



Многопрофильная
инженерная олимпиада
«Звезда»

Шифр A-73-11-06

N1

Дано:

$$r = 54,6 \text{ млн км}$$

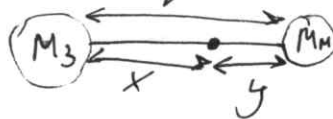
$$M_3 = 6 \cdot 10^{24} \text{ кг}$$

$$M_m = 6,4 \cdot 10^{23} \text{ кг}$$

$x = ?$

или
 $5,46 \cdot 10^7 \text{ м}$

Решение:



$$x + y = r$$

$$F_T = G \frac{M_3 m}{x^2} = G \frac{M_m m}{y^2}$$

$$\frac{M_3}{x^2} = \frac{M_m}{y^2} \Rightarrow y = x \sqrt{\frac{M_m}{M_3}}$$

Пусть x - расстояние от Земли до точки Лагранжа, y - расстояние от Марса до точки.

$$x + x \sqrt{\frac{M_m}{M_3}} = r$$

$$x \left(1 + \sqrt{\frac{M_m}{M_3}} \right) = r$$

$$x = \frac{r}{1 + \sqrt{\frac{M_m}{M_3}}}$$

$$x = \frac{5,46 \cdot 10^7 \text{ м}}{1 + \sqrt{\frac{6,4 \cdot 10^{23}}{6 \cdot 10^{24}}}} \approx 4,12 \cdot 10^7 \text{ м} = 41,2 \text{ млн км}$$

Ответ: $x = 41,2 \text{ млн км}$

N2

Дано:

$$R = 3430 \cdot 10^3 \text{ м}$$

$$M = 6,4 \cdot 10^{23} \text{ кг}$$

$$G = 6,67 \cdot 10^{-11} \frac{\text{Н} \cdot \text{м}^2}{\text{кг}^2}$$

$g_m = ?$

$$mg_m = F_T$$

$$F_T = G \frac{M_m}{R^2}$$

$$mg_m = G \frac{M_m}{R^2}$$

$$g_m = G \frac{M}{R^2}$$

$$g_m = 6,67 \cdot 10^{-11} \cdot \frac{6,4 \cdot 10^{23}}{(3430 \cdot 10^3)^2} \approx 3,63 \frac{\text{Н}}{\text{кг}}$$

Ответ: $g_m = 3,63 \frac{\text{Н}}{\text{кг}}$

N 4

Dano:

$$h = 3430 \cdot 10^3 \text{ m}$$

$$R_M = 3430 \cdot 10^3 \text{ m}$$

$$\frac{A_1}{A_2} = ?$$

$$A_1 = \Delta W_n = m g_m h - 0 = m g_m h$$

$$A_2 = \Delta W_k = \frac{m v^2}{2} - 0 = \frac{m v^2}{2}$$

$$\frac{A_1}{A_2} = \frac{m g_m h}{\frac{m v^2}{2}} = \frac{2 g_m h}{v^2}$$

$$m g_m = G \frac{M_m}{(R_m + h)^2} \quad g_m = \frac{G M}{(R_m + h)^2}$$

$$m a_y = G \frac{M_m}{(R_m + h)^2}$$

$$a_y = \frac{v^2}{R_0} = \frac{v^2}{R_m + h}$$

$$\frac{m v^2}{R_m + h} = G \frac{M_m}{(R_m + h)^2} \quad v^2 = \frac{G M}{R_m + h}$$

$$\frac{A_1}{A_2} = \frac{2 g_m h}{v^2} = \frac{2 \cdot \frac{G M}{(R_m + h)^2} \cdot h}{\frac{G M}{R_m + h}} = \frac{2 h}{R_m + h}$$

$$\frac{A_1}{A_2} = \frac{2 \cdot 3430 \cdot 10^3 \text{ m}}{3430 \cdot 10^3 + 3430 \cdot 10^3} = 1$$

Otwet: $\frac{A_1}{A_2} = 1$

N 5

Dano:

$$v = 12 \frac{\text{km}}{\text{c}}$$

$$S = 54,6 \cdot 10^6 \text{ km}$$

$$t = ?$$

$$S = v t \Rightarrow t = \frac{S}{v} \quad t = \frac{54,6 \cdot 10^6}{12} = 4550000 \text{ c}$$

Otwet: $t = 4550000 \text{ c}$

N 3

Dano:

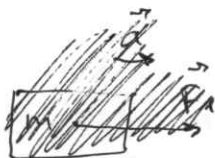
$$v = 10 \frac{\text{km}}{\text{c}} = 10^4 \frac{\text{m}}{\text{c}}$$

$$m_0 = 2 \cdot 10^{-5} \text{ kg}$$

$$S = 49 \text{ m}^2$$

$$\alpha = 1 \frac{\text{mikroskop}}{\text{m}^3}$$

$$\Delta F = ?$$



$$F_2 = F_1 + F_g$$

$$\Delta F = F_2 - F_1 = F_g$$

$$F_g = \alpha m S v^2 = \Delta F$$

$$\Delta F = 1 \cdot 2 \cdot 10^{-5} \cdot 49 \cdot (10^4)^2 = 9800 \text{ H}$$

Otwet: $\Delta F = 9800 \text{ H}$