University of Central Florida (UCF) CHM2046 Chemistry Fundamentals II Test 3 Practice Test (Sample)

Study Guide

BY EXAMZIFY

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Questions

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1. Which equation is used to describe the dissociation of a strong acid in water?

   A. $HA \rightleftharpoons H^+ + A^-$

   B. $HA \rightarrow H^+ + A^-$

   C. $HA + H_2O \rightleftharpoons H_3O^+ + A^-$

   D. $HA + OH^- \rightarrow A^- + H_2O$

2. What function does the salt bridge serve in an electrochemical cell?

   A. To connect the two half-cells electrically

   B. To maintain concentration of reactants

   C. To allow the transfer of electrons

   D. To maintain electrical neutrality by allowing ionic flow

3. Which term is designated for the transfer of protons in acid-base chemistry?

   A. Bronsted-Lowry Theory

   B. Arrhenius Theory

   C. Lewis Theory

   D. Kinetic Theory

4. What is the term for the maximum amount of solute that can dissolve in a solvent at a given temperature?

   A. Concentration

   B. Solubility

   C. Saturation point

   D. Dilution limit

5. Which ion is produced by an Arrhenius base in an aqueous solution?

   A. H+

   B. H3O+

   C. OH-

   D. Na+

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6. Which of the following substances is an oxidizing agent?

A. A substance that donates electrons

B. A substance that causes reduction

C. A substance that accepts electrons

D. A substance that remains unchanged during the reaction

7. How can you find the concentration given only the pH of a solution?

A. 10^pH

B. pH/10

C. 10^-pH

D. pH^10

8. What is the primary factor affecting the rate of a chemical reaction?

A. Temperature of reactants

B. Concentration of reactants

C. Surface area of reactants

D. Catalyst presence

9. What is the relationship between oxidation state and electron transfer in redox reactions?

A. Oxidation state increases with electron gain

B. Oxidation state increases with electron loss

C. Oxidation state decreases with electron gain

D. Oxidation state does not change

10. What is the general formula of an alkane?

A. CnH2n

B. CnH2n+2

C. CnH2n-2

D. CnH2n+1

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Answers

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

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Explanations

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1. Which equation is used to describe the dissociation of a strong acid in water?

A. $HA \rightleftharpoons H^+ + A^-$

B. $HA \rightarrow H^+ + A^-$

C. $HA + H_2O \rightleftharpoons H_3O^+ + A^-$

D. $HA + OH^- \rightarrow A^- + H_2O$

The equation that describes the dissociation of a strong acid in water is written as $HA \rightarrow H^+ + A^-$. This notation indicates that a strong acid, represented by HA, dissociates completely in water to yield hydrogen ions (H^+) and conjugate base ions (A^-). The key point in understanding this is that strong acids are characterized by their ability to ionize completely in aqueous solution, which means that nearly all molecules of the acid dissociate to form ions. The use of the arrow (→) instead of a double arrow (⇌) signifies that the reaction goes to completion and does not establish an equilibrium, consistent with the behavior of strong acids. This clarity in representation reflects how, once a strong acid is added to water, it produces a high concentration of H^+ ions, resulting in a lower pH of the solution. By contrast, other options involving reversible reactions or the addition of hydroxide ions do not accurately depict the complete dissociation characteristic of strong acids.

2. What function does the salt bridge serve in an electrochemical cell?

A. To connect the two half-cells electrically

B. To maintain concentration of reactants

C. To allow the transfer of electrons

D. To maintain electrical neutrality by allowing ionic flow

In an electrochemical cell, the salt bridge plays a crucial role in maintaining electrical neutrality by allowing ionic flow between the two half-cells. As a redox reaction occurs, electrons flow through an external circuit from the anode to the cathode, causing changes in charge. This buildup of positive or negative charge in the respective half-cells can impede the reaction. The salt bridge contains an electrolyte solution, typically a gel or a liquid that has ions present, which can migrate to balance the charge by compensating for the loss or gain of electrons. For instance, if electrons leave the anode half-cell, positive ions from the salt bridge will move toward the anode, while negative ions will move toward the cathode, thus maintaining the electrical neutrality of the overall system. This function is vital for the continuous operation of the electrochemical cell, enabling a sustained flow of electricity. This role of the salt bridge distinguishes it from the other options. Connecting the two half-cells electrically focuses on electron flow, while maintaining concentration of reactants refers more to the solution within the half-cells themselves rather than the balance of charges. Allowing the transfer of electrons primarily describes the external circuit rather than the role of the salt bridge. Therefore, the

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3. Which term is designated for the transfer of protons in acid-base chemistry?

