ENTRANCE EXAMINATION FOR ADMISSION, MAY 2012.

Ph.D. (CHEMISTRY)

COURSE CODE : 107

Register Number :

Signature of the Invigilator
(with date)

COURSE CODE : 107

Time : 2 Hours

Max : 400 Marks

Instructions to Candidates :

1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.

2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.

3. Read each question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.

4. Avoid blind guessing. A wrong answer will fetch you -1 mark and the correct answer will fetch 4 marks.

5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.

6. Do not open the question paper until the start signal is given.

7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.

8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.

9. Use of Calculators, Tables, etc. are prohibited.

1. The violet colour of $[Ti(H_2O)_6]^{3+}$ is due to

   (A) ligand to metal charge transfer transition

   (B) metal to ligand charge transfer transition

   (C) d-d transition

   (D) f-f transition

2. Among the following pair of metal ions, the first one functions as an electron transfer agent and the second one catalyzes the hydrolysis reactions. The correct pair is

   (A) Fe and Zn   (B) Mg and Fe   (C) Co and Mo   (D) Ca and Cu

3. The crystal systems having the highest and lowest symmetries are

   (A) cubic and rhombohedral   (B) cubic and monoclinic

   (C) rhombohedral and monoclinic   (D) cubic and triclinic

4. The magnetic moment of an octahedral Co(II) complex is $4.0 \mu_B$. The d electron configuration of Co(II) is

   (A) $t_{2g}^4 e_g^3$ (B) $t_{2g}^5 e_g^2$ (C) $t_{2g}^6 e_g^1$ (D) $t_{2g}^3 e_g^4$

5. $[CoCl_4]^{2-}$ is a blue coloured complex. Controlled treatment of this complex with water generates two isomeric light pink coloured complexes of composition $[Co(H_2O)_4Cl_2]$. The point groups for $[CoCl_4]^{2-}$ and two isomeric complexes of $[Co(H_2O)_4Cl_2]$ are

   (A) D_{4h} and (C_{2v} and C_{2h})   (B) T_d and (C_{2v} and D_{4h})

   (C) D_{4h} and (C_{2v} and D_{4h})   (D) T_d and (C_{2v} and C_{4v})

6. The reaction between $[PdCl_4]^{2-}$ and C_2H_4 in presence of water produces a new compound. This reaction is an example for

   (A) hydrogenation of alkene   (B) oxidation of olefin

   (C) hydroformyltion of alkene   (D) reduction of olefin

7. The square planar complex, $[IrCl(PPh_3)_3]$ undergoes oxidative addition of Cl_2 to give two products, which are

   (A) fac- and mer- isomers   (B) cis- and trans- isomers

   (C) linkage isomers   (D) optical isomers

8. Nature has chosen Zn(II) ion at the active site of many hydrolytic enzymes because
   (A) Zn(II) is a poor Lewis acid
   (B) Zn(II) does not have chemically accessible redox states
   (C) Zn(II) forms both four and higher coordination complexes
   (D) Zn(II) forms weak complexes with oxygen donor ligands

9. The mechanism of the reaction between $[Fe(CN)_6]^{4-}$ and $(Fe(2,2'\text{-bipyridine})_3]^{3+}$ is
   (A) outer-sphere electron transfer
   (B) inner-sphere electron transfer
   (C) self-exchange reaction
   (D) ligand-exchange followed by electron-transfer

10. The most suitable route to prepare the trans isomer of $[PtCl_2(NH_3)(PPh_3)]$ is
    (A) $[PtCl_4]^{2-}$ with PPh_3 followed by reaction with NH_3
    (B) $[PtCl_4]^{2-}$ with NH_3 followed by reaction with PPh_3
    (C) $[Pt(NH_3)_4]^{2+}$ with HCl followed by reaction with PPh_3
    (D) $[Pt(NH_3)_4]^{2+}$ with PPh_3 followed by reaction with HCl

