2015

Name _____ Date _____ Period _____

UNIT 12: SOLUTIONS, ACIDS AND BASES

7. Solutions, Rates of Reaction, and Equilibrium

Broad Concept: Solids, liquids, and gases dissolve to form solutions. Rates of reaction and chemical equilibrium are dynamic processes that are significant in many systems (biological, ecological, and geological).

7.1 Describe the process by which solutes dissolve in solvents.

7.3 Identify and explain the factors that affect the rate of dissolving, such as, temperature, concentration, surface area, pressure, and mixing.

8. Acids and Bases and Oxidation-Reduction Reactions

Broad Concept: Acids and bases are important in numerous chemical processes that occur around us, from industrial procedures to biological ones, from the laboratory to the environment. Oxidation-reduction reactions occur when one substance transfers electrons to another substance and constitutes a major class of chemical reactions.

8.1 Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronsted-Lowry theory of acids and bases in terms of proton donor and acceptor.

8.2 Relate hydrogen ion concentrations to the pH scale, and to acidic, basic, and neutral solutions. Compare and contrast the strength of various common acids and bases such as vinegar, baking soda, soap, and citrus juice.

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CHAPTER 13 SOLUTIONS (Ch. 12 in Blue book)

Sections 13.1 page 395
at home 12.1 page 401

1. (a) How are mixtures classified?

   (b) Identify three types of mixtures.

2. What is meant by the term soluble?

3. What is a solution?

4. Identify and define two components of a solution.

5. Give two examples of common solutions.

6. Distinguish between electrolytes and nonelectrolytes and give an example of each.

7. Generally what types of substances are electrolytes?

8. What is a suspension?

9. How does it differ from a solution?

10. What is a colloid?

11. Identify its two phases. _____

12. Identify a common colloid that is
    a) an emulsion _____ c) an emulsifying agent _____
    b) a gel _____

13. What is the Tyndall effect?

Do Section Review p. 400. #s 1-5

(page 410 at home)

Answer the Section Review Questions here:

Section 13-2 (12-2)

14. List three ways in which the rate at which sugar is dissolved can be increased.
    1. _____
    2. _____
    3. _____

15. What is solution equilibrium?

    _____

16. The point at which equilibrium is reached for any solute-solvent combination is dependent on what 3 factors?

    _____ _____ _____

    What is the difference between dissolving and recrystallizing?

    _____

17. What is a saturated solution? What visible evidence is there to indicate a solution is at its point of saturation?

    _____

18. What is an unsaturated solution?

    _____

19. What is meant by the solubility of a substance?

    _____

20. List three factors that effect the solubility of a substance?
    1. _____
    2. _____
    3. _____

21. What would be an example of substances that are immiscible?

    _____

22. Gasoline is an excellent solvent to dissolve fats, oils, and grease. Explain why this is a true statement.

    _____

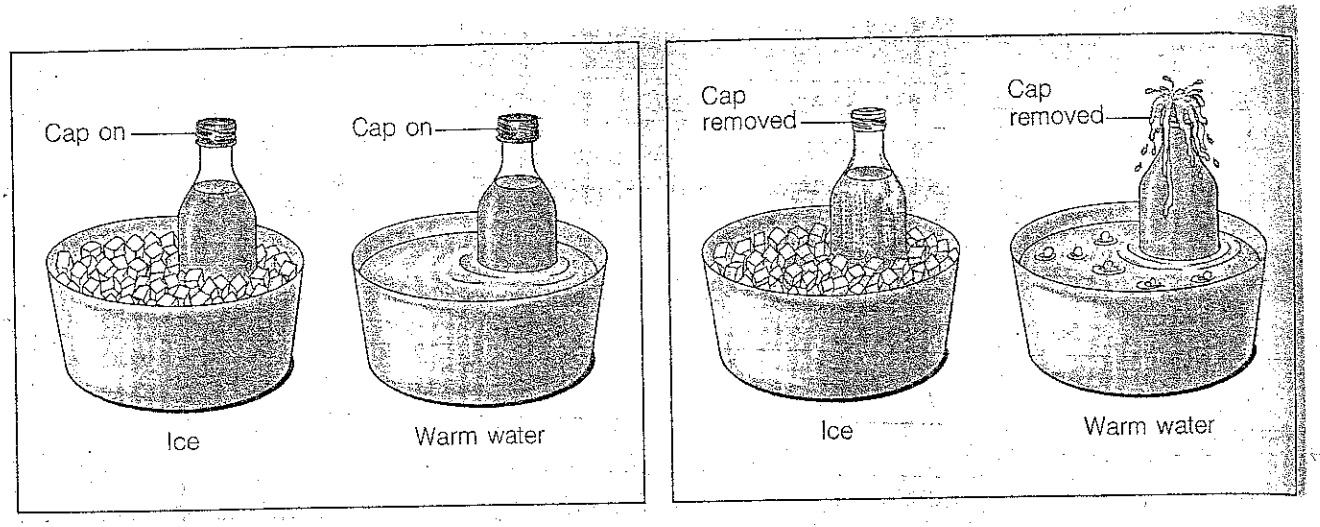
23. Compare the diagram 1 to diagram 2 in terms of temperature, pressure and the solubility of the gas in the sodas.

