CHMY 121
Problem Set 5

1. Which of the following solutions has the greatest osmotic pressure? (Calculate the osmolarity for each solution)
   a) 0.6 M NaCl  b) 0.35 M AlCl₃  c) 0.8% wt/v NaCl  d) 0.2 M CaBr₂

2. If you have a container with two chambers separated by a semipermeable membrane if compartment A contains 4% wt/v BaCl₂, which of the following solutions when placed in compartment B will cause the level in A to rise? (Calculate the osmolarity for each solution)
   a) 4% wt/v Al₂(SO₄)₃  b) 4% wt/v K₂CO₃  c) 4% wt/v NaBr  d) 4% wt/v BaBr₂

3. A 0.89% wt/v saline (NaCl) solution is isotonic with blood plasma... Determine whether the following solutions would cause crenation, hemolysis (cells burst) or leave the cells alone.
   a) 0.89% wt/v NaBr  b) 0.89% wt/v glucose (C₆H₁₂O₆)  c) 0.15 M BaCl₂  d) 0.15 M KCl

4. Below are the conditions for 5 reactions: A + B -----> C
<table>
<thead>
<tr>
<th>Reaction</th>
<th>Ea</th>
<th>Temp</th>
<th>Concentrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>low</td>
<td>high</td>
<td>1 mole A and 1 mole B</td>
</tr>
<tr>
<td>2</td>
<td>low</td>
<td>low</td>
<td>1 mole A and 2 mole B</td>
</tr>
<tr>
<td>3</td>
<td>low</td>
<td>low</td>
<td>1 mole A and 2 mole B</td>
</tr>
<tr>
<td>4</td>
<td>high</td>
<td>low</td>
<td>1 mole A and 1 mole B</td>
</tr>
<tr>
<td>5</td>
<td>high</td>
<td>high</td>
<td>1 mole A and 1 mole B</td>
</tr>
</tbody>
</table>

   Predict which reaction of the pair will proceed faster for each of the following pairs:
   a) 1 and 2  b) 1 and 3  c) 2 and 3  d) 4 and 5

5. Write the equilibrium expression for each of the following reactions:
   a) 2NaHCO₃(s) <=> Na₂CO₃(s) + H₂O(g) + CO₂(g)
   b) C(s) + CO₂(g) <=> 2CO(g)
   c) 2H₂S(g) + CH₄(g) <=> CS₂(g) + 4H₂(g)

6. At a certain temperature the reaction: CO(g) + 2H₂(g) ⇌ CH₃OH(g)
   has an equilibrium constant of 0.500. If a reaction mixture at equilibrium contains 0.210 M CO and 0.0153 M CH₃OH what is the concentration of H₂?

7. What is the equilibrium constant of the reaction 2NO₂(g) + 7H₂(g) ⇌ 2NH₃(g) + 4H₂O(g) at a given temperature if the concentrations were found to be as follows? Is the forward or reverse reaction favored?
   [NO₂] = 0.200 M, [H₂] = 1.50 M, [NH₃] = 0.500 M, and [H₂O] = 0.360 M

8. Using Le Chatelier's Principle predict which way the equilibrium will shift (right, left or no change) for the following exothermic reaction upon the following changes.

   N₂(g) + 3H₂(g) ⇌ 2NH₃(g)
   a) add N₂  b) remove NH₃  c) remove H₂  d) increase temperature
   e) add a catalyst  f) add an inert gas  g) decrease volume

9. What is the conjugate acid of each of the following?
   a) Cl⁻  b) SO₄²⁻  c) H₂PO₄⁻  d) NH₃  e) HCO₃⁻

10. What is the conjugate base for each of the following?
    a) HSO₄⁻  b) HNO₃  c) H₃O⁺  d) HCO₃⁻  e) HPO₄²⁻

11. Calculate the Kₘₜ for the following base. Is the base weak or strong?
    B + H₂O ⇌ HB⁺ + OH⁻
    where [B] = 8.0 x 10⁻², [HB⁺] = 1.2 x 10⁻² and [OH⁻] = 1.2 x 10⁻²
12. Calculate the pH of a solution which has a hydronium ion concentration of $9.43 \times 10^{-6}$. Is this solution acidic, basic or neutral?

13. Calculate the hydroxide ion concentration for a solution with the pH of 9.41

14. Calculate the hydronium ion concentration for a solution with the pOH of 4.67.

15. How many grams of magnesium hydroxide ($\text{Mg(OH)}_2$) are needed to prepare 250.0 mL of a 1.54 N solution?

16. What is the normality of a solution made by dissolving 32.68 g of aluminum hydroxide in enough water to make a total solution volume of 500.0 mL?

17. What is the normality of a phosphoric acid solution if 25.50 mL of a 1.25 N solution of sodium hydroxide is needed to titrate 15.00 mL of the acid?

18. What is the molarity of a 51.7 mL sample of $\text{H}_2\text{SO}_4$ solution that is titrated with 43.6 mL of a 0.135 N solution of NaOH?

19. What is the molarity of a carbonic acid solution that needed 10.25 mL of a 3.00 N potassium hydroxide solution to titrate 15.00 mL of the acid.