11. The d-d absorption band of $[Fe(H_2O)_6]^{2+}$ is split due to
    (A) presence of octahedral geometry
    (B) static Jahn-Teller distortion
    (C) dynamic Jahn-Teller distortion
    (D) presence of trigonal bipyramidal geometry

12. Structurally nickelocene is similar to ferrocene. Nickelocene attains stability due to the formation of
    (A) a monocation   (B) a dication   (C) a monoanion   (D) a dianion

13. Rare earth ions are good NMR shift reagents because
    (A) they have large magnetic moments arising from the presence of f electrons
    (B) they have short electron spin-lattice relaxation times
    (C) they have long electron spin-lattice relaxation times
    (D) they have short nuclear spin-lattice relaxation times

14. The zero magnetic moment of octahedral K_2NiF_6 is due to
    (A) low spin d^6 Ni(IV) complex
    (B) low spin d^8 Ni(II) complex
    (C) high spin d^8 Ni(II) complex
    (D) high spin d^6 Ni(IV) complex

15. The Monsanto catalyst for acetic acid synthesis is

    (A) [Rh(PPh₃)₃Cl]   (B) [Rh(CO)₂I₂]⁻   (C) [HCo(CO)₄]   (D) [PdCl₄]²⁻

16. The structures of the complexes [Cu(NH₃)₄](ClO₄)₂ and [Cu(NH₃)₄](ClO₄) in solution respectively are

    (A) tetrahedral and square planar   (B) octahedral and square pyramidal

    (C) square planar and tetrahedral   (D) octahedral and trigonal bipyramidal

17. The number of framework electron pairs present in the borane cluster [B₁₂H₁₂]²⁻ is

    (A) ten   (B) eleven   (C) twelve   (D) thirteen

18. Solid Co₂(CO)₈ shows infrared CO stretching bands at 1857, 1886, 2001, 2031, 2044, 2059, 2071 and 2112 cm⁻¹. When Co₂(CO)₈ is dissolved in hexane, the carbonyl bands at 1857 and 1886 cm⁻¹ disappeared. These changes in infrared spectrum in hexane are due to

    (A) loss of terminal CO

    (B) dissociation of Co₂(CO)₈ to Co(CO)₄

    (C) structural changes involving conversion of terminal CO to bridging CO

    (D) structural changes involving conversion of bridging CO to terminal CO

19. The neutral complex which follows the 18-electron rule is

    (A) $\left(\eta^5-C_5H_5\right)Fe(CO)_2$ (B) $\left(\eta^5-C_5H_5\right)Mo(CO)_3$

    (C) $\left(\eta^5-C_5H_5\right)_2 CO$ (D) $\left(\eta^5-C_5H_5\right)Re\left(\eta^6-C_6H_6\right)$

20. A six coordinate transition metal complex is EPR and Mossabauer active. The effective magnetic moment of this complex is 5.9 B.M. The complex is

    (A) [Mn(H₂O)₆]²⁺   (B) [Fe(H₂O)₆]²⁺   (C) [Fe(H₂O)₆]³⁺   (D) [Fe(CN)₆]³⁻

21. [Ru(2,2'-bipyridyl)₃]²⁺, when it absorbs at 452 nm, is a very good oxidizing as well as reducing agent due to the formation of

    (A) [Ruᴵ(2,2'-bipyridyl)₃]⁺

    (B) [Ruᴵ(2,2'-bipyridyl)₂(2,2'-bipyridyl⁺)]²⁺

    (C) [Ruᴵᴵᴵ(2,2'-bipyridyl)₃]³⁺

    (D) [Ruᴵᴵᴵ(2,2'-bipyridyl)₂(2, 2'-bipyridyl⁻)]²⁺

22. An iron complex $[FeL_6]^{2+}$ (L = neutral monodentate ligand) catalyses the oxidation of $(CH_3)_2S$ by perbenzoic acid. The formation of the organic product in the above reaction can be monitored by

