University of Central Florida (UCF) CHM1020 Concepts in Chemistry Final Practice Exam (Sample)

Study Guide

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Questions

1. What will happen to a 0.25 M solution of sucrose when tested for conductivity?

   A. The bulb will light up

   B. The bulb will not light up

   C. It will dimly light up

   D. It will explode

2. What does the term "thermal energy" signify?

   A. The energy stored in the chemical bonds of a substance

   B. The energy needed to change a solid into a gas

   C. The total kinetic energy of particles within a substance

   D. The energy associated with chemical reactions only

3. What kind of bonds are found in the molecules described in the reaction between NH3 and F2?

   A. Double bonds only

   B. Triple bonds only

   C. Only single bonds

   D. Complex bonds

4. Which of the following gases is noted as a promising alternative to fossil fuels?

   A. Carbon dioxide (CO_2)

   B. Methane (CH_4)

   C. Hydrogen (H_2)

   D. Nitrogen dioxide (NO_2)

5. In a titration, what is typically used to determine the endpoint?

   A. A change in color

   B. The temperature of the solution

   C. The pressure of the gas produced

   D. The total volume of the solution

6. What is the primary purpose of a titration?

A. To mix two solids together

B. To measure the temperature of a solution

C. To determine the concentration of a solute

D. To identify a chemical reaction type

7. What is the primary fuel source for heating in many rural residences?

A. Natural gas

B. Electricity

C. LP gas

D. Wood

8. What is the pH of a solution with a hydroxide concentration of 2.5 x 10^-9 M?

A. 7.0

B. 5.4

C. 4.3

D. 10.0

9. In a solution, what is a solute?

A. A substance dissolved in another substance

B. The liquid that dissolves the solute

C. The solid that forms during a reaction

D. A gaseous compound in equilibrium

10. What is a characteristic of the correct Lewis structure for HCl?

A. Hydrogen must have eight electrons

B. Chlorine must have more than two electrons

C. All atoms must have an octet except hydrogen

D. Chlorine cannot bond with hydrogen

Answers

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

Explanations

1. What will happen to a 0.25 M solution of sucrose when tested for conductivity?

A. The bulb will light up

B. The bulb will not light up

C. It will dimly light up

D. It will explode

A 0.25 M solution of sucrose will not conduct electricity, and as a result, the bulb will not light up. This is because sucrose is a non-electrolyte, meaning that when it dissolves in water, it does not dissociate into ions. Conductivity in solutions is primarily due to the presence of free-moving charged particles, such as ions. In the case of sucrose, it dissolves completely to form molecules, but since there are no ions present to carry an electrical current, the solution does not conduct electricity. Thus, when tested for conductivity, the bulb remains off, confirming that the sucrose solution does not allow for the flow of electric current.

2. What does the term "thermal energy" signify?

A. The energy stored in the chemical bonds of a substance

B. The energy needed to change a solid into a gas

C. The total kinetic energy of particles within a substance

D. The energy associated with chemical reactions only

Thermal energy refers to the total kinetic energy of the particles within a substance, which includes the energy due to the motion of both the individual particles and their vibrations. This kinetic energy is directly related to temperature; as the temperature of a substance increases, the thermal energy increases because the particles move more rapidly. This concept is fundamental in understanding heat transfer and the behavior of matter in different states. The other options focus on different forms of energy. The first option discusses chemical bond energy, which pertains to the potential energy associated with the arrangement of atoms in a molecule rather than their motion. The second option describes the energy needed for a phase change, such as from solid to gas, highlighting a specific process rather than the overall kinetic energy of particles. The last option confines the definition to energy in chemical reactions, while thermal energy encompasses the broader concept of particle motion, regardless of whether a reaction is occurring. Thus, focusing on the total kinetic energy provides the most accurate and comprehensive understanding of thermal energy.

