

## Problem 1.28

[Difficulty: 1]

**1.28** Derive the following conversion factors:

- (a) Convert a volume flow rate in cubic inches per minute to cubic millimeters per minute.
- (b) Convert a volume flow rate in cubic meters per second to gallons per minute (gpm).
- (c) Convert a volume flow rate in liters per minute to gpm.
- (d) Convert a volume flow rate of air in standard cubic feet per minute (SCFM) to cubic meters per hour. A standard cubic foot of gas occupies one cubic foot at standard temperature and pressure ( $T=15^{\circ}\text{C}$  and  $p=101.3\text{ kPa}$  absolute).

**Given:** Data in given units

**Find:** Convert to different units

**Solution:**

$$(a) \quad 1 \cdot \frac{\text{in}^3}{\text{min}} = 1 \cdot \frac{\text{in}^3}{\text{min}} \times \left( \frac{0.0254 \text{ m}}{1 \cdot \text{in}} \times \frac{1000 \text{ mm}}{1 \cdot \text{m}} \right)^3 \times \frac{1 \cdot \text{min}}{60 \cdot \text{s}} = 273 \cdot \frac{\text{mm}^3}{\text{s}}$$

$$(b) \quad 1 \cdot \frac{\text{m}^3}{\text{s}} = 1 \cdot \frac{\text{m}^3}{\text{s}} \times \frac{1 \cdot \text{gal}}{4 \times 0.000946 \text{ m}^3} \times \frac{60 \cdot \text{s}}{1 \cdot \text{min}} = 15850 \text{ gpm}$$

$$(c) \quad 1 \cdot \frac{\text{liter}}{\text{min}} = 1 \cdot \frac{\text{liter}}{\text{min}} \times \frac{1 \cdot \text{gal}}{4 \times 0.946 \cdot \text{liter}} \times \frac{60 \cdot \text{s}}{1 \cdot \text{min}} = 0.264 \cdot \text{gpm}$$

$$(d) \quad 1 \cdot \text{SCFM} = 1 \cdot \frac{\text{ft}^3}{\text{min}} \times \left( \frac{0.0254 \cdot \text{m}}{\frac{1}{12} \cdot \text{ft}} \right)^3 \times \frac{60 \cdot \text{min}}{1 \cdot \text{hr}} = 1.70 \cdot \frac{\text{m}^3}{\text{hr}}$$