Names: _____

Thermochemistry / Equilibrium Workshop

1. Complete the blanks in the following statement. Significant quantities of both reactants and products are present at equilibrium for a reversible chemical reaction if $\Delta G°$ for that reaction is between _____ and _____.

2. Find the value of K_{sp} for iron(III) hydroxide from your textbook or other source, then determine the value of $\Delta G°$ for the solution reaction of this slightly soluble solid. How does this value compare to the value determined by using $\Delta G_f°$ values? Show your calcualtion.

	$\Delta G_f°$ (kJ/mol)
$Fe(OH)_3$ (s)	-696.6
Fe^{3+} (aq)	-4.7
OH^- (aq)	-157.2

3. One of the reaction steps for the metabolism of glucose in animals is not spontaneous:

   2-phosphoglycerate → phosphoenolpyruvate $\Delta G°' = 1.7$ kJ/mol

   (The prime indicates biochemistry standard state, which is the same as chemistry standard state except that biochemistry uses pH = 7.0 as a condition.) Will this reaction take place in a cell where [2-phosphoglycerate] = 2.3×10^{-4} M and [phosphoenolpyruvate] = 8.4×10^{-5} M? Show your calculation and explain your answer.

4. Most of the direct energy needs of a cell are provided by the reaction of adenosine 5'-triphosphate (ATP) to form adenosine 5'-diphosphate (ADP) and hydrogen phosphate ion (P_i):

$$ATP \rightarrow ADP + P_i$$

$\Delta G° = -30.0$ kJ/mol for this reaction. What is ΔG when the concentrations in a cell are $[ATP] = 3.2 \times 10^{-3}$ M, $[ADP] = 1.4 \times 10^{-3}$ M, and $[P_i] = 5.0 \times 10^{-3}$ M and the cell is @ 37°C? Show your calculation.

If you are ill with a fever of 39.5 °C, what is cellular free energy output having the same concentrations? Show your calculation.