Quizzes

12 Solutions

Section: Types of Mixtures

1. a	2. b
3. c	4. b
5. d	6. c
7. a	8. a
9. b	10. c

Section: The Solution Process

1. d	2. a
3. d	4. c
5. a	6. c
7. a	8. d
9. d	10. d

Section: Concentration of Solutions

1. c	2. a
3. a	4. d
5. c	6. d
7. a	8. d
9. b	10. c

Quizzes

13 Ions in Aqueous Solutions and Colligative Properties

Section: Compunds in Aqueous Soutions

1. d	2. a
3. a	4. c
5. a	6. d
7. c	8. a
9. b	10. b

Section: Colligative Properties of Solutions

1. b	2. b
3. d	4. b
5. c	6. a
7. c	8. b
9. c	10. b

14 Acids and Bases

Section: Properties of Acids and Bases

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.

Section: Acid-Base Theories

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.

Section: Acid-Base Reactions

1.	2. c
3.	4.
5.	6.
7.	8.
9. a	10.

15 Acid-Base Titration and pH

Section: Aqueous Solutions and the Concept of pH

1.	2. d
3.	4.
5.	6.
7.	8.
9.	10.

Section: Determining pH and Titrations

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.

16 Reaction Energy

Section: Thermochemistry

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.

Section: Driving Forces of Reactions

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.

Name _____ Date _____ Class _____

CHAPTER 12 REVIEW

Solutions

SECTION 1

SHORT ANSWER **Answer the following questions in the space provided.**

1. Match the type of mixture on the left to its representative particle diameter on the right.

c	solutions	(a) larger than 1000 nm
a	suspensions	(b) 1 nm to 1000 nm
b	colloids	(c) smaller than 1 nm

2. Identify the solvent in each of the following examples:

alcohol	**a.** tincture of iodine (iodine dissolved in ethyl alcohol)
water	**b.** sea water
the gels	**c.** water-absorbing super gels

3. A certain mixture has the following properties:

- No solid settles out during a 48-hour period.
- The path of a flashlight beam is easily seen through the mixture.
- It appears to be homogeneous under a hand lens but not under a microscope.

Is the mixture a suspension, colloid, or true solution? Explain your answer.

The mixture is a colloid. The properties are consistent with those reported in Table 3 on page 404 of the text. The particle size is small, but not too small, and the mixture exhibits the Tyndall effect.

4. Define each of the following terms:

a. alloy

a homogeneous mixture of two or more solid metals

b. electrolyte

a substance that dissolves in water to form a solution that conducts an electric current

SECTION 1 continued

c. aerosol

a colloidal dispersion of a solid or a liquid in a gas

d. aqueous solution

a mixture with a soluble solute and water as the solvent

5. For each of the following types of solutions, give an example other than those listed in **Table 1** on page 402 of the text:

a. a gas in a liquid

oxygen gas dissolved in water (needed by fish)

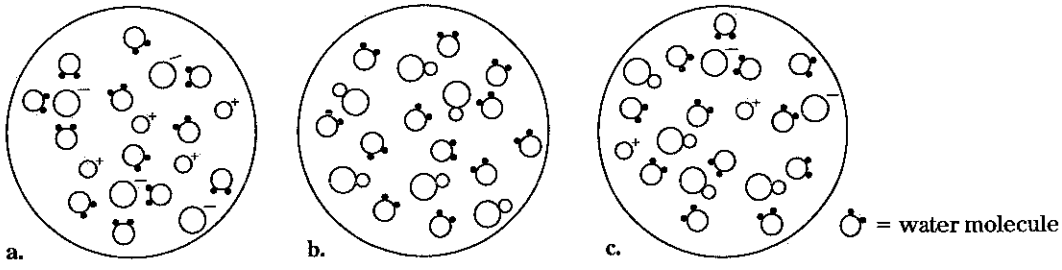
b. a liquid in a liquid

antifreeze, which is ethylene glycol dissolved in water

c. a solid in a liquid

salt dissolved in water or iodine in alcohol

6. Using the following models of solutions shown at the particle level, indicate which will conduct electricity. Give a reason for each model.



a. will conduct electricity because ions are present

b. will not conduct electricity because ions are not present

c. will conduct electricity slightly because some ions have formed

Name _____ Date _____ Class _____

CHAPTER 12 REVIEW

Solutions

SECTION 2

SHORT ANSWER **Answer the following questions in the space provided.**

1. The following are statements about the dissolving process. Explain each one at the molecular level.

a. Increasing the pressure of a solute gas above a liquid solution increases the solubility of the gas in the liquid.