    (A) gas chromatography   (B) cyclic voltammetry

    (C) electron spin resonance   (D) fluorescence spectroscopy

23. Among, RO^-, $AsMe_3$, ROR, CN^-, RCO_2^-, SCN^-, the set of ligands with good π-acceptor nature are

    (A) RO^-, RCO_2^-, SCN^- (B) RO^-, RCO_2^-, $AsMe_3$

    (C) $AsMe_3$, CN^-, SCN^- (D) RO^-, ROR', RCO_2

24. If CIF_3 were to be stereochemically rigid, its ^{19}F NMR spectrum (I for $^{19}F = 1/2$) would be (assume Cl is not NMR active)

    (A) a doublet and a triplet   (B) a singlet

    (C) a doublet and a singlet   (D) two singlets

25. The bonding in Cp in $Fe(Cp)_2(CO)_2$ is such that

    (A) both Cp rings are pentahapto

    (B) one Cp ring is pentahapto and other Cp ring is monohapto

    (C) both Cp rings are monohapto

    (D) both Cp rings are ionically bonded

26. In the transformation of deoxyhemoglobin to oxyhemoglobin,

    (A) Fe(II) in the high spin state changes to Fe(II) in the low spin state

    (B) Fe(II) in the high spin state changes to Fe(III) in the high spin state

    (C) Fe(II) in the low spin state changes to Fe(II) in the high spin state

    (D) Fe(II) in the low spin state changes to Fe(III) in the low spin state

27. The correct order of υ_{CO} for the compounds $[Mo(CO)_3(NMe_3)_3]$, $[Mo(CO)_3(P(OPh)_3)_3]$, $[Mo(CO)_3(PMe_3)_3]$ and $[Mo(CO)_3(PCl_3)_3]$ in the IR spectrum is

    (A) $[Mo(CO)_3(NMe_3)_3]>[Mo(CO)_3(P(OPh)_3)_3]>[Mo(CO)_3(PMe_3)_3]>[Mo(CO)_3(PCl_3)_3]$

    (B) $[Mo(CO)_3(PCl_3)_3]>[Mo(CO)_3(NMe_3)_3]>[Mo(CO)_3(P(OPh)_3)_3]>[Mo(CO)_3(PMe_3)_3]$

    (C) $[Mo(CO)_3(PCl_3)_3]>[Mo(CO)_3(P(OPh)_3)_3]>[Mo(CO)_3(PMe_3)_3]>[Mo(CO)_3(NMe_3)_3]$

    (D) $[Mo(CO)_3(PMe_3)_3]>[Mo(CO)_3(NMe_3)_3]>[Mo(CO)_3(PCl_3)_3)]$ $[Mo(CO)_3(P(OPh)_3)_3]$

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28. The absorption spectra of rare earth complexes are not much affected by the ligands and this is due to

(A) 4f orbitals are inner-lying and shielded by outer electronic shells

(B) the f orbitals have $l = 3$

(C) the rare earths are more electropositive

(D) the rare earths complexes are more stable

29. Aluminum chloride melts at a much lower temperature than that of sodium chloride because

(A) the Al-Cl bond is more ionic than that of Na-Cl

(B) aluminium chloride is dimeric

(C) Al-Cl bond is highly covalent while NaCl is ionic

(D) aluminium chloride is polymeric

30. Treatment of $W(CO)_6$ with one equivalent of $Na(C_5H_5)$ in THF solution gives the ionic compound M. Reaction of M with glacial acetic acid results in product N. The ^1H NMR spectrum of N displays two singlets of relative intensity 5:1. The compounds M and N, respectively, are

