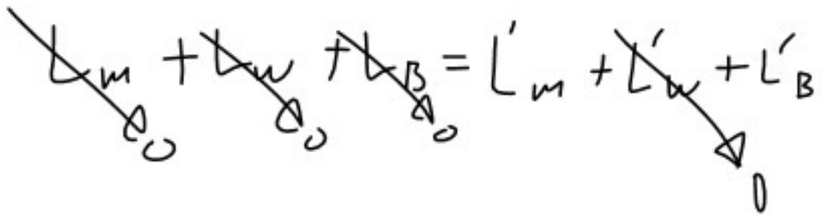
14.0



$$L_m + L_w + L_B = L'_m + L'_w + L'_B$$

$$L'_m + L'_w + L'_B = 0$$

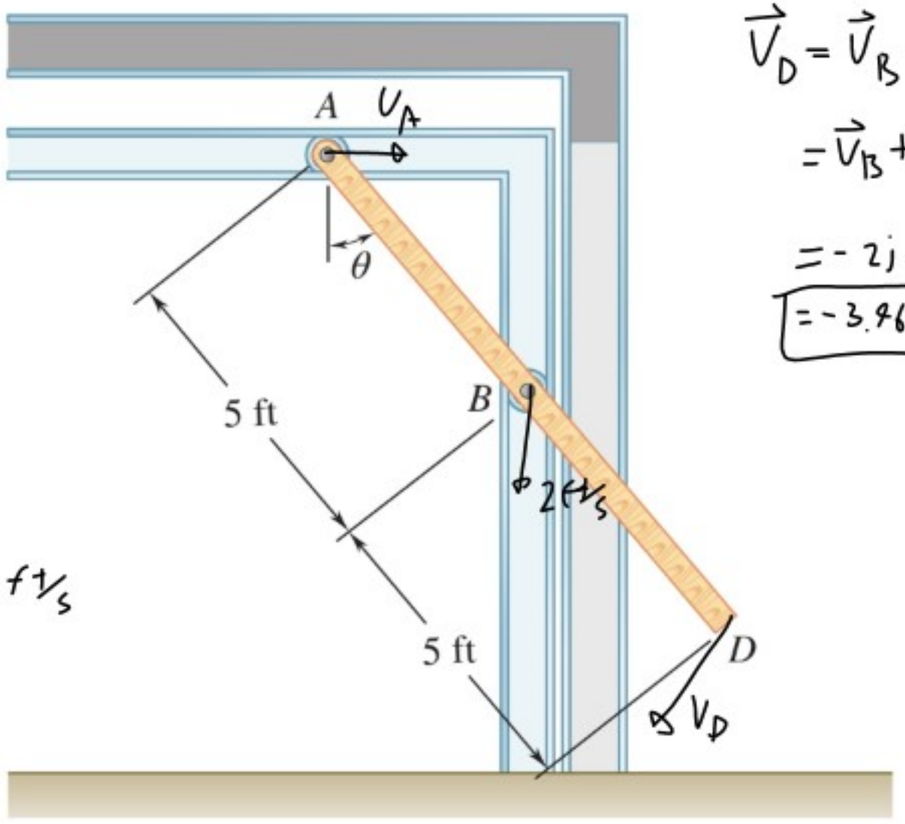
$$m_m v_m + m_w v_w + m_B v_B = 0$$

$$(m_m + m_B) v_B = -m_w v_w$$

$$L''_m + L''_w + L''_B = L'_m + L'_w + L'_B$$

$$m_m v_m + m_w v_w + m_B v_B' = m_m v_B + m_w v_w + m_B v_B$$

An overhead door is guided by wheels at A and B that roll in horizontal and vertical tracks. Knowing that when $\theta = 30°$ the velocity of wheel B is 2 ft/s downward, determine (a) the angular velocity of the door, (b) the velocity of end D of the door.



