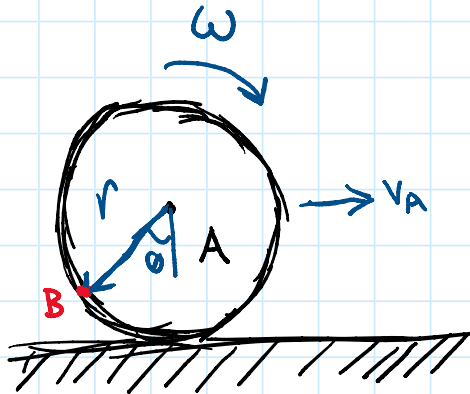


20-R-KM-DK-8

Beginner

Velocity (Relative Motion)

Inspiration: None



A wheel moves at a velocity of  $v_A = 3 \text{ m/s}$  to the right. If it rotates at an angular velocity of  $\omega = 6 \text{ rad/s}$  clockwise, what is the magnitude of the velocity at point B? The radius of the wheel is  $r = 0.3 \text{ m}$  and B is at angle of 45 degrees with the vertical.

$$\begin{aligned}\vec{v}_B &= \vec{v}_A + \vec{\omega} \times \vec{r} = 3\hat{i} + (-6\hat{k}) \times (0.3\cos 45^\circ \hat{i} - 0.3\sin 45^\circ \hat{j}) \\ &= 3\hat{i} + \frac{9\sqrt{2}}{10}\hat{j} - \frac{9\sqrt{2}}{10}\hat{i} = \left(1.7272\hat{i} + \frac{9\sqrt{2}}{10}\hat{j}\right) \text{ m/s} \\ \|\vec{v}_B\| &= \sqrt{1.7272^2 + \left(\frac{9\sqrt{2}}{10}\right)^2} \\ &= \boxed{2.1455 \text{ m/s}}\end{aligned}$$