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PAPER – II

CHEMICAL SCIENCES

Signature of the Invigilator

Question Booklet No. 010922

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 at top of this page.
2. Fill in the necessary information in the spaces provided on the OMR response sheet.
3. This booklet consists of seventy five (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.**

01-16

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PAPER-II
CHEMICAL SCIENCES

1. By what factor the spacing between first two energy levels of an electron trapped in a cubical box will change if its dimensions are doubled ?
   (A) Will become doubled
   (B) Decreases to half the initial value
   (C) Become quadrupled
   (D) Reduce to $1/4^{th}$ of initial value

2. Which of the following is INCORRECT statement ?
   (A) The acceptable wave function has to be continuous, finite and single valued
   (B) Eigen functions of Hermitian operator have to be degnerate or orthogonal
   (C) All the components of angular momentum operator commute with each other as well as with the square of total angular momentum
   (D) Multiplication of any eigen-function of a linear operator by a constant does not change its eigen value

3. A particle of mass m is confined in a box of length a. If we assume that $\Delta x = a$ and Δp_x (min) $= \langle p^2 \rangle^{1/2}$ where p is total linear momentum of the particle, then using the uncertainty principle, the estimate of the energy of the particle would be :
   (A) $h^2/(8ma^2)$ (B) $\hbar^2/(8ma^2)$
   (C) $h^2/(32ma^2)$ (D) $\hbar^2/(2ma^2)$

4. A particle on the surface of a sphere in the state having $J = 4$, $mJ = 4$:
   (A) Has $E = 16\ \hbar^2/(2I)$
   (B) Has a z-component of angular momentum of $4\hbar$
   (C) Doesn't exist because this state violates quantum number rules
   (D) Has a degeneracy of 20

5. Which of the following term symbols becomes NOT allowed if the configuration changes from $n_1p^1n_2p^1$ to np^2 ?
   (A) ^1P (B) ^3P
   (C) ^1D (D) ^1S

6. Select the INCORRECT statement :
   (A) The spacing between successive energy levels of rigid rotator decreases if its reduced mass decreases
   (B) The spacing between successive energy levels of an anharmonic oscillator decreases with increase in quantum number
   (C) Degeneracy of energy levels of a rigid rotator is one more than twice its quantum number
   (D) Zero point energy of an electron is halved if one dimension of the square box containing it vanishes

7. Which of the following is INCORRECT for ladder operators ?
   (A) The ladder operator $\mathbf{M_+}$ does not commute with $\mathbf{M_-}$
   (B) Angular momentum operator $\mathbf{M_x}$ does not commute with $\mathbf{M_+}$
   (C) Angular momentum operator $\mathbf{Mz}$ commutes with $\mathbf{M_+}$ or $\mathbf{M_-}$
   (D) $\mathbf{M^2}$ operator commutes with $\mathbf{M_+}$ or $\mathbf{M_-}$

8. Select the INCORRECT statement :
   (A) Increase in solvent dielectric constant decreases the rate for reaction between oppositely charged ions
   (B) Decrease in solvent dielectric constant increases the rate for reaction between similarly charged ions
   (C) Increase of ionic strength decreases the rate for reaction of oppositely charged ions
   (D) Increase of ionic strength increases the rate for reaction of similarly charged ions

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9. Consider the following statements :

(1) Half-life period of second order reaction is directly proportional to the initial concentration of reactants

(2) A catalyst increases the rate of a reaction by decreasing the heat of reaction

(3) A zero order reaction takes infinite time for completion while the first order reaction would get completed in finite time

Which of the above statement(s) is/are CORRECT ?

(A) (1) & (2) (B) (2) & (3)

(C) (1) & (3) (D) None of these

10. Q, W, ΔE and ΔH for a reversible isothermal expansion of one mole of an ideal monoatomic gas at 27°C from volume of 10 dm^3 to 20 dm^3, are ____ respectively.