Increasing the pressure of the solute gas above the solution puts stress on the equilibrium of the system. Gas molecules collide with the liquid surface more often, causing an increase in the rate of gas molecules entering into solution.

b. Increasing the temperature of water speeds up the rate at which many solids dissolve in this solvent.

As the temperature of the water increases, water molecules move faster, increasing their average kinetic energy. At higher temperatures, collisions between the water molecules and the solute are more frequent and are of higher energy than at lower temperatures. This helps to separate solute particles from one another and to disperse them among the water molecules.

c. Increasing the surface area of a solid solute speeds up the rate at which it dissolves in a liquid solvent.

Increasing the surface area of a solid exposes more of the solute to the solvent, allowing the solvent to come into contact with more of the solute in a shorter length of time.

2. The solubility of $KClO_3$ at 25°C is 10. g of solute per 100. g of H_2O.

a. If 15 g of $KClO_3$ are stirred into 100 g of water at 25°C, how much of the $KClO_3$ will dissolve? Is the solution saturated, unsaturated, or supersaturated?

10 g of $KClO_3$ will dissolve, but 5 g will not, despite thorough stirring. The solution is saturated.

Name _____ Date _____ Class _____

SECTION 2 continued

b. If 15 g of $KClO_3$ are stirred into 200 g of water at 25°C, how much of the $KClO_3$ will dissolve? Is the solution saturated, unsaturated, or supersaturated?

All 15 g of $KClO_3$ will dissolve; the solution is unsaturated.

PROBLEMS **Write the answer on the line to the left. Show all your work in the space provided.**

3. Use the data in **Table 4** on page 410 of the text to answer the following questions:

250. g **a.** How many grams of LiCl are needed to make a saturated solution with 300. g of water at 20°C?

50. g **b.** What is the minimum amount of water needed to dissolve 51 g of $NaNO_3$ at 40°C?

KI **c.** Which solute forms a saturated solution when 36 g of it are dissolved in 25 g of water at 20°C?

4. KOH is an ionic solid readily soluble in water.

−1.027 kJ/g **a.** What is its enthalpy of solution in kJ/g? Refer to the data in **Table 5** on page 416 of the text.

b. Will the temperature of the system increase or decrease as the dissolution of KOH proceeds? Why?

The temperature of the system will increase because the enthalpy of solution is negative, indicating that the reaction is exothermic, giving off energy as heat and warming up the system.

Name _____ Date _____ Class _____

CHAPTER 12 REVIEW

Solutions

SECTION 3

SHORT ANSWER **Answer the following questions in the space provided.**

1. Describe the errors made by the following students in making molar solutions.

a. James needs a 0.600 M solution of KCl. He measures out 0.600 g of KCl and adds 1 L of water to the solid.

James made several errors. First, 0.600 mol of KCl does not have a mass of 0.600 g. Also, adding 1.0 L of water to the solid does not produce 1.0 L of solution. He did not make a 0.600 M solution.

b. Mary needs a 0.02 M solution of $NaNO_3$. She calculates that she needs 2.00 g of $NaNO_3$ for 0.02 mol. She puts this solid into a 1.00 L volumetric flask and fills the flask to the 1.00 L mark.

Mary did not produce the required solution either. First, 0.02 mol of $NaNO_3$ has a mass of 1.70 g, not 2.00 g. Also, she should have made sure the solute was completely dissolved before continuing to fill the volumetric flask to the 1.00 L mark.

