4. auditorna vježba

Z1) $m = 0,5\ kg$

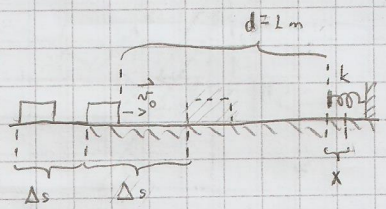
$v_0 = 4\ m/s$

$d = 2\ m$

$k = 10\ N/m$

$\mu = 0.1$

$s = ?$



$E_{poč} = \frac{m \cdot v_0^2}{2}$

$E_{x1} = \frac{m \cdot v_x^2}{2}$

$W_{tr} = F_{tr} \cdot d$

$E_{x1} = E_{poč} - W_{tr}$

$\frac{m v_x^2}{2} = \frac{m \cdot v_0^2}{2} - \mu \cdot m \cdot g \cdot d \quad / \cdot \frac{2}{m}$

$v_x^2 = v_0^2 - 2\mu \cdot g \cdot d$

$v_x = \sqrt{v_0^2 - 2\mu \cdot g \cdot d}$

$E_{x1} = \frac{m \cdot (v_0^2 - 2\mu \cdot g \cdot d)}{2}$

$E_{x1} - E_{ep} = 0$

$E_{x1} = E_{ep} + W_{trx}$

$E_{ep} = \frac{k \cdot x^2}{2}$

$\frac{m(v_0^2 - 2\mu \cdot g \cdot d)}{2} = \frac{k \cdot x^2}{2} + \mu \cdot m \cdot g \cdot x$

$k x^2 + (2\mu \cdot m \cdot g) \cdot x - m(v_0^2 - 2\mu \cdot g \cdot d) = 0$

$10 x^2 + 0.981 x - 6.038 = 0$

$x = 0.7295\ m$

$E_{x2} = E_{ep} - W_{trx}$

$= \frac{k x^2}{2} - \mu \cdot m \cdot g \cdot x$

$E_{x2} = F_{tr}(d + \Delta s)$

$= \mu \cdot m \cdot g \cdot d + \mu \cdot m \cdot g \cdot \Delta s$

$\mu \cdot m \cdot g \cdot \Delta s = \frac{k x^2}{2} - \mu \cdot m \cdot g \cdot x - \mu \cdot m \cdot g \cdot d \quad / : \mu \cdot m \cdot g$

$\Delta s = \frac{k x^2}{2 \mu \cdot m \cdot g} - x - d$

$\Delta s = 2,6953\ m$

$s = -2,6953\ m$

Z2) $v_1 = 60\ km/h = 16.66\ m/s$

$P_1 = 5\ kW = 5000\ W$

$F_{otpor} = k \cdot v^2$

$P_{max} = 50\ kW = 50\,000\ W$

$v_{max} = ?$

$P = \frac{W}{t} = \frac{F \cdot s}{t} = F \cdot v$

$P_1 = F_1 \cdot v_1 = k \cdot v_1^2 \cdot v_1 = k \cdot v_1^3$

$P_{max} = F_{max} \cdot v_{max} = k \cdot v_{max}^3$

$v_{max} = \sqrt[3]{\frac{P_{max}}{k}}$

$k = \frac{P_1}{v_1^3}$

$v_{max} = \sqrt{\frac{v_1^3 \cdot P_{max}}{P_1}} = v_1 \cdot \sqrt{\frac{P_{max}}{P_1}}$

$= 16.666 \cdot \sqrt{\frac{50\,000}{5000}} = 35.907\ m/s = 129.266\ m/s$

Z3) $m = 500\ t = 5 \cdot 10^5\ kg$

$v_0 = 10\ km/h = 2.77\ m/s$

$\Delta t = 30\ s$

$P = 2\ MW = 2 \cdot 10^6\ W$

$s(\Delta t) = ?$

$v_k = ?$

$P = \frac{dW}{dt} \rightarrow dW = P \cdot dt \quad / S$

$$W = \int_{t_0}^{t_k} P \cdot dt = P \cdot t \Big|_{t_0}^{t_k} = P \cdot \Delta t$$

