4. $PV = mR_dT \quad \rho = \frac{m}{V} = \frac{P}{R_dT}$

a. Parcel 1 $\rho_1 = 9.60 \times 10^4 / (287 \cdot 300) = 1.12 \text{ kg m}^{-3}$

Parcel 2 $\rho_2 = 9.6 \times 10^4 / (287 \cdot 270) = 1.24 \text{ kg m}^{-3}$

b. When the two parcels mix, we do not know that the total volume will be the sum of the two volumes. We do know that the number of molecules and masses add together.

- $m_{total} = m_1 + m_2 = \rho_1 V_1 + \rho_2 V_2 \Rightarrow N_{total} = N_1 + N_2$

∴ The final density is just the weighted sum of the two densities.

$$\rho_{total} = \frac{m_1}{m_1+m_2}\rho_1 + \frac{m_2}{m_1+m_2}\rho_2 = \frac{N_1}{N_1+N_2}\rho_1 + \frac{N_2}{N_1+N_2}\rho_2$$

$$\rho_{total} = \frac{(1.12)(2000)}{(1.12)(2000)+(1.24)(8000)} \cdot 1.12 + \frac{1.24(8000)}{1.12(2000)+1.24(8000)} \cdot 1.24$$

$$= .206 + 1.01 = 1.21 \text{ kg m}^{-3}$$

c. Use the same averaging technique with T

$$T_{total} = \frac{m_1}{m_1+m_2}T_1 + \frac{m_2}{m_1+m_2}T_2 = .184 \cdot 300 + .816 \cdot 270$$

$$= 276 \text{ K}$$

5. Constant volume. use $c_v \Rightarrow du = c_v dT = c_v M dT$

$dq = c_v M dT = c_v \left(\frac{pV}{R_dT}\right) dT$

a. $dT = \frac{dq \cdot R_dT}{c_v pV} = \frac{(10^5)(287 \cdot 290)}{(717)(10^5)(10^3)} = 0.12 \text{ K}$

b. from Ideal Gas Law, $dp = \frac{mR_d}{V} dT = \frac{(1.20 \times 10^3 \text{ kg})(287)}{10^3} 0.12$

$dp = 40 \text{ Pa}$