CHE-371 Fall 2008

**Homework #7**

1. The molar enthalpy of vaporization of benzene at its normal boiling point (80.09 °C) is 30.72 kJ/mol. Assuming that $\Delta_{vap}\overline{H}$ and $\Delta_{vap}\overline{S}$ are temperature independent, calculate the values of $\Delta_{vap}\overline{G}$ at 75 °C and 85.0 °C. Explain your results.

2. What are the natural variables of entropy? Explain your answers briefly.

3. Starting from dU=TdS-PdV derive the Maxwell relation below:

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

4. How much energy is available for sustaining muscular and nervous activity from the combustion of 1.00 mol of glucose molecules under standard conditions at 37 °C (i.e., body temperature)? The standard entropy of reaction is 182.4 $J\cdot K^{-1}\cdot mol^{-1}$ and the standard enthalpy of reaction is -2808 $kJ\cdot mol^{-1}$. How is this related to the maximum non-PV work?

5. Calculate $\Delta_r G(375K)$ for the reaction $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ from the appropriate values of $\Delta_r G(298K)$, $\Delta_r H(298K)$, and the Gibbs-Helmholtz equation. Info you may need: $\Delta_f H(298K)$: CO = -110.53 $kJ\cdot mol^{-1}$ and $CO_2$ = -393.51 $kJ\cdot mol^{-1}$. $\Delta_f S(298K)$: CO = 197.66 $J\cdot K^{-1}\cdot mol^{-1}$, $O_2$ = 205.07 $J\cdot K^{-1}\cdot mol^{-1}$, and $CO_2$ = 213.79 $J\cdot K^{-1}\cdot mol^{-1}$.

6. a) When 2 moles of gas at 330 K and 3.50 atm is subjected to isothermal compression, the entropy drops by 25.0 J/K. Find the final pressure and Gibbs free energy. Assume a monatomic, ideal gas.
   b) Repeat the calculation for an adiabatic compression.