Modul 9 - Zadaci

Tuesday, January 2, 2024 6:40 PM

9.5) $\theta(t) = \gamma t + \beta t^3$

$\gamma = 0{,}40\ rad/s$

$\beta = 0{,}0120\ rad/s^3$

a) $\omega = \frac{d\theta}{dt} \quad \omega dt = d\theta \ / \int$

$\boxed{\omega = \gamma + 3\beta t^2}$

b) $\boxed{\omega(0) = \gamma = 0{,}4\ rad/s}$

c) $\omega_2(5) = \gamma + 75\beta \qquad \omega_{2-sr}(0-5) = \frac{\Delta\theta}{\Delta t} = \frac{\theta(5)-\theta(0)}{5}$

$\boxed{\omega_2(5) = 1{,}3\ rad/s} \qquad \boxed{\omega_{2-sr} = 0{,}7\ rad/s}$

9.11) $\varepsilon = 1{,}50\ rad/s^2$

a) $\omega(t_1) = 36\ rad/s$

$\omega(0) = 0\ rad/s$

$t_1 = \frac{\omega(t_1)}{\varepsilon} \qquad \boxed{t_1 = 24\ s}$

b) $\theta = \frac{1}{2}\varepsilon_0 t^2 + \omega_0 t$

$\theta(24) = \frac{1}{2}(1{,}5)\cdot 24^2 + 0\cdot t$

$\boxed{\theta(24) = 432\ rad}$

9.20) $d = 10^{-7}\ m$

$r_1 = 25{,}0\ mm$

$r_2 = 58{,}0\ mm$

$v = 1{,}25\ m/s$

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a) $v = r\omega$

$\boxed{\omega = \frac{v}{r}}$

$\boxed{\omega_1 = \frac{1{,}25}{25\cdot 10^{-3}} = 50.0\ rad/s \qquad \omega_2 = \frac{1{,}25}{58\cdot 10^{-3}} = 21{,}55\ rad/s}$

b) $t_{max} = 70 min$

$l = v t = 1,25 \cdot 70 \cdot 60$

$\boxed{l = 5250 m}$

c) $\varepsilon_{sr} = ?$

$\varepsilon_{sr} = \frac{21,55 - 50}{70 \cdot 60}$

$\boxed{\varepsilon_{sr} = -0,000677 \, rad/s^2}$

9.23) $r = 0,30 m$

$\varepsilon = 0,60 \, rad/s^2$

a) $t = 0 s$

$\varepsilon_{tan} = \varepsilon_r = 0,18$

$\varepsilon_{rad} = r\omega^2 = 0$

$\varepsilon = \sqrt{\varepsilon_{tan}^2 + \varepsilon_{rad}^2} = 0,18$

c) $\alpha = 120°$

$\theta - \theta_0 = 120°$

$\varepsilon_{tan} = r\varepsilon = 0,18 m/s^2$

$\theta - \theta_0 = 120° \left(\pi \, rad / 180°\right)$

$\theta - \theta_0 = 2,09 \, rad$

$\omega = ?$ $\omega_{0z} = 0$, $\varepsilon = 0,6$, $\omega_z = ?$

$\omega_z^2 = \omega_{0z}^2 + 2\varepsilon_z(\theta - \theta_0)$

$\omega_z = 1,58 \, rad/s = \omega$

$\boxed{\varepsilon_{rad} = r\omega^2 = 0,748 \, rad/s^2}$

$\varepsilon = \sqrt{\varepsilon_{tan}^2 + \varepsilon_{rad}^2}$ $\boxed{\varepsilon = 0,769 \, m/s^2}$

b) $\alpha = 60°$

$\theta - \theta_0 = 60°$

$\varepsilon_{tan} = r\varepsilon = 0,18 m/s^2$

$\omega = ?$

$\theta - \theta_0 = 60° \left(\pi \, rad / 180°\right) = 1,047 rad$

$\omega_{0z} = 0$, $\varepsilon = 0,6$, $\omega_z = ?$

$\omega_z^2 = \omega_{0z}^2 + 2\varepsilon_z(\theta - \theta_0)$

$\omega_z = \sqrt{\omega_{0z}^2 + 2\varepsilon_z(\theta - \theta_0)}$

$\boxed{\omega_z = 1,12 \, rad/s}$ $(\omega = \omega_z)$

$\varepsilon_{rad} = r\omega^2 = 0,376 m/s^2$

$\varepsilon = \sqrt{\varepsilon_{tan}^2 + \varepsilon_{rad}^2}$ $\boxed{\varepsilon = 0,4168 \, m/s^2}$

9.27) $R = 12,7 mm = 12,7 \cdot 10^{-3} m$

$\omega = 1250 °/min$, $2\pi \, rad = 1 \, obrt. \Rightarrow \pi \, rad/s = 30 \, obrt/min$

a) $v_{obim} = \omega r = 1250 °/min \cdot \frac{\pi \, rad/s}{30 \, obrt/min} \cdot \frac{12,7 \cdot 10^{-3}}{2}$

(max)

