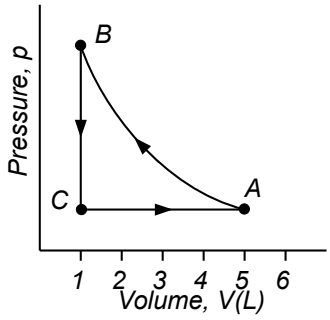
Chapter 18 Problem 37 †



Given
$P_A = 60\ kPa$

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

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

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 $P_A V_A$.

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

$$W = -483\ J$$

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

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

$$W = 240\ J$$

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

$$W = -483\ J + 0\ J + 240\ J = -243\ J$$

†Problem from Essential University Physics, Wolfson