

## ZH1-A

1.

$$r = 3i - 5t^3j + 9k \quad t = 2s$$

$$a(2) = \ddot{r}(2) = (-15t^2)' = -30t = -60$$

$$a(2) = 60 \frac{m}{s^2}$$

2.

Bontsuk a mozgást 3 szakaszra:

- első 2 másodperc
- köztes szakasz
- utolsó 2 másodperc

Határozzuk meg minden szakaszra az ottani elmozdulást és végsebességet.

1. szakasz:

$$\Delta r_1 = \frac{1}{2}g \cdot 2^2 = 20m$$

$$v_1 = g \cdot 2 = 20 \frac{m}{s}$$

2. szakasz:

$$\Delta r_2 = v_1 \cdot t_x + \frac{1}{2}g \cdot t_x^2 = 20t_x + 5t_x^2$$

$$v_2 = v_1 + g \cdot t_x = 20 + 10t_x$$

3. szakasz:

$$\Delta r_3 = v_2 \cdot 2 + \frac{1}{2}g \cdot 2^2 = 60 + 20t_x$$

$$v_3 = v_2 + g \cdot 2 = 40 + 10t_x$$

A 3. szakasz átlagsebessége 3 szorososa az első szakaszénak:

$$3v_{\text{átlag1}} = v_{\text{átlag3}}$$

$$3 \frac{\Delta r_1}{2} = \frac{\Delta r_3}{2}$$

$$60 + 20t_x = 60$$

$$t_x = 0$$

$$v_3 = v_2 + g \cdot 2 = 40 + 10t_x = 40 \frac{m}{s}$$

3.

$$m = 40 \text{ kg}; s = 150 \text{ m}; F = 100 \text{ N}; v_0 = 5 \frac{m}{s}; v = 20 \frac{m}{s}$$

$$a = \frac{v - v_0}{t} = \frac{15}{t}$$

$$s = v_0 t + \frac{1}{2} a t^2 = 5t + \frac{15}{2} t = \frac{25}{2} t$$

$$t = \frac{2 \cdot 150}{25} = 12 \quad a = \frac{15}{12} = \frac{5}{4}$$

$$a = \frac{F \cos \alpha}{m} \Rightarrow \cos \alpha = \frac{\frac{5}{4} \cdot 40}{100} = \frac{1}{2} \Rightarrow \alpha = 60^\circ$$

4.

$$h_1 = 1,25 \text{ m}; h_2 = 0,5 \text{ m}; m = 0,1 \text{ kg}; t = 0,1 \text{ s}$$

$$h_1 = \frac{1}{2} v_1^2 \Rightarrow t_1 = \sqrt{2 \frac{h_1}{g}} \Rightarrow v_1 = v_0 + g t_1 = \sqrt{2 h_1 g} = \sqrt{25} = 5$$

$$h_2 = v_2 t_2 - \frac{1}{2} g t_2^2 \quad 0 = v_2 - g t_2$$

$$h_2 = g t_2^2 - \frac{1}{2} g t_2^2 = \frac{1}{2} g t_2^2 \quad t_2 = \sqrt{2 \frac{h_2}{g}} \quad v_2 = \sqrt{2 h_2 g} = \sqrt{16} = 4$$

$$F = \frac{0,1 \text{ s} \cdot 5 \text{ m} - 0,1 \text{ s} \cdot 4 \text{ m}}{0,1 \text{ kg}} = 1 \text{ N}$$

5.

$$v_{\text{fel}} = 3 \frac{m}{s}; v_{\text{le}} = 10 \frac{m}{s}$$

$$v_{\text{át}} = \frac{s}{t} = \frac{s}{\frac{s}{2v_{\text{fel}}} + \frac{s}{2v_{\text{le}}}} = \frac{2v_{\text{le}}v_{\text{fel}}}{v_{\text{le}}} + v_{\text{fel}} = \frac{60}{13} = 4,6 \frac{m}{s}$$

6.

$$A(3,7,-4) \quad m_A=1; \quad B(-4,4,-2) \quad m_B=3; \quad C(2,-5,1) \quad m_C=6 \Rightarrow m_{TKP}=10$$

$$TKP\left(\frac{m_A x_A + m_B x_B + m_C x_C}{m_{TKP}}; \frac{m_A y_A + m_B y_B + m_C y_C}{m_{TKP}}; \dots\right)$$

$$TKP\left(\frac{3-12+12}{10}; \frac{7+12-30}{10}; \frac{-4-6+6}{10}\right)$$

$$d(O, TKP) = \sqrt{x_{TKP}^2 + y_{TKP}^2 + z_{TKP}^2} = \sqrt{\frac{9}{100} + \frac{121}{100} + \frac{16}{100}} = \frac{\sqrt{146}}{10} = 1,208$$

7.

$$m_1 = 1 \text{ kg}; \quad m_2 = 9 \text{ kg}$$

$$\frac{|\Delta K|}{K} = \left| \frac{\frac{1}{2} m_1 v_1^2 - \frac{1}{2} (m_1 + m_2) v'^2}{\frac{1}{2} m_1 v_1^2} \right| = \left| \frac{v_1^2 - 10(v')^2}{v_1^2} \right|$$

$$v' = \frac{m_1 v_1 + 0}{m_1 + m_2} = \frac{v_1}{10} \quad \frac{|\Delta K|}{K} = \frac{v_1^2 - 10\left(\frac{v_1}{10}\right)^2}{v_1^2} = \frac{90}{100} = 0,9$$

8.

$$L = Mt = 100 \text{ kg} \frac{m^2}{s}$$

9.

$$K_{\text{max}} = \frac{1}{2} k x^2 = 0,18 \text{ J} = 180 \text{ mJ}$$

10.

$$h = 10 \text{ m}; \quad \alpha = 5^\circ; \quad m = 1800 \text{ kg}; \quad v = 3 \frac{m}{s}$$

$$a = \frac{F_{\text{eredő}}}{m} = \frac{m g \sin 5^\circ - F_{\text{fék}}}{m} \quad W = F_{\text{fék}} \frac{h}{\sin x}$$

$$\frac{h}{\sin x} = \frac{1}{2} t^2 = \frac{1}{2} \frac{v^2}{a} \quad a = \frac{h \cdot 2}{\sin x v^2} = \frac{m g \sin x - F_{\text{fék}}}{m}$$

$$F_{\text{fék}} = m g \sin x - \frac{2 h m}{\sin x v^2} = 180000 - \frac{2000}{\sin 5^\circ * 9} = 177 \text{ kJ}$$