Chapter 18 – Solutions

Section 18.1 – Properties of Solutions

1.1. Name and distinguish between the two components of a solution. (q. 40)

1.2. Explain why the dissolved component does not settle out of a solution. (q. 41)

1.3. Define *solubility*, *saturated solution*, and *unsaturated solution*. (q. 43)

1.4 If a saturated solution of sodium nitrate is cooled, what change might you observe? (q. 45)

Practice Problems

1. The solubility of a gas in water is 0.16 g/ L at 104 kPa of pressure. What is the solubility when the pressure of the gas is increased to 288 kPa? Assume the temperature remains constant.

2. A gas has a solubility in water at 0℃ of 3.6 g/ L at a pressure of 1.0 atm. What pressure is needed to produce an aqueous solution containing 9.5 g/ L of the same gas at 0℃?

Section Review 18.1

3. Name three factors that influence the rate at which a solute dissolves in a solvent.

a.

b.

c.

4. How can you calculate the solubility of a gas in a liquid under different pressure conditions?

5. What mass of NaCl can be dissolved in 7.50×10^2 g of water at 25℃?

6. What could you do to change

a. a saturated solution to an unsaturated solution?

b. an unsaturated solution to a saturated solution?

7. Use the solid substances listed in Table 18.1 on page 504 to make a general statement that relates a change in solubility of a solid to a change in temperature.

Section 18.2 – Concentrations of Solutions

2.1. Having a measure of the molarity of a solution is more meaningful than knowing whether a solution is dilute or concentrated. Explain. (q. 49)

2.2. Define molarity. (q. 51)

Practice Problems

8. A solution has a volume of 2.0 L and contains 36.0 g of glucose. If the molar mass of glucose is 180 g/ mol, what is the molarity of the solution?

9. A solution has a volume of 250 mL, and contains 0.70 mol NaCl. What is its molarity?

10. How many moles of ammonium nitrate are in 335 mL of 0.425M NH_4NO_3?

11. How many moles of solute are in 250 mL of 2.0M $CaCl_2$? How many grams of $CaCl_2$ is this?

12. How many milliliters of a stock solution of 4.00M KI would you need to prepare 250.0 mL of 0.760M KI?

13. Suppose you need 250 mL of 0.20M NaCl, but the only supply of sodium chloride you have is a solution of 1.0M NaCl. How do you prepare the required solution? Assume that you have the appropriate volume-measuring devices on hand.

14. If 10 mL of pure acetone is diluted with water to a total solution volume of 200 mL, what is the percent by volume of acetone in the solution?

15. A bottle of hydrogen peroxide antiseptic is labeled 3.0% (v/v). How many mL H_2O_2 are in a 400.0-mL bottle of this solution?

16. Calculate the grams of solute required to make 250 mL of 0.10% $MgSO_4$ (m/v).

17. A solution contains 2.7 g $CuSO_4$ in 75 mL of solution. What is the percent (mass/ volume) of the solution?

Section Review 18.2

18. How are problems involving solution molarity solved?

19. Describe how dilute solutions are prepared from more concentrated solutions of known molarity.

20. Distinguish between percent (v/ v) and percent (m/ v) solutions.

21. Calculate the molarity of each solution.

a. 400 g $CuSO_4$ in 4.00 L of solution

b. 0.060 mol $NaHCO_3$ in 1500 mL of solution

22. You have the following stock solutions available: 2.00M NaCl, 4.0M KNO_3, and 0.50M $MgSO_4$. Calculate the volumes you must dilute to make the following solutions.

a. 500.0 ml of 0.500M NaCl

b. 2.0 L of 0.20M $MgSO_4$

c. 50.0 mL of 0.20M KNO_3

23. What is the concentration, in percent (m/ v), of a solution with 75 g K_2SO_4 in 1500 mL of solution?

Section 18.3 – Colligative Properties of Solutions

Section Review 18.3

24. Why does a solution have a lower vapor pressure than the pure solvent of that solution?

25. Why does a solution have an elevated boiling point and a depressed freezing point compared with the pure solvent?

26. Would a dilute or a concentrated sodium fluoride solution have a higher boiling point? Explain.

27. An equal number of moles of KI and MgF_2 are dissolved in equal volumes of water. Which solution has the higher

a. boiling point?

b. vapor pressure?

c. freezing point?

Section 18.4 – Calculations Involving Colligative Properties

Practice Problems

28. How many grams of sodium fluoride are needed to prepare a 0.400m NaF solution that contains 750.0 g of water?

29. Calculate the molality of a solution prepared by dissolving 10.0 g NaCl in 600 g of water.

30. What is the mole fraction of each component in a solution made by mixing 300 g of ethanol (C_2H_5OH) and 500 g of water?

31. A solution contains 50.0 g of carbon tetrachloride (CCl_4) and 50.0 g of chloroform ($CHCl_3$). Calculate the mole fraction of each component in the solution.

32. What is the boiling point of a solution that contains 1.25 mol $CaCl_2$ in 1400 g of water?

33. What mass of NaCl would have to be dissolved in 1.000×10^3 g of water to raise the boiling point by 2.00℃?

34. The freezing point of the water is lowered to -0.390℃ when 3.90 g of a nonvolatile molecular solute is dissolved in 475 g of water. Calculate the molar mass of the solute.

35. A solution containing 16.9 g of a nonvolatile molecular compound in 250 g of water has a freezing point of -0.744℃. What is the molar mass of the substance?

Section Review 18.4

36. How many kilograms of water must be added to 9.0 g of oxalic acid ($H_2C_2O_4$) to prepare a 0.025 m solution?

37. One mole of a compound of iron and chlorine is dissolved in 1 kg of water. The boiling point of this aqueous solution is 102.05℃. the freezing point of this aqueous solution is -7.44℃. What is the formula of the solute compound?

38. How are boiling point elevation and freezing point depression related to molality?

39. Estimate the freezing point of a solution of 12.0 g of carbon tetrachloride dissolved in 750 g of benzene (which has a freezing point of 5.48℃).