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  (e) 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
c. aerosol
   a colloidal dispersion of a solid or a liquid in a gas

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

   a. [Diagram showing ions present]
   Will conduct electricity because ions are present

   b. [Diagram showing no ions]
   Will not conduct electricity because ions are not present

   c. [Diagram showing some ions present]
   Will conduct electricity slightly because some ions have formed
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 KClO₃ at 25°C is 10. g of solute per 100. g of H₂O.

a. If 15 g of KClO₃ are stirred into 100 g of water at 25°C, how much of the KClO₃ will dissolve? Is the solution saturated, unsaturated, or supersaturated?

10 g of KClO₃ will dissolve, but 5 g will not, despite thorough stirring. The solution is saturated.
b. If 15 g of KClO₃ are stirred into 200 g of water at 25°C, how much of the KClO₃ will dissolve? Is the solution saturated, unsaturated, or supersaturated?

All 15 g of KClO₃ 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:

   a. How many grams of LiCl are needed to make a saturated solution with 300 g of water at 20°C?
   
   b. What is the minimum amount of water needed to dissolve 51 g of NaNO₃ at 40°C?

   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.

   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.
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 NaNO₃. She calculates that she needs 2.00 g of NaNO₃ 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 NaNO₃ 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  CH₃OH is soluble in water. What is the molality of a solution made by dissolving 8.0 g of CH₃OH in 250. g of water?
4. Marble chips effervesce when treated with hydrochloric acid. This reaction is represented by the following equation:

\[
\text{CaCO}_3(s) + 2\text{HCl}(aq) \rightarrow \text{CaCl}_2(aq) + \text{CO}_2(g) + \text{H}_2\text{O}(l)
\]

To produce a reaction, 25.0 mL of 4.0 M HCl is added to excess CaCO₃.

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

b. How many liters of CO₂ are produced at STP?

c. How many grams of CaCO₃ are consumed?

5. Tincture of iodine is I₂(s) dissolved in ethanol, C₂H₅OH. A 1% solution of tincture of iodine is 10.0 g of solute for 1000. g of solution.

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

b. How many moles of solute are in 10.0 g of I₂?

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.
MIXED REVIEW

SHORT ANSWER  Answer the following questions in the space provided.

1. Solid CaCl₂ does not conduct electricity. Explain why it is considered to be an electrolyte.

   CaCl₂ 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 CO₂ molecules escape through the liquid’s surface, leaving fewer molecules in solution to effervesce.

3. An unknown compound is observed to mix with toluene, C₆H₅CH₃, 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.
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 CuSO₄ 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 \times 10^{13}**  b. The concentration of the OH⁻ ions in pure water is known to be 1.0 \times 10^{-7} M. How many OH⁻ ions are present in each milliliter of pure water?

6. 90. g of CaBr₂ 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?