

Sample Problem 5/3

The right-angle bar rotates clockwise with an angular velocity which is decreasing at the rate of 4 rad/s^2 . Write the vector expressions for the velocity and acceleration of point A when $\omega = 2 \text{ rad/s}$.

Solution. Using the right-hand rule gives

$$\omega = -2\mathbf{k} \text{ rad/s} \quad \text{and} \quad \alpha = +4\mathbf{k} \text{ rad/s}^2$$

The velocity and acceleration of A become

$$[\mathbf{v} = \omega \times \mathbf{r}] \quad \mathbf{v} = -2\mathbf{k} \times (0.4\mathbf{i} + 0.3\mathbf{j}) = 0.6\mathbf{i} - 0.8\mathbf{j} \text{ m/s} \quad \text{Ans.}$$

$$[\mathbf{a}_n = \omega \times (\omega \times \mathbf{r})] \quad \mathbf{a}_n = -2\mathbf{k} \times (0.6\mathbf{i} - 0.8\mathbf{j}) = -1.6\mathbf{i} - 1.2\mathbf{j} \text{ m/s}^2$$

$$[\mathbf{a}_t = \alpha \times \mathbf{r}] \quad \mathbf{a}_t = 4\mathbf{k} \times (0.4\mathbf{i} + 0.3\mathbf{j}) = -1.2\mathbf{i} + 1.6\mathbf{j} \text{ m/s}^2$$

$$[\mathbf{a} = \mathbf{a}_n + \mathbf{a}_t] \quad \mathbf{a} = -2.8\mathbf{i} + 0.4\mathbf{j} \text{ m/s}^2 \quad \text{Ans.}$$

The magnitudes of \mathbf{v} and \mathbf{a} are

$$v = \sqrt{0.6^2 + 0.8^2} = 1 \text{ m/s} \quad \text{and} \quad a = \sqrt{2.8^2 + 0.4^2} = 2.83 \text{ m/s}^2$$

