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

Thermodynamics and Isotopes in Geology, Problem 3

Dissolved Oxygen in Surface Water.

Let's use thermodynamics to calculate how much oxygen gas (O_2) can be dissolved in water at 25ºC and 1 bar pressure. Let's try to get our final answer in parts per million (ppm) by weight (mass).

Step 1:
In the space below, write a reaction between oxygen in the atmosphere and oxygen in surface water:

Step 2:

$\Delta G_{O2\ (g)}$ = 0.0 KJ/mol
$\Delta G_{O2\ (aq)}$ = 16.4 KJ/mol

Using the Gibbs Free Energies for oxygen gas and dissolved (aqueous) oxygen gas listed above, calculate the ΔG of the reaction in Step 1. Express your final answer in J/mole.

Step 3:
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 3, and what you know is the $aO_{2\ (g)}$ in our atmosphere, calculate the $aO_{2\ (aq)}$ dissolved in surface water:

Step 6:
For "ideal" solutes, activity (*a*) is the same as molality (*m*; moles of solute per kilogram of solvent). Express your answer in Step 5 as molality.

Step 7:
The mass of O_2 is 32 grams per mole. Based on your answer in Step 6, how many grams of $O_{2\ (aq)}$ are found in surface water?

Step 8:
Lastly, convert the value obtained in Step 7 to ppm (by weight).

How many ppm O_2 can be dissolved in surface water? _______________

What do you think happens to the equilibrium amount of $O_{2\ (aq)}$ at T = 5ºC (i.e. cold water)?

What impact may this have on respiring organisms like fish?