NCEA Level 3 Chemistry – Aqueous Chemistry (AS91393) Practice Exam (Sample)

Study Guide

Everything you need from our exam experts!

Questions

1. **How can the degree of ionization of a weak acid be determined?**
   - A. By measuring the temperature change during dissociation
   - B. By comparing the concentration of undissociated acid with the initial concentration
   - C. By calculating the pressure change during the reaction
   - D. By observing the color change of a pH indicator

2. **In a buffered solution, which component typically neutralizes added acids?**
   - A. The conjugate base
   - B. The weak acid
   - C. Both components equally
   - D. The solvent

3. **How do you calculate the number of moles of a solute?**
   - A. Divide mass of solute by its molar mass
   - B. Multiply mass of solute by its density
   - C. Subtract the mass from the total volume
   - D. Add mass to the number of particles

4. **Which factors influence the rate of a reaction in aqueous solutions?**
   - A. Concentration and area alone
   - B. Only temperature
   - C. Concentration, temperature, surface area, and catalysts
   - D. Only the type of solute

5. **How does increasing pressure affect the solubility of solids in liquids?**
   - A. It generally has a significant effect, increasing solubility.
   - B. It has little effect on the solubility of solids in liquids.
   - C. It universally decreases solubility across all substances.
   - D. It increases solubility only in gaseous solutions.

6. What does it imply if Kc is greater than 1?

- **A. The reaction favors the formation of reactants**
- **B. The reaction favors the production of products**
- **C. The system reaches completion and no reactants remain**
- **D. The position of equilibrium is neutral**

7. Which type of acid is an Arrhenius acid?

- **A. One that produces hydroxide ions in solution**
- **B. One that decreases the concentration of H+ ions**
- **C. One that increases the concentration of H+ ions**
- **D. One that remains neutral in solution**

8. Which statement best describes a solution that contains unreacted ions?

- **A. The solution reacts violently with acids**
- **B. The solution remains neutral**
- **C. The solution changes pH when a base is added**
- **D. The solution's pH is unchanged**

9. What effect does the common ion effect have on the solubility of salts?

- **A. It increases the solubility of salts.**
- **B. It has no effect on solubility.**
- **C. It reduces the solubility of a salt when a compound with a common ion is added.**
- **D. It enhances the solubility of a salt in acidic solutions.**

10. How does temperature typically affect the saturation of a solute in a solution?

- **A. It decreases the saturation point**
- **B. It has no effect on saturation**
- **C. It increases the saturation point**
- **D. It varies the saturation unpredictably**

Answers

1. **B**
2. **A**
3. **A**
4. **C**
5. **B**
6. **B**
7. **C**
8. **D**
9. **C**
10. **C**

Explanations

1. How can the degree of ionization of a weak acid be determined?

A. By measuring the temperature change during dissociation

B. By comparing the concentration of undissociated acid with the initial concentration

C. By calculating the pressure change during the reaction

D. By observing the color change of a pH indicator

The degree of ionization of a weak acid can be determined by comparing the concentration of undissociated acid with its initial concentration. This method involves measuring how much of the acid has dissociated into its ions in solution. For example, if you start with a known initial concentration of a weak acid and you measure the concentration of the undissociated acid at equilibrium, you can then compute the amount of acid that has ionized. The degree of ionization is expressed as a fraction or percentage of the initial concentration that has formed ions. This provides a clear quantitative measure of the acid's ionization in aqueous solution. In contrast, measuring the temperature change during dissociation is not a reliable method for determining degree of ionization, as temperature changes could result from various factors unrelated to the extent of ionization. Calculating pressure change during the reaction is also not applicable for weak acids in liquid solutions, as this approach is more suited to gas-phase reactions or processes where gas production is significant. Observing the color change of a pH indicator may provide an indication of the acid's strength and the solution's pH, but it doesn’t quantitatively measure the extent of ionization, making it less effective for this purpose.

2. In a buffered solution, which component typically neutralizes added acids?

A. The conjugate base

B. The weak acid

C. Both components equally

D. The solvent

In a buffered solution, the component that typically neutralizes added acids is the conjugate base. When an acid is added to a buffered solution, the conjugate base reacts with the H^+ ions introduced by the acid. This reaction helps to minimize changes in the pH of the solution by converting the added H^+ ions into a weak acid. This system allows the buffer to maintain its pH within a relatively narrow range despite the addition of acids (or bases). The weak acid present in the buffer does play an important role in neutralizing added bases, but it is primarily the conjugate base that responds to the addition of acids. Therefore, when considering the function of the components of a buffer in the context of acid neutralization, the conjugate base is the active agent in counteracting the effects of the added acid, maintaining the overall stability of the solution's pH.