_____

_____

_____

❖ Raising the temperature of a gas-in-liquid solution decreases the solubility of the gaseous solute. Thus, the solubility of a gas decreases as the temperature increases.



24. What is the heat of solution? What happens when the heat of solution is positive? When it is negative?

_____

_____

_____

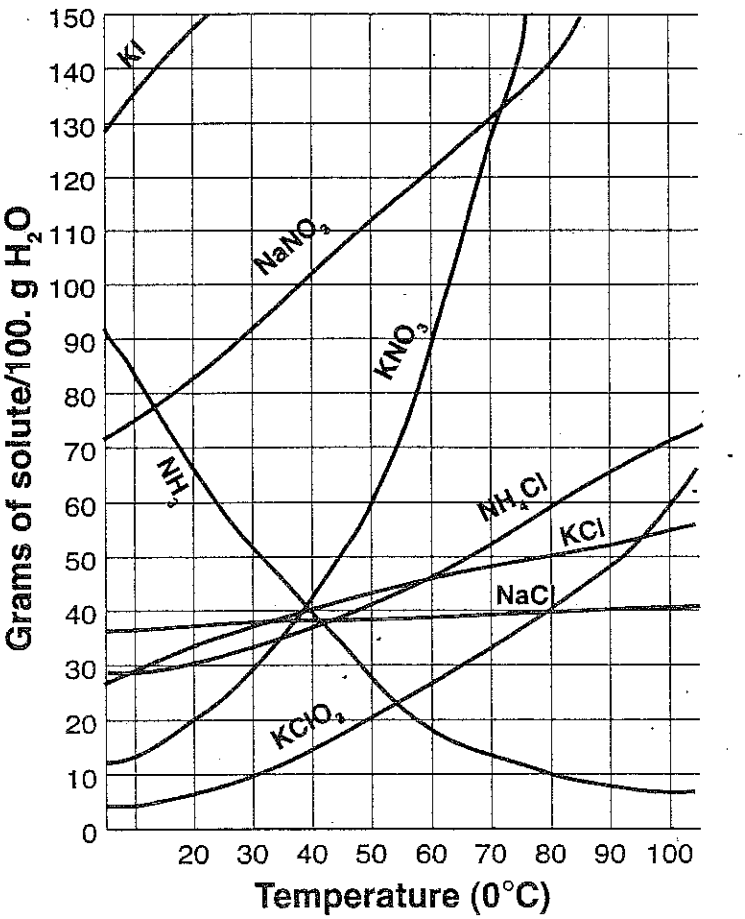
_____

Page 410 Section Review #s 1-5 (page 416 at home)

SOLUBILITY CURVES

Name _____

Answer the following questions based on the solubility curve below.



1. Which salt is least soluble in water at 20° C? _____

2. How many grams of potassium chloride can be dissolved in 200 g of water at 80° C?

   _____

3. At 40° C, how much potassium nitrate can be dissolved in 300 g of water? _____

4. Which salt shows the least change in solubility from 0° – 100° C?

   _____

5. At 30° C, 90 g of sodium nitrate is dissolved in 100 g of water. Is this solution saturated, unsaturated or supersaturated?

   _____

6. A saturated solution of potassium chlorate is formed from one hundred grams of water. If the saturated solution is cooled from 80° C to 50° C, how many grams of precipitate are formed? _____

7. What compound shows a decrease in solubility from 0° to 100° C? _____

8. Which salt is most soluble at 10° C? _____

9. Which salt is least soluble at 50° C? _____

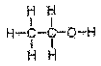
10. Which salt is least soluble at 90° C? _____

SOLUBILITY (POLAR VS. NONPOLAR)

Name _____

Generally, "like dissolves like." Polar molecules dissolve other polar molecules and ionic compounds. Nonpolar molecules dissolve other nonpolar molecules. Alcohols, which have characteristics of both, tend to dissolve in both types of solvents, but will not dissolve ionic solids.