(A) $[(C_5H_5)W(CO)_3]Na$ and $[(C_5H_5)W(CO)_4H]$

(B) $[(C_5H_5)W(CO)_3]Na$ and $[(C_5H_5)W(CO)_3H]$

(C) $[(C_5H_5)W(CO)_4]Na$ and $[(C_5H_5)W(CO)_4H]$

(D) $[(C_5H_5)W(CO)_4]Na$ and $[(C_5H_5)W(CO)_3H]$

31. Optically active diol among the following is

(A) cis-1,4-dihydroxycyclohexanediol   (B) trans-1, 4-dihydroxycylohexanediol

(C) cis-1, 3-dihydroxycyclohexanediol   (D) trans-1, 3-cyclohexanediol

32. Major product formed in the nitration of toluene with HNO_3/conc. H_2SO_4 is

(A) 2-nitrotolune   (B) 3-nitrotoluene

(C) 4-nitrotoluene   (D) 2,4-dinitrotoluene

33. A carbohydrate molecule that reacts with phenylhydrazine to form an osazone is

(A) α-D-glucopyranose

(B) α-D-glucopyranosepentaacetate

(C) methyl α-D-glucopyranoside

(D) methyl 2,3,4,6-tetra-O-methyl-α-D-glucopyranoside

34. Reaction of glucose with nitric acid provides

(A) 1-nitroglucose   (B) Glucaric acid   (C) glucofuranoside   (D) glucitol

35. Electrophiles among the following are
    (i)   EtSH   (ii) PhOH
    (iii) BH₃.SMe₂   (iv) CH₃COCHNaCOCH₃
    (v)   Hg(OAc)₂
    (A) (i) and (ii)   (B) (i) and (iv)   (C) (iii) only   (D) (iii) and (v)

36. The order of water solubility among the following alcohols is
    i.   ethanol   ii.   octanol
    iii   2-methyl-3-pentanol   iv.   n-butanol
    (A) i>ii>iii>iv   (B) i>iv>iii>ii   (C) i>iii>iv>ii   (D) iv>ii>iii>i

37. Most acidic hydrogen in the following molecule is
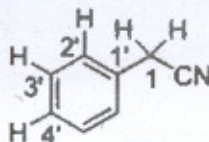
    (A) C1H   (B) C2'H   (C) C3'H   (D) C4'H

38. The major product of the following reaction is
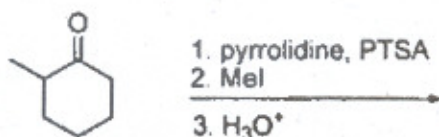
    (A) 2,2-diemthylcyclohexanone
    (B) cis-2,6-dimethylcyclohexanone
    (C) trans-2,6-dimethylcyclohexanone
    (D) 1, 2dimethyl-1-cyclohexanol

39. The reaction of 1-heptyne with Hg(OAc)₂ followed by treatment with dil. H₂SO₄ provides
    (A) 1-heptanol   (B) 2-heptanol   (C) 1-heptanal   (D) 2-heptanone

40. Number of ¹³C NMR signals in the ¹H decoupled NMR spectrum of the following compound will be
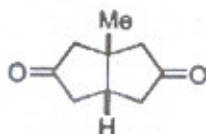
    (A) nine   (B) six   (C) five   (D) four

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41. The following ester displayed two singlet signals in its ^{1}H NMR spectrum at δ 2.3 and 3.9 ppm. The signals can be assigned respectively to
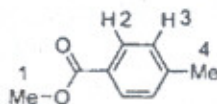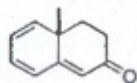

(A) CH(1) and CH(2)   (B) CH(1) and CH(3)

(C) CH(1)andCH(4)   (D) CH(4) and CH(1)

42. Match the following compounds with most intense and characteristic bands found in their IR spectra
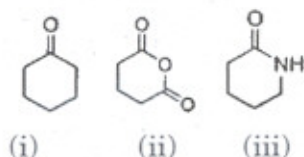
(a) 1830 cm^{-1}

(b) 1700 cm^{-1}

(c) 1650 cm^{-1}

(i)   (ii)   (iii)

