Vasquez High School -- AP Chemistry -- Exam #5 -- Spring -- Chapters 14/18 -- 85 points

Write TRUE if the statement is true OR write the word that substitutes for the underlined word that would make it true. Writing false only earns partial credit. Three points each.

_____ 1) The standard entropy of a chemical reaction can be calculated from the absolute entropies of reactants and products.

_____ 2) The reversible reaction between hydrogen, nitrogen and ammonia is a good example of heterogeneous equilibrium.

_____ 3) The equilibrium constant of a reaction and the standard free-energy change of the reaction are related by the equation $\Delta G^o = -RT \ln K$.

_____ 4) ΔH is commonly known as heat content, but best defined as the enthalpy.

_____ 5) The equilibrium constant is the ratio of the rate constant for the forward reaction to that of the reverse reaction.

Short answer/Fill-in. Be neat, be clear, be complete. Three points each.

6) Give examples of a) physical equilibrium, b) chemical equilibrium, c) a spontaneous reaction at room temp.

a) _____

b) _____

c) _____

7) How did Boltzmann define entropy in terms of microstates? _____

8) Consider the reaction: $2H_2(g) + O_2(g) \text{ <==> } 2H_2O(g)$. Would there be an increase or decrease in entropy? Explain why. _____

_____

9) Why is it we can neglect solids in equilibrium constant expressions? _____

_____.

10) Complete this expression:

ΔG°_{rxn} = _____

Calculations. Be clear and neat and state appropriate formulas as necessary. Five points each unless stated.

11) How many microstates are possible for seven particles to be in any one of three locations? Evaluate.

12) Write the equilibrium constant expression for the reaction:

$$2NO_2(g) + 7H_2(g) \;<==>\; 2NH_3(g) + 4H_2O(l)$$

13) Calculate the equilibrium constant, K_{eq}, for the Haber reaction of the formation of ammonia given the concentration data at some equilibrium point: $[NH_3] = .933$ M, $[N_2] = .533$ M, $[H_2] = 1.600$ M.

14) Consider the decomposition of dinitrogen pentoxide: $2N_2O_5(g) \;<==>\; 4NO_2(g) + O_2(g)$

A 3.60 mole quantity of the dintrogen pentoxide was initially contained in a 4.50 L reaction vessel at 650 K. After equilibrium was established, it was found that only 12.0% of the N_2O_5 had decomposed. Calculate the equilibrium constant K_c for the reaction. Ten points on this one.

15) Write the general equation for Gibbs Free Energy: _____

Then consider whether an exothermic reaction is spontaneous or not if: (write your conclusion)

a) $\Delta H > 0$ and $\Delta S > 0$ _____

b) $\Delta H > 0$ and $\Delta S < 0$ _____

c) $\Delta H < 0$ and $\Delta S > 0$ _____

d) $\Delta H < 0$ and $\Delta S < 0$ _____

16) Calculate the temperatures at which reactions with the following ΔH and ΔS values would become spontaneous (five points each):

a) ΔH = -126 kJ/mol, ΔS = 84 J/Kmol

b) ΔH = -11.7 kJ/mol, ΔS = -105 J/Kmol

17) Write an expression for solving for Kc in terms of Kp for the reaction shown in problem 12 at a temperature of 77 °C.

18) Pure nitrosyl chloride, NOCl, gas was heated to 240 °C in a 1.00 L container. At equilibrium, the total pressure was exactly 1.00 atm and the NOCl pressure was 0.64 atm. The reaction looks like the one from the homework:

$$2NOCl(g) \;<==>\; 2NO(g) + Cl_2(g)$$

a) Calculate the partial pressures of NO and Cl_2 in the system.

b) Calculate the equilibrium constant, K_p.