$\boxed{v_{obim} = 0,831 \, m/s}$

(max)

$\boxed{v_{0bim} = 0{,}831\ m/s}$

b) $a_{norm.} = \frac{v_{0bim}^2}{r} = 108{,}74\ m/s^2$

9.44) $Q = 40N \qquad Q = mg$

$r = 0{,}25m$

$v_0 = \omega_0 = 0$

$P,\ l = 5m,\ v_1 = 6m/s$

$P = ?$ $\qquad Ek_0 = 0$

$A = Pl$ $\qquad Ek_1 = \frac{1}{2} J\omega^2 \Rightarrow Ek_1 = \frac{1}{2}\frac{Q}{g} r^2 \omega_1^2 \quad \left(\omega_1 = \frac{v_1}{r}\right)$

$A = \Delta Ek$ $\qquad J = \frac{Q}{g} \cdot r^2$

$\boxed{Ek_1 = \frac{Q r^2 v_1^2}{2 g r^2} = \frac{Q v_1^2}{2g}}$

$Pl = \Delta Ek = Ek_1 - Ek_0$

$Pl = \frac{Q v_1^2}{2g} \Rightarrow P = \frac{Q v_1^2}{2gl}$ $\qquad \boxed{P = 14{,}6789N}$

9.47) $m_d = 2{,}50kg$

$r_d = 20{,}0cm = 0{,}20m$

$m_k = 1{,}50kg$

$v_0 = \omega_0 = 0$

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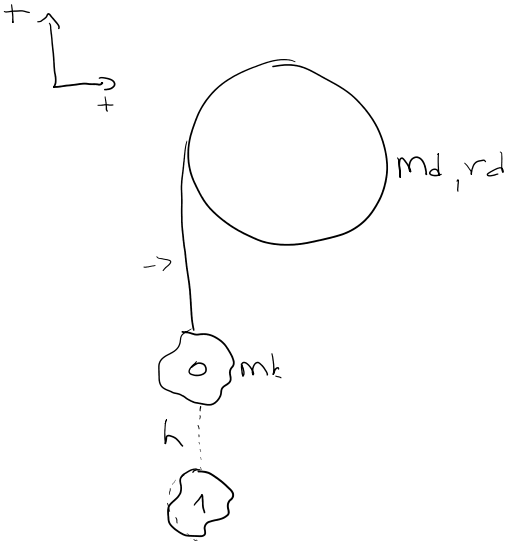
a) $h = ?$ $\quad \Delta h < 0$

$Ek_0 + \Pi_0 = Ek_1 + \Pi_1$

$Ek_0 + \Pi_0 = 0$

$\boxed{Ek_1 + \Pi_1 = 0}$



$Ek_{d_1} = 4{,}50\ J,\ Ek_{d_0} = 0$

$Ek_d = \frac{1}{2} J_d \omega^2$

$Ek_{d_1} = \frac{1}{2} J_d \omega_1^2,\ J_d = \frac{1}{2} m r_d^2$

$Ek_{d_1} = \frac{m r_d^2}{4} \omega_1^2 \Rightarrow \omega_1 = \sqrt{\frac{4 Ek_{d_1}}{m r_d^2}}$

$\boxed{\omega_1 = 13{,}41\ rad/s}$

$\omega_1 = 13{,}44\ rad/s$

$v_1 = r\omega$ $\quad v_1 = v_{k_1} = 2{,}682\ m/s$ $\quad \Rightarrow E_{kk_1} = \frac{1}{2} m v_{k_1}^2$ $\quad E_{kk_1} = 5{,}394\ J$

$\Pi_1 = -E_{k_1} \Rightarrow \Pi_1 = -(E_{kk_1} + E_{kd_1})$ $\quad \Rightarrow h = \frac{-(E_{kk_1} + E_{kd_1})}{mg}$

$mgh = -(E_{kk_1} + E_{kd_1})$

$\Delta h = -0{,}6723$

b) $\frac{E_{kd}}{E_{k_1}} = \frac{E_{kd_1}}{E_{kk_1} + E_{kd_1}} = 0{,}454 \Rightarrow 45{,}4\ \%$

g.64) $\theta(t) = \gamma t^2 - \beta t^3$

$\gamma = 3{,}20\ rad/s^2$

$\beta = 0{,}50\ rad/s^3$

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a) $\omega(t) = ?$

$\omega = \frac{d\theta}{dt}$

$\omega(t) = 2\gamma t - 3\beta t^2$

b) $\varepsilon(t) = ?$

$\varepsilon = \frac{d\omega}{dt}$

$\varepsilon(t) = 2\gamma - 6\beta t$

c) $\omega(t_1) \rightarrow \omega$ je max

$t_1 = ?$, $\omega(t_1) = ?$

$2\gamma - 6\beta t_1 = 0$

$6\beta t_1 = 2\gamma$

$t_1 = \frac{2\gamma}{6\beta} = \frac{\gamma}{3\beta}$

$t_1 = 2{,}1\overline{33}\ s$

g.65) $r = 25{,}0\ cm = 0{,}250\ m$

$a(t) = At$, A - const.

