

CHEMICAL SCIENCES

Paper II

Time Allowed : 75 Minutes]

[Maximum Marks : 100

Note : This paper contains **Fifty (50)** multiple choice questions, each question carrying **Two (2)** marks. Attempt *All* questions.

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| <p>1. An atom with a single electron has an atomic number of z. m and e are the mass and charge of an electron, respectively. n is the principal quantum number of a circular orbit of the electron, around the nucleus. Considering the electrostatic attraction between the electron and the nucleus to be balanced exactly by the centrifugal force arising from the circular motion of the electron, the radius of the orbit of $n = 2$ is :</p> <p>(A) $\frac{4(h/2\pi)^2}{mze^2}$</p> <p>(B) $\frac{2(h/2\pi)^2}{mze^2}$</p> <p>(C) $\frac{4mze^2}{(h/2\pi)^2}$</p> <p>(D) $\frac{2mze^2}{(h/2\pi)^2}$</p> | <p>2. The number of quantum numbers of a free electron (one that is not bound to a nucleus) is :</p> <p>(A) 0</p> <p>(B) 1</p> <p>(C) 2</p> <p>(D) 4</p> <p>3. The highest occupied molecular orbital of O_2 is (neglecting bonding/antibonding character) :</p> <p>(A) σ_g</p> <p>(B) π_g</p> <p>(C) σ_u</p> <p>(D) π_u</p> |
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4. According to VSEPR, the geometry of a AX_7E_0 molecule is :
- (A) Square antiprismatic
(B) Pentagonal pyramidal
(C) Pentagonal bipyramidal
(D) Octahedral
5. An ideal gas is allowed to expand adiabatically against vacuum (opposing pressure is zero). Which of the following statements is *false* ?
- (A) The equation $PV^\gamma = \text{constant}$ holds for this process
(B) The expansion is isothermal
(C) No work is done in this expansion
(D) The process is irreversible
6. Entropy, S, is defined as :
- (A) $\int \frac{dw}{T}$
(B) $\int \frac{dw_{rev}}{T}$
(C) $\int \frac{dq}{T}$
(D) $\int \frac{dq_{rev}}{T}$
7. Osmotic pressure of a solution depends upon :
- (A) Atmospheric pressure
(B) Solubility
(C) Temperature
(D) Vapor pressure of solvent
8. The pH of an aqueous solution 1.0 M ammonium formate is (Given : pK_a of formic acid = 3.75, pK_b of NH_3 = 4.75) :
- (A) 9.75
(B) 13
(C) 3.25
(D) 6.5

9. On increasing temperature of the solution, the Debye-Huckel reciprocal length will :
- (A) Increase
- (B) Decrease
- (C) Not change
- (D) Change, depending on concentration
10. The oxidation numbers of Cr in K_2CrO_4 and $K_2Cr_2O_7$ are, respectively :
- (A) 3 and 6
- (B) 6 and 3
- (C) 6 and 6
- (D) 3 and 3
11. Which of the following statements is *true* ?
- (A) An elementary reaction can be of zeroth order
- (B) Every chemical reaction must have a well-defined order
- (C) A third order reaction is more probable than a second order reaction
- (D) It is possible that the rate of some reactions may decrease with increase in temperature
12. A tetrahedral molecule lacks the following symmetry element :
- (A) Point of inversion
- (B) Simple axis of symmetry
- (C) Plane of symmetry
- (D) Alternating axis of symmetry

13. Which of the following molecules will exhibit a microwave rotational spectrum ?

- (A) CH₄
- (B) SF₆
- (C) CH₃I
- (D) N₂

14. Visible light *cannot* be used to obtain crystal structures because :

- (A) Its wavelengths are too large
- (B) Its wavelengths are too small
- (C) Its intensity is too high
- (D) Its intensity is too low

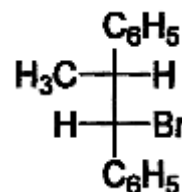
15. The Nernst equation for the reaction $O + ne = R$ is best described as :

- (A) $E = E^0 - \frac{RT}{nF} \ln \frac{c_0}{c_R}$
- (B) $E = E^0 + \frac{RT}{nF} \ln \frac{a_0}{a_R}$
- (C) $\frac{a_0}{a_R} = e^{\frac{(E - E^0)nF}{RT}}$
- (D) $\frac{a_0}{a_R} = e^{-\frac{(E - E^0)nF}{RT}}$