3. What kind of bonds are found in the molecules described in the reaction between NH3 and F2?

A. Double bonds only

B. Triple bonds only

C. Only single bonds

D. Complex bonds

In the reaction between ammonia (NH3) and fluorine (F2), the types of bonds present are primarily single bonds. Ammonia consists of single covalent bonds between the nitrogen atom and the three hydrogen atoms. When ammonia reacts with fluorine, it can form molecules such as nitrogen trifluoride (NF3) and HF (hydrofluoric acid), which also consist of single bonds between the nitrogen and fluorine atoms and between hydrogen and fluorine. Fluorine, as a diatomic molecule, has a single bond between its two fluorine atoms. When discussing bond types in this reaction, it's important to recognize that both reactants and the resulting products involve single bonds. Therefore, characterizing the bonds found in these molecules properly identifies them as single bonds, making this the correct choice. This consideration of bond formation and the chemical nature of the involved species helps solidify the understanding that single bonds are indeed the dominant bond type in the reaction described.

4. Which of the following gases is noted as a promising alternative to fossil fuels?

A. Carbon dioxide (CO2)

B. Methane (CH4)

C. Hydrogen (H2)

D. Nitrogen dioxide (NO2)

Hydrogen is considered a promising alternative to fossil fuels due to its potential for clean energy production. When burned or used in fuel cells, hydrogen produces only water as a byproduct, contributing to a reduction in greenhouse gas emissions and air pollutants compared to fossil fuels that release carbon dioxide and other harmful substances. Additionally, hydrogen can be produced from various renewable energy sources, such as water through electrolysis using solar or wind power, making it a versatile and sustainable fuel. This characteristic positions hydrogen as a key player in the transition towards more sustainable energy systems, aiming to reduce our reliance on fossil fuels and mitigate climate change. In contrast, carbon dioxide is a greenhouse gas typically produced by burning fossil fuels, and while methane does have applications as a cleaner fossil fuel, it is still a hydrocarbon that can contribute to greenhouse gas emissions if not managed properly. Nitrogen dioxide is primarily a pollutant from combustion processes and does not serve as a viable alternative to fossil fuels.

5. In a titration, what is typically used to determine the endpoint?

A. A change in color

B. The temperature of the solution

C. The pressure of the gas produced

D. The total volume of the solution

In a titration, the endpoint is typically determined by a change in color, which indicates that the reactants have reacted in stoichiometric proportions. This change is often achieved using an indicator, a substance that changes color at a specific pH or concentration level. For example, phenolphthalein turns from colorless to pink at a pH around 8.2, signaling that the solution has reached its endpoint for a typical acid-base titration. The use of color change allows the experimenter to visually identify when the titration is complete without the need for complex instrumentation. This method is particularly effective because it provides a clear and immediate indication that the titration has reached the desired level of reaction, allowing for more accurate results. Other methods, such as measuring the temperature, pressure, or total volume of the solution, do not provide the same direct indication of completion for a titration. Temperature changes may occur but are not definitive for endpoint detection, pressure is relevant in gas-producing reactions but not typically in titrations, and the total volume measurement doesn't accurately represent the reaction's completion. Therefore, the change in color serves as a reliable and straightforward indicator for determining the endpoint in a titration.

6. What is the primary purpose of a titration?

A. To mix two solids together

B. To measure the temperature of a solution

C. To determine the concentration of a solute

D. To identify a chemical reaction type

The primary purpose of a titration is to determine the concentration of a solute in a solution. This analytical technique involves carefully adding a titrant, which is a solution of known concentration, to a solution of unknown concentration until a reaction between the two is complete. Typically, this point of completion is indicated by a change in color (using an indicator) or by reaching a certain pH level, depending on the type of titration being conducted. Titration is widely used in various fields, including chemistry, biology, and environmental science, to calculate the molarity of an unknown solution based on the volume of titrant used. By knowing the concentration of the titrant and measuring how much is needed to react with the solute, one can use stoichiometric relationships to find the unknown concentration. The other options do not align with the purpose of titration. Mixing two solids does not measure concentration, measuring temperature assesses thermal properties rather than chemical concentration, and identifying a chemical reaction type does not inherently involve determining solute concentrations. Thus, the focus and utility of titration lie specifically in the quantification of solute concentration in a solution.