PROBLEMS **Write the answer on the line to the left. Show all of your work in the space provided.**

2. **0.33 M** What is the molarity of a solution made by dissolving 2.0 mol of solute in 6.0 L of solvent?

3. **1.0 *m*** CH_3OH is soluble in water. What is the molality of a solution made by dissolving 8.0 g of CH_3OH in 250. g of water?

Name _____ Date _____ Class _____

SECTION 3 continued

4. Marble chips effervesce when treated with hydrochloric acid. This reaction is represented by the following equation:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

To produce a reaction, 25.0 mL of 4.0 M HCl is added to excess $CaCO_3$.

0.10 mol **a.** How many moles of HCl are consumed in this reaction?

1.1 L **b.** How many liters of CO_2 are produced at STP?

5.0 g **c.** How many grams of $CaCO_3$ are consumed?

5. Tincture of iodine is $I_2(s)$ dissolved in ethanol, C_2H_5OH. A 1% solution of tincture of iodine is 10.0 g of solute for 1000. g of solution.

990. g **a.** How many grams of solvent are present in 1000. g of this solution?

0.0394 mol **b.** How many moles of solute are in 10.0 g of I_2?

0.0398 *m* **c.** What is the molality of this 1% solution?

d. To determine a solution's molarity, the density of that solution can be used. Explain how you would use the density of the tincture of iodine solution to calculate its molarity.

The density of a solution can be expressed in g/mL or in kg/L. Divide 1.00 kg by the solution's density to find the volume of solution in liters. Then divide 0.0394 mol by this volume to arrive at the molarity.

Name _____ Date _____ Class _____

CHAPTER 12 REVIEW

Solutions

MIXED REVIEW

SHORT ANSWER **Answer the following questions in the space provided.**

1. Solid $CaCl_2$ does not conduct electricity. Explain why it is considered to be an electrolyte.

$CaCl_2$ is an ionic solid. In the crystal form, its ions are locked in position. Dissolving the crystal in water releases the ions to move freely, allowing them to conduct electricity.

2. Explain the following statements at the molecular level:

a. Generally, a polar liquid and a nonpolar liquid are immiscible.

Polar molecules tend to attract one another, forcing the nonpolar molecules to remain in a separate layer.

b. Carbonated soft drinks taste flat when they warm up.

The solubility of gases usually decreases as the temperature of the solution increases. At higher temperatures, more CO_2 molecules escape through the liquid's surface, leaving fewer molecules in solution to effervesce.

3. An unknown compound is observed to mix with toluene, $C_6H_5CH_3$, but not with water.

a. Is the unknown compound ionic, polar covalent, or nonpolar covalent? Explain your answer.

nonpolar covalent, because it mixes with nonpolar toluene and not with polar water

b. Suppose the unknown compound is also a liquid. Will it be able to dissolve table salt? Explain why or why not.

No; being nonpolar, the solvent molecules are unable to remove ions from sodium chloride's crystal surfaces.

Name _____ Date _____ Class _____

MIXED REVIEW continued

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

4. Consider 500. mL of a 0.30 M $CuSO_4$ solution.

0.15 mol **a.** How many moles of solute are present in this solution?

24 g **b.** How many grams of solute were used to prepare this solution?

5. **a.** If a solution is electrically neutral, can all of its ions have the same type of charge? Explain your answer.

No; to be neutral the total positive charge must equal the total negative charge.

6.0×10^{13} ions **b.** The concentration of the OH^- ions in pure water is known to be 1.0×10^{-7} M. How many OH^- ions are present in each milliliter of pure water?

6. 90. g of $CaBr_2$ are dissolved in 900. g of water.

900. mL **a.** What volume does the 900. g of water occupy if its density is 1.00 g/mL?

0.50 *m* **b.** What is the molality of this solution?

Name _____ Date _____ Class _____

CHAPTER 13 REVIEW

Ions in Aqueous Solutions and Colligative Properties

SECTION 1

SHORT ANSWER **Answer the following questions in the space provided.**

1. Use the guidelines in **Table 1** on page 437 of the text to predict the solubility of the following compounds in water:

soluble **a.** magnesium nitrate

insoluble **b.** barium sulfate

insoluble **c.** calcium carbonate

soluble **d.** ammonium phosphate

2. 1.0 mol of magnesium acetate is dissolved in water.

