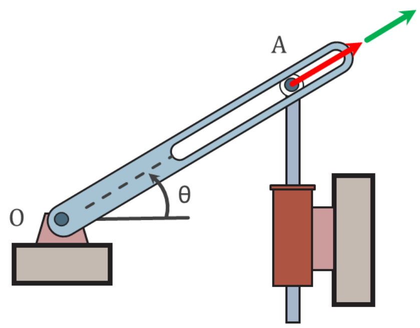
Slider Inside Radially Slotted Arm



Rotation of the radially slotted arm is governed by $\theta = -3t + \frac{2}{15}t^3$, where θ is in radians and t is in seconds. Simultaneously, slider B is hydraulically moved, its distance from O is described by $r = -3 + 2t^2$. Determine the magnitude of the velocity for the instant when $t = 3s$.

Using known expressions:

$$v_\theta = r \cdot \dot{\theta} \tag{1}$$

$$v_r = \dot{r} \tag{2}$$

$$v = \sqrt{{v_\theta}^2 + {v_r}^2} \tag{3}$$

Given:
Distance: $r(t) = -3 + 2t^2$
Angle: $\theta(t) = -3t + \frac{2}{15}t^3$
Time: $t = 3s$

Taking the derivative of r results in $\dot{r}$:

$$\dot{r} = 4 \cdot t \tag{4}$$

Taking the derivative of θ results in $\dot{\theta}$:

$$\dot{\theta} = -3 + \frac{6}{15}t^2 \tag{5}$$

Inserting $t = 3s$ results in $r = -3 + 2 \cdot 3^2 = 15m$, $\dot{r} = 4 \cdot 3 = 12m/s$ and $\dot{\theta} = -3 + \frac{6}{15} \cdot 3^2 = 0.6rad/s$. Now all all variables of Equation 2 and 1 have been found and values for v_r and v_θ can be calculated.

$$v_\theta = r \cdot \dot{\theta} \quad \Rightarrow \quad v_\theta = 15 \cdot 0.6 = 9m/s \tag{6}$$

$$v_r = \dot{r} \quad \Rightarrow \quad v_r = 12m/s \tag{7}$$

Combining this results in a final answer for the total velocity:

$$v = \sqrt{{v_\theta}^2 + {v_r}^2} \quad \Rightarrow \quad v = \sqrt{9^2 + 12^2} = 15m/s \tag{8}$$