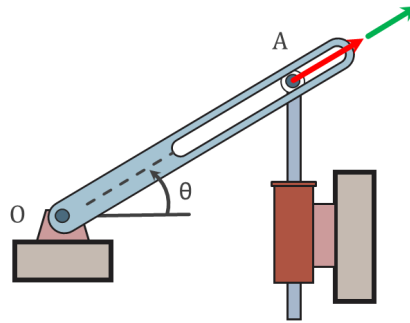


## Slider Inside Radially Slotted Arm



Rotation of the radially slotted arm is governed by  $\theta = -3t + \frac{2}{15}t^3$ , where  $\theta$  is in radians and  $t$  is in seconds. Simultaneously, slider A 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:

$$v_{\theta} = r \cdot \dot{\theta} \quad (1)$$

$$v_r = \dot{r} \quad (2)$$

$$v = \sqrt{v_{\theta}^2 + v_r^2} \quad (3)$$

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  $\dot{r}$ :

$$\dot{r} = 4 \cdot t \quad (4)$$

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

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

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  $v_\theta$  can be calculated.

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

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

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

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