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CHAPTER 15 CHAPTER ASSESSMENT

Solutions

Reviewing Vocabulary

Match the definition in Column A with the term in Column B.

Column A		Column B
g	1. The diffusion of solvent particles across a semipermeable membrane from areas of lower solute concentration to areas of higher solute concentration	a. Brownian motion
k	2. A mixture with particles that settle out if undisturbed	b. colloid
a	3. The erratic movement of colloid particles	c. concentration
h	4. The amount of additional pressure caused by water molecules moving into a solution	d. heat of solution
c	5. A measure of how much solute is dissolved in a specific amount of solvent or solution	e. Henry's law
d	6. The overall energy change that occurs when a solution forms	f. mole fraction
b	7. A heterogeneous mixture of intermediate size particles	g. osmosis
i	8. The process of surrounding solute particles with solvent particles to form a solution	h. osmotic pressure
f	9. The ratio of the number of moles of solute in solution to the total number of moles of solute and solvent	i. solvation
j	10. The scattering of light by dispersed colloid particles	j. Tyndall effect
e	11. The statement that the solubility of a gas in a liquid is directly proportional to the pressure of the gas above the liquid	k. suspension

Describe each pair of related terms.

12. soluble, insoluble
If a substance dissolves in another substance, the first substance is soluble. If a substance does not dissolve in another substance, the first substance is insoluble.

13. miscible, immiscible
Miscible liquids are soluble in each other, and immiscible liquids are not.

14. molarity, molality
Molarity is the number of moles of solute dissolved per liter of solution. Molality is the ratio of the number of moles of solute dissolved in one kilogram of solvent.

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CHAPTER 15 CHAPTER ASSESSMENT

Understanding Main Ideas (Part A)

In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.

true — 1. A solution may exist as a gas, a liquid, or a solid depending on the state of the *solvent*.

moles per liter — 2. Molar solutions are calculated and expressed in *grams per liter*.

water — 3. The most common solvent among liquid solutions is *ethanol*.

true — 4. Nonpolar solutes are more soluble in *nonpolar* solvents.

more — 5. A supersaturated solution contains *less* dissolved solute than a saturated solution at the same temperature.

true — 6. The *lowering* of the vapor pressure of a pure solvent when a solution is formed is a colligative property.

true — 7. A 1*m* solution of a nonelectrolyte will have a *lesser* effect on the colligative properties of its solution than a 1*m* solution of an electrolyte will have on the colligative properties of its solution.

gas — 8. In an aerosol, the dispersing medium is a *liquid*.

true — 9. A *dilute* solution contains a small amount of solute relative to the solute's solubility.

electrostatic — 10. Attractions between the dispersed particles and the particles of the dispersing medium of a colloid produce *magnetic* layers that keep the dispersed particles from settling out.

boiling point elevation — 11. *Boiling point depression* is the temperature difference between a solution's and a pure solvent's boiling point.

Circle the letter of the response that best answers the question.

12. What term describes a solution in which the dissolved solute is in equilibrium with the undissolved solute?
a. dilute solution (b.) saturated solution c. supersaturated solution d. unsaturated solution

13. Which of the following statements explains the solubility of ionic substances in water?
a. The molar mass of water is 18.02 g/mol.
b. An oxygen atom has six electrons in its outermost energy level.
(c.) Water molecules are polar.
d. Water is a covalent substance.

14. Which of the following compounds provides the most solute particles when completely dissociated in water?
a. $MgCl_2$ b. KBr c. NaCl (d.) Na_3PO_4

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CHAPTER 15 CHAPTER ASSESSMENT

Understanding Main Ideas (Part B)

Answer the following questions.

1. Briefly describe the solvation of sodium chloride to form an aqueous solution.

When a sodium chloride crystal is placed in water, the charged ends of the polar water molecules attract the positive sodium ions and the negative chloride ions. Because the attraction between the water molecules and the ions is greater than the attraction between the ions in the crystal, the ions break away from the crystal. The water molecules surround the ions and keep them separated, forming a solution.