A. Bronsted-Lowry Theory

B. Arrhenius Theory

C. Lewis Theory

D. Kinetic Theory

In acid-base chemistry, the transfer of protons is specifically defined by the Bronsted-Lowry Theory. This theory posits that an acid is a substance that donates a proton (H^+) to another substance, while a base is a substance that accepts a proton. This concept is critical in understanding how acids and bases interact in various chemical reactions. The focus on proton transfer distinguishes the Bronsted-Lowry Theory from other theories. For instance, the Arrhenius Theory defines acids as substances that increase the concentration of hydrogen ions in solution and bases as substances that increase the concentration of hydroxide ions, but it does not encompass proton transfer in a broader sense. Similarly, the Lewis Theory is centered around the donation and acceptance of electron pairs rather than protons. The Kinetic Theory is not applicable here, as it deals with the behavior of gases rather than acid-base reactions. Therefore, the Bronsted-Lowry Theory is the correct term for describing proton transfer in acid-base chemistry, as it specifically identifies the roles of acids and bases based on their ability to donate or accept protons.

4. What is the term for the maximum amount of solute that can dissolve in a solvent at a given temperature?

A. Concentration

B. Solubility

C. Saturation point

D. Dilution limit

The term "solubility" refers specifically to the maximum amount of solute that can be dissolved in a solvent at a given temperature and pressure. This concept is crucial in chemistry, as it defines how much of a substance can be incorporated into a solution before it becomes saturated. When a solute is added to a solvent, it continues to dissolve until it reaches a point where no more solute can be dissolved; this is when the solution is said to be saturated. Solubility is typically expressed in units such as grams of solute per liter of solvent (g/L) at a specific temperature, which indicates the extent of solute dissolution. Other terms like concentration, saturation point, and dilution limit, while related to solutions, do not accurately capture the definition of the maximum amount of solute that can dissolve. Concentration refers to the amount of solute in a given volume of solution, the saturation point describes a state rather than a quantitative value, and dilution limit is not a standard term in this context. This distinction highlights why "solubility" is the correct choice.

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5. Which ion is produced by an Arrhenius base in an aqueous solution?

A. H+

B. H3O+

C. OH-

D. Na+

An Arrhenius base is defined as a substance that, when dissolved in water, increases the concentration of hydroxide ions (OH-) in the solution. This is a fundamental principle of the Arrhenius theory of acids and bases. For example, when sodium hydroxide (NaOH) is dissolved in water, it dissociates into sodium ions (Na+) and hydroxide ions (OH-). The production of hydroxide ions is what characterizes an Arrhenius base. When these hydroxide ions are present in an aqueous solution, they can neutralize hydronium ions (H3O+) produced by an Arrhenius acid, thereby affecting the pH of the solution. This understanding is essential for grasping the behavior of bases in aqueous environments and is directly linked to acid-base chemistry, influencing reactions and equilibrium in solutions.

6. Which of the following substances is an oxidizing agent?

A. A substance that donates electrons

B. A substance that causes reduction

C. A substance that accepts electrons

D. A substance that remains unchanged during the reaction

An oxidizing agent is defined as a substance that accepts electrons during a chemical reaction. This process facilitates the oxidation of another substance, which is losing electrons. When the oxidizing agent accepts electrons, it itself undergoes reduction (the gain of electrons). This key feature allows us to identify the correct answer clearly. In the context of redox reactions, the interaction between the oxidizing agent and the reducing agent (the substance that donates electrons) is essential for the overall electron transfer process. The oxidizing agent is crucial for enabling this change, as it effectively "pulls" electrons away from the reducing agent. Thus, identifying the oxidizing agent as one that accepts electrons illustrates its role in promoting reduction and oxidation simultaneously. The other choices relate to different characteristics that do not align with the definition of an oxidizing agent. For instance, a substance that donates electrons refers to a reducing agent, while a substance that causes reduction is inherently involved in the reduction process but does not directly define the property of accepting electrons. Similarly, a substance that remains unchanged during a reaction does not accurately reflect an oxidizing agent's active role in the electron transfer process.

