

## 2. auditorska vježba

z1)  $t(r=2a_t)=?$

$r = 0.5 \text{ m}$

$a_t = 0.01 \text{ m/s}^2 = \text{konst}$

$\frac{dv}{dt} = a_t \xrightarrow{\text{konst}} v = a_t \cdot t$

$a_r = w \cdot v \cdot \sin 90^\circ = w \cdot v = w \cdot a_t \cdot t$

$= |w = \frac{v}{r}| = \frac{a_t \cdot t}{r}$

$= |a_r = \frac{v^2}{r}| = \frac{a_t^2 \cdot t^2}{r}$

$2a_t = \frac{a_t^2 \cdot t^2}{r}$

$\frac{2r}{a_t} = t^2$

$t = \sqrt{\frac{2r}{a_t}}$

$= \sqrt{\frac{2 \cdot 0.5}{0.01}} = 10 \text{ s}$

$\tan \phi = \frac{(\beta \cdot t)^{\frac{3}{2}} r}{|\beta \cdot t \cdot r|}$

$\tan 60^\circ = \frac{\beta \cdot t^{\frac{3}{2}}}{4}$

$t = \sqrt[3]{\frac{4 \tan 60^\circ}{0.02}} = 7.023 \text{ s}$

z4)  $D = 2 \text{ m}$

$\varphi = 45^\circ$

$f = 30 \text{ rpm} = 0.5 \text{ Hz}$

$v(\varphi = 45^\circ) = ?$

$v = \frac{dx}{dt}$

$\tan \varphi = \frac{x}{D}$

$w = \frac{d\varphi}{dt} \rightarrow \varphi = w \cdot t$

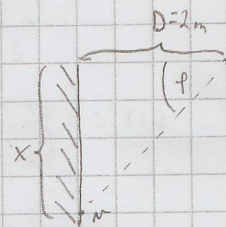
$w = 2\pi f$

$\tan(wt) = \frac{x}{D} \rightarrow x = D \cdot \tan(wt)$

$v = (D \cdot \tan(wt))' = \frac{D \cdot w}{\cos^2(wt)}$

$= \frac{D \cdot w}{\cos^2 \varphi} = \frac{D \cdot 2\pi f}{\cos^2 \varphi}$

$= \frac{2 \cdot 2 \cdot \pi \cdot 0.5}{\cos^2 45^\circ} = 4\pi = 12.566 \text{ m/s}$



