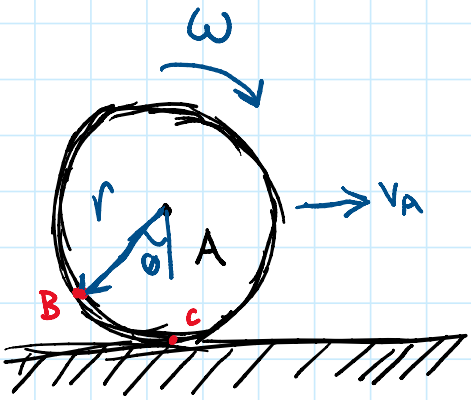
20-R-KM-DK-8

July 31, 2020 11:24 AM

20-R-KM-DK-8 Beginner Velocity (Relative Motion)

Inspiration: None



A wheel traverses across ice and moves at a velocity of ***v_A = 3 m/s*** to the right. Assume the wheel is slipping across the ground. If it rotates at an angular velocity of ***omega = 6 rad/s*** clockwise, what is the magnitude of the velocity at point B? The radius of the wheel is ***r = 0.3 m*** and B is at angle of 45 degrees with the vertical. What would be the magnitude of the velocity at point C?

$$\vec{V}_B = \vec{V}_A + \vec{\omega} \times \vec{r}_{B/A} = 3\hat{i} + (-6\hat{k}) \times (0.3\cos 45\,\hat{i} - 0.3\sin 45\,\hat{j})$$

$$= 3\hat{i} + \frac{9\sqrt{2}}{10}\hat{j} - \frac{9\sqrt{2}}{10}\hat{i} = \left(1.7272\,\hat{i} + \frac{9\sqrt{2}}{10}\hat{j}\right) m/s$$

$$\|\vec{V}_B\| = \sqrt{1.7272^2 + \left(\frac{9\sqrt{2}}{10}\right)^2}$$

$$= \boxed{2.1455\ m/s}$$

$$\vec{V}_C = \vec{V}_A + \omega \times \vec{r}_{C/A} = 3\hat{i} + (-6\hat{k}) \times (-0.3\hat{j})$$

$$= 3\hat{i} - 1.8\hat{i}$$

$$= 1.2\,\hat{i}\ m/s \qquad \boxed{\|\vec{V}_C\| = 1.2\ m/s}$$