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7. How can you find the concentration given only the pH of a solution?

A. 10^pH

B. pH/10

C. 10^-pH

D. pH^10

To determine the concentration of hydrogen ions in a solution from its pH, it is important to understand the relationship defined by the pH scale. The pH of a solution is calculated using the formula: pH = -log[H^+] Where [H^+] represents the concentration of hydrogen ions in moles per liter. To isolate the concentration from this equation, you rearrange it as follows: 1. Start with the equation: pH = -log[H^+] 2. Multiply both sides by -1: -pH = log[H^+] 3. Use the inverse of the logarithmic function to solve for [H^+]: [H^+] = 10^(-pH) This means that to find the concentration of hydrogen ions, you need to take 10 to the power of the negative pH value. This is why the correct method is represented as 10^-pH, which corresponds to the concentration of hydrogen ions in the solution. In contrast, the other methods provided do not accurately reflect this relationship. Therefore, using 10^-pH is the correct approach when calculating the concentration based on the pH value.

8. What is the primary factor affecting the rate of a chemical reaction?

A. Temperature of reactants

B. Concentration of reactants

C. Surface area of reactants

D. Catalyst presence

The primary factor affecting the rate of a chemical reaction is the concentration of reactants. As the concentration of reactants increases, the number of particles or molecules available for reaction also rises. This leads to a greater frequency of collisions between the reactant particles, which is essential for a reaction to occur. More collisions result in a higher likelihood of overcoming the activation energy barrier, ultimately increasing the reaction rate. While temperature, surface area, and the presence of a catalyst are also significant in influencing reaction rates, they typically serve to enhance or modify the rate rather than being the most direct and consistent factor. For instance, increasing temperature usually provides reactants with more energy, leading to faster movements and more frequent collisions, but it is the concentration that fundamentally alters the collision dynamics. A change in surface area primarily affects reactions occurring at surfaces, typically benefiting heterogeneous reactions, and catalysts lower the activation energy, making reactions proceed more quickly without being consumed. However, the concentration of reactants serves as a foundational driver for reaction rate across a wide variety of reactions.

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9. What is the relationship between oxidation state and electron transfer in redox reactions?

A. Oxidation state increases with electron gain

B. Oxidation state increases with electron loss

C. Oxidation state decreases with electron gain

D. Oxidation state does not change

In redox reactions, the oxidation state is fundamentally tied to the concept of electron transfer. When an atom loses electrons, it is said to be oxidized, and this process results in an increase in its oxidation state. This is because the removal of negatively charged electrons makes the atom more positively charged, hence elevating its oxidation state. For example, if you consider a transition metal that might start with an oxidation state of +2 and loses two electrons, it would transition to a +4 oxidation state. This demonstrates the direct correlation between electron loss and an increase in oxidation state. This principle is essential in understanding how redox reactions function, as they involve the simultaneous oxidation and reduction of different species. The atom that loses electrons experiences an increase in oxidation state, illustrating the relationship between oxidation and the transfer of electrons within redox processes.

10. What is the general formula of an alkane?

A. CnH2n

B. CnH2n+2

C. CnH2n-2

D. CnH2n+1

The general formula for alkanes, which are saturated hydrocarbons, is CnH2n+2. This formula indicates that for every 'n' carbon atoms in an alkane molecule, there are '2n+2' hydrogen atoms. Alkanes are characterized by having single bonds between carbon atoms, which allows them to be fully saturated with hydrogen. This saturation is crucial because it determines the chemical properties of alkanes, such as their stability and reactivity compared to unsaturated hydrocarbons like alkenes and alkynes, which have double or triple bonds, respectively. When considering the formula, if you start with a single carbon (n=1), you can see that C1 would yield H(2*1+2) = H4, which corresponds to methane (CH_4). As you increase the number of carbon atoms, the pattern continues, showcasing that alkanes consistently follow this formula throughout the series. Thus, this consistent ratio of hydrogen to carbon atoms is key to identifying alkanes within organic chemistry.

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