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 **Figure 1.3** of the text to predict the solubility of the following compounds in water:

    _____ a. magnesium nitrate

    _____ b. barium sulfate

   _____ c. calcium carbonate

    _____ d. ammonium phosphate

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

    _____ a. Write the formula for magnesium acetate.

    _____ b. How many moles of ions are released into solution?

    _____ 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

    _____ a. when solutions of magnesium chloride and potassium phosphate are combined.

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

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

    a. $Na_3PO_4(s)$

    _____

    b. iron(III) sulfate(s)

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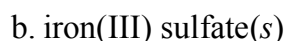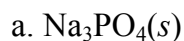
5. a. Write the net ionic equation for the reaction that occurs when solutions of lead(II) nitrate and ammonium sulfate are combined.

    _____

    b. What are the spectator ions in this system?

   _____

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.

   _____

   _____

   b. List all spectator ions present in this system.

   _____

   _____

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

   $$Al(s) + HCl(aq) \rightarrow AlCl_3(aq) + H_2(g) \text{ (unbalanced)}$$
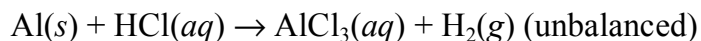
   _____ a. In an aqueous solution of HCl, virtually every HCl molecule is ionized. True or False?

   _____ 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.

   _____

   _____ 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^+.

   _____

CHAPTER 13 REVIEW

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SECTION 2

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

1. _____ a. Predict the boiling point of a 0.200 m solution of glucose in water.

   _____ 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.

   _____ 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?

   _____ b. How many grams of ethylene glycol does the quantity in part a represent?

   _____ 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?

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_____

_____

_____

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 **Figure 2.3** of the text for any other data needed to answer the following questions:

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

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

_____ 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?

_____ 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.

_____

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