16. For 6.000×10^{-5} M HCl, the rounded off value of pH is :

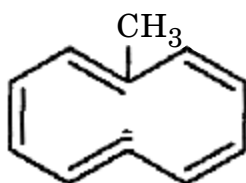
- (A) 4.2218488
- (B) 4.2218
- (C) 4.221
- (D) 4.22

17. The IUPAC name of the following compound is :



- (A) Threo-2-bromo-1,2-diphenylpropane
- (B) Erythro-1-bromo-1,2-diphenylpropane
- (C) Threo-1-bromo-1,2-diphenylpropane
- (D) Erythro-2-bromo-1,2-diphenylpropane

18. The stereochemical notations for the following compound is :

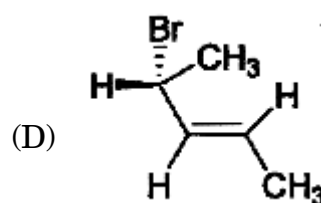
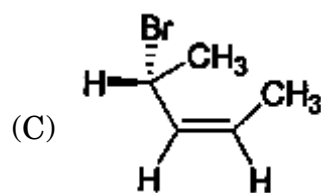
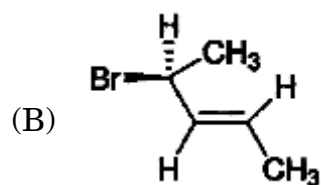
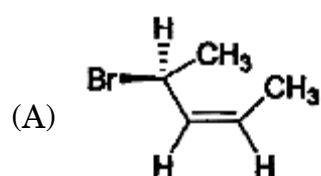


- (A) 1Z, 3Z, 5E, 7Z, 9Z
 (B) 1E, 3Z, 5E, 7Z, 9Z
 (C) 1E, 3Z, 5Z, 7Z, 9Z
 (D) 1E, 3Z, 5E, 7Z, 9E
19. The *trans*-1, 2-dimethylcyclohexane is :
- (A) Interconvertible diaxial and diequatorial isomers as inseparable dl-pair
 (B) Interconvertible axial-equatorial and equatorial-axial isomers as dl-pair
 (C) Interconvertible diaxial and diequatorial isomers as dl-pair
 (D) Interconvertible axial-equatorial and equatorial-axial as inseparable dl-pair

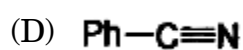
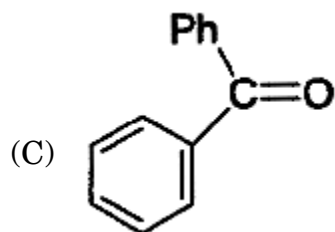
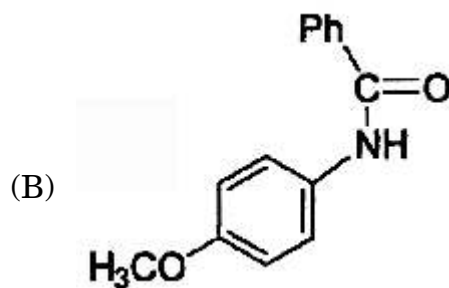
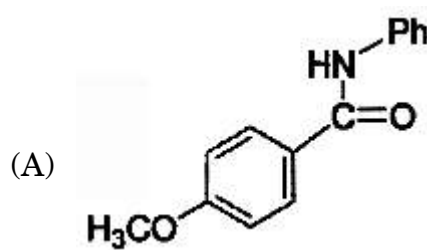
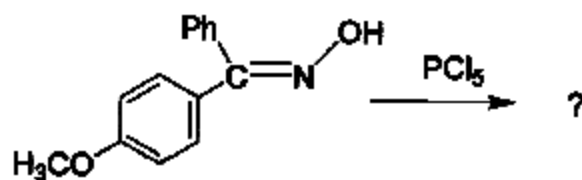
20. *Meso*-tartaric acid is achiral since :

- (A) It has a plane of symmetry in both the eclipsed and staggered conformations.
 (B) It has a centre of symmetry in the eclipsed conformation and plane of symmetry in the staggered conformation.
 (C) It has a centre of symmetry in both the eclipsed and staggered conformations.
 (D) It has a plane of symmetry in the eclipsed conformation and centre of symmetry in the staggered conformation.

