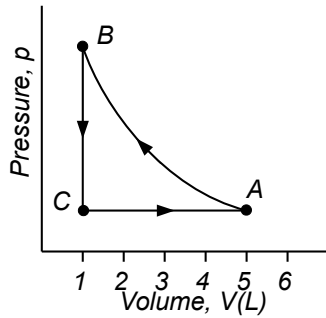


Chapter 18 Problem 39 †



Given

$$P_A = 60 \text{ kPa}$$

Solution

a) Find the pressure at B.

From the ideal gas law

$$PV = nRT$$

Since the process A-B is isothermal, the right hand side of the equation is a constant. Therefore,

$$P_A V_A = P_B V_B$$

Solving for the pressure at B gives us

$$P_B = \frac{V_A}{V_B} P_A = \frac{5.0 \text{ L}}{1.0 \text{ L}} (6.0 \times 10^4 \text{ Pa}) = 3.0 \times 10^5 \text{ Pa} = 300 \text{ kPa}$$

b) Find the net work done on the gas.

The work done for the isothermal process is

$$W = -nRT \ln \left(\frac{V_f}{V_i} \right)$$

Since nRT is constant, we can replace it with $P_A V_A$.

$$W = -P_A V_A \ln \left(\frac{V_B}{V_A} \right) = -(6.0 \times 10^4 \text{ Pa})(5.0 \times 10^{-3} \text{ m}^3) \ln \left(\frac{1.0 \text{ L}}{5.0 \text{ L}} \right)$$

$$W = 483 \text{ J}$$

The work done for the isochoric process is 0 J since the volume doesn't change. The work done for the isobaric process is

$$W = -P_C (V_A - V_C) = -(6.0 \times 10^4 \text{ Pa})(5 \times 10^{-3} \text{ m}^3 - 1 \times 10^{-3} \text{ m}^3)$$

$$W = -240 \text{ J}$$

The net work is the sum of the work done for all three processes. This net work is then

$$W = 483 \text{ J} + 0 \text{ J} - 240 \text{ J} = 243 \text{ J}$$

†Problem from Essential University Physics, Wolfson