(A) 300 R, –300 R, 3/2 R and 5/2 R

(B) +300Rℓn2, –300Rℓn2, 0 and 0

(C) 0, –300Rℓn2, 3/2 R and 5/2 R

(D) 0, 0, 3/2 R and 5/2 R

11. The cooling can be achieved by the following processes ?

(1) Adiabatic expansion

(2) Adiabatic demagnetization

(3) Joule-Thomson effect

(4) Evaporation

The correct sequence of these processes in order of their ability to produce lower and lower temperature is :

(A) (4) (1) (2) (3)

(B) (4) (1) (3) (2)

(C) (1) (4) (3) (2)

(D) (1) (4) (2) (3)

12. Which of the following statement(s) is/are true ?

(1) H_2O is an IR-active molecule

(2) The spacing between any two successive spectral lines in a pure rotational spectrum of a diatomic molecule is 2B

(3) At absolute zero all translational, rotational and vibrational motions of a molecule cease

(A) (1) & (2) (B) (2) & (3)

(C) (1) & (3) (D) (1), (2) & (3)

13. Boltzons are :

(A) Identical, distinguishable, quantum particles

(B) Identical, indistinguishable, quantum particles

(C) Identical, distinguishable, classical particles

(D) Identical, indistinguishable, classical particles

14. Which of the following is true for Schottky defects in a solid ?

(A) They are equilibrium, localized and dynamic defects

(B) They are nonequilibrium, localized and dynamic defects

(C) They are nonequilibrium, extended and static defects

(D) They are equilibrium, extended and dynamic defects

15. Consider a tetragonal unit cell having dimensions $a = b \neq c$; $c = 2a$ and a cubic unit cell with dimensions a. The ratio of the interplanar spacing between (100) planes in tetragonal unit cell to that of same planes in cubic unit cell would be :

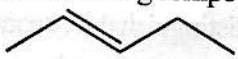
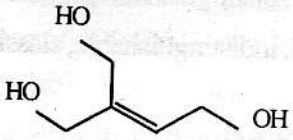
(A) 1 : 1 (B) 2 : 1

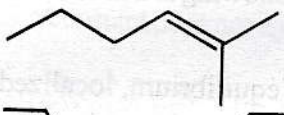
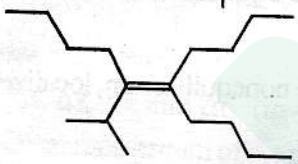
(C) 1 : 2 (D) 1 : 3

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16. The pK_a of a weak acid HA is 3.5. The pOH of an aqueous solution of HA in which 50% of the acid is ionized would be :
(A) 3.5 (B) 8.5
(C) 10.5 (D) 7.0

17. The percentage of a constituent y in a compound was found to be 50.32, 50.36 and 50.22. The mean deviation would be :
(A) 50.3 (B) 0.053
(C) 0.0035 (D) 50.36

18. Which of the following compounds is stereoisomeric ?
(A) 
(B) 

(C) 
(D) 

19. Which of the following is non-aromatic ?
(A) Cyclopentadienyl cation
(B) Cycloheptatrienyl anion
(C) Cyclooctatrienyl cation
(D) Cyclopropenyl anion

20. Bipheny ℓ-2,2'-sulphonic acid is chiral due to the presence of :
(A) Chiral centre
(B) Chiral plane
(C) Chiral axis
(D) Lack of plane of symmetry

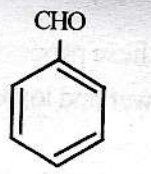
21. Which of the following carbocations is expected to exhibit least selectivity towards reaction with the nucleophiles Cl^- and H_2O ?
(A) $^+CH_2\text{-}CH{=}CH_2$ (B) $^+C_6H_5$
(C) $CH_3\text{-}^+C{=}O$ (D) $(CH_3)_3C^+$

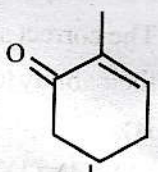
22. Which of the following sigmatropic rearrangements is rare ?
(A) [1, 3] (B) [3, 3]
(C) [1, 5] (D) [1, 7]