z2)  $\alpha = \beta \cdot t = 0.02 t$

$\beta = 2 \cdot 10^{-2} \text{ rad/s}^3$

$t(\vec{\alpha}, \vec{\alpha}_t = 60^\circ) = ?$

$\tan \phi = \frac{a_r}{a_t}$

$a_r = w \cdot r$

$a_t = \frac{dv}{dt} = \frac{d}{dt} r \cdot w$

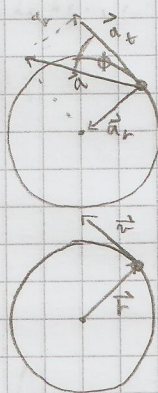
$\alpha = \frac{dw}{dt}$

$dw = \beta t dt / s$

$\frac{dw}{dt} = \frac{\beta t^2}{2} = w(t)$

$v = w \cdot r = \frac{\beta \cdot t^3 \cdot r}{2}$

$a_t = \frac{\beta \cdot t^2 \cdot r}{2} \frac{d}{dt} = \beta \cdot r \cdot t$



z5)  $m_1 = 2 \text{ kg}$

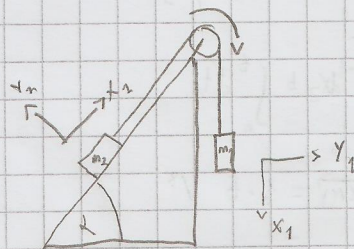
$m_2 = 1.2 \text{ kg}$

$\alpha = 50^\circ$

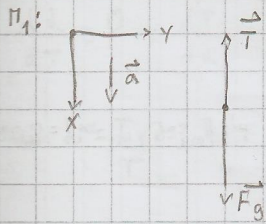
$\mu = 1.2$

$a = ?$

$F_{tr} = N \cdot \mu$





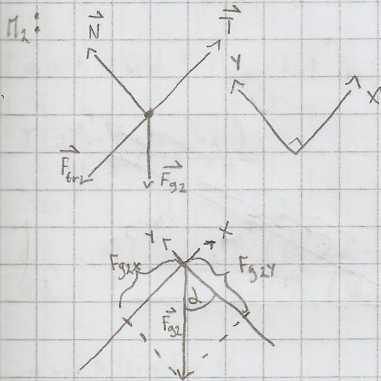


$$m_1 \cdot \vec{a}_1 = \vec{F}$$

$$= \vec{F}_{g1} + \vec{T}$$

$$m_1 \cdot a_1 = F_{g1} - T$$

$$m_1 \cdot a_1 = m_1 \cdot g - T$$



$$m_2 \cdot \vec{a}_2 = \vec{T} + \vec{N} + \vec{F}_{fr} + \vec{F}_{g2}$$

$$\vec{F}_{g2} = m \cdot \vec{g}$$

$$\cos \alpha = \frac{F_{g2y}}{m \cdot g} \rightarrow F_{g2y} = m \cdot g \cdot \cos \alpha$$

$$\sin \alpha = \frac{F_{g2x}}{m \cdot g} \rightarrow F_{g2x} = m \cdot g \cdot \sin \alpha$$

$$y_1: m_2 \cdot a_{2y} = N - m_2 \cdot g \cdot \cos \alpha = 0$$

$$N = m_2 \cdot g \cdot \cos \alpha$$

$$x_2: m_2 \cdot a_{2x} = T - F_{fr} - m_2 \cdot g \cdot \sin \alpha$$

$$= T - \mu \cdot N - m_2 \cdot g \cdot \sin \alpha$$

$$= T - \mu \cdot m_2 \cdot g \cdot \cos \alpha - m_2 \cdot g \cdot \sin \alpha$$

$$= T - m_2 \cdot g (\mu \cos \alpha + \sin \alpha)$$

$$a_1 = a_2$$

$$m_1 \cdot a = m_1 \cdot g - T$$

$$m_2 \cdot a = T - m_2 \cdot g (\mu \cos \alpha + \sin \alpha)$$

$$a(m_1 + m_2) = g[m_1 - m_2(\mu \cos \alpha + \sin \alpha)]$$

$$a = g \cdot \left[ \frac{m_1 - m_2(\mu \cos \alpha + \sin \alpha)}{m_1 + m_2} \right]$$

$$a \approx 9.81 \cdot \left[ \frac{2 - 1.2 \cdot (1.2 \cdot \cos 50^\circ + \sin 50^\circ)}{2 + 1.2} \right] = 0.4756 \text{ m/s}^2$$

$$a = g \cdot \sin \alpha$$

$$s(t) = \frac{a \cdot t^2}{2} + v_0 \cdot t + s_0$$

$$s(t_{\text{kon}}) = l = \frac{a \cdot t_{\text{kon}}^2}{2} = \frac{g \cdot \sin \alpha \cdot t^2}{2}$$

$$\cos \alpha = \frac{A}{l} \rightarrow l = \frac{A}{\cos \alpha}$$

$$\frac{A}{\cos \alpha} = \frac{g \cdot \sin \alpha \cdot t^2}{2}$$

$$t = \sqrt{\frac{2A}{g \cdot \sin(2\alpha)}} = \sqrt{\frac{4 \cdot A}{g \cdot \sin(2\alpha)}}$$

$$\frac{dt^2}{d\alpha} = \frac{-4A \cdot g \cdot \cos(2\alpha) \cdot 2}{g \cdot \sin^2(2\alpha)}$$

$$= -\frac{8A \cos(2\alpha)}{g \cdot \sin^2(2\alpha)} = 0$$

$$\cos(2\alpha) = 0$$

$$2\alpha = 90^\circ \quad | :2$$

$$\alpha = 45^\circ$$

$$t = \sqrt{\frac{4 \cdot 4}{9.81 \cdot \sin(90^\circ)}} = 1.2771 \text{ s}$$

$$z_6) d_{\min}^2$$

$$t(d) = ?$$

$$\frac{dt}{dd} = 0$$

$$A = 4 \text{ m}$$

$$m \cdot a = F_{gx} = m \cdot g \cdot \sin \alpha$$

