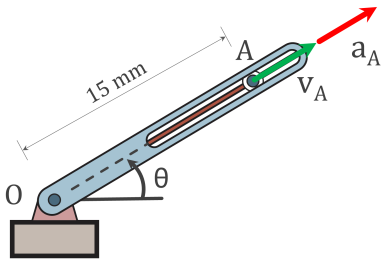
Slider in a Rotating Arm



A slider moves inside a rotating radial slot. This slot is hinged at O. Determine the acceleration mm/s^2 in radial direction at $t = 3$ seconds.

At this time instant the distance between the slider and point O is 15 mm, the sliders velocity is 12 mm/s and its acceleration is 4 mm/s^2. Furthermore, it is given that $v_\theta = 3.75$ mm/s. Round to the nearest integer (no decimals).

Using known expressions:

$$v_\theta = r\dot{\theta} \quad \Rightarrow \quad \dot{\theta} = \frac{v_\theta}{r} \tag{1}$$

$$a_r = \ddot{r} - r\dot{\theta}^2 \tag{2}$$

Given quantities:

Velocity in θ-direction: $v_\theta = 3.75$ mm/s
Distance between slider and O: $r = 15$ mm
Velocity of the slider: $\dot{r} = 12$ mm/s
Acceleration of the slider: $\ddot{r} = 4$ mm/s^2

Solution:

Calculating $\dot{\theta}$ using Equation 1 gives:

$$\dot{\theta} = \frac{v_\theta}{r} = \frac{3.75}{15} = 0.25 \text{ rad/s} \tag{3}$$

Now a_r can be calculated as follows:

$$a_r = \ddot{r} - r\dot{\theta}^2 = 4 - 15 \cdot 0.25^2 = 3.0625 \text{ mm/s}^2 \approx 3 \text{ mm/s}^2 \tag{4}$$