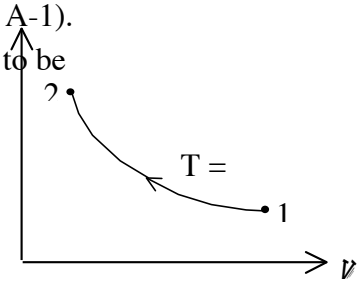
Solutions for 4

4-15 Air in a cylinder is compressed at constant temperature until its pressure rises to a specified value. The boundary work done during this process is to be determined.

Assumptions **1** The process is quasi-equilibrium. **2** Air is an ideal gas.

Properties The gas constant of air is $R = 0.287$ kJ/kg.K (Table A-1).

Analysis The boundary work is determined from its definition to be



$$W_{b,out} = \int_1^2 P\,dV = P_1V_1 \ln\frac{V_2}{V_1} = mRT\ln\frac{P_1}{P_2}$$

$$= (2.4\text{ kg})(0.287\text{ kJ/kg}\cdot\text{K})(285\text{ K})\ln\frac{150\text{ kPa}}{600\text{ kPa}}$$

$$= -272\text{ kJ}$$

Discussion The negative sign indicates that work is done on the system (work input).

4-23 Several sets of pressure and volume data are taken as a gas expands. The boundary work done during this process is to be determined using the experimental data.

Assumptions The process is quasi-equilibrium.

Analysis Plotting the given data on a *P-V* diagram on a graph paper and evaluating the area under the process curve, the work done is determined to be **0.25 kJ**.

3-2C A liquid that is about to vaporize is saturated liquid; otherwise it is compressed liquid.

3-10C At supercritical pressures, there is no distinct phase change process. The liquid uniformly and gradually expands into a vapor. At subcritical pressures, there is always a distinct surface between the phases.

3-14C Yes. Otherwise we can create energy by alternately vaporizing and condensing a substance.