

Answers

ME206 midterm-1
13.04.2022

① a) $r\ddot{\theta} = 3$ $r\dot{\theta} = 3t$ (18) $40 \frac{2\pi}{60} = 3t$ $t = 11.17s$

b) $8(1.8)^2 = 25.92$ $\sqrt{25.92^2 + 3^2} = 26.09 \frac{m}{s^2}$

② $\vec{a} = (\ddot{r} - r\dot{\theta}^2) \vec{u}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta}) \vec{u}_\theta$

$\dot{r} = 4t$ $\ddot{r} = 4$ $\dot{\theta} = \omega$ $\ddot{\theta} = 0$

$\dot{r} = 4(0.3) = 1.2$ $r = 0.375 + 2(0.3)^2 = 0.555$

$\vec{a} = (4 - 0.555\omega^2) \vec{u}_r + (0 + 2 \cdot 1.2 \cdot \omega) \vec{u}_\theta$

$(4 - 0.555\omega^2)^2 + (2.4\omega)^2 = 7.9^2$

$16 - 4.44\omega^2 + 0.308\omega^4 + 5.76\omega^2 = 62.41$

$0.308\omega^4 + 1.32\omega^2 - 46.41 = 0$

$\omega^2 = \frac{-1.32 \pm \sqrt{1.32^2 + 4(0.308)(46.41)}}{2(0.308)}$

$\omega^2 \rightarrow -14.6 \rightarrow \text{not used}$
 $\omega^2 \rightarrow 10.3 \rightarrow \text{real}$

$\omega = \sqrt{10.3} = 3.2 \frac{\text{rad}}{s}$

③

$a_x = 0$

$v_x = v \cos \theta$

$s_x = v \cos \theta t$

$800 + 1000 \cos 20 = v \cos \theta (16)$

$v \cos \theta = 108.73$

$\tan \theta = 0.53$

$v \sin \theta = 57.10$

$\theta = 27.82^\circ$

$v = \frac{108.73}{\cos(27.82)}$

$v = 122.9 \frac{m}{s}$

$a_y = -g$

$v_y = -gt + v \sin \theta$

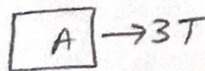
$s_y = -0.5gt^2 + v \sin \theta t$

$-1000 \sin 20 = -4.905(16)^2 + v \sin \theta (16)$

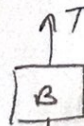
④

$\vec{v}_A = \vec{v}_B + \vec{v}_{A/B} = 800 - 100 = 700 \text{ km/h}$

⑤



$3T = 8a_A$



$5g - T = 5a_B$

$49.05 - 15a_A = T$

$3(49.05 - 15a_A) = 8a_A$

$a_A = 2.77 \frac{m}{s^2}$