21. The *correct* molecule having the absolute configuration as (S)-4-bromo-*cis*-2-pentene is :



22. The product in the following reaction is :



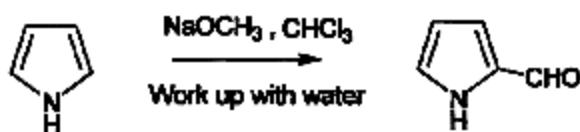
23. The intermediate involved in the Hofmann rearrangement is :

- (A) Amine
- (B) Acid
- (C) Isocyanate
- (D) Acid chloride

24. The Stobbe condensation is treatment of ketone or aldehyde in presence of base with :

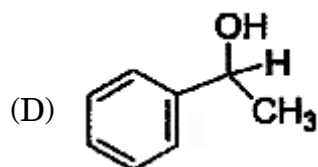
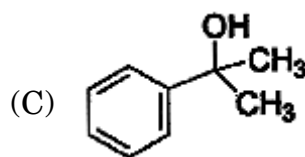
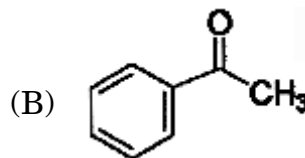
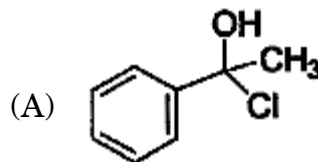
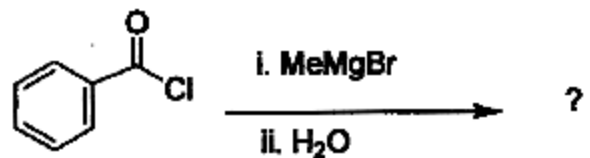
- (A) Anhydride
- (B) Diester
- (C) Aldehyde
- (D) Ketone

25. The following reaction is an example of :

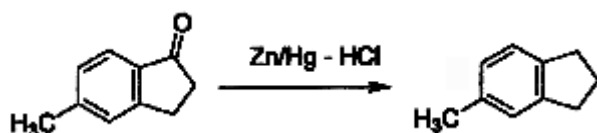


- (A) Mannich reaction
- (B) Vilsmeier-Haack formylation
- (C) Fridel-Craft reaction
- (D) Reimer-Tiemann reaction

26. The product of the following reaction is :



27. The following reaction is an example of :



- (A) Clemmensen reduction
- (B) Wolff-Kishner reduction
- (C) Birch reduction
- (D) Meerwein-Ponndorf-Verley reduction

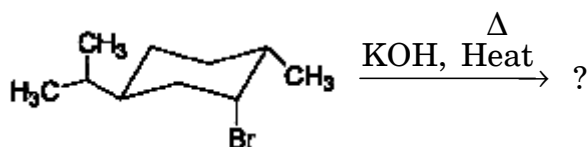
28. Which of the following alkyne reacts with the solution of silver nitrate in alcohol ?

- (A) $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{H}$
- (B) $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{CH}_3$
- (C) $\text{H}_3\text{CH}_2\text{C}-\text{C}\equiv\text{C}-\text{CH}_3$
- (D) $\text{H}_3\text{CH}_2\text{C}-\text{C}\equiv\text{C}-\text{CH}_2\text{CH}_3$

29. Heating of isopropyl alcohol in the presence of sulphuric acid gives :

- (A) 1-Propene
- (B) Propane
- (C) Hexane
- (D) Diisopropyl ether

30. The major product formed in the following reaction is :



- (A)
- (B)
- (C)
- (D)

31. The mass spectrum of a halogen containing compound showed M^+ and $M^+ + 2$ of equal intensity.

Therefore, the compound contains :

- (A) Bromine
- (B) Chlorine
- (C) Iodine
- (D) Fluorine

32. Acetylenic protons are shielded due to :

- (A) Inductive effect
- (B) Hybridisation effect
- (C) Resonance effect
- (D) Diamagnetic anisotropic effect

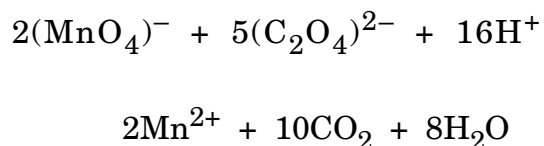
33. Hemoglobin (Hb) is an iron containing protein involved in binding and transport of O_2 in blood. The O_2 binding affinity of Hb depends on pressure and pH under physiological conditions. The oxygen affinity of Hb :