$\vec{V}_D = \vec{V}_B + \vec{V}_{D/B}$

$= \vec{V}_B + \vec{\omega} \times \vec{r}_{D/B}$

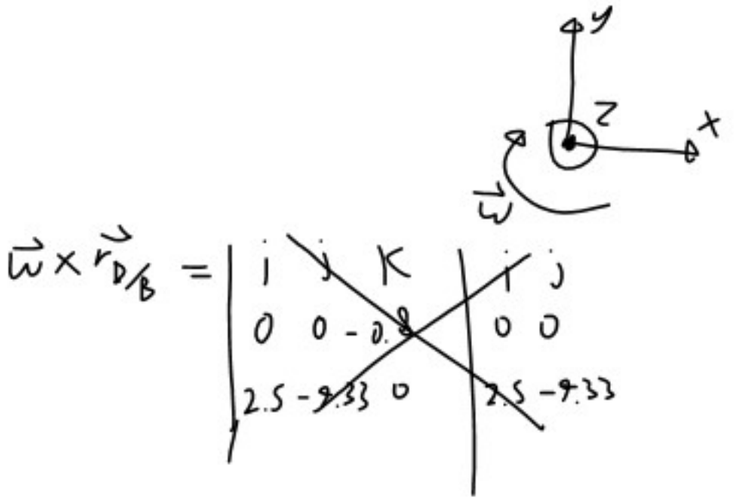
$= -2j - 3.96i - 2j$

$= -3.96i - 4j$ ft/s

$\vec{r}_{D/B} = 5\sin 30\, i - 5\cos 30\, j$

$= 2.5i - 4.33j$ ft

$\vec{\omega} = -0.8K$ rad/s

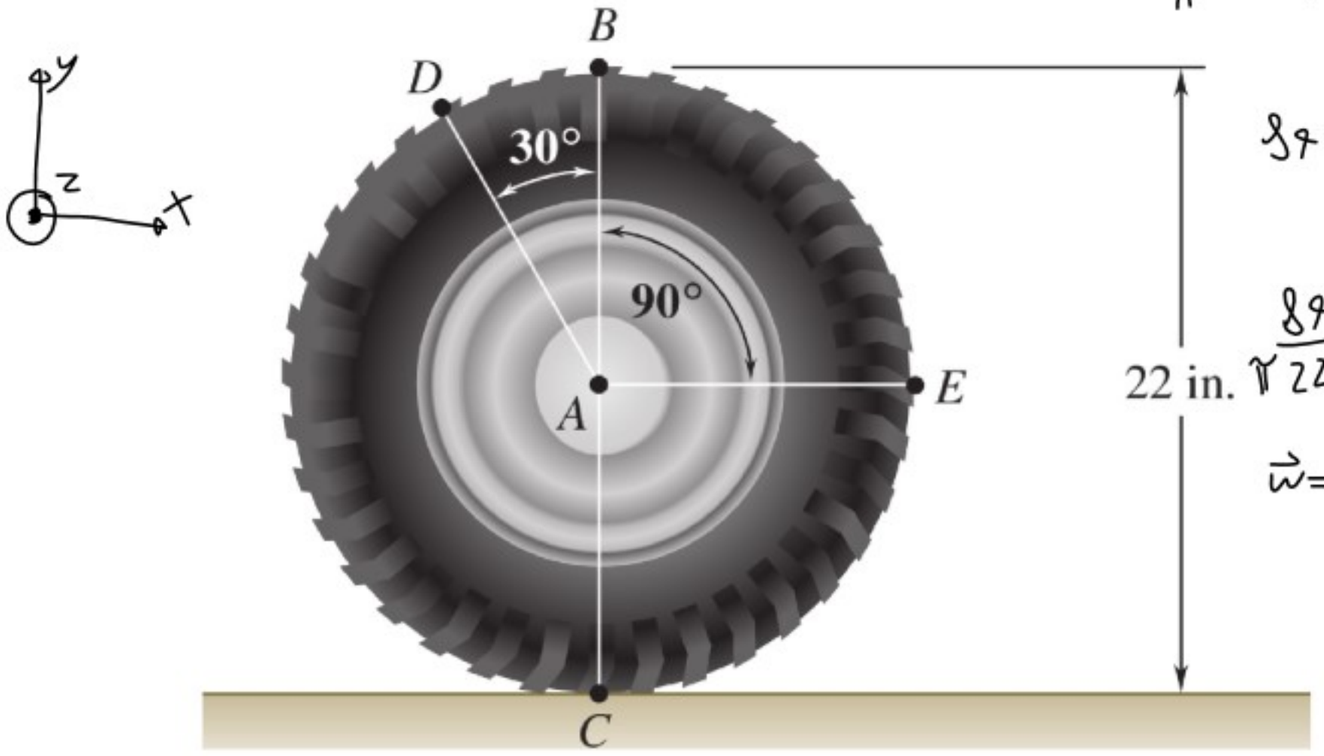


$\vec{\omega} \times \vec{r}_{D/B} = \begin{vmatrix} i & j & K \\ 0 & 0 & -0.8 \\ 2.5 & -4.33 & 0 \end{vmatrix} \begin{matrix} i & j \\ 0 & 0 \\ 2.5 & -4.33 \end{matrix}$

$= -0.8 \cdot 4.33 i - 0.8 \cdot 2.5 j = -3.46i - 2j$ ft/s

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.

$V_A = 845.3 \text{ in/s}$



$845 \text{ in/s} = \pi d\,\omega$

$= \pi 22 \text{ in}\,\omega$

$\frac{845 \text{ in/s}}{\pi 22 \text{ in/rev}} = 12 \text{ rev/s}$ $\frac{2\pi \text{ rad}}{1 \text{ rev}} = 77 \text{ rad/s} = \omega$

$\vec{\omega} = -77\,\mathbf{k} \text{ rad/s}$