2. How would you prepare each of the following solutions? Show your calculations.

   a. 1.00 L of a 2.00*M* aqueous solution of sodium hydroxide (NaOH)

   Molarity = moles of solute/liters of solution

   2.00*M* NaOH = 2.00 mol NaOH/1.00 L of solution

   (2.00 ~~mol NaOH~~)(40.00 g NaOH/1 ~~mol NaOH~~) = 80.00 g NaOH

   Add 80.00 g of NaOH to a 1-L volumetric flask. Add distilled water to the flask to completely dissolve the NaOH. Carefully add additional distilled water to bring the solution up to the 1-L calibration line.

   b. 90.0 mL of a 1.20*M* aqueous solution of sodium oxalate ($Na_2C_2O_4$) from a 2.00*M* solution of $Na_2C_2O_4$

   $M_1V_1 = M_2V_2$

   $V_1 = V_2(M_2/M_1)$ = (90.0 mL)(1.20~~*M*~~/2.00~~*M*~~) = 54.0 mL

   Add 54.0 mL 2.00*M* $Na_2C_2O_4$ to a graduated cylinder. Carefully add distilled water to bring the solution up to the 90.0-mL calibration line.

3. What is the mole fraction of the solute in a 1.00*m* solution of barium chloride ($BaCl_2$)? Show your calculations.

   Molality = moles of solute/kilograms of solvent

   1.00*m* $BaCl_2$ = 1.00 mol $BaCl_2$/1.00 kg H_2O

   (1.00 × 10^3 ~~g H_2O~~)(1 mol H_2O/18.02 ~~g H_2O~~) = 55.5 mol H_2O

   $X_{BaCl_2} = n_{BaCl_2}/(n_{BaCl_2} + n_{H_2O})$ = 1.00 mol $BaCl_2$/(1.00 mol $BaCl_2$ + 55.5 mol H_2O)

   X_{BaCl_2} = 0.0177

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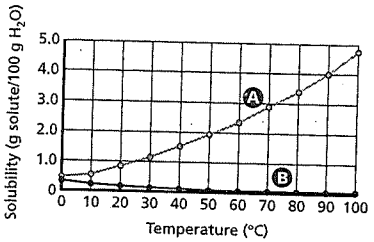
CHAPTER 15 CHAPTER ASSESSMENT

Thinking Critically

The graph below shows the solubility versus temperature for two compounds, *A* and *B*. Use the graph to answer the questions below.



1. One of the curves represents carbon dioxide (CO_2); the other represents tin(II) iodide (SnI_2). Identify compounds *A* and *B*. Explain your reasoning.

Compound A is tin(II) iodide, and compound B is carbon dioxide. The curve for compound A indicates that the solubility of the substance increases with increasing temperature. This trend is characteristic of most solid solutes dissolved in liquid solvents, such as tin(II) iodide dissolved in water. The curve for compound B indicates that the solubility of the substance decreases with increasing temperature. This trend is characteristic of gases dissolved in liquid solvents, such as carbon dioxide dissolved in water.

2. A third substance, $HgBr_2$, has a solubility of 0.50 g $HgBr_2$/100.0 g H_2O at 20°C. If the solution is saturated at this temperature, calculate the molality of the solution.

(0.50 ~~g $HgBr_2$~~)(1 mol $HgBr_2$/360.30 ~~g $HgBr_2$~~) = 1.4 × 10^{-3} mol $HgBr_2$

(100.0 g H_2O)(1 kg/1000 g) = 0.1000 kg H_2O

Molality = moles of solute/kilograms of solvent

= 1.4 × 10^{-3} mol $HgBr_2$/0.1000 kg H_2O

= 1.4 × 10^{-2} mol $HgBr_2$/kg H_2O = 1.4 × 10^{-2}*m* $HgBr_2$

3. Calculate the molarity of the $HgBr_2$ solution. Assume the density of the solution is the same as the density of the solvent.

Mass of solution = 1000 g + 0.50 g = 1000.50 g

Volume of solution = (1000.50 g)(1 kg/1000 g)(1L/1kg) = 0.1005 L

Molarity = moles of solute/liters of solution = 1.4 × 10^{-3} mol $HgBr_2$/0.1005 L

= 1.4 × 10^{-2} mol $HgBr_2$/L = 1.4 × 10^{-2}*M* $HgBr_2$