- (A) increases with increase in pressure and pH
- (B) decreases with increase in pressure and pH
- (C) increases with increase in pressure but decreases with increase in pH
- (D) decreases with increase in pressure but independent of pH

34. The copper containing protein involved in oxygen transport is :

- (A) cytochrome c
- (B) hemerythrin
- (C) hemocyanin
- (D) myoglobin

35. In the redox reaction :



20 mL of 0.1 M KMnO_4 reacts quantitatively with :

- (A) 20 mL of 0.1 M oxalate
- (B) 40 mL of 0.05 M oxalate
- (C) 50 mL of 0.25 M oxalate
- (D) 50 mL of 0.1 M oxalate

36. Tollen's reagent is :

- (A) $[\text{Ag}(\text{NH}_3)_2]^+$
- (B) Ag_2O
- (C) $[\text{Cu}(\text{OH})_4]^{2-}$
- (D) Cu_2O

37. A straight line passing through origin is observed in the absorption spectra at different concentrations of a compound for (T = transmittance, C = concentration, λ = wavelength) :

- (A) T versus λ
- (B) $\log 1/T$ versus C
- (C) %T versus C
- (D) $1/T$ versus C

38. The reference compound used in ESR spectroscopy is :

- (A) diphenylpicrylhydrazyl radical
- (B) diphenylpicryl hydrazine
- (C) diphenylpicrylhydrazine dihydrate
- (D) diphenylpicrylhydrazinium iodine

39. Active catalyst species for hydrogenation is :
- (A) $[\text{RuCl}_2(\text{PPh}_3)]$
(B) $[\text{HCo}(\text{CO})_3]$
(C) $[\text{RhCl}(\text{PPh}_3)_3]$
(D) $\text{K}_2[\text{PtCl}_6]$
40. The Ni ion in the crystal lattice of nickel arsenide (NiAs) is surrounded by :
- (A) 4 arsenic in a tetrahedral geometry
(B) 6 arsenic in an octahedral geometry
(C) 6 arsenic in a trigonal prismatic geometry
(D) 8 arsenic in a cubic geometry
41. The oxidation states of chlorine in Cl_2O , Cl_2 , $(\text{ClO}_3)^-$ are respectively :
- (A) +5, 0, +1
(B) +1, -1, +5
(C) -1, 0, +5
(D) +1, 0, +5
42. Two compounds X and Y have the same formula $[\text{Co}(\text{en})_2\text{Cl}_2]^+$. X can be converted to Y by boiling with dil. HCl. A solution of X reacts with oxalic acid to form $[\text{Co}(\text{en})_2\text{C}_2\text{O}_4]$ while Y does not react :
- (A) X is cis isomer and Y is trans isomer
(B) X and Y are two optical isomers in cis geometry
(C) X is trans isomer and Y is cis isomer
(D) X and Y are two optical isomers in trans geometry
43. Which of the following complex ion has a magnetic moment value same as $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$?
- (A) $[\text{Cu}(\text{NH}_3)_4]^{2+}$
(B) $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$
(C) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
(D) $[\text{Mn}(\text{H}_2\text{O})_6]^{4+}$
44. The electronic ground state of tetrahedral $[\text{CoCl}_4]^{2-}$ is :
- (A) ${}^4\text{T}_{2g}$
(B) ${}^3\text{E}$
(C) ${}^4\text{A}_2$
(D) ${}^4\text{T}_{1g}$

45. The H-B-H bond angle in BH_4^- is :
- (A) 180°
 (B) 90°
 (C) 120°
 (D) 109°
46. Beryl is a :
- (A) beryllium containing group like $-\text{BeH}_3$, named in analogy with silyl, alkyl etc.
 (B) precious stone with diamond like structure
 (C) cyclic silicate
 (D) beryllium oxide
47. Catena means :
- (A) special type dimeric structure
 (B) a chain structure
 (C) a tetrameric structure
 (D) a trimeric structure
48. A 50 mL solution of pH = 1 is mixed with a 50 mL solution of pH = 2. The pH of the mixture will be :
- (A) 0.86
 (B) 1.26
 (C) 1.76
 (D) 2.26
49. Metallocenes are :
- (A) metal complexes of halides
 (B) metal complexes of aliphatic amines
 (C) metal complexes of cyclopentadienyl anion
 (D) metal complexes of cyanide
50. Which of the following will *not* form clathrates ?
- (A) Ar
 (B) He
 (C) Kr
 (D) Xe

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