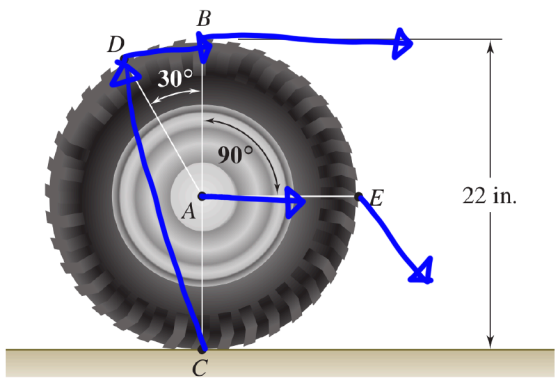
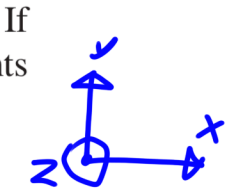
An automobile travels to the right at a constant speed of 48 mi/h. If the diameter of a wheel is 22 in., determine the velocities of points *B*, *C*, *D*, and *E* on the rim of the wheel.





$48\ mph = 845\ in/s \qquad \vec{V}_A = 845\,i\ \ in/s$

$$w = \frac{|V_A|}{c} = \frac{|V_A|}{\pi d} = \frac{845\ in/s}{\pi 22\ in/rev} = 12.2\ \frac{rev}{s}\left(\frac{2\pi\ rad}{1\ rev}\right) = 76.82\ rad/s$$

$\vec{\omega} = -76.82k\ \ rad/s$

$\vec{r}_B = 11j\ \ in$

$$\vec{V}_B = \vec{V}_A + \vec{\omega} \times \vec{r}_B = 845\,i + \begin{vmatrix} i & j & k \\ 0 & 0 & -76.82 \\ 0 & 11 & 0 \end{vmatrix} \begin{matrix} i & j \\ 0 & 0 \\ 0 & 11 \end{matrix}$$

$$= 845\,i + 76.82 \cdot 11\,i\ \ in/s = 1690\,i\ \ in/s$$

$\vec{r}_C = -11j\ \ in$

$$\vec{V}_C = \vec{V}_A + \vec{\omega} \times \vec{r}_C = 845\,i + \begin{vmatrix} i & j & k \\ 0 & 0 & -76.82 \\ 0 & -11 & 0 \end{vmatrix} \begin{matrix} i & j \\ 0 & 0 \\ 0 & -11 \end{matrix}$$

$$= 845\,i - 76.82 \cdot 11\,i = 845\,i - 845\,i = \vec{0}$$

$\vec{V}_D = \vec{V}_C + \vec{\omega} \times \vec{r}_{D/C} \qquad \vec{r}_{D/C} = -11\sin 30\,i + (11 + 11\cos 30)\,j\ \ in$

$= -5.5\,i + 20.53\,j\ \ in$

$$= \vec{0} + \begin{vmatrix} i & j & k \\ 0 & 0 & -76.82 \\ -5.5 & 20.53 & 0 \end{vmatrix} \begin{matrix} i & j \\ 0 & 0 \\ -5.5 & 20.53 \end{matrix}$$

$= 76.82 \cdot 5.5\,j + 76.82 \cdot 20.53\,i\ \ in/s$

$= 1577\,i + 423\,j\ \ in/s$

$\vec{r}_E = 11i\ \ in$

$$\vec{V}_E = \vec{V}_A + \vec{\omega} \times \vec{r}_E = 845\,i + \begin{vmatrix} i & j & k \\ 0 & 0 & -76.82 \\ 11 & 0 & 0 \end{vmatrix} \begin{matrix} i & j \\ 0 & 0 \\ 11 & 0 \end{matrix}$$

$$= 845\,i - 76.82 \cdot 11\,j = 845\,i - 845\,j\ \ in/s$$