(A) i—a; ii—b; iii—c   (B) i—b;ii—a; iii—c

(C) i—b; ii—c; iii—a   (D) i—c; ii—b; iii—a

43. The λ_{max} (nm) for the following compound is likely to be at

(A) 275 nm   (B) 300 nm   (C) 325 nm   (D) 350 nm

44. An organic compound displayed following spectral data:

^{1}H NMR δ: 0.92 (d, J = 7.1 Hz, 6H), 1.71-1.84 (m, 3H), 3.43 (b, J = 7.1 Hz, 2H); ^{13}C NMR δ: 21, 28, 32, 42; MS m/z: 150/152 (M$^+$), 71, 43 (100%). The compound is

(A) 1 -bromopentane   (B) 2-bromopentane

(C) 2-bromo-3-methylbutane   (D) 2-bromo-3-methylbutane

45. The product obtained in the following thermal reaction is

(A)

(B)

(C)

(D)

46. In the stable conformation of the following molecule the i) hydroxyl, ii) methyl and iii) t-butyl groups respectively occupy
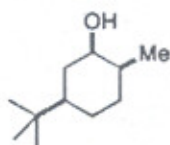

(A) equatorial, axial, equatorial

(B) axial, equatorial, equatorial

(C) equatorial, axial, axial

(D) equatorial, equatorial, equatorial

47. The reagent systems that can be used for the following conversion is

(A) i) benzoic acid, $CHCl_3$ ii) KOH, MeOH, iii. H_3O^+

(B) i) H_2O_2, NaOH ii). H_3O^+

(C) i) perbenzoic acid, $CHCl_3$ ii) KOH, MeOH, iii. H_3O^+

(D) i) $F_3B.OEt_2$, $CHCl_3$ ii) H_3O^+

48. Major product formed in the following reaction is

(A)

(B)

(C)

(D)
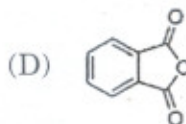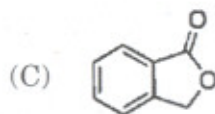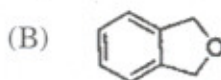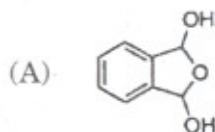
49. The following photochemical ring contraction goes through
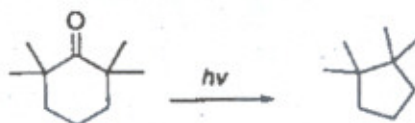
(A) Wolff-rearrangement

(B) Paterno-Buchi reaction

(C) Norrish Type-I reaction

(D) Norrish Type-II reaction

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50. The reagent that can be used for the conversion of 3-hexyne to cis-3-hexene is

(A) Li, NH$_3$

(B) i. disamylborane, THF; ii. AcOH

(C) H$_2$, PtO$_2$

(D) Sn, HCl

51. Reaction of indole with acetyl chloride and ZnCl$_2$ at 0°C provides

(A) 2-acetylindole

(B) 3-acetylindole

(C) 5-acetylindole

(D) 6-acetylindole

52. The major product formed in the following reaction is
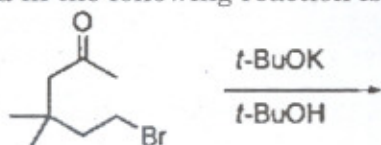

(A)

(B)

(C)

(D)

53. Ring opening of cis-3,4-dimethylcyclobut-1 -ene to (2E,4E)-hexa-2,4-diene goes through

(A) CON rotation under photochemical conditions

(B) DIS rotation under photochemical conditions

(C) CON rotation under thermal conditions

(D) DIS rotation under thermal conditions

54. Reaction of bromobenzene with i. Mg, Et$_2$O, ii. ethylene oxide provides

(A) 1 -phenylethanol

(B) 2-phenylethanol

(C) 1,2-diphenylethane

(D) 1, 1-dipehnylethane

55. An organic compound dissolves in dil NaOH solution. It gives effervescence with aqueous sodium carbonate solution. It forms a product with fruity smell when reacted with dry ethanol in presence of catalytic amount of conc. H$_2$SO$_4$. The compound could be

