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AP Chemistry – K_{eq} and LeChâtelier's Principle – 44

Name _____Per ___

1. Methanol, CH_3OH, can be made by the reaction: $CO_{(g)} + 2H_{2(g)} \leftrightarrow CH_3OH_{(g)}$.
(a) Use thermochemical data to calculate $\Delta H°$ for this reaction.

(b) In order to maximize the equilibrium yield of methanol, would you use a high or low temperature? Explain.

(c) In order to maximize the equilibrium yield of methanol, would you use a high or low pressure? Explain.

2. At $25°^C$ the reaction $CaCrO_{4(s)} \leftrightarrow Ca^{2+}_{(aq)} + CrO_4^{2-}{}_{(aq)}$ has an equilibrium constant $K_{eq} = 7.1 \times 10^{-4}$. What are the equilibrium concentrations of Ca^{2+} and CrO_4^{2-} in a saturated solution of $CaCrO_4$?

3. How is a reaction quotient used to determine whether a system is at equilibrium?

4. If $Q > K_{eq}$, how must the reaction proceed to reach equilibrium?

5. At the start of a certain reaction, only reactants are present. What is the value of Q at this point?

6. Consider the following reaction: $CaSO_{4(s)} \leftrightarrow Ca^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)}$. At $25^{\circ C}$ the equilibrium constant is $K_{eq} = 2.4 \times 10^{-5}$ for this reaction.
(a) If excess $CaSO_4$ is mixed with water at $25^{\circ C}$ to produce a saturated solution of $CaSO_4$, what are the equilibrium concentrations of Ca^{2+} and SO_4^{2-}?

(b) If the resulting solution has a volume of 3.0 L, what is the minimum mass of $CaSO_{4(s)}$ needed to achieve equilibrium?

7. A mixture of CH_4 and H_2O is passed over a nickel catalyst at 1000. K. The emerging gas is collected in a 5.00 L flask and is found to contain 8.62 g of CO, 2.60 g of H_2, 43.0 g of CH_4, and 48.4 g of H_2O. Assuming that equilibrium has been reached, calculate K_{eq} for the reaction.

8. The following electron configurations represent excited states. Identify the element and write its condensed ground state electron configuration.
(a) $1s^2 2s^2 3p^2 4p^1$

(b) $[Ar]3d^{10} 4s^1 4p^4 5s^1$

(c) $[Kr]4d^6 5s^2 5p^1$

9. Determine the empirical formulas of the compounds with the following compositions by mass:
(a) 24.5% Na, 14.9% Si and 60.6%F

(b) 62.1% C, 5.21% H, 12.1%N and 20.7% O

10. Calculate the molarity of a solution made by dissolving 0.125 moles of Na_2SO_4 in enough water to form exactly 750. mL of solution.

11. How many moles of $KMnO_4$ are present in 125 mL of a 0.0850 M solution?

12. How many milliliters of 11.6 M HCl solution are needed to obtain 0.255 moles of HCl?

13. Write Lewis structures for N_2H_4, N_2H_2 and N_2 and determine the hybridization around nitrogen in each case.