

SET 2013

PAPER – II

CHEMICAL SCIENCES

Signature of the Invigilator

Question Booklet No.

1. OMR Sheet No..

Subject Code **01**

ROLL No.

Time Allowed : **75 Minutes**

Max. Marks : **100**

No. of pages in this Booklet : **8**

No. of Questions : **50**

INSTRUCTIONS FOR CANDIDATES

1. Write your Roll No and the OMR Sheet No in the spaces provided on top of this page.
2. Fill in the necessary information in the spaces provided on the OMR response sheet.
3. This booklet consists of fifty (50) compulsory questions each carrying 2 marks.
4. Examine the question booklet carefully and tally the number of pages/questions in the booklet with the information printed above. **Do not accept a damaged or open booklet.** Damaged or faulty booklet may be got replaced within the first 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time given.
5. Each Question has four alternative responses marked (A), (B), (C) and (D) in the OMR sheet. You have to completely darken the circle indicating the most appropriate response against each item as in the illustration.



6. All entries in the common OMR response sheet for Papers I and II are to be recorded in the original copy only.
7. Use only Blue/Black Ball point pen.
8. Rough Work is to be done on the blank pages provided at the end of this booklet.
9. If you write your Name, Roll Number, Phone Number or put any mark on any part of the OMR Sheet, except in the spaces allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, you will render yourself liable to disqualification.
10. You have to return the Original OMR Sheet to the invigilators at the end of the examination compulsorily and must not carry it with you outside the Examination Hall. **You are, however, allowed to carry the test booklet and the duplicate copy of OMR Sheet** on conclusion of examination.
11. Use of any calculator, mobile phone or log table etc. is strictly prohibited.
12. **There is no negative marking.**

01-13

CHEMICAL SCIENCES
PAPER — II

Note : This paper contains **fifty (50)** objective type questions; each question carrying **two (2)** marks.

Attempt **all** the questions.

1. In $\text{Co}_2(\text{CO})_8$ each Co atom is :
(A) dsp^3 hybridized
(B) d^2sp^3 hybridized
(C) d^2sp^2 hybridized
(D) d^3sp^3 hybridized
2. Tetrahedral complex formation is favored when :
(A) Ligands are strong field
(B) Ligands are large and bulky
(C) Central metal atom is in high oxidation state
(D) Electronic configuration of central atom is not d^0, d^5 and d^{10}
3. The number of B-H-B bonds in $\text{B}_{10}\text{H}_{14}$ is :
(A) 4
(B) 5
(C) 6
(D) 7
4. Which of the following possesses a quadruple bond ?
(A) $\{\text{Re}_3\text{Cl}_{12}\}^{3-}$
(B) $\{\text{Re}_2\text{Cl}_8\}^{2-}$
(C) $\{\text{Os}_2\text{Cl}_8\}^{2-}$
(D) $\text{Mn}_2(\text{CO})_{10}$
5. The geometry which is not possible for a seven-coordinate complex is :
(A) Pentagonal bipyramid
(B) Capped trigonal prism
(C) Square anti-prism
(D) Capped octahedron
6. The ground state term symbol for Nd^{3+} is :
(A) ${}^4\text{G}_{5/2}$
(B) ${}^4\text{G}_{7/2}$
(C) ${}^2\text{H}_{11/2}$
(D) ${}^4\text{I}_{9/2}$
7. Among the following complex ions, which one is an outer orbital complex ?
(A) $[\text{Cr}(\text{NH}_3)_6]^{3+}$
(B) $[\text{Ni}(\text{NH}_3)_6]^{3+}$
(C) $[\text{Mn}(\text{CN})_6]^{4-}$
(D) $[\text{Fe}(\text{CN})_6]^{4-}$
8. Among the complexes NiCl_4^{2-} , $\text{Ni}(\text{CN})_4^{2-}$ and $\text{Ni}(\text{CO})_4$, the hybridization of Ni atom is respectively :
(A) sp^3, dsp^2, sp^3
(B) sp^3, sp^3, dsp^2
(C) dsp^2, sp^3, sp^3
(D) dsp^2, dsp^2, sp^3
9. The highest energy orbital in a square planar crystal field is :
(A) d_{xz}
(B) d_{z^2}
(C) d_{xy}
(D) $d_{x^2-y^2}$
10. Sodium azide is used in air bags to rapidly release gas to inflate the bag. The gas is :
(A) Oxygen
(B) Nitrogen
(C) Both nitrogen and oxygen
(D) Argon
11. CO as a ligand can stabilize the lower oxidation states of transition metal ions. This is mainly because :
(A) It is a strong Lewis base
(B) It is a strong reducing agent
(C) It can form $d\pi-p\pi$ back bonding
(D) It lies at higher end of spectrochemical series

