

Sample Questions - Chemithon

Subject Fundamental Question

1. Which of the following statements accurately describes the role of a catalyst in a chemical reaction?

- a) Catalysts alter the equilibrium constant of a reaction.
- b) Catalysts change the rate of a reaction without being consumed.**
- c) Catalysts increase the activation energy required for a reaction.
- d) Catalysts only function in exothermic reactions.

2. How does increasing temperature affect the rate constant of a reaction?

- a) The rate constant decreases with increasing temperature.
- b) The rate constant remains constant regardless of temperature.
- c) The rate constant increases with increasing temperature.**
- d) The rate constant is not influenced by temperature changes.

3. In a chemical reaction, if the reaction quotient Q is greater than the equilibrium constant K , what can be concluded about the direction of the reaction?

- a) The reaction proceeds in the forward direction to reach equilibrium.
- b) The reaction proceeds in the reverse direction to reach equilibrium.**
- c) The reaction has already reached equilibrium.
- d) The direction of the reaction cannot be determined from Q and K values.

4. Which of the following statements accurately describes the relationship between atomic radius and ionization energy?

- a) **Atomic radius decreases as ionization energy increases.**
- b) Atomic radius increases as ionization energy increases.
- c) Atomic radius and ionization energy are inversely proportional.
- d) Atomic radius and ionization energy are not correlated.

5. Which of the following compounds exhibits the phenomenon of geometric isomerism?

- a) CH₄
- b) **C₂H₄**
- c) C₂H₆
- d) C₃H₈

On-site Learning Question

6. In organic chemistry, chirality refers to the property of a molecule that is not superimposable on its mirror image. Chiral molecules often contain asymmetric carbon atoms, also known as stereocenters, where four different groups are bonded to the central carbon atom. Enantiomers are non-superimposable mirror images of each other and exhibit identical physical properties except for their interaction with other chiral molecules, such as in biological systems.

Based on the provided material, which of the following statements about enantiomers

is true?

- a) Enantiomers have identical physical properties.
- b) Enantiomers can be superimposed on each other.
- c) **Enantiomers interact identically with other chiral molecules.**
- d) Enantiomers contain symmetric carbon atoms.

7. The Henderson-Hasselbalch equation is a useful tool in acid-base chemistry for calculating the pH of a solution containing a weak acid and its conjugate base or a weak base and its conjugate acid. The equation is $\text{pH} = \text{pK}_a + \log\left(\frac{[\text{A}^-]}{[\text{HA}]}\right)$, where $[\text{A}^-]$ represents the concentration of the conjugate base and $[\text{HA}]$ represents the concentration of the weak acid.

Referencing the Henderson-Hasselbalch equation provided, what happens to the pH of a buffer solution when the ratio of $[\text{A}^-]/[\text{HA}]$ is increased?

- a) The pH decreases.
- b) **The pH increases.**
- c) The pH remains constant.
- d) The pH becomes unpredictable.

8. In electrochemistry, Faraday's laws describe the quantitative relationship between the amount of substance produced or consumed in an electrolysis reaction and the amount of electricity passed through the electrolyte. The first law states that the amount of substance produced or consumed at an electrode is directly proportional to the quantity of electricity passed through the cell. The second law states that the

amount of different substances produced or consumed by the same quantity of electricity is proportional to their equivalent weights.

Considering Faraday's laws described in the material, what would be the effect on the mass of a substance produced during electrolysis if the quantity of electricity passed through the cell is doubled?

- a) The mass of the substance produced is halved.
- b) The mass of the substance produced remains the same.
- c) **The mass of the substance produced is doubled.**
- d) The mass of the substance produced cannot be determined.

9. In chemical kinetics, the rate-determining step (or rate-limiting step) is the slowest step in a reaction mechanism. It is often characterized by the highest activation energy among the steps involved in the reaction. Understanding the rate-determining step is crucial for designing strategies to optimize reaction conditions and increase reaction efficiency.

Referring to the material provided, what is the significance of identifying the rate-determining step in a reaction mechanism?

- a) It indicates the step with the lowest activation energy.
- b) **It determines the overall rate of the reaction.**
- c) It signifies the step with the highest concentration of reactants.
- d) It represents the final step in the reaction mechanism.

10. In spectroscopy, Raman spectroscopy is a technique used to study vibrational, rotational, and other low-frequency modes in a system. It relies on the inelastic scattering of monochromatic light, usually from a laser source, where a small fraction of the incident photons interacts with the sample, resulting in a shift in energy. Raman spectroscopy is widely used in various fields, including chemistry, physics, and materials science.

Referring to the material provided, what type of scattering is utilized in Raman spectroscopy?

- a) Elastic scattering
- b) Inelastic scattering**
- c) Rayleigh scattering
- d) Absorption scattering

Subject Advanced Question

11. In the context of organic chemistry, what role does a leaving group play in a substitution reaction?

- a) Attracting electrons towards itself.
- b) Facilitating the departure of a nucleophile.**
- c) Increasing the steric hindrance of the reaction.
- d) Stabilizing the transition state of the reaction.

12. Which of the following molecules exhibits the strongest hydrogen bonding?

- a) **CH₃OH**
- b) CH₃SH
- c) CH₃NH₂
- d) CH₃CH₃

13. When considering the Lewis structure of ozone (O₃), how many lone pairs of electrons are present on each oxygen atom?

- a) One oxygen atom has one lone pair, and the other two have two lone pairs each.
- b) Each oxygen atom has one lone pair.**
- c) Each oxygen atom has two lone pairs.
- d) Ozone does not have any lone pairs.

14. Arrange the following elements in order of increasing electronegativity: F, O, N, Cl.

- a) Cl < N < O < F
- b) F < Cl < O < N
- c) N < Cl < O < F**
- d) O < N < Cl < F

15. In a NMR spectrum, what does the chemical shift value indicate?

- a) The number of protons in the molecule.
- b) The location of the peak on the spectrum.
- c) The electron density surrounding the nucleus.**

d) The magnetic field strength experienced by the nucleus.