

$$P_i V_i^\gamma = P_f V_f^\gamma$$

$$PV = NkT$$

$$P = \frac{NkT}{V}$$

$$NkT_i V_i^{\gamma-1} = NkT_f V_f^{\gamma-1}$$

$$T_i V_i^{\gamma-1} = T_f V_f^{\gamma-1}$$

$$T_f = T_i \left(\frac{V_i}{V_f} \right)^{\gamma-1}$$

$$T_f = (303)(10)^{7/5-1}$$

$$\boxed{T_f = 761 \text{ K}}$$

$$\Delta U = Q + W$$

$$Q = 0$$

$$U = \frac{1}{2} f N k T$$

$$\Delta U = \frac{5}{2} N k \Delta T = W$$

$$W = \frac{5}{2} N k \Delta T$$

$$N = \frac{P_i V_i}{k T_i}$$

$$W = \left(\frac{5}{2}\right) \left(\frac{P_i V_i}{k T_i}\right) k (T_f - T_i)$$

$$= \frac{5}{2} \frac{P_i V_i}{T_i} (T_f - T_i)$$

$$= \frac{5}{2} \frac{(10^5)(5 \times 10^{-4})}{303} (761 - 303)$$

$$W = 189 \text{ J}$$

$$0.5 \text{ L} \times \frac{1 \text{ m}^3}{1000 \text{ L}} = 5 \times 10^{-4} \text{ m}^3$$