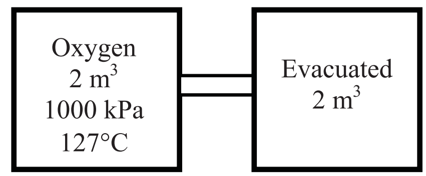
5-123 Two adiabatic chambers are connected by a valve. One chamber contains oxygen while the other one is evacuated. The valve is now opened until the oxygen fills both chambers and both tanks have the same pressure. The total internal energy change and the final pressure in the tanks are to be determined.

Assumptions **1** Oxygen is an ideal gas since it is at a high temperature and low pressure relative to its critical point values of 154.8 K and 5.08 MPa. **2** The kinetic and potential energy changes are negligible, $\Delta \mathrm{ke} \cong \Delta \mathrm{pe} \cong 0$. **3** Constant specific heats at room temperature can be used. **4** Both chambers are insulated and thus heat transfer is negligible.

Analysis We take both chambers as the system. This is a *closed system* since no mass crosses the boundaries of the system. The energy balance for this system can be expressed as



$$\underbrace{E_{in} - E_{out}}_{\substack{\text{Net energy transfer} \\ \text{by heat, work, and mass}}} = \underbrace{\Delta E_{\text{system}}}_{\substack{\text{Change in internal, kinetic,} \\ \text{potential, etc. energies}}}$$

$$\mathbf{0} = \Delta U = mc_v(T_2 - T_1)$$

Since the internal energy does not change, the temperature of the air will also not change. Applying the ideal gas equation gives

$$P_1 V_1 = P_2 V_2 \longrightarrow P_2 = P_1 \frac{V_1}{V_2} = (1000 \text{ kPa}) \frac{2 \text{ m}^3}{4 \text{ m}^3} = \mathbf{500 \text{ kPa}}$$

5-124 … 5-129 Design and Essay Problems

5-128 A claim that fruits and vegetables are cooled by 6°C for each percentage point of weight loss as moisture during vacuum cooling is to be evaluated.

Analysis Assuming the fruits and vegetables are cooled from 30ºC and 0ºC, the average heat of vaporization can be taken to be 2466 kJ/kg, which is the value at 15ºC, and the specific heat of products can be taken to be 4 kJ/kg.ºC. Then the vaporization of 0.01 kg water will lower the temperature of 1 kg of produce by 24.66/4 = 6ºC. Therefore, the vacuum cooled products will lose 1 percent moisture for each 6ºC drop in temperature. Thus the claim is **reasonable**.