

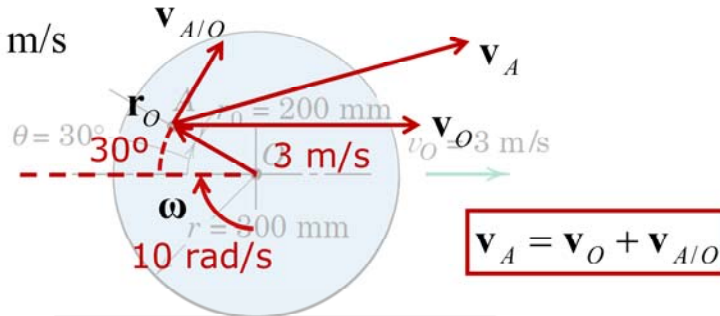
Solution of Relative-Velocity Equation: Case #2

Vector

$$\mathbf{v}_A = \mathbf{v}_O + \mathbf{v}_{A/O} = \mathbf{v}_O + \boldsymbol{\omega} \times \mathbf{r}_0$$

$$\mathbf{v}_A = 3\mathbf{i} + \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 0 & 0 & -10 \\ -0.17 & 0.1 & 0 \end{vmatrix} = 3\mathbf{i} + 1.7\mathbf{j} + \mathbf{i} = 4\mathbf{i} + 1.7\mathbf{j} \text{ m/s}$$

$$|\mathbf{v}_A| = 4.36 \text{ m/s}$$



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Solution II (Vector). We will now use Eq. 5/6 and write

$$\mathbf{v}_A = \mathbf{v}_O + \mathbf{v}_{A/O} = \mathbf{v}_O + \boldsymbol{\omega} \times \mathbf{r}_0$$

where

$$\boldsymbol{\omega} = -10\mathbf{k} \text{ rad/s}$$

$$\mathbf{r}_0 = 0.2(-\mathbf{i} \cos 30^\circ + \mathbf{j} \sin 30^\circ) = -0.1732\mathbf{i} + 0.1\mathbf{j} \text{ m}$$

$$\mathbf{v}_O = 3\mathbf{i} \text{ m/s}$$

We now solve the vector equation

$$\mathbf{v}_A = 3\mathbf{i} + \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 0 & 0 & -10 \\ -0.1732 & 0.1 & 0 \end{vmatrix} = 3\mathbf{i} + 1.732\mathbf{j} + \mathbf{i}$$

$$= 4\mathbf{i} + 1.732\mathbf{j} \text{ m/s}$$

Ans.

The magnitude $v_A = \sqrt{4^2 + (1.732)^2} = \sqrt{19} = 4.36 \text{ m/s}$ and direction agree with the previous solution.

on the wheel for practice.

- ④ The vector $\boldsymbol{\omega}$ is directed into the paper by the right-hand rule, whereas the positive z -direction is out from the paper; hence, the minus sign.