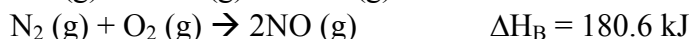
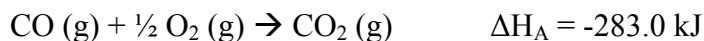


Exam 2: Practice Problems

1. Calculate the work, heat, internal energy, and entropy involved when 1 mol of ideal gas is compressed adiabatically from $T_1 = 300$ K to $T_2 = 400$ K. Assume C_V is temperature independent and equal to 10 J/K·mol.

2. An environmental chemist is studying ways to convert CO and NO (two pollutants in auto exhaust) to CO_2 and N_2 and needs to know the enthalpy of reaction. He knows:



What is the enthalpy of the reaction she is interested in? Is the reaction endo- or exothermic?

3. The differential equation defining enthalpy is: $dH = TdS + VdP$. Use this equation to derive the Maxwell relation:

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

4. From statistical mechanics, we know that the entropy is given by:

$$\bar{S} / R = \frac{7}{2} + \ln \left[\left(\frac{2\pi M k_B T}{h^2} \right)^{3/2} \frac{\bar{V}}{N_A} \right] + \ln g_{el} - \ln(1 - e^{-\Theta_B/T}) + \frac{\Theta_B/T}{e^{\Theta_B/T} - 1} + \ln \left(\frac{T}{\sigma \Theta_A} \right)$$

Label the pieces of this equation that originate from the translational, rotational, vibrational, and electronic partition functions. (You can ignore the $7/2$ term as it comes from several different partition functions).

5. Which statement about the Helmholtz and Gibbs energies is NOT true?
- Helmholtz energies are defined for processes at constant V and T
 - PV is the difference between Helmholtz and Gibbs energies
 - Gibbs energies are defined for processes at constant P and T
 - The Gibbs and Helmholtz energies are state functions
 - The Gibbs and Helmholtz energies can determine the spontaneity only for isolated systems
6. The entropy of an isolated system will continue to _____ until no more spontaneous processes occur, in which case the system will be at _____.
7. From Maxwell's relationships, we derived the following expression

$$\left(\frac{\partial H}{\partial P}\right)_T = V - T\left(\frac{\partial V}{\partial T}\right)_P$$
 Use this expression to calculate $\left(\frac{\partial H}{\partial P}\right)_T$ for a gas that obeys the equation of state: $P(V-B) = nRT$ where B is a constant.