

CHAPTER 14 STUDY GUIDE

Mixtures and Solutions

Section 14.1 Heterogeneous and Homogeneous Mixtures

In your textbook, read about suspensions and colloids.

For each statement below, write *true* or *false*.

- _____ 1. A solution is a mixture containing particles that settle out of the mixture if left undisturbed.
- _____ 2. The most abundant substance in a colloid is the dispersion medium.
- _____ 3. A colloid can be separated by filtration.
- _____ 4. A solid emulsion consists of a liquid dispersed in a solid.
- _____ 5. Whipped cream is an example of a foam.
- _____ 6. In an aerosol, the dispersing medium is a liquid.
- _____ 7. Brownian motion results from the collisions of particles of the dispersion medium with the dispersed particles.
- _____ 8. Dispersed particles in a colloid do not tend to settle out because they have polar or charged atomic groups on their surfaces.
- _____ 9. Stirring an electrolyte into a colloid stabilizes the colloid.
- _____ 10. Colloids demonstrate the Tyndall effect.

The table below lists the characteristics of particles in colloids, solutions, and suspensions. Place a check in the column of each mixture whose particles have a particular characteristic.

Characteristics of Particles	Colloid	Solution	Suspension
11. Less than 1 nm in diameter			
12. Between 1 nm and 1000 nm in diameter			
13. More than 1000 nm in diameter			
14. Settle out if undisturbed			
15. Pass through standard filter paper			
16. Lower vapor pressure			
17. Scatter light			

Section 14.2 Solution Concentration

In your textbook, read about expressing concentration and using percent to describe concentration.

Data related to aqueous solutions of sodium chloride (NaCl) and aqueous solutions of ethanol (C₂H₅OH) are provided in the table below. Use the table to answer the following questions. Circle the letter of the choice that best answers the question.

Solution	Mass (g)		Solution	Volume (mL)	
	NaCl	H ₂ O		C ₂ H ₅ OH	H ₂ O
1	3.0	100.0	5	2.0	100.0
2	3.0	200.0	6	5.0	100.0
3	3.0	300.0	7	9.0	100.0
4	3.0	400.0	8	15.0	100.0

- What is the percent by mass of NaCl in solution 1?
 - 0.030%
 - 2.9%
 - 3.0%
 - 33%
- Which of the following solutions is the most dilute?
 - Solution 1
 - Solution 2
 - Solution 3
 - Solution 4
- What is the percent by volume of C₂H₅OH in Solution 5?
 - 0.2%
 - 1.9%
 - 2.0%
 - 22%
- Which of the following solutions is the most concentrated?
 - Solution 5
 - Solution 6
 - Solution 7
 - Solution 8

In your textbook, read about molarity and preparing molar solutions.

Read the following problem and then answer the questions.

An 85.0-mL aqueous solution contains 7.54 g iron(II) chloride (FeCl₂). Calculate the molarity of the solution.

- What is the mass of the solute? _____
- What is the volume of the solution? _____
- Write the equation that is used to calculate molarity.

- In what unit must the amount of the solute be expressed to calculate molarity? _____
- In what unit must the volume of the solution be expressed to calculate molarity? _____
- Write the expression needed to convert the volume of the solution given in the problem to the volume needed to calculate molarity. _____

Section 14.2 *continued*

11. What quantity must be used to convert the mass of the solute given in the problem to the amount of solute needed to calculate molarity?

12. Write the expression used to calculate the amount of solute.

13. Calculate the molarity of the solution. Show all your work.

In your textbook, read about molality and mole fractions.

Answer the following questions.

14. How does molality differ from molarity?

15. Calculate the molality of a solution of 15.4 g sodium bromide (NaBr) dissolved in 125 g of water. Show all your work.

16. What is mole fraction?

17. Calculate the mole fraction of HCl in an aqueous solution that contains 33.6% HCl by mass. Show all your work.

CHAPTER 14 **STUDY GUIDE**

Section 14.3 Solvation and Solubility?

In your textbook, read about the characteristics of solutions.