3. How do you calculate the number of moles of a solute?

A. Divide mass of solute by its molar mass

B. Multiply mass of solute by its density

C. Subtract the mass from the total volume

D. Add mass to the number of particles

To calculate the number of moles of a solute, you need to divide the mass of the solute by its molar mass. Moles are a measure of the number of particles (atoms, molecules, or formula units) in a substance, and molar mass tells us how much one mole of that substance weighs. The relationship can be represented by the formula: \[\text{Number of moles} = \frac{\text{mass of solute (g)}}{\text{molar mass (g/mol)}} \] This formula highlights that knowing both the mass of the solute and its molar mass allows you to determine how many moles are present. For instance, if you have 10 grams of sodium chloride (NaCl), and its molar mass is approximately 58.44 g/mol, using this formula would give you: \[\text{Number of moles} = \frac{10 \text{ g}}{58.44 \text{ g/mol}} \approx 0.171 \text{ moles} \] This method is fundamental in chemistry as it connects mass measurements to the amount of substance in a quantitative way. The other methods provided in the choices do not

4. Which factors influence the rate of a reaction in aqueous solutions?

A. Concentration and area alone

B. Only temperature

C. Concentration, temperature, surface area, and catalysts

D. Only the type of solute

The correct option highlights that the rate of a reaction in aqueous solutions is influenced by multiple factors, specifically concentration, temperature, surface area, and catalysts. Concentration plays a crucial role in reaction rates because increasing the concentration of reactants typically leads to a greater number of effective collisions between particles, thereby increasing the likelihood of reaction events. Temperature affects the rate of reaction due to its impact on the kinetic energy of the particles; as temperature rises, particles move faster, which increases collision frequency and energy, often leading to a higher reaction rate. Surface area, particularly in heterogeneous reactions, also influences the rate. A larger surface area allows more collisions to occur, as more particles of reactants are exposed and available to react. Lastly, catalysts provide an alternative reaction pathway with a lower activation energy, thereby speeding up the rate of reaction without being consumed in the process. The other options do not encompass the full range of factors that affect reaction rates in aqueous environments. Concentration and area alone, temperature only, and simply the type of solute are incomplete frameworks for understanding how various conditions impact reaction kinetics.

5. How does increasing pressure affect the solubility of solids in liquids?

A. It generally has a significant effect, increasing solubility.

B. It has little effect on the solubility of solids in liquids.

C. It universally decreases solubility across all substances.

D. It increases solubility only in gaseous solutions.

Increasing pressure generally has little effect on the solubility of solids in liquids because the solubility of most solids is not significantly influenced by changes in pressure. Solubility of solids typically depends more on temperature and the nature of the solvent and solute rather than pressure. In liquid solutions, the solubility equilibrium is primarily affected by the interactions between the solute particles and the solvent. Since solids typically have a much higher density than liquids and the volume change when a solid dissolves is minimal, applying increased pressure does not lead to a notable change in the number of solid particles that can dissolve. In contrast, gases show a significant increase in solubility with increased pressure because gas molecules can be forced into the liquid phase more effectively under higher pressure due to the decrease in volume of the gas. This concept aligns with Henry's law, which states that the solubility of gases in liquids is directly proportional to the pressure above the liquid. Hence, increasing pressure primarily affects gaseous solubility rather than that of solids dissolved in liquids.

6. What does it imply if Kc is greater than 1?

A. The reaction favors the formation of reactants

B. The reaction favors the production of products

C. The system reaches completion and no reactants remain

D. The position of equilibrium is neutral

When Kc is greater than 1, it indicates that at equilibrium, the concentration of products is greater than the concentration of reactants. This suggests that the reaction favors the production of products, meaning that the formation of products is more favorable than the reverse reaction. In terms of equilibrium, a Kc value greater than 1 signifies that the reaction has shifted to the right, which results in a higher proportion of products compared to reactants. This does not necessarily imply that the reaction goes to completion since not all reactants may be converted to products, but it does indicate a tendency towards product formation under the given conditions. A Kc greater than 1 does not suggest a neutral position in equilibrium or an absence of reactants. In fact, equilibrium can still exist with both reactants and products present. Additionally, while a large Kc might indicate a significant formation of products, it doesn't guarantee that all reactants are used up, which rules out completion. Hence, the correct interpretation of a Kc greater than 1 is that the reaction indeed favors the production of products.