Check the appropriate columns as to whether the solute is soluble in a polar or nonpolar solvent.

SOLUTES	SOLVENTS		
	Water	CCl_4	Alcohol
1. NaCl			
2. I_2			
3. ethanol 			
4. benzene 			
5. Br_2			
6. KNO_3			
7. toluene 			
8. $Ca(OH)_2$			

Solutions

II. Concentration

Solutions II Concentration

- The amount of solute in a solution.
- Describing Concentration
  - % by mass - medicated creams
  - % by volume - rubbing alcohol
  - ppm, ppb - water contaminants
  - molarity - used by chemists
  - molality - used by chemists

A. Molarity

- Concentration of a solution.

substance being dissolved

$$Molarity\,(M) = \frac{moles\ of\ solute}{liters\ of\ solution}$$

total combined volume

A. Molarity

$2M\ HCl$ What does this mean?

$$M = \frac{mol}{L}$$

$$2M\ HCl = \frac{2\ mol\ HCl}{1\ L}$$

A. Molarity Calculations

- How many grams of NaCl are required to make 0.500L of 0.25*M* NaCl?

$$0.500\,\cancel{L} \times \frac{0.25\,\cancel{mol}}{1\,\cancel{L}} \times \frac{58.44\ g}{1\,\cancel{mol}} = 7.3\ g\ NaCl$$

$$0.25M = \frac{0.25\ mol}{1\ L}$$

A. Molarity Calculations

- Find the molarity of a 250 mL solution containing 10.0 g of NaF.

$$10.0\,\cancel{g} \times \frac{1\ mol}{41.99\,\cancel{g}} = 0.238\ mol\ NaF$$

$$M = \frac{mol}{L}$$

$$M = \frac{0.238\ mol}{0.25\ L} = 0.95M\ NaF$$

B. Molality

$$\text{molality } (m) = \frac{\text{moles of solute}}{\text{kg of solvent}}$$

mass of solvent only

$$0.25m = \frac{0.25\ mol}{1\ kg}$$

1 kg water = 1 L water

B. Molality

- Find the molality of a solution containing 75 g of $MgCl_2$ in 250 mL of water.

75 g ~~$MgCl_2$~~	1 mol $MgCl_2$	
	95.21 ~~g $MgCl_2$~~	0.25 kg water

$$m = \frac{mol}{kg}$$

= 3.2*m* $MgCl_2$

B. Molality

- How many grams of NaCl are req'd to make a 1.54*m* solution using 0.500 kg of water?

0.500 ~~kg water~~	1.54 ~~mol NaCl~~	58.44 g NaCl
	1 ~~kg water~~	1 ~~mol NaCl~~

$$1.5m = \frac{1.5\ mol}{1\ kg}$$

= 45.0 g NaCl

C. Dilution

- Preparation of a desired solution by adding water to a concentrate.
- Moles of solute remain the same.

$$M_1V_1 = M_2V_2$$

C. Dilution

- What volume of 15.8*M* HNO_3 is required to make 250 mL of a 6.0*M* solution?

GIVEN:	WORK:
M_1 = 15.8*M*	$M_1V_1 = M_2V_2$
V_1 = ?	(15.8*M*) V_1 = (6.0*M*)(250mL)
M_2 = 6.0*M*	V_1 = 95 mL of 15.8*M* HNO_3
V_2 = 250 mL	

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CONCENTRATION – UNIT 12

1. Find the molarity of a solution in which 58 g of NaCl are dissolved in 2.5 L of solution.

GIVEN	WORK
ANSWER:	

2. How many grams of $KMnO_4$ should be used to prepare 2.00 L of a 0.500*M* solution?

GIVEN	WORK
ANSWER:	

3. What volume of 0.25*M* solution can be made from 5.0 g of KCl?

GIVEN	WORK
ANSWER:	

4. What is the molality of a solution containing 7.8 g of $MgCl_2$ in 725 g of water?

GIVEN	WORK
ANSWER:	

5. How many grams of ethanol, C_2H_5OH, are required to make a 7.1*m* solution using 160.0 g of water?

GIVEN	WORK
ANSWER:	

6. What volume of concentrated 18*M* H_2SO_4 is required to prepare 250 mL of a 6.0*M* solution?

GIVEN	WORK
ANSWER:	