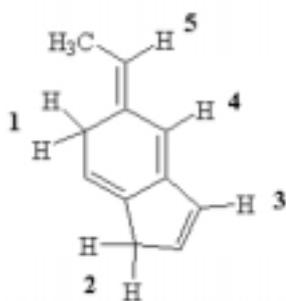
12. Electronic configuration of actinide elements are rather uncertain because of :
- Overlapping of inner orbitals
 - Actinide contraction
 - Smaller energy difference between $5f$ and $6d$ orbitals
 - Free movement of electrons over all the orbitals
13. Among the octahedral complexes $[\text{Cr}(\text{NH}_3)_6]^{3+}$, $[\text{CrF}_6]^{3-}$, $[\text{Cr}(\text{CN})_6]^{3-}$, and $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$, the correct increasing order of their crystal field splitting are :
- $[\text{Cr}(\text{NH}_3)_6]^{3+} < [\text{CrF}_6]^{3-} < [\text{Cr}(\text{CN})_6]^{3-} < [\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
 - $[\text{CrF}_6]^{3-} < [\text{Cr}(\text{H}_2\text{O})_6]^{3+} < [\text{Cr}(\text{NH}_3)_6]^{3+} < [\text{Cr}(\text{CN})_6]^{3-}$
 - $[\text{Cr}(\text{H}_2\text{O})_6]^{3+} < [\text{Cr}(\text{NH}_3)_6]^{3+} < [\text{Cr}(\text{CN})_6]^{3-} < [\text{CrF}_6]^{3-}$
 - $[\text{Cr}(\text{CN})_6]^{3-} < [\text{CrF}_6]^{3-} < [\text{Cr}(\text{H}_2\text{O})_6]^{3+} < [\text{Cr}(\text{NH}_3)_6]^{3+}$
14. The ligands CN^- , CO , H_2O and NH_3 have been arranged in increasing order of their ligand-field strengths. The correct order is :
- $\text{H}_2\text{O} < \text{NH}_3 < \text{CN}^- < \text{CO}$
 - $\text{CN}^- < \text{CO} < \text{H}_2\text{O} < \text{NH}_3$
 - $\text{NH}_3 < \text{H}_2\text{O} < \text{CN}^- < \text{CO}$
 - $\text{NH}_3 < \text{H}_2\text{O} < \text{CO} < \text{CN}^-$
15. The compound in which the same element possesses two different oxidation states is :
- $\text{Na}_2\text{S}_2\text{O}_3$
 - $\text{H}_2\text{S}_2\text{O}_8$
 - CaOCl_2
 - All of these
16. Which of the following is a low-spin complex ?
- $\text{K}_4[\text{Fe}(\text{CN})_6]$
 - $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
 - $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$
 - $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
17. Hard acids are metal ions with :
- Small size and low polarizability
 - Small size and high polarizability
 - Large size and low polarizability
 - Large size and high polarizability
18. The microwave spectrum of a molecule yields three rotational constants. The molecule is :
- Prolate symmetric top
 - Spherical top
 - Asymmetric top
 - Oblate symmetric top
19. Consider the compounds, (a) SnF_4 , (b) SnCl_4 and (c) R_3SnCl . The nuclear quadrupole splitting are observed for :
- (a), (b) and (c)
 - (a) and (b) only
 - (b) and (c) only
 - (a) and (c) only
20. Which of the molecules will have the highest zero point vibrational energy ?
- CF_4
 - CH_4
 - CCl_4
 - CBr_4
21. Identify the molecule whose rotational constant cannot be determined by spectroscopic methods :
- CH_4
 - H_2
 - CO_2
 - HCl
22. The most convenient spectroscopic technique to establish the presence of inter-molecular hydrogen bonding in hydroxy compounds is :
- UV
 - IR
 - EPR
 - Mass

23. An electron is confined to a molecule of length of 1nm (about 5 atom long). The probability of finding the electron in region of molecule lying between $x = 0$ and $x = 0.2$ nm is :
- (A) 0.0048
(B) 0.48
(C) 0.048
(D) Cannot calculate
24. Apply the variation function $x(\ell - x)$ to the particle in a box and estimate the ground state energy. The percent error in energy is :
- (A) +1.24
(B) +12.4
(C) +.124
(D) -1.24
25. The energy levels for cyclobutadiene are $\alpha+2\beta$, α , α and $\alpha-2\beta$. The delocalization energy in this molecule is :
- (A) 0
(B) -4β
(C) -8β
(D) 4α
26. For ideal solution :
- (A) $\Delta V_{\text{MIX}} > 0, \Delta H_{\text{MIX}} > 0$
(B) $\Delta V_{\text{MIX}} < 0, \Delta H_{\text{MIX}} < 0$
(C) $\Delta V_{\text{MIX}} = 0, \Delta H_{\text{MIX}} = 0$
(D) $\Delta V_{\text{MIX}} < 0, \Delta H_{\text{MIX}} > 0$
27. The osmotic pressure at given temperature is expected to be highest for :
- (A) 2% NaCl solution
(B) 3% urea solution
(C) 4% sucrose solution
(D) 5% glucose solution
28. Which of the following solutions produces maximum elevation in boiling point ?
- (A) 0.1 M glucose
(B) 0.2 M sucrose
(C) 0.1M BaCl_2
(D) 0.1 M MgSO_4
29. The V_{rms} of a gas at 300 K is $30 R^{1/2}$. The molar mass of the gas, in Kg^{-1} , is :
- (A) 1.0
(B) 1.0×10^{-1}
(C) 1.0×10^{-2}
(D) 1.0×10^{-3}
30. Reference electrode used in polarography is :
- (A) SCE or large pool of Hg
(B) DME
(C) Pt electrode
(D) None
31. The possible J values for 3D term symbol are :
- (A) 2
(B) 3
(C) 4
(D) 5
32. At 480 K and a total pressure of 1 atm, a mixture of $\text{N}_2(\text{g})$ and $\text{H}_2(\text{g})$ in the mole ratio of 1:3 contain 16% of $\text{NH}_3(\text{g})$ at equilibrium. What is K_p of the reaction ?
- (A) 0.654
(B) 0.544
(C) 0.50
(D) 0.644
33. Proton bombardment of Th^{230} followed by emission of two alpha particles produce :
- (A) Rn^{232}
(B) Ra^{233}
(C) Fr^{223}
(D) Fr^{222}