7. What is the primary fuel source for heating in many rural residences?

A. Natural gas

B. Electricity

C. LP gas

D. Wood

The primary fuel source for heating in many rural residences is wood. In rural areas, particularly where natural gas pipelines or electricity may be less accessible, wood serves as a locally available, efficient, and cost-effective resource for heating. Many rural homeowners use wood for its high heat output and the ability to source it from their land or local areas, making it a sustainable option. Additionally, wood-burning stoves or fireplaces are often utilized for both space heating and aesthetic purposes. Natural gas, while prevalent in many suburban and urban areas, may not be as readily available or economical in rural settings. Similarly, electricity can be more expensive and is subject to supply constraints in more remote locations. LP gas (liquefied petroleum gas) is also used for heating in some rural homes, but wood typically has a stronger tradition and broader use due to its accessibility and cost-effectiveness. Thus, wood remains a primary fuel source for heating in many rural residences.

8. What is the pH of a solution with a hydroxide concentration of 2.5 x 10^-9 M?

A. 7.0

B. 5.4

C. 4.3

D. 10.0

To determine the pH of a solution when given the hydroxide ion concentration, it is essential to utilize the relationship between pH, pOH, and the ion concentrations. First, we can calculate the pOH using the formula: $pOH = -\log[OH^-]$ Substituting the provided hydroxide concentration: pOH = -log(2.5 x 10^-9) Calculating this will give a pOH of approximately 8.6. Next, we can find the pH using the relationship between pH and pOH, which is: pH + pOH = 14 By rearranging this equation, we can solve for pH: pH = 14 - pOH Substituting the value calculated for pOH: pH = 14 - 8.6 = 5.4 Thus, the pH of the solution is 5.4. This means that the solution is slightly acidic, as a pH of 7 is neutral, and values lower than 7 indicate acidity. This process highlights the importance of understanding the relationships between hydroxide and hydrogen ion concentrations when determining pH levels in solutions.

9. In a solution, what is a solute?

A. A substance dissolved in another substance

B. The liquid that dissolves the solute

C. The solid that forms during a reaction

D. A gaseous compound in equilibrium

A solute is defined as a substance that is dissolved in a solvent to form a solution. In this context, the solute is typically present in a smaller amount compared to the solvent, which is the substance that does the dissolving. For example, when salt (the solute) is added to water (the solvent), the salt dissolves and disperses uniformly throughout the water, creating a saline solution. This fundamental concept is essential for understanding various chemical processes, such as reactions in solution, concentration calculations, and properties of solutions. The other options relate to different aspects of chemical solutions but do not correctly define a solute. The solvent, for instance, refers specifically to the liquid that facilitates dissolution, while solid formation or gaseous compounds in equilibrium do not pertain to the definitions of solutes. Understanding the role of solutes is crucial in chemistry as it allows for better grasp of solution behavior and interactions.

10. What is a characteristic of the correct Lewis structure for HCl?

A. Hydrogen must have eight electrons

B. Chlorine must have more than two electrons

C. All atoms must have an octet except hydrogen

D. Chlorine cannot bond with hydrogen

In the Lewis structure for hydrogen chloride (HCl), the important concept is that hydrogen can only accommodate a maximum of two electrons due to its position in the first period of the periodic table. Therefore, rather than adhering to the octet rule—which states that atoms tend to bond in a way that gives them eight electrons in their valence shell—hydrogen is content with just two electrons. Chlorine, on the other hand, is a second-period element and can follow the octet rule. In HCl, chlorine shares one of its electrons with hydrogen, effectively allowing both atoms to achieve a stable electronic configuration. While chlorine indeed has more than two electrons in the overall structure (it accommodates a full octet), hydrogen's unique behavior means that it doesn't need eight electrons to be stable. This highlights that all atoms except hydrogen can be expected to fulfill the octet rule in a Lewis structure. Thus, the characteristic that all atoms must have an octet except for hydrogen is essential in accurately depicting the bonding and electron sharing found in HCl.