(A) cholesterol

(B) 4-cyanotoluene

(C) picric acid

(D) 2-naphthoic acid

56. The reaction of 3-methylthiophene with N-bromosuccinimide in presence of dibenzoylperoxide will provide the following as a major product

(A) 2-bromothiophene

(B) 4-bromothiophene

(C) 5-bromothiophene

(D) 3-(bromomethyl)thiophene

57. Following reaction is an example of
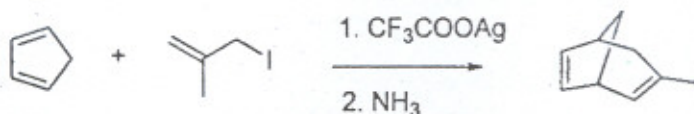

(A) $2\pi_s + 2\pi_a$ cycloaddition

(B) $4\pi_s + 2\pi_a$ cycloaddition

(C) $4\pi_a + 4\pi_s$ cycloaddition

(D) $6\pi_s + 4\pi_a$ cycloaddition

58. Conversion of 1-pehenoxy2-butene to 2-(but-3-en-2-yl) phenol goes through

(A) 2,3-sigmatropic rearrangement

(B) 1,5-sigmatropic rearrangement

(C) 3,3-sigmatropic rearrangement

(D) 1 3-sigmatropic rearrangement

59. An organic compound A of MF $C_8H_8O_2$ undergoes isomerisation to provide B when heated with anhydrous aluminum chloride. While A is insoluble in dilute NaOH solution, B is soluble. Moreover, the IR spectrum of B does not show dependence on dilution. A and B respectively

(A) phenylacetic acid and 2-hydroxy-1-phenylethanone

(B) phenyl acetate and 2-hydroxyacetophenone

(C) phenyl acetate and 4-hydroxyacetophenone

(D) phenyl acetic acid and phenyl acetate

60. A hydrocarbon of MF $C_{10}H_8$ is intensely blue colored solid. It undergoes substitution reactions rather than addition reactions. The hydrocarbon could be

(A) naphtalene

(B) azulene

(C) 1 -ethynyl-4-vinylbenzene

(D) 1 -ethynyl-2-vinylbenzene

61. Consider the partial derivatives of Maxwell relations (i) $(\delta T/\delta V)_S = (\delta P/\delta S)_V$ and
(ii) $(\delta T/\delta P)_S = (\delta V/\delta S)_P$, pick out the correct statement from the following

(A) (i) is true and (ii) is false

(B) (i) is false and (ii) is true

(C) both are true

(D) both are false

62. 20 g of a nonvolatile solute of molecular weight 241 gmol^{-1} is dissolved in 200 g of water. Freezing point of depression was observed to be 0.178° C. The activity coefficient (y) of the solute is

   (A) y = 23   (B) y = 2.3   (C) y = 0.23   (D) y = 0.023

63. The compound that can not undergo micellization process is

   (A) $C_{17}H_{35}COONa$ (B) $(R_1R_2R_3R_4)NBr$ (C) Triton-x 100   (D) Acryl amide

64. Raman spectroscopy discusses ———————— is an anisotropic quantity and its value depends on the direction of the electric field relative to the molecular axis

   (A) polarizability   (B) relative permittivity

   (C) dipole moment   (D) paramagnetism

65. In an alkaline cell, the cathode reaction $2MnO_{2(s)} + H_2O_{(l)} + 2e = Mn_2O_{3(s)}+2OH^-_{(aq)}$ proceeds, when E° is

   (A) −0.76 V   (B) 0.76 V   (C) 0 V   (D) −7.6 V

66. Boiling point is a much stronger function of the pressure than freezing point, which is due to the fact that the slope of liquid-gas coexistence is ———————— that of solid-liquid coexistence curve.

