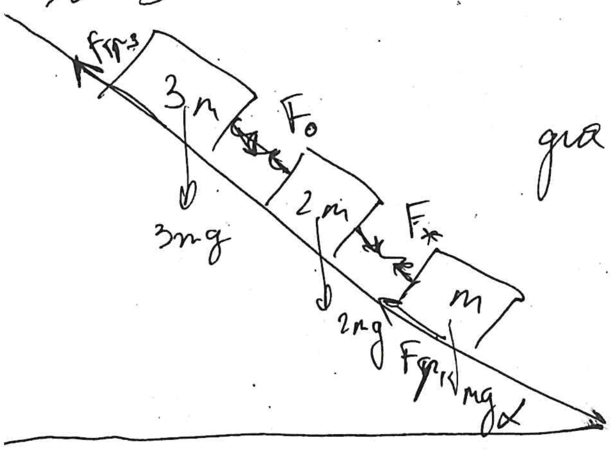
$$\boxed{\eta = \frac{(T_2 - T_1)\nu R \cdot \frac{1}{2}}{\frac{3}{2}(T_2 - T_1)\nu R} = \frac{1}{3}}$$

X

$C = \frac{3}{2}\nu R + \frac{\nu R}{2} = 2\nu R$; да, постоянна.

почему

N 5



~~$6mg \cdot \cos\alpha \mu = 6mg \sin\alpha.$~~

$2 tg\alpha.$

для 3m: $3mg \cdot \cos\alpha\, \mu = k\Delta l_1 + 3mg \sin\alpha.$

для 3m: $\frac{3mg \sin\alpha}{k} = \Delta l_1$

для m: $mg \sin\alpha = -k\Delta l_2 + mg\cos\alpha\, \mu.$

$$\Delta l_2 = \frac{mg \sin\alpha}{k}$$

К1 1б

К2,3 2б

$$\boxed{L = 2L_0 + \Delta l_2 + \Delta l_1 = 2L_0 + \frac{4mg \sin\alpha}{k}}$$