Chemistry 121, Fall 2010
Quiz 8

1. Calculate the concentration of a solution produced by adding 800.0 mL of water to 400.0 mL of 2.4 M NaCl.

\[
M_2 = \frac{M_1 V_1}{V_2} = \frac{(2.4 \text{ M})(400.0 \text{ mL})}{(1200.0 \text{ mL})} = 0.80 \text{ M NaCl}
\]

2. Each of the following pairs of aqueous ionic compounds are mixed. For each pair, determine whether a precipitation reaction will result. If not, write “no reaction.” If a reaction does occur, write and circle the formula of the precipitate.

a) Li₂CO₃(aq) + NaBr (aq) \[\text{No Rxn}\]

b) (NH₄)₂PO₄ (aq) + Mg(NO₃)₂ (aq) \[\text{Mg₃(PO₄)₂}\]

c) Na₃PO₄(aq) + CaCl₂ (aq) \[\text{Ca₃(PO₄)₂}\]

3. Complete the following molecular equation below, for a precipitation reaction, and then write a complete and balanced total ionic and net ionic equation as well. Make sure that every reactant and product has a state of matter labeled.

**Molecular:** \[2 \text{K}_3\text{PO}_4(aq) + 3 \text{BaCl}_2 (aq) \rightarrow \text{Ba}_3(\text{PO}_4)_2 (s) + 6 \text{KCl (aq)}\]

**Total Ionic:**

\[
6\text{K}^+ (aq) + 2\text{PO}_4^{3-} (aq) + 3\text{Ba}^{2+} (aq) + 6\text{Cl}^- (aq) \rightarrow \text{Ba}_3(\text{PO}_4)_2 (s) + 6\text{K}^+ (aq) + 6\text{Cl}^- (aq)
\]

**Net Ionic:**

\[3\text{Ba}^{2+} (aq) + 2\text{PO}_4^{3-} (aq) \rightarrow \text{Ba}_3(\text{PO}_4)_2 (s)\]

4. List **three things** you can do in the laboratory to speed up a reaction. Be specific!

- \[\Rightarrow \text{increase } T\]
- \[\Rightarrow \text{increase concentration of one or more reactants}\]
- \[\Rightarrow \text{add a catalyst}\]

5. Suppose you are conducting a reaction in the laboratory (A + B \rightarrow C), and run the reaction two times. For Trial 1, the temperature is 65 degrees C. For Trial 2, the concentrations of A and B are the same as Trial 1, but the reaction temperature is now only 15 degrees C. What difference in the rate do you expect to see for Trial 2? Explain your answer in terms of collision theory. Be specific.

\[\times \text{ Trial 2 should be slower.}\]

\[\times \text{ This occurs because at a lower } T, \text{ two molecules have less kinetic energy (are moving more slowly) therefore, the collisions between reactants will be [less frequent] and [less forceful], \& fewer collisions will result in the reaction} \]
6. Write an expression for \( K_{eq} \) for each of the following reactions:

\[
\text{a) } \text{H}_2\text{O (l)} + \text{HNO}_2 (\text{aq}) \rightleftharpoons \text{NO}_2^- (\text{aq}) + \text{H}_3\text{O}^+ (\text{aq}) \quad \text{b) } 2 \text{Na (s)} + \text{Cl}_2 (g) \rightleftharpoons 2 \text{NaCl (s)}
\]

\[
K_{eq} = \frac{[\text{NO}_2^-][\text{H}_3\text{O}^+]}{[\text{HNO}_2]} \quad \text{Key} = \frac{1}{[\text{Cl}_2]}
\]

7. For an exothermic reaction (\( A + B \rightleftharpoons C \)), what would be the effect on equilibrium if the temperature is increased?

**Shifts left (towards reactants).**

8. For an endothermic reaction (\( X + Y \rightleftharpoons W \)), what would be the effect on equilibrium if the temperature is decreased?

**Shifts left (towards reactants).**

9. Based on the reaction below and the molecular-level view of the reaction container at equilibrium, would you expect the value of \( K_{eq} \) to be less than 1 or greater than 1? The nitrogen atoms are black and the hydrogens are white.

\[
\text{N}_2 + 3 \text{H}_2 \rightleftharpoons 2 \text{NH}_3
\]

\[
\begin{array}{ccc}
\text{products are favored} & \Rightarrow & \text{Key} < 1
\end{array}
\]

9. For the equilibrium below, predict the effect each of the following changes will have on the equilibrium. The reaction is exothermic.

\[
\text{C}_6\text{H}_12\text{O}_6 (s) + 6 \text{O}_2 (g) \rightleftharpoons 6 \text{CO}_2 (g) + 6 \text{H}_2\text{O} (g) \quad + \text{heat}
\]

a) Gaseous water is added to the reaction chamber. **Shifts left.**

b) The reaction container is compressed. **Shifts left.**

c) The reaction mixture is cooled. **Shifts right.**

d) More \( \text{C}_6\text{H}_12\text{O}_6 \) is added. **No effect**

e) A substance is added to consume most of the oxygen gas in the reaction. **Shifts left.**

\[
\text{K}_{eq} = \text{amount products/amount reactants} \quad \text{M}_1\text{V}_1 = \text{M}_2\text{V}_2
\]