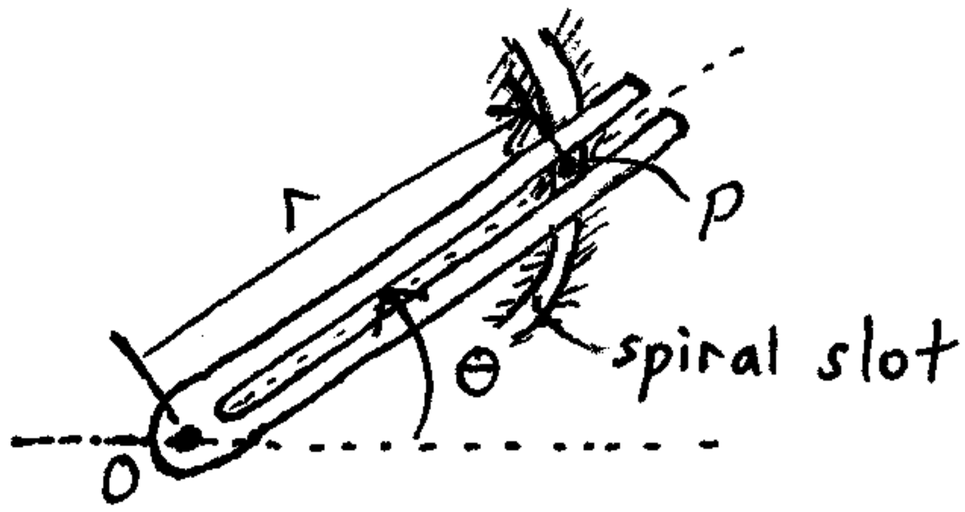
March 19, 2020

This is a curvilinear motion problem involving radial and transverse components (engineering mechanics).



A slotted link rotates about point O with a constant angular velocity $\dot{\theta} = 4$ rad/s. As a result of this motion, a peg P is being pushed along a spiral slot defined by $r = 0.3\theta$ meters, where θ is in radians. Determine the radial and transverse components of the velocity and acceleration of P at the instant when $\theta = \frac{\pi}{3}$ radians.

Solution:

$$v_r = \dot{r} = 0.3\dot{\theta} = 0.3(4) = 1.2 \text{ m/s} \quad \text{(answer)}$$

$$v_\theta = r\dot{\theta} = 0.3\left(\frac{\pi}{3}\right)(4) = 1.26 \text{ m/s} \quad \text{(answer)}$$

$$a_r = \ddot{r} - r\dot{\theta}^2 = 0.3\ddot{\theta} - 0.3\left(\frac{\pi}{3}\right)(4)^2 = -5.03 \text{ m/s}^2 \quad \text{(ans.)}$$

($\ddot{\theta} = 0$)

$$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta} = 0.3\left(\frac{\pi}{3}\right)(0) + 2(0.3)(4)(4) = 9.6 \text{ m/s}^2$$

(answer)