34. Which metal thiol is used in the treatment of arthritis ?
- (A) Cu
(B) Ag
(C) Au
(D) Pt

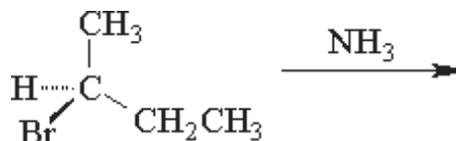
35. Which of the following is the same as the tropylium ion ?
- (A) Cyclopentadienyl cation
(B) Cyclopentadienyl anion
(C) Cycloheptatrienyl anion
(D) Cycloheptatrienyl cation

36. Which of the labeled H atoms (1 -5) in the following molecule would be predicted to be the most acidic ?



- (A) 2
(B) 3
(C) 4
(D) 1
37. Electrophilic aromatic substitution in pyridine is preferentially at position :
- (A) 1
(B) 3
(C) 4
(D) 2

38. Which of the following statements describes the nucleophilic substitution product obtained from the following reaction of S-2-bromobutane with ammonia in a non-polar solvent ?



- (A) This reaction yields R-2-aminobutane as the major substitution product
(B) This reaction yields S-2-aminobutane as the major substitution product
(C) This reaction yields a racemic mixture as the major substitution products
(D) All of the above are incorrect
39. S_N2 reactions involving chiral electrophiles usually proceed with :
- (A) Inversion of configuration
(B) Slightly more inversion than retention
(C) Slightly more retention than inversion
(D) Retention of configuration
40. The correct order of reactivity of acid derivatives towards nucleophilic attack is :
- (A) Anhydrides > amides > carboxylates
(B) Anhydrides > amides > esters
(C) Anhydrides > acids > acid chlorides
(D) Esters > acid anhydrides > amides
41. Which alcohol reacts most rapidly with the Lucas reagent ?
- (A) Isobutanol
(B) Benzyl alcohol
(C) Methanol
(D) 2-Propanol

42. When (R)-butan-2-ol is treated with TsCl in pyridine, the product formed is :
- An achiral compound
 - A single enantiomer
 - A racemic mixture
 - A mixture of diastereomers
43. A mixture with an enantiomeric excess of 40% R has what composition of enantiomers ?
- 40 % R 60 %S
 - 40 % S 60 %R
 - 70 % S 30 %R
 - 70 % R 30 %S
44. What effect does conjugation typically have on the frequency at which absorption by C = C occurs ?
- Conjugation decreases the frequency at which absorption occurs
 - Conjugation increases the frequency at which absorption occurs
 - Conjugation does not affect the frequency at which absorption occurs
 - Conjugation occasionally increases the frequency at which absorption occurs
45. The IR spectrum of a sample contains absorptions at 3050, 2950, and 1620 cm^{-1} . To what class of organic compound does this sample most likely belong ?
- Alcohol
 - Ester
 - Alkene
 - Alkane
46. What m/z characterizes a strong peak in the mass spectrum of cyclopentanol ?
- 84
 - 86
 - 68
 - 63
47. Using a 60-MHz spectrometer, the protons in dichloromethane appear at 5.30 ppm. When the same sample is placed in a 100-MHz instrument, where does the signal appear ?
- 3.18
 - 8.33
 - 5.30
 - Cannot be determined from information given
48. To which class of hormones does the steroid cortisone belong ?
- Androgen
 - Glucocorticoids
 - Mineralocorticoids
 - Estrogen
49. Which of the following terms best describes the compound below ?
- $$\text{CH}_3(\text{CH}_2)_{26}\text{CO}_2\text{CH}_2(\text{CH}_2)_{32}\text{CH}_3$$
- A wax
 - A fat
 - An oil
 - A terpene
50. The volatile oils are the complex mixtures of :
- Mono- and sesquiterpenes as well as phenylpropane derivatives
 - Mono- and diterpene alcohols and ethers
 - Sesquiterpenes and other aromatic compounds
 - Monoterpene acids and lactones

ROUGH WORK

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