$$W = \frac{m \cdot v_1^2}{2} - \frac{m v_0^2}{2}$$

$$2 \cdot P \cdot \Delta t + m \cdot v_0^2 = m \cdot v_1^2$$

$$v_1 = \sqrt{\frac{2P\Delta t}{m} + v_0^2}$$

$$= \sqrt{\frac{2 \cdot 2 \cdot 10^6 \cdot 30^6}{5 \cdot 10^5} + 2,77^2} = 15,739 \text{ m/s} = 56.66 \text{ km/h}$$

$$v = \frac{ds}{dt} \rightarrow ds = v\,dt \;/S$$

$$s = \int_{t_0}^{t_1} \sqrt{v_0^2 + \frac{2P \cdot \Delta t}{m}}\; dt$$

$$= \left| Y = v_0^2 + \frac{2P \cdot \Delta t}{m} \qquad dY = \frac{2P}{m} dt \qquad dt = \frac{m}{2P} dY \right|$$

$$= \frac{m}{2P} \cdot \int_{t_0}^{t_k} \sqrt{Y}\, dY$$

$$= \frac{m}{2P} \cdot \frac{2Y^{\frac{3}{2}}}{3} \cdot \Delta t$$

$$= \frac{m}{3P} \cdot \Delta t \cdot \left(v_0^2 + \frac{2P\Delta t}{m} \right)^{\frac{3}{2}} ?$$

$s = 324,9$ m ?

$E_{pH} = E_{ph} + E_{kh}$ $\quad h(s_{max}) = ?$

$$E_p = m \cdot g \cdot h$$

$$E_k = \frac{m \cdot v^2}{2}$$

$$m \cdot g \cdot H = m \cdot g \cdot h + \frac{m \cdot v^2}{2} \quad / \cdot \frac{2}{m}$$

$$v = \sqrt{2g(H-h)}$$

$$Y(t) = h - \frac{g \cdot t^2}{2}$$

$$X(t) = v_0 \cdot t$$

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$$x = \sqrt{2g(H-h)} \cdot t \rightarrow t = \frac{x}{\sqrt{2g(H-h)}}$$

$$Y(x) = h - \frac{g}{2} \cdot \frac{x^2}{2g(H-h)}$$

$$= h - \frac{x^2}{4(H-h)}$$

$$Y(x = s) = 0$$

$$h - \frac{s^2}{4(H-h)} = 0$$

$$s = 2\sqrt{Hh - h^2}$$

$$\frac{ds}{dh} = 0 = \frac{1}{\sqrt{Hh - h^2}} \cdot H - 2h$$

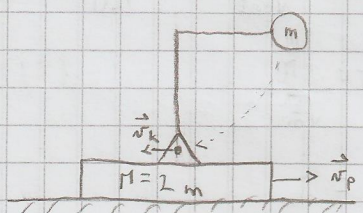
$$0 = H - 2h$$

$$\boxed{h(s_{max}) = \frac{H}{2}}$$

$$s_{max} = 2 \cdot \sqrt{H \cdot \frac{H}{2} - \frac{H^2}{4}} = 2\sqrt{\frac{H^2}{4}}$$

$$\boxed{s_{max} = H}$$

Z5) $l = 30 \text{ cm} = 0,3$ m



$m_{postolja} = 2\, m_{kuglice}$

$v_p = ?$

$$E_p = m \cdot g \cdot l$$

$$E_{kk} = \frac{m \cdot v_k^2}{2}$$

$$E_{kp} = \frac{m_p \cdot v_p^2}{2}$$

$$E_p = E_{kk} + E_{kp} \quad \text{ZOE}$$

$$m_k \cdot g \cdot l = \frac{m_k \cdot v_k^2}{2} + \frac{2m_k \cdot v_p^2}{2} \quad / \cdot \frac{2}{m_k}$$

$$2gl = v_k^2 + v_p^2$$

$$I_p = I_{kk} - I_{kp} \quad \text{ZOI}$$

$$0 = m_k v_k - m_p \cdot v_p$$

$$v_k = \frac{m_p \cdot v_p}{m_k} = \frac{2m_k \cdot v_p}{m_k} = 2v_p$$

$$2gl = 4v_p^2 + 2 \cdot v_p^2 \quad / :2$$

$$gl = 3v_p^2$$

$$v_p = \sqrt{\frac{gl}{3}}$$

$$= \sqrt{\frac{9,81 \cdot 0,3}{3}} = 0,99 \text{ m/s}$$