GLY 560 -- Thermodynamics and Isotopes in Geology **Name _____**

Thermodynamics and Isotopes in Geology, Problem 2

Stability of Gypsum versus Anhydrite

Let's use thermodynamics to determine which of the above two minerals is stable at the Earth's surface. You may recall that gypsum ($CaSO_4 \cdot 2H_2O$) can be made by reacting anhydrite ($CaSO_4$) with liquid water (H_2O).

Step 1:
In the space below, write a balanced reaction that will form gypsum from anhydrite and liquid water (at 25ºC, 1 bar):

Step 2:

ΔG_{gypsum} = -1797.28 KJ/mol
$\Delta G_{anhydrite}$ = -1321.79 KJ/mol
$\Delta G_{water\ (liq)}$ = -237.129 KJ/mol

Using the Gibbs Free Energies for gypsum, anhydrite, and liquid water listed above, calculate the ΔG of the products, and reactants:

ΔG products: _____

ΔG reactants: _____

Which is the "stable" side of the reaction at the Earth's surface? _____

Why? _____

Calculate the ΔG of reaction (in KJ/mol):

Describe the relationship between the sign of ΔG_{rxn} and which way the reaction will proceed under the conditions (i.e. is the *product* stable or is the *reactant* stable?).

_____

_____

Step 3:
List the ΔG_{rxn} for your reaction in Step 2 in J/mol (rather than KJ/mol): _____

Step 4:
Calculate the $\log K_{eq}$ for your reaction using the equation discussed in class.
Express your final answer with a value for K_{eq} (i.e. $K_{eq} = 10^{x}$).

Step 4:
Write an expression for the K_{eq} using activities of products and reactants.

Step 5:
Using K_{eq} from Step 4, calculate the $aH_2O_{(l)}$ in equilibrium with gypsum and anhydrite.

Would anhydrite react with water to form gypsum if a crystal of anhydrite were placed in a bucket of pure water (at 25ºC, 1 bar) where $aH_2O = 1$? _____

Would anhydrite react with water to form gypsum if a crystal of anhydrite were placed in a bucket of brine (at 25ºC, 1 bar) where $aH_2O = 0.74$? _____