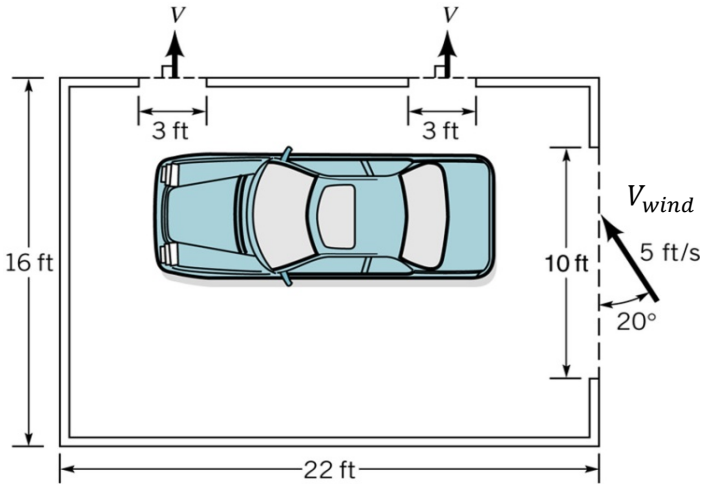
October 5, 2016

NAME

Quiz 6. The wind blows through a 7 ft × 10 ft garage door opening with a speed of 5 ft/s as shown in the figure. Determine the average speed, V, of the air through the two 3 ft × 4 ft openings in the windows.



Attendance (+2 points), format (+1 point)

Solution:

From the conservation of mass law for steady flow,

$$\sum \dot{m}_{out} - \sum \dot{m}_{in} = 0$$

$$\dot{m}_{\substack{garage\\door}} = \dot{m}_{window} + \dot{m}_{window} \qquad \text{(+3 points)}$$

By noting that $\dot{m} = \rho A V$,

$$\rho A_{\substack{garage\\door}} V_{\substack{normal\ to\\garage\ door}} = \rho A_{window} V + \rho A_{window} V$$

or,

$$V = \frac{A_{\substack{garage\\door}} \cdot (V_{wind} \cdot \sin 20°)}{2 \cdot A_{window}} \qquad \text{(+3 points)}$$

Thus,

$$V = \frac{(7\text{ ft})(10\text{ ft})\left(5\ \frac{\text{ft}}{\text{s}}\right)(\sin 20°)}{(2)(3\text{ ft})(4\text{ ft})} = 4.99\,\text{ft/s} \qquad \text{(+1 points)}$$