1.40

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.

$$\text{volume} = \frac{\text{mass}}{\rho}$$

$$\rho = \frac{p}{RT} = \frac{(300 + 101) \times 10^3 \frac{N}{m^2}}{\left(286.9 \frac{J}{kg \cdot K}\right)\left[(80°C + 273)K\right]} = 3.96 \frac{kg}{m^3}$$

$$\text{volume} = \frac{5\ kg}{3.96 \frac{kg}{m^3}} = \underline{\underline{1.26\ m^3}}$$

1.41

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?

$$p = \rho RT \qquad \text{(Eq. 1.8)}$$

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

$$\frac{p_1}{T_1} = \frac{p_2}{T_2} \qquad (1)$$

where $p_1 = 90$ psia, $T_1 = 60°F + 460 = 520°R$, and $T_2 = 110°F + 460 = 570°R$. From Eq. (1)

$$p_2 = \frac{T_2}{T_1} p_1 = \left(\frac{570°R}{520°R}\right)(90\ \text{psia}) = \underline{\underline{98.7\ \text{psia}}}$$