   (A) small   (B) high

   (C) much smaller than   (D) much higher than

67. The possible quantum states for a carbon atom with the configuration $1s^22s^22p^2$ is

   (A) 6   (B) 2   (C) 15   (D) 234

68. The distribution of energy associated with the dominant configuration is known as

   (A) Boltzmann distribution   (B) Einstein distribution

   (C) Bose distribution   (D) Dirac distribution

69. The steric effects on molecular ordering of the following crystals are minimal. Therefore, molar entropies for the crystals are (i) same; (ii) different
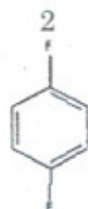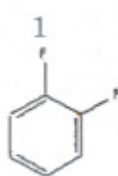
   (A) (i) is true   (B) (ii) is true

   (C) (i) and (ii) are true   (D) (i) and (ii) are false

70. Most important state function considering an ideal gas that can be used to determine the spontaneity of a chemical reaction is

(A) $G = -nRT\ln(N/q)$

(B) $G = -nRT\ln(nq/N)$

(C) $G = -nR\ln(q/N)$

(D) $G = -nRT\ln(q/N)$

71. The bond length of HCl whose moment of inertia is 2.71×10^{-40} gcm^2 is

(A) $12.9\,\text{Å}$

(B) $2.71\,\text{Å}$

(C) $1.29\,\text{Å}$

(D) $0.129\,\text{Å}$

72. Similarity transform of C_3 in the similarity transformation $(\sigma''')^{-1}C_3\sigma'''$ in ammonia is

(A) C_3^2

(B) C_3

(C) σ'''

(D) $(\sigma''')^{-1}$

73. The point groups for the molecules $POCl_3$ and $PtCl_4^{-2}$ are

(A) C_{3v} and D_{2h}

(B) C_{2v} and D_{4h}

(C) C_{3v} and D_{4h}

(D) C_{3v} and D_4

74. In a system, the number of molecules that is phase points in each cell of the phase space, such as n_1 molecules in cell1, n_2 molecules in cell2 etc., is known as

(A) microstate

(B) macrostate

(C) ensemble

(D) occupation number

75. Determine the order of the reaction; $2NO + 2H_2 = N_2 + 2H_2O$, in which the initial pressure of gaseous mixture was (294 mm of mercury) converted into half the value in 149 s and 336 mm was converted into half the value in 109s

(A) 0

(B) 1

(C) 2

(D) 3

76. Whenever the adsorption isotherm follows sigmoid relationship, the adsorption is related to multimolecular $(E_1<E_2)$ while the hyperbolic adsorption is related to multimolecular $(E_1>E_2)$ in character.

(A) first statement is true; second is false

(B) first statement is false; second is true

(C) first statement is true

(D) second statement is false

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77. Acrylic acid was polymerized at 330 K for 180 s and the resulting polymer was found to contain 20% of macromolecules with molecular weight 5000 and 80% of the macromolecules with molecular weight 25000. The weight average molecular weight is

    (A) 25000   (B) 5000   (C) 21000   (D) 30000

78. Consider the cell: $Pt/Fe^{2+}, Fe^{3+}/salt\ bridge/H^+$ (a=1)H_2 (Pt) 1 atm. When one faraday of current is passed through the cell from left to right, the cell reaction becomes

    (A) $Fe^{3+} + \frac{1}{2}H_2 = Fe^{2+} + H^+$ (B) $Fe^{3+} + H^+ = Fe^{3+} + \frac{1}{2}H_2$

    (C) $Fe^{3+} + H^+ + 2e = Fe^{2+} + \frac{1}{2}H_2$ (D) $Fe^{2+} + \frac{1}{2}H_2 = Fe^{3+} + H^+ + 2e$

79. Atomic heats of solid elements, at ordinary temperatures, are constant and approximately equal to

    (A) 4.6   (B) 46   (C) 6.4   (D) 64

80. In a body centered cubic lattice, fraction of the total volume occupied by the spheres is

    (A) 0.32   (B) 0.62   (C) 0.9   (D) 0.1

81. The α and β penta-acetyl glucoses show dipole moments of 3.52 and 2.48 Debye units respectively. Therefore, the β-form must be

