Practice Key

1. Adiabatic... $\boxed{q=0}$ $\boxed{S = q_{rev}/T = 0}$

$$U = q + w \qquad U = w \qquad dU = C_v\,dT$$

$$U = \int_{300}^{400} C_v\,dT = C_v[400-300]$$
$$= 10(100) \quad \text{J/mol}$$
$$= 1000 \text{ J/mol}$$

2. $CO_{(g)} + NO_{(g)} \rightarrow CO_{2(g)} + \frac{1}{2}N_{2(g)} \qquad \Delta H = ?$

$$CO + \tfrac{1}{2}O_2 \rightarrow CO_2 \qquad \Delta H = -283.0\text{ kJ}$$
$$NO \rightarrow \tfrac{1}{2}N_2 + \tfrac{1}{2}O_2 \qquad \Delta H = -180.6/2 \text{ kJ}$$
$$CO + NO \rightarrow CO_2 + \tfrac{1}{2}N_2 \qquad \Delta H = -373.3\text{ kJ}$$

exothermic

3. $dH = TdS + VdP$ total (formal) derivative:

$$dH = \left(\frac{\partial H}{\partial S}\right)_P dS + \left(\frac{\partial H}{\partial P}\right)_S dP$$

$$\left(\frac{\partial H}{\partial S}\right)_P = T \qquad \left(\frac{\partial H}{\partial P}\right)_S = V$$

$$\left(\frac{\partial^2 H}{\partial P \partial S}\right) = \left(\frac{\partial T}{\partial P}\right)_S \qquad \frac{\partial^2 H}{\partial S \partial P} = \left(\frac{\partial V}{\partial S}\right)_P$$

$$\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$$

4. Trans: $\ln\left[\left(\frac{2\pi M k_B T}{h^2}\right)^{3/2} \frac{\bar{V}}{N_A}\right] \cancel{+ \ln g_{e1} - \ln\left(1 - e^{-\Theta_B/T}\right) + \frac{\Theta_B/T}{e^{\Theta_B/T} - 1} + \ln\left(\frac{T}{\sigma\Theta_A}\right)}$ OPPS!

Rot: $\ln\left(\frac{T}{\sigma\Theta_A}\right)$

Vib: $-\ln\left(1 - e^{-\Theta_B/T}\right) + \frac{\Theta_B/T}{e^{\Theta_B/T} - 1}$

Elec: $\ln g_{e1}$

5. e

6. increase, equilibrium

7. $V = \frac{nRT}{P} + B$

$\left(\frac{\partial V}{\partial T}\right)_P = \frac{nR}{P}$

$$\left(\frac{\partial H}{\partial P}\right)_T = V - T\frac{nR}{P}$$
$$= V - (V - B)$$
$$= B$$

The change in enthalpy with respect to pressure is always equal to B.