University of Central Florida (UCF) CHM2045C Chemistry Fundamentals I Practice Exam 3 (Sample)

Study Guide

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Questions

1. What is the definition of specific heat capacity?

   A. The amount of heat needed to freeze one gram of a substance

   B. The amount of heat required to vaporize one gram of a substance

   C. The amount of heat required to raise the temperature of one gram of a substance by one degree Celsius

   D. The amount of energy released when a substance cools

2. What is entropy in the context of thermodynamics?

   A. A measure of energy in a system

   B. A measure of the randomness or disorder of a system

   C. A measure of the temperature of a system

   D. A measure of heat transfer

3. What is true about a non-polar molecule?

   A. It contains charged groups

   B. It has a partial positive and negative charge

   C. It has no significant charge difference across the molecule

   D. It readily dissolves in polar solvents

4. What is activation energy?

   A. The energy released during a chemical reaction

   B. The energy required to break chemical bonds

   C. The minimum energy required for a chemical reaction to occur

   D. The energy needed to maintain a chemical reaction

5. What happens to the concentration of a solution during dilution?

   A. It increases

   B. It decreases

   C. It stays the same

   D. It can either increase or decrease

6. What is the impact of cohesion in a liquid's surface tension?

A. It causes the liquid to evaporate quickly

B. It causes the liquid to form droplets

C. It allows for a higher temperature

D. It contributes to the liquid's conductivity

7. What is a balanced chemical equation?

A. An equation lacking any reactants

B. An equation with unequal numbers of atoms for each element

C. An equation with equal numbers of atoms for each element on both sides

D. An equation that represents the overall energy change

8. What would be the effect of increasing the concentration of reactants in a reaction?

A. It would slow down the reaction

B. It would have no impact on the reaction rate

C. It would generally increase the reaction rate

D. It would change the reaction's equilibrium position

9. How is a homogeneous mixture characterized?

A. By distinct separate phases

B. By uniform composition throughout

C. By varying proportions of components

D. By containing larger particles

10. What is a redox reaction?

A. A reaction that only involves oxidation

B. A reaction that only involves reduction

C. A reaction involving the transfer of protons

D. A reaction involving the transfer of electrons between substances

Answers

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

Explanations

1. What is the definition of specific heat capacity?

A. The amount of heat needed to freeze one gram of a substance

B. The amount of heat required to vaporize one gram of a substance

C. The amount of heat required to raise the temperature of one gram of a substance by one degree Celsius

D. The amount of energy released when a substance cools

Specific heat capacity is defined as the amount of heat required to raise the temperature of one gram of a substance by one degree Celsius. This property is crucial in understanding how different materials respond to heat. It essentially indicates how much energy must be added to or removed from a substance to change its temperature, which is fundamental in thermodynamics and various applications in chemistry and engineering. The specific heat capacity varies between substances, reflecting their unique molecular structures and bonding, which influence how they absorb and store thermal energy. High specific heat capacity means a substance can absorb a lot of heat without significant temperature changes, while a low specific heat capacity indicates it heats up or cools down rapidly with the addition or removal of heat. In contrast, the other options describe different thermodynamic processes. Freezing and vaporization pertain to phase changes rather than temperature change, and the amount of energy released during cooling relates to heat transfer rather than the specific heat capacity itself.

2. What is entropy in the context of thermodynamics?

A. A measure of energy in a system

B. A measure of the randomness or disorder of a system

C. A measure of the temperature of a system

D. A measure of heat transfer

In thermodynamics, entropy is defined as a measure of the randomness or disorder of a system. It quantifies the number of specific ways in which a thermodynamic system can be arranged, reflecting the level of uncertainty or disorder. As a system becomes more disordered, its entropy increases; conversely, as it becomes more ordered, its entropy decreases. This concept is pivotal in understanding the second law of thermodynamics, which states that in an isolated system, the total entropy can never decrease over time, meaning that processes in such systems naturally tend toward increased disorder. For example, when ice melts into water, the structured arrangement of molecules in the solid state becomes more disordered in the liquid state, resulting in an increase in entropy. The other options relate to different concepts in thermodynamics. Energy refers to the capacity to do work, temperature is a measure of the average kinetic energy of particles, and heat transfer describes the movement of thermal energy from one object to another. While these concepts are interconnected, they do not encapsulate the definition of entropy, which specifically relates to disorder and randomness in a system.

