

# Chapter 17

## Problem 114

$$v_{\text{sound}} = 338 \text{ m/s}$$

$$f_s = 880 \text{ Hz} \quad \text{note by trumpeter}$$

$$f_o = 888 \text{ Hz} \quad \text{observed frequency}$$

What is the speed of the musician?

The formula for the Doppler effect is

$$f_o = f_s \left( \frac{v + v_o}{v - v_s} \right)$$

$$v_o = 0 \quad (\text{stationary observer})$$

$$v_s = ? \quad (\text{moving source})$$

$$v = 338 \quad (\text{speed of sound})$$

Then  $f_o = f_s \frac{v}{v - v_s}$

Solve for  $v_s$

$$\frac{f_o}{f_s} = \frac{v}{v - v_s} \rightarrow (v - v_s) \frac{f_o}{f_s} = v$$

$$v - v_s = \frac{v f_s}{f_o} \rightarrow v - \frac{v f_s}{f_o} = v_s$$

$$\begin{aligned} \text{so } v_s &= v \left[ 1 - \frac{f_s}{f_o} \right] = (338 \text{ m/s}) \left[ 1 - \frac{880}{888} \right] \\ &= (338 \text{ m/s}) (0.00901) \end{aligned}$$

$$\boxed{v_s = 3.05 \text{ m/s}}$$