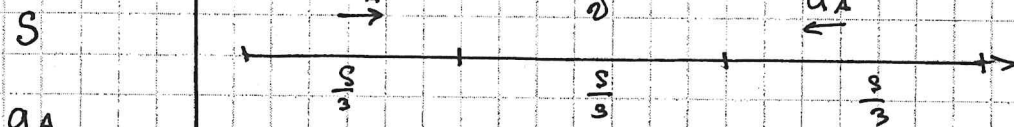


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68.5		Червонская АС	Жур
Шифр			320264

1. Дано

Антон:



$v = \text{const}$

$$1) \frac{S}{3} = \frac{a_A t_1^2}{2} \quad v = v_0 + a_A t_1 = a_A t_1$$

a_B
кто первый?
 Δt - ?

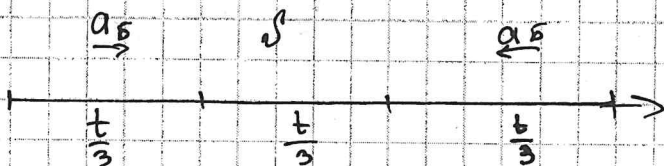
$$2) \frac{S}{3} = v t_2 \Rightarrow \frac{a_A t_1^2}{2} = v t_2 \Rightarrow \frac{a_A t_1^2}{2} = a_A t_1 \cdot t_2 \Rightarrow t_2 = \frac{t_1}{2}$$

$$3) \frac{S}{3} = \frac{a_A t_1^2}{2} = \frac{v t_1}{2} \Rightarrow t_1 = \frac{2S}{3v}; \quad t_2 = \frac{2S}{2v} = \frac{S}{3v}$$

$$T_A = 2t_1 + t_2 = \frac{2 \cdot 2S}{3v} + \frac{S}{3v} = \frac{5S}{3v}$$

T_A - общее время Антона на весь путь.

Борис:



$$S_1 = \frac{a_B t^2}{2} \quad S_2 = v t \quad S_3 = \frac{a_B t^2}{2}; \quad v = a_B t$$

$$S = S_1 + S_2 + S_3$$

$$S = a_B t^2 + v t = v t + v t = 2v t \Rightarrow t = \frac{S}{2v}$$

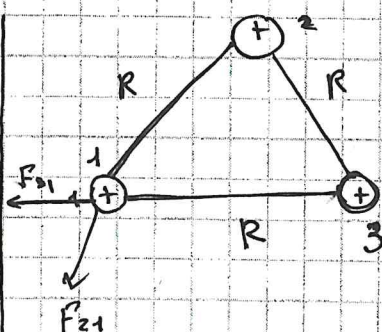
$$T_B = 3t = \frac{3S}{2v}$$

T_B - общее время Бориса на весь путь.

$$\Delta t = T_A - T_B = \frac{5S}{3v} - \frac{3S}{2v} = \frac{S}{6v}$$

Ответ: Борис придет к финишу первым; $\Delta t = \frac{S}{6v}$.

1. Дано



$$\varphi_1 = \frac{q_1 k}{R}; \quad \varphi_2 = \frac{q_2 k}{R}; \quad \varphi_3 = \frac{q_3 k}{R}$$

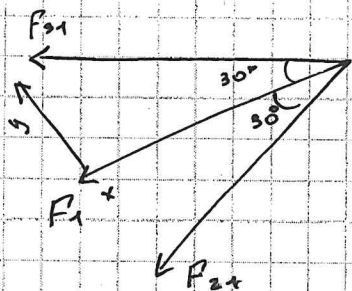
F_{31} - сила на 1 шарик от 3

F_{21} - сила на 1 шарик от 2.