7. If 25.0 mL of 15*M* nitric acid is diluted to 125 mL, what is the concentration of the new solution?

GIVEN	WORK
ANSWER:	

8. Describe how you would prepare the solutions in #2 and #3. (see figure 13-17 pg. 413 in orange MC text or Figure 17 page 419 in the blue MC text book)

Unit 12 Solutions

Notes Part III. Colligative Properties

A. Definition

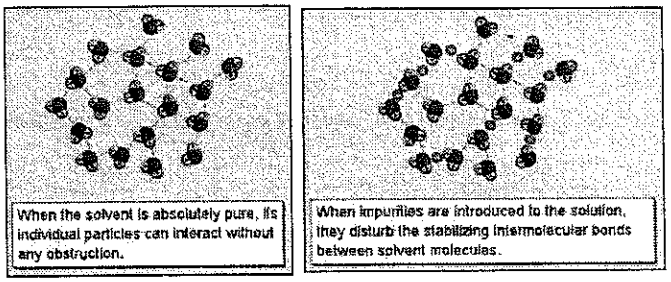
- Colligative Property
  - _____
    _____
    _____
    _____

B. Types

- Freezing Point Depression (Δt_f)
  - _____
    _____
- Boiling Point Elevation (Δt_b)
  - _____
    _____

B. Types

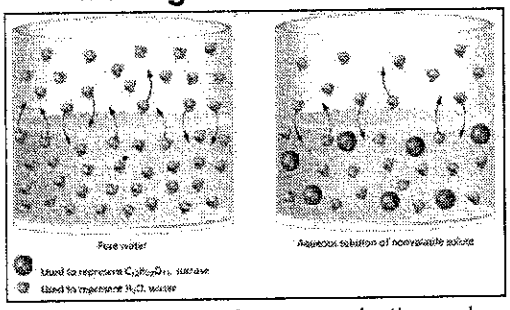
Freezing Point Depression



View Flash animation.

B. Types

Boiling Point Elevation



Solute particles weaken _____ in the solvent.

B. Types

- Applications
  - _____
  - _____
  - _____
    - cars (-64°C to 136°C)
  - _____

C. Calculations

$$\Delta t = k \cdot m \cdot n$$

Δt: change in temperature (°C)

k: constant based on the solvent ($°C \cdot kg/mol$)

m: molality (m)

n: # of particles

C. Calculations

◆ **# of Particles**

- **Nonelectrolytes (_____)**
  - _____
  - _____
- **Electrolytes (_____)**
  - _____
  - _____

C. Calculations

◆ At what temperature will a solution that is composed of 0.73 moles of glucose in 225 g of phenol boil?

GIVEN:	WORK:
b.p. = Δt_b = k_b = m = n = $\Delta t_b = k_b \cdot m \cdot n$	m =

C. Calculations

◆ Find the freezing point of a saturated solution of NaCl containing 28 g NaCl in 100. mL water.

GIVEN:	WORK:
f.p. = Δt_f = k_f = m = n = $\Delta t_f = k_f \cdot m \cdot n$	

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COLLIGATIVE PROPERTIES OF SOLUTIONS B.P. ELEVATION AND F.P. DEPRESSION

PART A – CALCULATIONS (See lecture handout or p. 438 for reference information.)

1. Indicate how many particles are formed when the following solutes dissolve.

SOLUTE	# OF PARTICLES	SOLUTE	# OF PARTICLES
sucrose ($C_{12}H_{22}O_{11}$)		magnesium chloride ($MgCl_2$)	
sodium sulfate (Na_2SO_4)		methanol (CH_3OH)	

2. When 5.0 g of $CaCl_2$ dissolves in 50.0 g of water, what is the boiling point of the solution?

GIVEN	WORK
ANSWER:	

3. Find the boiling point of a solution containing 6.0 g benzene, C_6H_6, in 35 g of napthalene. → NBP 217.7°C K_b = 5.80°C/m

GIVEN	WORK
ANSWER:	

4. Ms. Robbins' feet are aching at the end of a long day. At home, she dissolves 26.0 g of Epsom salt, $MgSO_4$, in 1.5 kg of water. What is the freezing point of this solution?

GIVEN	WORK
ANSWER:	

PART B – APPLICATIONS (Answer the following questions thoughtfully and in full sentences.)

5. Salt is often used to remove ice from roads and sidewalks. Explain how this process works in terms of colligative properties.

6. Which salt, NaCl or $CaCl_2$, has a greater effect on freezing point? Explain.