Study Guide – Honors Chemistry
Solubility, Concentration, Equilibrium

Chm.3.1.1 Explain the factors that affect the rate of a reaction (temperature, concentration, particle size and presence of a catalyst).

- Understand qualitatively that reaction rate is proportional to number of effective collisions. ***(Question 4)***
- Explain that nature of reactants can refer to their complexity and the number of bonds that must be broken and reformed in the course of reaction.
- Explain how temperature (kinetic energy), concentration, and/or pressure affects the number of collisions. ***(Question 5)***
- Explain how increased surface area increases number of collisions.
- Explain how a catalyst lowers the activation energy, so that at a given temperature, more molecules will have energy equal to or greater than the activation energy.

Chm.3.1.2 Explain the conditions of a system at equilibrium.

- Define chemical equilibrium for reversible reactions.
- Distinguish between equal rates and equal concentrations.
- Explain equilibrium expressions for a given reaction. ***(Questions 12,13)***
- Evaluate equilibrium constants as a measure of the extent that the reaction proceeds to completion. ***(Question 14)***

Chm.3.1.3 Infer the shift in equilibrium when a stress is applied to a chemical system (Le Chatelier's Principle).

- Determine the effects of stresses on systems at equilibrium. (Adding/ removing a reactant or product; adding/removing heat; increasing/decreasing pressure) ***(Questions 12,13)***
- Relate the shift that occurs in terms of the order/disorder of the system. ***(Questions 12,13)***

Chm.3.2.3 Infer the quantitative nature of a solution (molarity, dilution, and titration with a 1:1 molar ratio).

- Compute concentration (molarity) of solutions in moles per liter. ***(Question 7,8)***
- Calculate molarity given mass of solute and volume of solution. ***(Question 7)***
- Calculate mass of solute needed to create a solution of a given molarity and volume. ***(Questions 9,11)***
- Solve dilution problems: $M_1V_1 = M_2V_2$. ***(Question 10)***
- Perform 1:1 titration calculations: $M_AV_A = M_BV_B$
- Determine concentration of an acid or base using titration. Interpret titration curve for strong acid/strong base.

Chm.3.2.4 Summarize the properties of solutions.

- Identify types of solutions (solid, liquid, gaseous, aqueous). ***(Question 1)***
- Define solutions as homogeneous mixtures in a single phase.
- Distinguish between electrolytic and nonelectrolytic solutions.
- Summarize colligative properties (vapor pressure reduction, boiling point elevation, freezing point depression, and osmotic pressure). **Note:** *Conceptual understanding only–**no calculations***.

Chm.3.2.5 Interpret solubility diagrams.

- Use graph of solubility vs. temperature to identify a substance based on solubility at a particular temperature. ***(Questions 2,3,6)***
- Use graph to relate the degree of saturation of solutions to temperature. ***(Questions 2,3,6)***

Chm.3.2.6 Explain the solution process.

- Develop a conceptual model for the solution process with a cause and effect relationship involving forces of attraction between solute and solvent particles. A material is insoluble due to a lack of attraction between particles.
- Describe the energetics of the solution process as it occurs and the overall process as exothermic or endothermic.
- Explain solubility in terms of the nature of solute-solvent attraction, temperature and pressure (for gases). ***(Question 5)***

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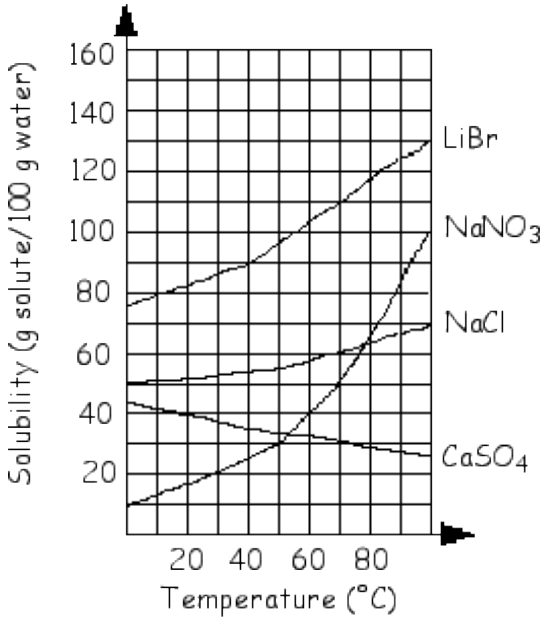
Practice Problems:

Solubility:

1) **CIRCLE** each substance below that should be soluble in water based on "Like Dissolves Like" and the Solubility Rules.
***** MAKE SURE YOU KNOW WHY!! *****

a) $BaCO_3$
b) $NaNO_3$
c) $AgCl$
d) $CuSO_4$
e) $LiC_2H_3O_2$
f) $(NH_4)_2S$
g) $Fe(OH)_3$
h) PbI_2
i) NH_3
j) CH_4
k) Br_2
l) SCl_2

2) Use the solubility curve to the right. Is a solution of 22.0 g of NaCl in 40.0 g of water at 70° C saturated, unsaturated or supersaturated? ***Show your work!!***



3) Using the solubility curve above, how much water is needed to dissolve 11.0 g of LiBr at 70° C? ***Show your work!!***

4) What are three (3) ways of speeding up ***the rate*** at which sugar dissolves in water?

5) A) How would you increase ***the amount*** of a solid solute that dissolves in a solution?

B) How would you increase ***the amount*** of a gas solute that dissolves in a solution?

6) Describe the procedure for making a supersaturated solution.

Concentration (Molarity):

7) If you have 3.00 g of LiOH dissolved in enough water to make a 45.0 mL solution, what is the molarity?

8) What volume of Na_2S solution should you measure out if you want 0.0150 moles of Na_2S and the solution has a concentration of 2.50 M?

9) What mass of solute is needed to prepare 50.0 mL of a 0.150 M solution of H_2SO_4 ?

10) If 35.0 mL of 1.50 M solution is diluted to 100. mL, what is the concentration of the dilute solution?

11) If 25.0 mL of 0.330 M $CuCl_2$ solution reacts with excess aluminum, what is the mass of copper that will form? *(Hint: Write a balanced chemical equation)*

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Equilibrium:

12) Use the equation below to answer the following questions:

$3\ Fe_{(s)} + 4\ H_2O_{(g)} \leftrightarrow Fe_3O_{4\ (s)} + 4\ H_{2\ (g)} + Energy$

a) Predict the shift ***(left or right)*** if the amount of water is increased. _____

b) Predict the shift ***(left or right)*** if H_2 is removed as it is formed. _____

c) Predict the shift ***(left or right)*** if temperature is increased. _____

d) Write the equilibrium constant expression:

13) Use the equation below to answer the following questions:

$2\ H_2S_{(g)} + Heat \leftrightarrow 2\ H_{2\ (g)} + S_{2\ (g)}$

a) Predict the shift ***(left or right)*** if pressure is increased. _____

b) Predict the shift ***(left or right)*** if H_2 is added. _____

c) Predict the shift ***(left or right)*** if temperature is increased. _____

d) Predict the shift ***(left or right)*** if volume is increased. _____

e) Predict the shift ***(left or right)*** if S_2 is removed. _____

f) Write the equilibrium constant expression:

14) Which are favored, reactants or products?

a) $K > 1$

b) $K < 1$