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$$F_{31} = \frac{q_1 q_3 k}{R^2} = \frac{\Phi_1 \Phi_3}{k}$$

$$F_{21} = \frac{q_1 q_2 k}{R^2} = \frac{\Phi_1 \Phi_2}{k}$$



$$F_y = F_{31} \sin 30^\circ - F_{21} \sin 30^\circ = (F_{31} - F_{21}) \sin 30^\circ$$

$$F_x = (F_{31} + F_{21}) \cos 30^\circ = \frac{\sqrt{3}}{2} (F_{31} + F_{21})$$

$$F_1 = \sqrt{F_y^2 + F_x^2} = \sqrt{\frac{(F_{31} - F_{21})^2}{4} + \frac{3(F_{31} + F_{21})^2}{4}}$$

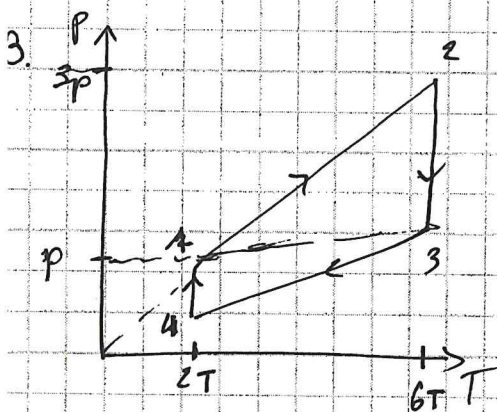
$$= \sqrt{\frac{F_{31}^2 - 2F_{31}F_{21} + F_{21}^2}{4} + \frac{3F_{31}^2 + 6F_{31}F_{21} + 3F_{21}^2}{4}} = \sqrt{F_{31}^2 + F_{31}F_{21} + F_{21}^2}$$

$$= \sqrt{\left(\frac{\Phi_1 \Phi_3}{k}\right)^2 + \frac{\Phi_1^2 \Phi_2 \Phi_3}{k^2} + \left(\frac{\Phi_1 \Phi_2}{k}\right)^2} = \sqrt{\frac{\Phi_1^2}{k^2} (\Phi_3^2 + \Phi_2 \Phi_3 + \Phi_2^2)}$$

$$= \frac{\Phi_1}{k} \sqrt{(\Phi_3^2 + \Phi_2 \Phi_3 + \Phi_2^2)}$$

Ответ: $\frac{\Phi_1}{k} \sqrt{\Phi_3^2 + \Phi_2 \Phi_3 + \Phi_2^2}$

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$$\eta = \frac{A}{Q_{\text{ren}}} \quad pV = \nu RT$$

$$1-2: \frac{T}{p} = \text{const} \quad V = \frac{\nu RT}{p} \Rightarrow V = \text{const} \Rightarrow A_{12} = 0$$

$$\Delta Q_{12} = A_{12} + \Delta U_{12} = \Delta U_{12} = \frac{3}{2} \nu R \Delta T = \frac{3}{2} \nu R (T_2 - T_1)$$

$$3-4: \frac{T}{p} = \text{const} \Rightarrow V = \text{const} \Rightarrow A_{34} = 0$$

$$\Delta Q_{34} = \frac{3}{2} \nu R (T_3 - T_4)$$

$$1-4: \nu RT = \text{const} \Rightarrow pV = \text{const}$$

$$\Delta Q_{41} = p_{41} \Delta V = A_{41}$$

$$p_{41} = \frac{p_1 V_1}{V_{41}} \quad \Delta Q_{41} = \frac{p_1 V_1 \Delta V}{V_{41}}$$

$$p_1 V_1 = p_{41} V_{41}$$

$$\int_0^Q \Delta Q_{41} = \int_{V_{41}}^{V_1} \frac{p_1 V_1 \Delta V}{V_{41}} = p_1 V_1 \ln V_{41} \Big|_{V_{41}}^{V_1}$$

$$\Delta Q_{41} = p_1 V_1 \ln \frac{V_1}{V_{41}}$$

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$$2-3: \Delta Q_{23} = p_2 V_2 = A_{23}$$

$$p_2 V_2 = p_3 V_3 = p_{23} V_{23}$$

$$\Delta Q_{23} = p_2 V_2 \ln \frac{V_3}{V_2}$$

$$A = A_{23} + A_{41} = p_2 V_2 \ln \frac{V_3}{V_2} + p_1 V_1 \ln \frac{V_1}{V_4}$$

