uniform circular motion

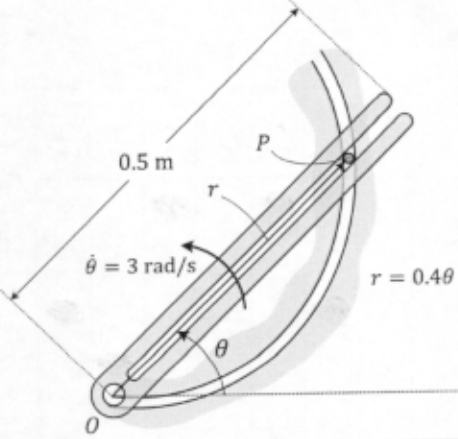
vertical?

Question 1:

(2 Marks)

The slotted link is pinned at O, and as a result of the constant angular velocity $\dot{\theta} = 3$ rad/s it drives the peg P for a short distance along the spiral guide $r = (0.4\theta)$ m, where θ is in radians. For the instant when P is at $\theta = \pi/3$ rad. Determine the following:

(Proceed according to the steps provided in solution boxes)



pin at O
$\omega = 3 \, rad s^{-1}$ (const)
$r = (0.4\theta)$ m
when P at $\theta = \frac{\pi}{3}^c$

Solution:

(a) Determine the radial (v_r) and transverse (v_θ) components of the velocity of P at the instant $\theta = \pi/3$ rad

$\vec{r} = 0.4\theta$

$\vec{v} = 0.4\omega$

$\vec{v}_\theta = 0.4 \times 3$

$= 1.2 \, ms^{-1}$

~~$\vec{v}_r = r\omega$~~

~~$= 0.4 \times \left(\frac{\pi}{3}\right) \times 3$~~

~~$= \frac{2\pi}{5} \, ms^{-1}$~~

~~$\vec{v}_r \approx 1.26 \, ms^{-1}$~~

1.1

$r = 0.4 \times \frac{\pi}{3} \times$

$=$

(b) Determine the radial (a_r) and transverse (a_θ) components of the acceleration of P at the instant $\theta = \pi/3$ rad

1.2

$\vec{v}_\theta = 0.4\omega$

$\vec{a}_\theta = 0.4\alpha$

$\therefore \vec{a}_\theta = 0$

$\vec{a}_r = r\omega^2$

$= 0.4 \times \left(\frac{\pi}{3}\right)^2$

$\therefore \vec{a}_r = 0.439 \, ms^{-2}$

4SY7NINZ 1

Continue your solution to part (b) here:

(c) Using your results from (b), calculate the magnitude of total acceleration of P

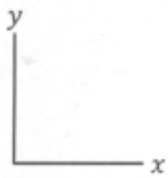
$\vec{a} = \vec{a}_r$

$= 0.439\ ms^{-2}$

2.1

(d) If the x-y axes are defined as shown, then use the radial and transverse components of accelerations obtained in (b) to get the acceleration components (a_x and a_y) along the x and y axes respectively.

$a = \sqrt{a_r^2 + a_\theta^2} = \sqrt{a_x^2 + a_y^2}$



(e) Using your results from (d), calculate the magnitude of total acceleration of P

(f) Briefly compare your results from (c) and (e)

Answers should be the same as they are the same acceleration in two different coordinate systems

Answers:	$v_r =$	$v_\theta =$ 1.2 ms^{-1}	$a_r =$ 0.439 ms^{-2}	$a_\theta =$ 0	4SY7NINE 2

Index of comments

1.1 This was correct! Never cross out working if you're not going to replace it with something else. I'm giving you the mark anyway. Be careful in the future!!

1.2 Use a_r = r_doubledot - r*omega^2 (ie. acceleration along the 'r' direction - normal acceleration).

a_theta = r*alpha [alpha = 0] + 2*r*omega [coriolis].

2.1 Pythagoras