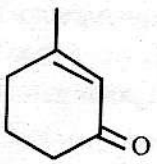
23. Which of the following reactions proceed through the intermediacy of an intermediate ?
(A) Diels-Alder reaction
(B) Paterno-Buchi reaction
(C) Electrocyclic reactions involving 4n+2 systems
(D) 1,7-sigmatropic rearrangements

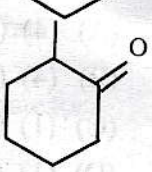
24. Wagner-Meerwein rearrangement which involves migration of methyl group is referred as :
(A) Wittig rearrangement
(B) Arndt-Eistert rearrangement
(C) Baeyer-Villiger rearrangement
(D) Nametkin rearrangement

25. Which of the following is a d^0-synthon ?
(A) $\bar{C}N$ (B) $\bar{C}H_3$
(C) $CH_3\bar{S}$ (D) $\bar{C}H_2$ - CHO

26. The product obtained upon selenium dioxide oxidation of 1-methylcyclohexene is preferably :
(A) 

(B) 

(C) 

(D) 

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27. Which of the following will exhibit -OH stretching band at higher frequency in the IR spectrum ?
(A) Undiluted sample of ethanol
(B) Ethanol dissolved in CS_2
(C) 95% ethanol
(D) Absolute ethanol

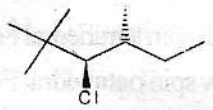
28. Hydroxylation of cholesterol gives a triol with hydroxyls which are :
(A) All 2°
(B) One is 3°, other two are 2°
(C) One is 1° other are 2°
(D) One is 2° others are 3°

29. Reduction of an ester to corresponding aldehyde is achievable by using :
(A) $LiAlH_4$
(B) Lithium diisobutylaluminium hydride
(C) NaC_2H_5OH
(D) Bu_3SnH

30. Photocatalytic bromination of a hydrocarbon chain already having a bromine atom is :
(A) Stereoselective
(B) Stereospecific
(C) Regioselective
(D) Regiospecific

31. The major product obtained upon addition of two moles of HBr to 2-butyne would be :
(A) (+) 1,2-dibromobutane
(B) (–) 1,2-dibromobutane
(C) Meso-1,2-dibromobutane
(D) 2,2-dibromobutane

32. E2 reaction of 2,2,4-trimethy ℓ-3-chlorohexane

() with a strong base is :
(A) Stereoselective
(B) Stereospecific
(C) Regioselective
(D) Regiospecific

33. Addition of bromine to trans-2-butene in dichloromethane would afford :
(A) Only a pair of enantiomer
(B) A pair of enantiomer and a meso-compound
(C) Only a pair of diastereoisomers
(D) Only a meso-compound

34. Which among the following reactions is used to bring about allylic bromination ?
(A) Wohl-Ziegler reaction
(B) Sandmayer reaction
(C) Haloform reaction
(D) Riemer-Tiemann reaction

35. Which of the following statements is incorrect ?
(A) Pb^{4+} is a stronger oxidizing agent than Sn^{4+}
(B) The two common oxidation states of Te are Te(IV) and Te(VI).
(C) Ru(II) has six 5d electrons in ground state
(D) $Kr + He^+ \rightarrow Kr^+ + He$, is a spontaneous gas phase reaction

36. Which of the following compounds will dissolve in water to give strongly acidic solution ?
(A) $NbCl_5$
(B) $AlBr_3$
(C) CBr_4
(D) IF_7

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37. Match the bioinorganic redox systems with their redox couple :

(I) Ferridoxin (i) High spin tetrahedral Fe^{II}/Fe^{III}
(II) Cytochromes (ii) Low spin octahedral Fe^{II}/Fe^{III}
(III) Blue Copper (iii) Pseudotetrahedral Cu^{I}/Cu^{II}
(IV) Rubredoxin (iv) Octahedral Cu^{I}/Cu^{II}