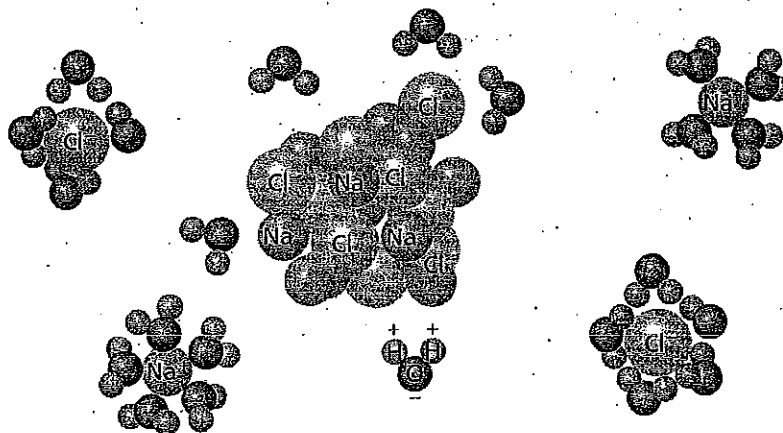
Use each of the terms below just once to complete the passage.

immiscible	liquid	soluble	solution
insoluble	miscible	solute	solvent

Air is a(n) **(1)** _____ of oxygen gas dissolved in nitrogen gas. The oxygen in air is the **(2)** _____, and nitrogen is the **(3)** _____. Because oxygen gas dissolves in a solvent, oxygen gas is a(n) **(4)** _____ substance. A substance that does not dissolve is **(5)** _____. **(6)** _____ solutions are the most common type of solutions. If one liquid is soluble in another liquid, such as acetic acid in water, the two liquids are **(7)** _____. However, if one liquid is insoluble in another, the liquids are **(8)** _____.

Read about solvation in aqueous solutions in your textbook.

The diagram shows the hydration of solid sodium chloride to form an aqueous solution. Use the diagram to answer the following questions.



9. Hydration is solvation in which the solvent is water. What is solvation?

Section 14.3 *continued*

10. As sodium chloride dissolves in water, what happens to the sodium and chloride ions?

11. Explain the orientation of the water molecules around the sodium ions and chloride ions.

12. How does the strength of the attraction between water molecules and sodium and chloride ions compare with the strength of the attraction between the sodium ions and chloride ions? How do you know?

13. List three ways that the rate of solvation may be increased.

In your textbook, read about heat of solution, solubility, and factors that affect solubility.

For each statement below, write *true* or *false*.

- _____ 14. The overall energy change that occurs when a solution forms is called the heat of solution.
- _____ 15. Solubility is a measure of the minimum amount of solute that dissolves in a given amount of solvent at a specified temperature and pressure.
- _____ 16. Solvation continues as long as the solvation rate is less than the crystallization rate.
- _____ 17. In a saturated solution, solvation and crystallization are in equilibrium.
- _____ 18. Additional solute can be dissolved in an unsaturated solution.
- _____ 19. The solubility of a gas dissolved in a liquid decreases as the temperature of the solution increases.

Section 14.4 Colligative Properties of Solutions

In your textbook, read about electrolytes and colligative properties, vapor pressure lowering, boiling point elevation, and freezing point depression.

Use the table to answer the following questions.

Solution	Density (g/L)	Boiling Point (°C)	Freezing Point (°C)
1.0m C ₂ H ₅ OH(aq)	1.05	100.5	-1.8
1.0m HCl(aq)	1.03	101.0	-3.7
1.0m NaCl(aq)	1.06	101.0	-3.7
2.0m NaCl(aq)	1.12	102.1	-7.4

1. Which properties in the table are colligative properties?

2. What can you conclude about the relationship between colligative properties and the number of ions in solution from the 1.0m NaCl(aq) and 2.0m NaCl(aq) solutions?

3. What can you conclude about the relationship between colligative properties and the type of ions in solution from the 1.0m HCl(aq) and 1.0m NaCl(aq) solutions?

Suppose that in a simple system, a semipermeable membrane is used to separate a sucrose-water solution from its pure solvent, water. Match the descriptions of the system in Column A with the terms in Column B.