3. What is true about a non-polar molecule?

A. It contains charged groups

B. It has a partial positive and negative charge

C. It has no significant charge difference across the molecule

D. It readily dissolves in polar solvents

A non-polar molecule is characterized by having an even distribution of charge, meaning there is no significant charge difference across the molecule. This lack of polarity arises because non-polar molecules either do not contain polar bonds or contain polar bonds that are arranged symmetrically, allowing their dipole moments to cancel out. In contrast to polar molecules, which have regions of partial positive and negative charges due to a difference in electronegativity between the atoms involved, non-polar molecules do not exhibit this phenomenon. Moreover, non-polar molecules typically do not readily dissolve in polar solvents, as like dissolves like; polar molecules interact well with other polar substances and non-polar molecules interact well with non-polar substances. Thus, the statement that a non-polar molecule has no significant charge difference accurately reflects its nature and is the reason why the correct answer is chosen.

4. What is activation energy?

A. The energy released during a chemical reaction

B. The energy required to break chemical bonds

C. The minimum energy required for a chemical reaction to occur

D. The energy needed to maintain a chemical reaction

Activation energy refers to the minimum energy that reactant molecules must possess for a chemical reaction to take place. It acts as a threshold barrier that must be overcome for the reactants to transform into products. This energy is essential because it determines the rate at which reactions occur. If the energy of the colliding particles is below this threshold, the reaction will not proceed. In many cases, activation energy is needed to break existing bonds so that new bonds can form, leading to product formation. However, while breaking bonds is part of the process, the key concept here is that it is about the energy necessary for initiating the reaction rather than just the energy associated with bond breaking. Additionally, the energy released during a reaction pertains to the exothermic processes, where energy is released upon the formation of products. This aspect does not relate to activation energy, which is concerned specifically with the initiation of the reaction itself. Finally, maintaining a reaction usually refers to the energy required to sustain the conditions under which a reaction occurs (like heat in an exothermic reaction), but this is distinct from the concept of activation energy, which is primarily about the energy input needed at the outset of the reaction.

5. What happens to the concentration of a solution during dilution?

A. It increases

B. It decreases

C. It stays the same

D. It can either increase or decrease

During dilution, the concentration of a solution decreases. This occurs because dilution involves adding a solvent—usually water—to a solution, which increases the total volume of the solution while the amount of solute (the substance dissolved in the solvent) remains constant. When the volume of solvent increases, the ratio of solute to the total volume of solution decreases, resulting in a lower concentration. Concentration is defined as the amount of solute per unit volume of solution. Therefore, as the volume increases due to the addition of more solvent, and the amount of solute does not increase, the concentration diminishes. This principle is fundamental in chemistry and is often expressed through the dilution equation, $C1V1 = C2V2$, where C represents concentration and V represents volume. In this formula, the initial concentration multiplied by the initial volume equals the final concentration multiplied by the final volume. When adding solvent and thus increasing the final volume, the final concentration must correspondingly decrease if the amount of solute remains unchanged.

6. What is the impact of cohesion in a liquid's surface tension?

A. It causes the liquid to evaporate quickly

B. It causes the liquid to form droplets

C. It allows for a higher temperature

D. It contributes to the liquid's conductivity

Cohesion is the intermolecular attraction between like molecules, which plays a crucial role in determining the surface tension of a liquid. Because cohesive forces are stronger at the surface of a liquid compared to those in the bulk, molecules at the surface experience a net inward force. This leads to the formation of surface tension, which causes the liquid to behave as if its surface is covered by a stretched elastic membrane. When cohesion causes a liquid to exhibit surface tension, it results in the liquid forming droplets rather than spreading out. Droplets form as the cohesive forces pull molecules together, minimizing the surface area for a given volume, which is a thermodynamically favorable arrangement. This phenomenon is particularly evident with water, which tends to form spherical droplets due to its high cohesive forces. While other options may touch on various properties or behaviors of liquids, they do not directly relate to the impact of cohesion on surface tension in the way that droplet formation does. Evaporation rate, temperature, and conductivity are influenced by different factors and are not the result of cohesion in the context of surface tension.

