4-54 CD EES A piston-cylinder device contains a saturated liquid-vapor mixture of water at 800 kPa pressure. The mixture is heated at constant pressure until the temperature rises to 350°C. The initial temperature, the total mass of water, the final volume are to be determined, and the *P*-v diagram is to be drawn.

Analysis (a) Initially two phases coexist in equilibrium, thus we have a saturated liquid-vapor mixture. Then the temperature in the tank must be the saturation temperature at the specified pressure,

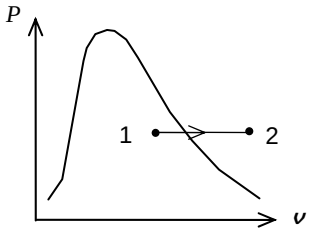
$$T = T_{\text{sat@800 kPa}} = \mathbf{170.41°C}$$

(b) The total mass in this case can easily be determined by adding the mass of each phase,

$$m_f = \frac{V_f}{v_f} = \frac{0.1\ \text{m}^3}{0.001115\ \text{m}^3/\text{kg}} = 89.704\ \text{kg}$$

$$m_g = \frac{V_g}{v_g} = \frac{0.9\ \text{m}^3}{0.24035\ \text{m}^3/\text{kg}} = 3.745\ \text{kg}$$

$$m_t = m_f + m_g = 89.704 + 3.745 = \mathbf{93.45\ kg}$$



(c) At the final state water is superheated vapor, and its specific volume is

$$\left.\begin{array}{l} P_2 = 800\ \text{kPa} \\ T_2 = 350^\circ\text{C} \end{array}\right\} \ v_2 = 0.35442\ \text{m}^3/\text{kg} \qquad \text{(Table A-6)}$$

Then,

$$V_2 = m_t v_2 = (93.45\ \text{kg})(0.35442\ \text{m}^3/\text{kg}) = \mathbf{33.12\ m^3}$$

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