7. Which type of acid is an Arrhenius acid?

A. One that produces hydroxide ions in solution

B. One that decreases the concentration of H+ ions

C. One that increases the concentration of H+ ions

D. One that remains neutral in solution

An Arrhenius acid is defined as a substance that increases the concentration of hydrogen ions (H+) in an aqueous solution. When an Arrhenius acid dissolves in water, it dissociates to release H+ ions, which is a key characteristic of acids according to Arrhenius's theory. This characteristic is pivotal in understanding acid-base reactions within aqueous solutions. For example, hydrochloric acid (HCl) dissociates in water to produce H+ ions and chloride ions (Cl-), thus increasing the concentration of H+ ions in the solution. This increase in H+ concentration is what defines its acidic properties and its behavior as an Arrhenius acid. In contrast, a substance that produces hydroxide ions in solution is classified as an Arrhenius base, not an acid. Similarly, a substance that decreases the concentration of H+ ions would not fit the Arrhenius definition, as it would be acting as a base rather than an acid. A neutral substance remains unchanged in its ion concentration in solution and does not contribute to the acidic properties defined by Arrhenius acids.

8. Which statement best describes a solution that contains unreacted ions?

A. The solution reacts violently with acids

B. The solution remains neutral

C. The solution changes pH when a base is added

D. The solution's pH is unchanged

A solution that contains unreacted ions is typically in a state where the ions present do not actively participate in any additional reactions that would affect the pH of the solution. When unreacted ions are present, they are often at equilibrium, meaning they are stable and not engaging in any significant chemical reactions with other substances in the solution. In this context, if the pH remains unchanged upon adding a base, it indicates that the existing ions are not reacting with the added base to form new products. This stability of the solution's pH suggests that the concentration of hydrogen ions (H^+) and hydroxide ions (OH^-) remains consistent despite the introduction of a base. Consequently, the presence of unreacted ions essentially buffers the solution, preventing significant changes to its pH. Therefore, the statement that the solution's pH is unchanged accurately describes the situation of unreacted ions, as the ions present do not lead to a reaction that would alter the acidity or basicity of the solution. This understanding reflects the behavior of equilibrium systems in aqueous solutions and the effect of additional species on that equilibrium.

9. What effect does the common ion effect have on the solubility of salts?

A. It increases the solubility of salts.

B. It has no effect on solubility.

C. It reduces the solubility of a salt when a compound with a common ion is added.

D. It enhances the solubility of a salt in acidic solutions.

The common ion effect refers to the phenomenon in which the solubility of a salt is decreased when a compound containing a common ion is added to the solution. This effect is rooted in Le Chatelier's principle, which states that if a system at equilibrium is subjected to a change in conditions, the equilibrium will shift to counteract that change. For example, consider a salt like silver bromide (AgBr). When AgBr dissolves in water, it dissociates into silver ions (Ag^+) and bromide ions (Br^-). Now, if you add sodium bromide (NaBr), which also provides Br^- ions to the solution, the increased concentration of Br^- will shift the equilibrium of the AgBr dissociation towards the solid state to reduce the concentration of Br^-, thereby reducing the solubility of AgBr. Thus, the presence of a common ion effectively suppresses the dissolution of the salt, leading to a reduced solubility. This principle is essential in various applications including qualitative analysis and understanding the behavior of electrolytes in different conditions.

10. How does temperature typically affect the saturation of a solute in a solution?

A. It decreases the saturation point

B. It has no effect on saturation

C. It increases the saturation point

D. It varies the saturation unpredictably

The correct answer indicates that increasing temperature typically increases the saturation point of a solute in a solution. When the temperature of a solvent rises, the kinetic energy of the solvent molecules increases, allowing them to collide more frequently and intensely with solute particles. This heightened energy facilitates the dissolution process, enabling more solute to dissolve until a new, higher saturation point is reached. This principle is particularly notable with solids dissolved in liquids, such as sugar in water, where heating the solution allows for significantly more sugar to be dissolved compared to lower temperatures. The increased thermal energy helps overcome the solute-solute interactions, allowing more solute molecules to disperse in the solvent. In contrast, for gases dissolved in liquids, the opposite effect occurs; generally, increasing temperature tends to decrease the solubility of gases due to the increased kinetic energy allowing gas molecules to escape more readily from the solvent. Understanding these dynamics helps in predicting how solubility and saturation levels will change with temperature variations in different contexts.