

## Problem 1.21

[Difficulty: 1]

**1.21** Derive the following conversion factors:

- (a) Convert a specific heat of  $4.18 \text{ kJ/kg} \cdot \text{K}$  to  $\text{Btu/lbm} \cdot ^\circ\text{R}$ .
- (b) Convert a speed of  $30 \text{ m/s}$  to  $\text{mph}$ .
- (c) Convert a volume of  $5.0 \text{ L}$  to  $\text{in}^3$ .

**Given:** Specific heat, speed, and volume data in certain units

**Find:** Convert to different units

**Solution:**

Using data from tables (e.g. Table G.2)

$$(a) \quad 4.18 \cdot \frac{\text{kJ}}{\text{kg} \cdot \text{K}} = 4.18 \cdot \frac{\text{kJ}}{\text{kg} \cdot \text{K}} \times \frac{1 \cdot \text{Btu}}{1.055 \cdot \text{kJ}} \times \frac{1 \cdot \text{kg}}{2.2046 \cdot \text{lbm}} \times \frac{1 \cdot \text{K}}{1.8 \cdot \text{R}} = 0.998 \cdot \frac{\text{Btu}}{\text{lbm} \cdot \text{R}}$$

$$(b) \quad 30 \cdot \frac{\text{m}}{\text{s}} = 30 \cdot \frac{\text{m}}{\text{s}} \times \frac{3.281 \cdot \text{ft}}{1 \cdot \text{m}} \cdot \frac{1 \cdot \text{mi}}{5280 \cdot \text{ft}} \cdot \frac{3600 \cdot \text{s}}{\text{hr}} = 67.1 \cdot \frac{\text{mi}}{\text{hr}}$$

$$(c) \quad 5 \cdot \text{L} = 5 \cdot \text{L} \times \frac{1 \cdot \text{m}^3}{1000 \cdot \text{L}} \times \left( \frac{100 \cdot \text{cm}}{1 \cdot \text{m}} \times \frac{1 \cdot \text{in}}{2.54 \cdot \text{cm}} \right)^3 = 305 \cdot \text{in}^3$$