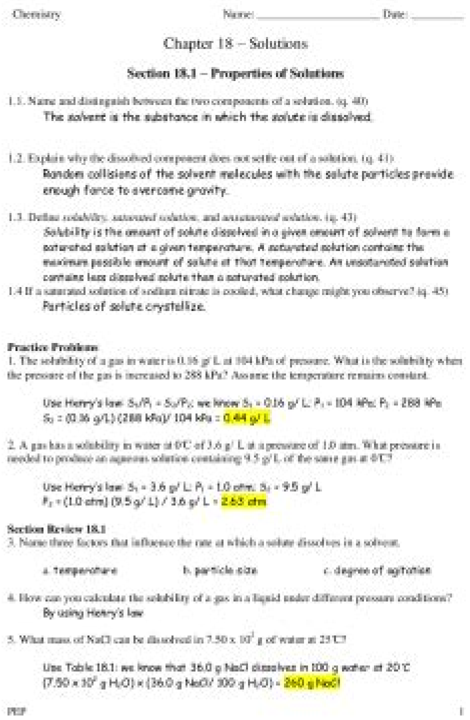
181 Properties Of Solutions Section Review Answers


Chemistry Name: ____________ Date: ________

Chapter 18 – Solutions

Section 18.1 – Properties of Solutions

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

The solvent is the substance in which the solute is dissolved.

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

Random collisions of the solvent molecules with the solute particles provide enough force to overcome gravity.

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

Solubility is the amount of solute dissolved in a given amount of solvent to form a saturated solution at a given temperature. A saturated solution contains the maximum possible amount of solute at that temperature. An unsaturated solution contains less dissolved solute than a saturated solution.

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

Particles of solute crystallize.

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.

Use Henry's law: $S_1/P_1 = S_2/P_2$; we know S_1 = 0.16 g/ L; P_1 = 104 kPa; P_2 = 288 kPa

S_2 = (0.16 g/L) (288 kPa)/ 104 kPa = 0.44 g/ L

2. A gas has a solubility in water at 0°C 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°C?

Use Henry's law: S_1 = 3.6 g/ L; P_1 = 1.0 atm; S_2 = 9.5 g/ L

P_2 = (1.0 atm) (9.5 g/ L) / 3.6 g/ L = 2.63 atm

Section Review 18.1

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

a. temperature b. particle size c. degree of agitation

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

By using Henry's law

5. What mass of NaCl can be dissolved in 7.50 x 10^2 g of water at 25°C?

Use Table 18.1: we know that 36.0 g NaCl dissolves in 100 g water at 20°C

(7.50 x 10^2 g H_2O) x (36.0 g NaCl/ 100 g H_2O) = 260 g NaCl

PEP 1

181 Properties of Solutions Section Review Answers delve into an essential topic in chemistry, exploring how different substances interact in solution form. Solutions, which are homogeneous mixtures of two or more components, play a crucial role in various chemical processes and applications. Understanding their properties is vital for students and professionals in the field. This article aims to provide a comprehensive overview of the properties of solutions as outlined in the section review answers, including definitions, key characteristics, types of solutions, and factors affecting solubility.

Understanding Solutions

A solution consists of a solvent, which is the substance that dissolves the solute, and the solute, which is the substance being dissolved. Solutions can exist in various phases, including gas, liquid, and solid. The most common type of solution encountered in everyday life is a liquid solution, where a solid, liquid, or gas is dissolved in a liquid solvent.

Types of Solutions

Solutions can be classified based on the physical states of the solute and solvent:

1. Gaseous Solutions: These consist of gases mixed together, such as air, which is a mixture of nitrogen, oxygen, carbon dioxide, and other gases.

2. Liquid Solutions: These include:
- Solid in Liquid: Saltwater, where salt (solute) is dissolved in water (solvent).
- Liquid in Liquid: Alcohol in water, where ethanol is the solute.
- Gas in Liquid: Carbonated beverages, where carbon dioxide gas is dissolved in liquid.

3. Solid Solutions: These involve solid solutes mixed with solid solvents, such as alloys like bronze and steel.

General Properties of Solutions

The properties of solutions can be broadly categorized into several key characteristics:

1. Homogeneity

Solutions are homogeneous, meaning that the composition is uniform throughout. This implies that one cannot distinguish the individual components with the naked eye.

2. Particle Size

The solute particles in a solution are at the molecular or ionic level, typically less than 1 nanometer in diameter. This small particle size contributes to the solution's uniform appearance and prevents light scattering.

3. Transparency

Most solutions are transparent, allowing light to pass through without scattering. However, this property can vary with the concentration of solute and the nature of the solvent.

4. Stability

Solutions are stable, meaning that the solute does not settle out over time. This stability is crucial for many applications, including pharmaceuticals and industrial processes.

