

62. We note that  $\Delta K = n \left( \frac{3}{2} R \right) \Delta T$  according to the discussion in §20-5 and §20-9. Also,  $\Delta E_{\text{int}} = nC_V \Delta T$  can be used for each of these processes (since we are told this is an ideal gas). Finally, we note that Eq. 20-49 leads to  $C_p = C_V + R \approx 8.0 \text{ cal/mol} \cdot \text{K}$  after we convert Joules to calories in the ideal gas constant value (Eq. 20-6):  $R \approx 2.0 \text{ cal/mol} \cdot \text{K}$ . The first law of thermodynamics  $Q = \Delta E_{\text{int}} + W$  applies to each process.

- Constant volume process with  $\Delta T = 50 \text{ K}$  and  $n = 3.0 \text{ mol}$ .  
 $\Delta K = (3.0) \left( \frac{3}{2} (2.0) \right) (50) = 450 \text{ cal}$   
 $\Delta E_{\text{int}} = (3.0)(6.00)(50) = 900 \text{ cal}$   
 $W = 0$  for constant volume processes since the application of force (from the pressure) is not associated with an displacements (see §7-2 and §7-3).  
The first law gives  $Q = 900 + 0 = 900 \text{ cal}$ .
- Constant pressure process with  $\Delta T = 50 \text{ K}$  and  $n = 3.0 \text{ mol}$ .  
 $\Delta K = (3.0) \left( \frac{3}{2} (2.0) \right) (50) = 450 \text{ cal}$   
 $\Delta E_{\text{int}} = (3.0)(6.00)(50) = 900 \text{ cal}$   
 $W = p\Delta V$  for constant pressure processes, so (using the ideal gas law)  $W = nR\Delta T = (3.0)(2.0)(50) = 300 \text{ cal}$ .  
The first law gives  $Q = 900 + 300 = 1200 \text{ cal}$ .
- Adiabatic process with  $\Delta T = 50 \text{ K}$  and  $n = 3.0 \text{ mol}$ .  
 $\Delta K = (3.0) \left( \frac{3}{2} (2.0) \right) (50) = 450 \text{ cal}$   
 $\Delta E_{\text{int}} = (3.0)(6.00)(50) = 900 \text{ cal}$   
 $Q = 0$  by definition of “adiabatic.”  
The first law leads to  $W = Q - \Delta E_{\text{int}} = 0 - 900 = -900 \text{ cal}$ .