1.40 A compressed air tank contains 5 kg of air at a temperature of 80 °C. A gage on the tank reads 300 kPa. Determine the volume of the tank.

\[
\text{volume} = \frac{\text{mass}}{\rho} = \frac{5 \text{ kg}}{3.96 \frac{\text{kg}}{\text{m}^3}} = 1.26 \text{ m}^3
\]

\[
\rho = \frac{P}{RT} = \frac{(300 + 101) \times 10^3 \frac{\text{N}}{\text{m}^2}}{(286.9 \frac{1}{\text{kg} \cdot \text{K}})[(280 + 273) \text{K}]} = 3.96 \frac{\text{kg}}{\text{m}^3}
\]

1.41 A rigid tank contains air at a pressure of 90 psia and a temperature of 60 °F. By how much will the pressure increase as the temperature is increased to 110 °F?

\[
\frac{P_2}{P_1} = \frac{RT_2}{RT_1} \quad (E_8.1.8)
\]

For a rigid closed tank the air mass and volume are constant so \(\rho = \text{constant}\). Thus, from Eq. 1.8 (with R constant)

\[
\frac{P_2}{P_1} = \frac{T_2}{T_1} \quad (1)
\]

where \(P_1 = 90 \text{ psia, } T_1 = 60^\circ \text{F} + 460 = 520^\circ \text{R, and } T_2 = 110^\circ \text{F} + 460 = 570^\circ \text{R. From Eq. (1)}

\[
P_2 = \frac{T_2}{T_1} P_1 = \left(\frac{570^\circ \text{R}}{520^\circ \text{R}}\right) (90 \text{ psia}) = 98.7 \text{ psia}
\]