5. Conductivity

Some solutions can conduct electricity, particularly those containing ionic compounds that dissociate into ions in solution. This property is essential in electrochemistry and various industrial applications.

Factors Affecting Solubility

The ability of a solute to dissolve in a solvent is influenced by several factors:

1. Nature of the Solute and Solvent

The principle of "like dissolves like" is a fundamental rule in chemistry. Polar solutes tend to dissolve in polar solvents, while nonpolar solutes are soluble in nonpolar solvents. Examples include:

- Polar Solute in Polar Solvent: Sugar in water.
- Nonpolar Solute in Nonpolar Solvent: Oil in hexane.

2. Temperature

Temperature plays a significant role in solubility. Generally, increasing the temperature increases the solubility of solids in liquids but decreases the solubility of gases in liquids. For example:

- Solids: More sugar can dissolve in warm water than in cold water.
- Gases: Warm soda loses carbonation faster than cold soda because gases are less soluble at higher temperatures.

3. Pressure

Pressure primarily affects the solubility of gases. According to Henry's law, the solubility of a gas in a liquid is directly proportional to the pressure of the gas above the liquid. This relationship is why carbonated beverages are bottled under high pressure.

4. Agitation

Stirring or shaking a solution can increase the rate at which a solute dissolves, although it does not affect the overall solubility limit.

Concentration of Solutions

The concentration of a solution refers to the amount of solute present in a given quantity of solvent or solution. Various ways to express concentration include:

1. Molarity (M)

Molarity is defined as the number of moles of solute per liter of solution. It is a commonly used unit in chemistry for expressing concentrations.

2. Molality (m)

Molality is the number of moles of solute per kilogram of solvent. This measurement is particularly useful in scenarios where temperature changes may affect the volume of the solution.

3. Percent Concentration

Percent concentration can be expressed in several ways, including weight/volume percent (g of solute per mL of solution) or volume/volume percent (mL of solute per mL of solution).

4. Parts Per Million (ppm)

This unit expresses the concentration of a solute in terms of million parts of the solution, often used for very dilute solutions, such as contaminants in water.

Colligative Properties of Solutions

Colligative properties depend on the number of solute particles in a solution rather than the identity of the solute. These properties include:

1. Boiling Point Elevation

The presence of a solute raises the boiling point of the solvent. The change in boiling point can be calculated using the formula:

$$\Delta T_b = i K_b m$$

where:
- ΔT_b = change in boiling point
- i = van 't Hoff factor (number of particles the solute dissociates into)
- K_b = ebullioscopic constant of the solvent
- m = molality of the solution

2. Freezing Point Depression

Similarly, a solute lowers the freezing point of the solvent. The formula for freezing point depression is:

$\Delta T_f = i K_f m$

where:
- ΔT_f = change in freezing point
- K_f = cryoscopic constant of the solvent

3. Osmotic Pressure

Osmotic pressure is the pressure required to prevent the flow of solvent into a solution through a semipermeable membrane. It can be calculated using:

$\pi = i C R T$

where:
- π = osmotic pressure
- C = molar concentration of the solution
- R = universal gas constant
- T = absolute temperature in Kelvin

Conclusion

In summary, the 181 Properties of Solutions Section Review Answers provide a detailed understanding of solutions in chemistry. From their definitions and classifications to their properties and factors affecting solubility, this knowledge is foundational for anyone studying or working in the field of chemistry. Solutions are not only central to laboratory practices but also play critical roles in industries ranging from pharmaceuticals to environmental science. Understanding these properties allows chemists to manipulate solutions effectively, leading to advancements in research and technology.

Frequently Asked Questions

What are the key properties of solutions discussed in the 181 properties of solutions section?

The key properties include concentration, boiling point elevation, freezing point depression, vapor pressure lowering, and osmotic pressure.

How does temperature affect the solubility of solids in liquids according to the 181 properties of solutions?

Generally, the solubility of solids in liquids increases with an increase in temperature.

What is the significance of colligative properties in solutions as per the 181 properties of solutions?

Colligative properties depend on the number of solute particles in a solution, not the identity of the solute, and are important for understanding boiling point elevation and freezing point depression.

Can you explain the concept of saturation in the context of solutions from the 181 properties of solutions?

Saturation refers to the point at which a solution can no longer dissolve additional solute at a given temperature and pressure, leading to the presence of undissolved solute.

What role does solvent choice play in the properties of solutions as outlined in the 181 properties of solutions?

The choice of solvent affects the solubility of solutes, the rate of dissolution, and the overall properties of the solution, such as conductivity and boiling point.

How do ionic and molecular solutes differ in their effects on the properties of solutions based on the 181 properties of solutions?

Ionic solutes typically dissociate into multiple particles, affecting colligative properties more significantly than molecular solutes, which do not dissociate in solution.

181 Properties Of Solutions Section Review Answers

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