(A) (I) - (i), (II) - (ii), (III) - (iii), (IV) - (iv)
(B) (I) - (i), (II) - (ii), (III) - (iii), (IV) - (i)
(C) (I) - (iv), (II) - (i), (III) - (iv), (IV) - (i)
(D) (I) - (ii), (II) - (i), (III) - (iv), (IV) - (iii)

38. Arrange the following metal carbonyls for decreasing order of carbonyl exchange reaction with free ^{13}C :

(1) $[Ni(CO)_4]$
(2) $[Fe(CO)_5]$
(3) $[Cr(CO)_6]$

(A) 3 > 1 > 2
(B) 3 > 2 > 1
(C) 1 > 2 > 3
(D) 2 > 3 > 1

39. What is incorrect in case of radio analytical techniques ?

(A) Neutron Activation Analysis (NAA) and Prompt Gamma variation of NAA (PGNAA) both are non-destructive method of analysis
(B) In case of radiometric titration of Ca^{2+} with EDTA in presence of $^{110}AgIO_3$, the radioactivity increases in solution after endpoint
(C) Radiochromatography was used by Seaborg in the detection and discovery of some trans Plutonium elements
(D) Neutron absorptiometry is an alternate method of analysis applicable to elements of very low neutron capture cross-section

40. Which of the following is not a redox indicator ?

(A) Phenosafranine
(B) Indigotetrasulfonate
(C) Diphenylamine
(D) Methyl-Red

41. Which of the following phosphine ligands have largest cone angle ?

(A) PH_3
(B) PMe_2Ph
(C) $PMePh_2$
(D) P^tBu_3

42. Siderophores - the biological molecules for iron transport do not have these donor sites :

(A) Catecholates
(B) Hydroxamates
(C) Aminocarboxylates
(D) Aromatic amines

43. The compound $GeCl_4$ is a liquid with melting point 223K while $GeCl_2$ is a solid with 400K melting point, this can be explained by :

(A) Normal trend expected of these compounds with ionic nature
(B) Normal trend expected of these compounds with polar covalent nature
(C) Polymeric nature of $GeCl_4$ and monomeric nature of $GeCl_2$
(D) Monomeric nature of $GeCl_4$ and Polymeric nature of $GeCl_2$

44. Which of the following dinuclear compounds have a metal–metal bond order 3.5 ?

(A) $[Tc_2Cl_8]^{2-}$
(B) $[Re_2Cl_4(PMe_2Ph)_4]$
(C) $[Mo_2(HPO_4)_4]^{2-}$
(D) $[Ru_2Cl_2(O_2CMe)_4]$

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45. Which of the following conditions are responsible for a strong John Teller distortion in octahedral complexes ?

(A) t_2g(sym) eg (sym)

(B) t_2g(unsym) eg (sym)

(C) t_2g(sym) eg (unsym)

(D) t_2g(unsym) eg (unsym)

46. For Ammonia as non-aqueous solvent which one of these is wrong ?

(A) $AgCl + KCl \rightarrow KCl(\downarrow) + AgNO_3$

(B) $KCl + AgNO_3 \rightarrow AgCl(\downarrow) + KNO_3$

(C) $NH_2(CO)NH_2 + NH_3 \rightarrow NH_4^+ NH_2CONH^-$

(D) $H^- + NH_3 \rightarrow NH_2^- + H_2 (\uparrow)$

47. The Iron(II)–Iron(III) redox couple will have highest oxidation potential in the complex with which of the following ligands ?

(A) 1,10-Phenanthroline

(B) Ethylenediamine

(C) Bipyridyl

(D) EDTA

48. To which group of the qualitative anaylsis scheme Cu^+ and Sn^{2+} ions would belong ?

(A) Group I and II

(B) Group II

(C) Group II and III

(D) Group III

49. Which of the compounds has one of the bond angles less than 90° ?

(A) SeF_6

(B) $(CH_3)_2PF_3$

(C) $POCl_3$

(D) IF_7

50. The Karl Fischer reaction used to determine amount of water in different samples is based on :

(A) Coulometric Titration

(B) Potentiometric Titration

(C) Amperometric Titration

(D) Colorimetric Titration

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