$Mg(CH_3COO)_2$ **a.** Write the formula for magnesium acetate.

3.0 mol **b.** How many moles of ions are released into solution?

0.60 mol **c.** How many moles of ions are released into a solution made from 0.20 mol magnesium acetate dissolved in water?

3. Write the formula for the precipitate formed

$Mg_3(PO_4)_2$ **a.** when solutions of magnesium chloride and potassium phosphate are combined.

Ag_2S **b.** when solutions of sodium sulfide and silver nitrate are combined.

4. Write ionic equations for the dissolution of the following compounds:

a. $Na_3PO_4(s)$

$Na_3PO_4(s) \rightarrow 3Na^+(aq) + PO_4^{3-}(aq)$

b. iron(III) sulfate(*s*)

$Fe_2(SO_4)_3(s) \rightarrow 2Fe^{3+}(aq) + 3SO_4^{2-}(aq)$

5. **a.** Write the net ionic equation for the reaction that occurs when solutions of lead(II) nitrate and ammonium sulfate are combined.

$Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$

b. What are the spectator ions in this system?

NO_3^- and NH_4^+ are spectator ions.

SECTION 1 continued

6. The following solutions are combined in a beaker: NaCl, Na_3PO_4, and $Ba(NO_3)_2$.

a. Will a precipitate form when the above solutions are combined? If so, write the name and formula of the precipitate.

Yes; barium phosphate, $Ba_3(PO_4)_2$, forms as a precipitate.

b. List all spectator ions present in this system.

Na^+, Cl^-, and NO_3^- are spectator ions in this system.

7. It is possible to have spectator ions present in many chemical systems, not just in precipitation reactions. Consider this example:

$$Al(s) + HCl(aq) \rightarrow AlCl_3(aq) + H_2(g) \text{ (unbalanced)}$$

True **a.** In an aqueous solution of HCl, virtually every HCl molecule is ionized. True or False?

$Cl^-(aq)$ **b.** There is only one spectator ion in this system. Is it $Al^{3+}(aq)$, $H^+(aq)$, or $Cl^-(aq)$?

c. Balance the above equation.

$2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g)$

11 L **d.** If 9.0 g of Al metal react with excess HCl according to the balanced equation in part **c**, what volume of hydrogen gas at STP will be produced? Show all your work.

8. Acetic acid, CH_3CO_2H, is a weak electrolyte. Write an equation to represent its ionization in water. Include the hydronium ion, H_3O^+.

$CH_3CO_2H(aq) + H_2O(l) \rightleftarrows CH_3CO_2^-(aq) + H_3O^+(aq)$

Name _____ Date _____ Class _____

CHAPTER 13 REVIEW

Ions in Aqueous Solutions and Colligative Properties

SECTION 2

PROBLEMS **Write the answer on the line to the left. Show all your work in the space provided.**

1. 100.102°C **a.** Predict the boiling point of a 0.200 *m* solution of glucose in water.

100.204°C **b.** Predict the boiling point of a 0.200 *m* solution of potassium iodide in water.

2. A chief ingredient of antifreeze is liquid ethylene glycol, $C_2H_4(OH)_2$. Assume $C_2H_4(OH)_2$ is added to a car radiator that is holding 5.0 kg of water.

48 mol **a.** How many moles of ethylene glycol should be added to the radiator to lower the freezing point of the water from 0°C to −18°C?

3.0×10^3 g **b.** How many grams of ethylene glycol does the quantity in part **a** represent?

2.7 L **c.** Ethylene glycol has a density of 1.1 kg/L. How many liters of $C_2H_4(OH)_2$ should be added to the water in the radiator to prevent freezing down to −18°C?

SECTION 2 continued

d. In World War II, soldiers in the Sahara Desert needed a supply of antifreeze to protect the radiators of their vehicles. The temperature in the Sahara almost never drops to 0°C, so why was the antifreeze necessary?

