

Advanced High School Chemistry Assessment

Chemistry · Answer Key · 25 Questions

1. Which of the following describes the rate-determining step in a multi-step reaction mechanism?

- A) The fastest elementary step
- B) The step with the highest activation energy**
- C) The step involving the most molecules
- D) The step with the lowest activation energy

2. What is the hybridization of the central carbon atom in a carbonate ion (CO_3^{2-})?

- A) sp
- B) sp^2**
- C) sp^3
- D) dsp^2

3. According to the Henderson-Hasselbalch equation, when the pH of a buffer solution equals the pK_a of the weak acid, what is true?

- A) $[\text{Acid}] = [\text{Conjugate Base}]$**
- B) $[\text{Acid}] = 0$
- C) $[\text{Conjugate Base}] = 0$
- D) $\text{pH} = 0$

4. In a galvanic cell, which electrode is defined as the site of reduction?

- A) Anode
- B) Cathode**
- C) Salt bridge
- D) Voltmeter

5. Which of the following functional groups is produced by the oxidation of a secondary alcohol?

- A) Aldehyde
- B) Carboxylic acid
- C) Ketone**
- D) Ether

6. What is the standard enthalpy of formation for an element in its most stable form at 298 K?

- A) -1.0 kJ/mol
- B) 1.0 kJ/mol
- C) 0 kJ/mol**
- D) 100 kJ/mol

7. Which type of intermolecular force is primarily responsible for the high boiling point of water compared to hydrogen sulfide?

- A) London dispersion forces
- B) Dipole-dipole interactions
- C) Hydrogen bonding**
- D) Ion-dipole forces

8. What does a negative value of Gibbs Free Energy (ΔG) indicate for a reaction?

- A) The reaction is non-spontaneous
- B) The reaction is at equilibrium
- C) The reaction is spontaneous**
- D) The reaction is endothermic

9. Which law states that the total pressure of a mixture of gases is equal to the sum of the partial pressures of the individual gases?

- A) Boyle's Law
- B) Charles's Law
- C) Dalton's Law**
- D) Avogadro's Law

10. What is the geometry of a molecule with a central atom that has four bonding pairs and two lone pairs of electrons?

- A) Tetrahedral
- B) Square planar**
- C) See-saw
- D) T-shaped

11. Which transition metal complex ion is typically responsible for a deep blue color in aqueous ammonia solutions?

- A) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- B) $[\text{Cu}(\text{NH}_3)_4]^{2+}$**
- C) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
- D) $[\text{Zn}(\text{NH}_3)_4]^{2+}$

12. In coordination chemistry, what term describes ligands that can bond through more than one donor atom?

- A) Monodentate
- B) Polydentate**
- C) Ambidentate
- D) Chelating

13. What is the unit of the rate constant for a second-order reaction?

- A) s^{-1}
- B) $M s^{-1}$
- C) $M^{-1} s^{-1}$**
- D) $M^{-2} s^{-1}$

14. Which quantum number describes the orientation of an orbital in space?

- A) Principal
- B) Angular momentum
- C) Magnetic**
- D) Spin

15. What is the primary product of the reaction between an alkene and hydrogen bromide in the presence of peroxides (anti-Markovnikov addition)?

- A) Primary alkyl bromide**
- B) Secondary alkyl bromide
- C) Tertiary alkyl bromide
- D) Alcohol

16. Which thermodynamic property represents the measure of disorder in a system?

- A) Enthalpy
- B) Entropy**
- C) Internal energy
- D) Work

17. What is the electronic configuration of a Chromium atom (Cr, atomic number 24) in its ground state?

- A) $[Ar] 4s^2 3d^4$
- B) $[Ar] 4s^1 3d^5$**
- C) $[Ar] 4s^0 3d^6$
- D) $[Ar] 3d^6$

18. Which compound is formed when a primary alcohol is fully oxidized using acidified potassium dichromate?

- A) Aldehyde
- B) Ketone
- C) Carboxylic acid**
- D) Ester

19. What is the common name for the reaction between a carboxylic acid and an alcohol to form an ester?

- A) Saponification
- B) Esterification**
- C) Neutralization
- D) Hydrogenation

20. Which law states that the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the liquid?

- A) Raoult's Law
- B) Henry's Law**
- C) Graham's Law
- D) Le Chatelier's Principle

21. What is the coordination number of the central atom in a Hexafluorosilicate ion (SiF_6^{2-})?

- A) 4
- B) 5
- C) 6**
- D) 8

22. Which type of crystal lattice is characteristic of ionic solids like sodium chloride?

- A) Face-centered cubic**
- B) Body-centered cubic
- C) Simple cubic
- D) Hexagonal close-packed

23. What is the effect of a catalyst on the equilibrium constant (K_c) of a reversible reaction?

- A) Increases K_c
- B) Decreases K_c
- C) No effect on K_c**
- D) Depends on the concentration

24. Which of the following is an example of an amphoteric oxide?

- A) Na_2O
- B) Al_2O_3**
- C) SO_3
- D) MgO

25. What is the value of the auto-ionization constant of water (K_w) at 25 degrees Celsius?

A) 1.0×10^{-7}

B) 1.0×10^{-14}

C) 7.0

D) 14.0