$$Q_{\text{тен}} = Q_{12} + Q_{23} = \frac{3}{2} \Delta R (T_1 - T_2) + p_2 V_2 \ln \frac{V_3}{V_2}$$

$$p_2 V_2 = \Delta R T_2$$

$$p_2 V_2 = p_3 V_3 \Rightarrow 3V_2 = V_3$$

$$\frac{T_2}{T_1} = \frac{6}{2} = 3$$

$$T_2 = 3T_1$$

$$V_4 = 3V_1$$

$$A = \Delta R T_2 \ln 3 + \Delta R T_1 \ln \frac{1}{3} = \Delta R T_1 (3 \ln 3 + \ln \frac{1}{3})$$

$$Q_{\text{тен}} = \frac{3}{2} \Delta R (T_2 - T_1) + \Delta R T_2 \ln 3 = \Delta R T_1 \left(\frac{3}{2} \cdot 2 + 3 \ln 3 \right)$$

$$\eta = \frac{A}{Q_{\text{тен}}} = \frac{\Delta R T_1 (3 \ln 3 + \ln \frac{1}{3})}{\Delta R T_1 (3 + 3 \ln 3)} = \frac{2 \ln 3}{3 + 3 \ln 3} = 0,348 \approx 35\%$$

Ответ: 35%

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2. Дано: Перейдем в С.О. л мяча

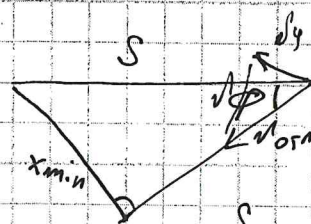
S

S

d_1

d_2

$x_{\min}$



Минимальное расстояние меняется относительно

скорости

$$x_{\min} = S \sin \varphi$$

$$v_{\text{отн}} = \sqrt{v_y^2 - v_x^2}$$

$$\sin \varphi = \frac{v_y}{v_{\text{отн}}}$$

$$v_y = v \sin d_1 - v \cos \alpha \sin d_2$$

$$v_x = v (\cos d_1 + \cos d_2)$$

$$\frac{2 v \sin d_1 \cos d_1}{g} = \frac{2 v \sin d_2 \cos d_2}{g}$$

$$\sin 2d_1 = \sin 2d_2$$

$$d_1 = \frac{\pi}{2} - d_2$$

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$$v_x = v(\sin \alpha_2 + \cos \alpha_2)$$

$$v_y = v(\cos \alpha_2 - \sin \alpha_2)$$

$$v_{отн} = \sqrt{v^2(\cos \alpha_2 - \sin \alpha_2)^2 + v^2(\cos \alpha_2 + \sin \alpha_2)^2} = v\sqrt{2 \cdot (\cos^2 \alpha_2 + \sin^2 \alpha_2)} = v\sqrt{2}$$

$$\sin \varphi = \frac{v(\sin \alpha_1 - \sin \alpha_2)}{v\sqrt{2}} = \frac{\sin \alpha_1 - \sin \alpha_2}{\sqrt{2}}$$

$$X_{min} = S \cdot \frac{(\sin \alpha_1 - \sin \alpha_2)}{\sqrt{2}}$$

Ответ: $\frac{S \cdot (\sin \alpha_1 - \sin \alpha_2)}{\sqrt{2}}$

100

1. $V = 5000 \text{ м}^3$

$p_B = 110 \cdot 10^3 \text{ Па}$

$T = 316 \text{ К}$

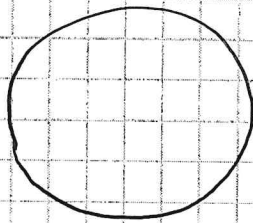
$\varphi_1 = 10\%$

$p_0 = 10^5 \text{ Па}$

$\varphi_2 = 90\%$

$p_{н.н.} = 9000 \text{ Па}$

$m_g = ?$



$$\varphi = \frac{p}{p_n} \cdot 100\%$$

05