    (A) less unsymmetrical   (B) less symmetrical

    (C) more unsymmetrical   (D) more symmetrical

82. The bond energy of the molecule is 285.7 cal/mol. The wave length of a lightwhich can be used to dissociate the molecule is

    (A) 285.7 Å   (B) 2857 Å   (C) 1000 Å   (D) 2000 Å

83. The emf of the cell without liquid junction potential: $Cu/Cu^{2+}(0.005M)/Cu^{2+}(0.1M)/Cu$ (RT/F = 0.059) is

    (A) 3.8V   (B) 0.38 V   (C) 0.038 V   (D) 0.0038 V

84. The melting point of zinc is 420° C, magnesium is 650° C and that of $Mg(Zn)_2$ is 590° C. The composition of $Mg(Zn)_2$ when it is melted is

    (A) composition will change

    (B) composition will not change

    (C) both composition and melting point will change

    (D) melting point will change and composition will not change

85. The product of molar volume of a liquid and its surface tension raised to the power of 14 is known as

(A) parachor

(B) relative permittivity

(C) molar viscosity

(D) refractive index

86. Enzyme catalysis is also known as

(A) micro-heterogeneous catalysis

(B) heterogeneous catalysis

(C) homogeneous catalysis

(D) acid-base catalysis

87. In the dissociation of magnesium fluoride, $MgF_{2(s)} \rightarrow Mg^{2+}_{(aq)} + 2F^-_{(aq)}$, salting in is observed when

(A) $y_{\pm} < 1$

(B) $y_{\pm} > 1$

(C) $y_{\pm} = 1$

(D) $y_{\pm} = 0$

88. The following symmetry element is absent in silicon tetrachloride molecule

(A) S_4

(B) C_3^2

(C) I

(D) σ

89. Supercritical fluids are unique that they exhibit favorable properties of

(A) liquids

(B) gases

(C) liquids and gases

(D) neither liquids nor gases

90. Residual entropy of the molecular crystals of CO at low temperature is due to electric dipole moment of the molecule which is

(A) weak

(B) strong

(C) very weak

(D) very strong

91. Fourfold degeneracy is available only in

(A) T_h

(B) T_d

(C) O_h

(D) I_h

92. The lone pairs in water molecule belong to the irreducible representation

(A) e_g

(B) e_u

(C) e

(D) none of the above

93. The entries in the character table under each class of symmetry operation represents
    (A) the determinant of the associated matrix
    (B) the dimension of the associated matrix
    (C) the trace of the associated matrix
    (D) the rank of the associated matrix

94. Which of the following point groups has center of symmetry?
    (A) S_4
    (B) T_d
    (C) D_{3d}
    (D) D_{3h}

95. A wave function that is symmetric or antisymmetric with respect to every symmetry operation of the molecule
    (A) must be degenerate
    (B) must be HOMO
    (C) must be LUMO
    (D) must be non-degenerate

96. The 3d orbital in hydrogen atom lies
    (A) higher than 4s
    (B) higher than 3p
    (C) equal to 3p
    (D) hydrogen has no 3d orbital

97. Solving the classical Schrodinger's equation leads to
    (A) four quantum numbers
    (B) three quantum numbers
    (C) antisymmetry principle
    (D) space quantization

98. The Coulomb integral includes kinetic energy of electrons in
    (A) Molecular orbital theory of H_2 molecule
    (B) Valence Bond theory of H_2 molecule
    (C) Huckel theory
    (D) Hartree-Fock theory

99. The extended Huckel theory is ideal in predicting energy variations associated with
    (A) bond-lengths   (B) bond angles   (C) dihedral angles   (D) spin states

100. The Z-matrix is
    (A) Unitary matrix
    (B) Hermitian matrix
    (C) Real matrix
    (D) None of the above