Antifreeze also raises the boiling point of water. It was needed to help prevent the water in the radiators of the vehicles from boiling over.

3. An important use of colligative properties is to determine the molar mass of unknown substances. The following situation is an example: 12.0 g of unknown compound X, a nonpolar nonelectrolyte, is dissolved in 100.0 g of melted camphor. The resulting solution freezes at 99.4°C. Consult **Table 2** on page 448 of the text for any other data needed to answer the following questions:

79.4°C **a.** By how many °C did the freezing point of camphor change from its normal freezing point?

2.00 *m* **b.** What is the molality of the solution of camphor and compound X, based on freezing-point data?

120. g **c.** If there are 12.0 g of compound X per 100.0 g of camphor, how many grams of compound X are there per kilogram of camphor?

60.0 g/mol **d.** What is the molar mass of compound X?

4. Explain why the ability of a solution to conduct an electric current is not a colligative property.

Electrical conductivity depends on the nature of the solute, unlike colligative properties, which depend only on concentration of solute particles.

Name _____ Date _____ Class _____

CHAPTER 13 REVIEW

Ions in Aqueous Solutions and Colligative Properties

MIXED REVIEW

SHORT ANSWER **Answer the following questions in the space provided.**

1. Match the four compounds on the right to their descriptions on the left.

b	an ionic compound that is quite soluble in water	(a) HCl
c	an ionic compound that is not very soluble in water	(b) $NaNO_3$
a	a molecular compound that ionizes in water	(c) AgCl
d	a molecular compound that does not ionize in water	(d) C_2H_5OH

2. Consider nonvolatile nonelectrolytes dissolved in various liquid solvents to complete the following statements:

solute **a.** The change in the boiling point does *not* vary with the identity of the ____ (solute, solvent), assuming all other factors remain constant.

solvent **b.** The change in the boiling point varies with the identity of the ____ (solute, solvent), assuming all other factors remain constant.

increases **c.** The change in the boiling point becomes greater as the concentration of the solute in solution ____ (increases, decreases).

3. **a.** Name two compounds in solution that could be combined to cause the formation of a calcium carbonate precipitate.

Answers will vary; any soluble calcium salt mixed with any soluble carbonate will form the precipitate. One example is calcium nitrate with sodium carbonate.

b. Identify any spectator ions in the system you described in part **a**.

In the example given, sodium and nitrate ions are spectator ions.

c. Write the net ionic equation for the formation of calcium carbonate.

$Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$

4. Explain why applying rock salt (impure NaCl) to an icy sidewalk hastens the melting process.

The vapor pressure of the NaCl solution that forms is lower than the vapor pressure of pure water at 0°C. The lower vapor pressure of the NaCl solution results in a lower freezing point.

Name _____ Date _____ Class _____

MIXED REVIEW continued

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

5. 13.4 *m* Some insects survive cold winters by generating an antifreeze inside their cells. The antifreeze produced is glycerol, $C_3H_5(OH)_3$, a nonvolatile nonelectrolyte that is quite soluble in water. What must the molality of a glycerol solution be to lower the freezing point of water to −25.0°C?

6. 2.14 g How many grams of methanol, CH_3OH, should be added to 200. g of acetic acid to lower its freezing point by 1.30°C? Refer to **Table 2** on page 448 of the text for any necessary data.

7. 0.67 *m* The boiling point of a solution of glucose, $C_6H_{12}O_6$, and water was recorded to be 100.34°C. Calculate the molality of this solution.

8. HF(*aq*) is a weak acid. A 0.05 mol sample of HF is added to 1.0 kg of water.

a. Write the equation for the ionization of HF to form hydronium ions.

$HF(aq) + H_2O(l) \rightarrow H_3O^+(aq) + F^-(aq)$

0.10 mol **b.** If HF became 100% ionized, how many moles of its ions would be released?

9. c Which solution has the highest osmotic pressure?

a. 0.1 *m* glucose
b. 0.1 *m* sucrose
c. 0.5 *m* glucose
d. 0.2 *m* sucrose