7. What is a balanced chemical equation?

A. An equation lacking any reactants

B. An equation with unequal numbers of atoms for each element

C. An equation with equal numbers of atoms for each element on both sides

D. An equation that represents the overall energy change

A balanced chemical equation is vital in illustrating the conservation of mass, which is a foundational principle in chemistry. In a balanced equation, the number of atoms for each element remains constant throughout the reaction, meaning that the total quantity of each type of atom is equal on both the reactant (left) and product (right) sides of the equation. This equality demonstrates that atoms are neither created nor destroyed during a chemical reaction; they are simply rearranged to form new substances. This concept is not just a formality; it has crucial implications for stoichiometry, predicting the outcome of reactions, and understanding the quantitative relationships between reactants and products. By ensuring that a balanced equation has equal numbers of atoms for each element on both sides, it provides a clear representation of what occurs in a chemical reaction without violating the law of conservation of mass.

8. What would be the effect of increasing the concentration of reactants in a reaction?

A. It would slow down the reaction

B. It would have no impact on the reaction rate

C. It would generally increase the reaction rate

D. It would change the reaction's equilibrium position

Increasing the concentration of reactants in a chemical reaction generally increases the reaction rate. This effect arises from the collision theory of chemical reactions, which states that the rate of a reaction is dependent on the frequency of collisions between reactant molecules. When the concentration of reactants is increased, there are more molecules present in a given volume, leading to a higher likelihood of collisions occurring. As a result, the chances of effective collisions that can overcome the activation energy barrier are enhanced, thus accelerating the rate at which products are formed. This is particularly relevant in reactions involving gases or solutions, where an increase in concentration directly correlates with an increase in the number of interactions at the molecular level. In contrast, the other response options do not accurately represent the relationship between reactant concentration and reaction rate. For example, stating that increasing concentration would slow down the reaction contradicts the fundamental principles of collision theory. Likewise, suggesting that it would have no impact on the reaction rate overlooks the significant connection established between concentration and the frequency of effective collisions. Finally, stating that it would change the equilibrium position is not pertinent to the immediate rate of reaction; rather, changes in concentration could shift equilibrium positions according to Le Chatelier's principle, but that involves different dynamics than

9. How is a homogeneous mixture characterized?

A. By distinct separate phases

B. By uniform composition throughout

C. By varying proportions of components

D. By containing larger particles

A homogeneous mixture is characterized by uniform composition throughout, meaning that the components that make up the mixture are evenly distributed at a molecular level. This results in a single phase, where the individual substances are indistinguishable from one another. For example, when salt is dissolved in water, the resulting solution appears clear and consistent, with no visible separation between the salt and water components. This uniformity of composition is a key factor that distinguishes homogeneous mixtures from heterogeneous mixtures, which can be identified by the presence of distinct separate phases where the different components remain visibly separate. For instance, oil and water do not mix uniformly and will form layers instead of one consistent mixture. The proportions of components in a homogeneous mixture can vary, but if they lead to a consistent composition without visible separation, it remains homogeneous. The size of the particles is also not a defining characteristic, as both small and large particles can exist in homogeneous mixtures depending on the substances involved.

10. What is a redox reaction?

A. A reaction that only involves oxidation

B. A reaction that only involves reduction

C. A reaction involving the transfer of protons

D. A reaction involving the transfer of electrons between substances

A redox reaction, short for reduction-oxidation reaction, is characterized by the transfer of electrons between substances. In these reactions, one substance undergoes oxidation, which involves the loss of electrons, while another substance undergoes reduction, which entails the gain of electrons. This transfer of electrons is key to many chemical processes and is fundamental in various fields such as electrochemistry, biological systems, and energy production. For example, in the reaction between zinc and copper sulfate, zinc is oxidized as it loses electrons, while copper ions are reduced as they gain electrons. This electron transfer is what distinguishes redox reactions from other types of chemical reactions, such as acid-base reactions that primarily involve proton exchange. Understanding this concept is crucial for analyzing and predicting the behavior of elements and compounds in chemical reactions.