$v_0 = \omega_0 = 0$

$t_1 = 3\ s$, $a_1 = 1{,}8\ m/s^2$

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a) $A = ?$

c) $\omega_2 = 15\ rad/s$

d) $\theta - \theta_0 = ?$

a) $A = ?$

$\boxed{A = 0,6}$

b) $\varepsilon(t) = ?$

$\varepsilon = \frac{A}{r} t$

$\boxed{\varepsilon = 2,4t}$

c) $\omega_2 = 15 \text{ rad/s}$

$t_2 = ?$

$\varepsilon = 2,4t$

$\varepsilon = \frac{d\omega}{dt}$

$\varepsilon dt = d\omega$

$\omega(t) = \frac{1}{2}(2,4)t^2 = 1,2t^2$

$t_2 = \sqrt{\frac{\omega_2}{1,2}}$ $\boxed{t_2 = 3,53 s}$

d) $\theta - \theta_0 = ?$

$\theta(t_2) = ?$

$\theta = \frac{d\omega}{dt}$

$dt\,\theta = d\omega\,/S$

$\theta(t) = \frac{1}{3}(1,2)t^3$

$\boxed{\theta(t_2) = 17,59 \text{ rad}}$

9.72) $\vartheta_0 = \omega_0 = 0$

ε - const.

$t_2 = 0,75 s$

$t_u = t_1 + t_2$

a) $t_1 = ?$

$\theta = \frac{1}{2}\varepsilon_0 t^2 + \omega_0 t$

$2\pi = \frac{1}{2}\varepsilon_0 t_1^2 + 0 \iff 4\pi = \varepsilon_0 t_1^2$

$4\pi = \frac{1}{2}\varepsilon_0 (t_1 + t_2)^2 + 0$

$\varepsilon_0 t_1^2 = \frac{1}{2}\varepsilon_0 (t_1 + t_2)^2$

$t_1^2 = \frac{1}{2}(t_1^2 + 2t_1 t_2 + t_2^2)$

$\frac{1}{2}t_1^2 - t_1 t_2 - \frac{1}{2}t_2^2 = 0$

~~$t_{1,1} = -0,31 s$~~ $\boxed{t_{1,2} = 1,81 s}$

b) $2\pi = \frac{1}{2}\varepsilon_0 t_1^2$

$\varepsilon_0 = \frac{4\pi}{t_1^2}$

$\boxed{\varepsilon_0 = 3,83 \text{ rad/s}^2}$

9.84) $r_c = 0,160 m$

$J = m_c \cdot r_c^2 = 0,48 \text{ kgm}^2$

$m_A = 2 kg$

$m_B = 4 kg$

$h = 5 m$

$\vartheta_0 = 0 m/s$

$E_{k_1} + \Pi_1 = E_{k_2} + \Pi_2$

$\Pi_1 - \Pi_2 = E_{k_2}$

$gh(m_B - m_A) = \frac{1}{2}(m_A + m_B)\vartheta_1^2 + \frac{1}{2} J \frac{\vartheta_1^2}{r_c^2}$

$\vartheta_1 = \sqrt{\frac{2gh(m_B - m_A)}{m_A + m_B + \frac{J}{r_c^2}}}$ $\boxed{\vartheta_1 = 2,81 m/s}$

$h = 3m$

$v_0 = 0 m/s$

$v_{1B} = ?$

$$v_1 = \sqrt{\frac{2gh(m_B - m_A)}{m_A + m_B + \frac{J}{r_c^2}}} \qquad \boxed{v_1 = 2{,}81 m/s}$$

$$Ek_{1A} = Ek_{1B} = Ek_{1C} = 0$$

$$Ek_2 = \frac{1}{2}(m_A + m_B) v_1^2 + \frac{1}{2} J \left(\frac{v_1}{r_c}\right)^2 \quad \left(\omega = \frac{v}{r}\right)$$

$$\Pi_1 = m_B g h$$

$$\Pi_2 = m_A g h$$

9.90) $m_A = 3kg$

$m_c = 5kg$

$r_c = 40cm = 0{,}4m$

$m_B = 2kg$

$r_B = 20cm = 0{,}2m$

$h = -1{,}5m$

$v_2 = ?$

$$J_B = m_B \cdot r_B^2 \frac{1}{2}$$

$$J_C = m_C \cdot r_C^2 \frac{1}{2}$$

$$\Pi_1 + Ek_1 = \Pi_2 + Ek_2$$

$$\Pi_1 = Ek_1 = 0$$

$$Ek_2 = -\Pi_2$$

$$\frac{1}{2} m_A v_2^2 + \frac{1}{4} m_B r_B^2 \frac{v_2^2}{r_B^2} + \frac{1}{4} m_C r_C^2 \frac{v_2^2}{r_C^2} = -m_A g h$$

$$v_2 = \sqrt{\frac{-m_A g h}{\frac{1}{2} m_A + \frac{1}{4}(m_B + m_C)}}$$

$$\boxed{v_2 = 3{,}68 m/s}$$