Column A

Column B

_____ 4. Cannot cross the semipermeable membrane

a. osmotic pressure

_____ 5. Can cross the semipermeable membrane

b. water molecules

_____ 6. The side that exerts osmotic pressure

c. semipermeable membrane

_____ 7. The diffusion of the solvent particles across the semipermeable membrane from the area of higher solvent concentration to the area of lower solvent concentration

d. sugar molecules

_____ 8. The barrier with tiny pores that allow some particles to pass through but not others

e. osmosis

f. solution side

_____ 9. The side from which more water molecules cross the semipermeable membrane

g. pure solvent side

_____ 10. A colligative property of solutions

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INTERPRETING GRAPHICS

Use with Section 16.1

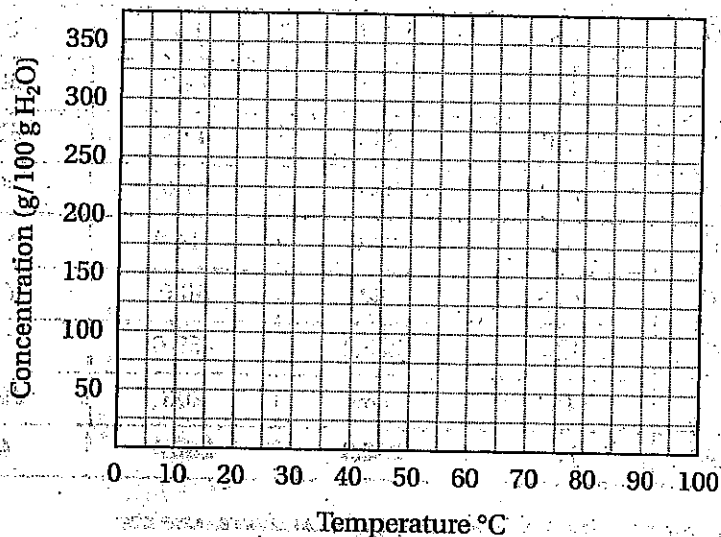
Solubilities of Some Substances in Water at Various Temperatures					
Substance	Formula	Solubility (g/100 g of H ₂ O)			
		0°C	20°C	50°C	100°C
Barium hydroxide	Ba(OH) ₂	1.67	31.89	—	—
Barium sulfate	BaSO ₄	0.00019	0.00025	0.00034	—
Calcium hydroxide	Ca(OH) ₂	0.189	0.173	—	0.07
Lead(II) chloride	PbCl ₂	0.60	0.99	1.70	—
Lithium carbonate	Li ₂ CO ₃	1.5	1.3	1.1	0.70
Potassium chlorate	KClO ₃	4.0	7.4	19.3	56.0
Potassium chloride	KCl	27.6	34.0	42.6	57.6
Sodium chloride	NaCl	35.7	36.0	37.0	39.2
Sodium nitrate	NaNO ₃	74	88.0	114.0	182
Sodium sulfate	Na ₂ SO ₄	4.76	62	50.0	41.0
Silver nitrate	AgNO ₃	122	222.0	455.0	733
Lithium bromide	LiBr	143.0	166	203	266.0
Cane sugar (sucrose)	C ₁₂ H ₂₂ O ₁₁	179	230.9	260.4	487

A portion of Table 16.1 from your textbook has been reproduced above. Use the table to answer the following questions.

- Saturated solutions of each of the following compounds are made at 20°C. Circle the letter(s) of the solution(s) that will form a precipitate upon heating.
 - NaCl
 - Na₂SO₄
 - Li₂CO₃
 - sucrose
- A saturated solution of potassium chloride is prepared in 100.0 g of water at 20°C. If the solution is heated to 50°C, how much more KCl must be added to obtain a saturated solution?

3. A saturated solution of sucrose in 1000.0 g of boiling water is cooled to 20°C. What mass of rock candy will be formed?

4. Using data from the table, plot the solubility curves of KCl, LiBr and Na₂SO₄ on the graph below. Be sure to label each curve. Use the graph to answer the following questions.



a. Which of the compounds is most soluble at 25°C?

b. Which of the compounds has the lowest solubility at 90°C?
