

ENTRANCE EXAMINATION FOR ADMISSION, MAY 2012.

M.Sc. (Chemical Sciences)

COURSE CODE : 369

Register Number :

Signature of the Invigilator
(with date)

COURSE CODE : 369

Time : 2 Hours

Max : 400 Marks

Instructions to Candidates :

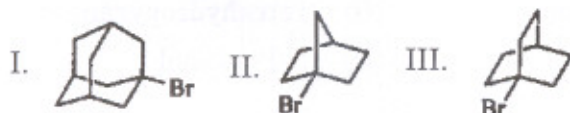
1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each question carefully and shade the relevant answer (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.

- The correct order of radii is
 (A) $N < Be < B$ (B) $F^- < O^{2-} < N^{3-}$
 (C) $Na < Li < K$ (D) $Fe^{3+} < Fe^{2+} < Fe^{4+}$
- The Ionization energy of an element $A(g)$ is I and the electron affinity of $A^+(g)$ is E . I and E are related as
 (A) $IE = 1$ (B) $IE = -1$ (C) $I = E$ (D) $I = -E$
- Which of the following metals when treated with cold dilute nitric acid generates molecular hydrogen?
 (A) Mn (B) Al (C) Fe (D) Cu
- The first ionization energy of hydrogen is
 (A) 485 kJ (B) 520 kJ (C) 1312 kJ (D) 1680 kJ
- The solution of sodium metal in liquid ammonia is strongly reducing due to the presence of
 (A) Sodium atoms (B) Solvated electrons
 (C) Salvation (D) Solvated protons
- Which of the following metals is used in the photoelectric cell?
 (A) Si (B) Mg (C) Li (D) Cs
- A metal is burnt in air and the ash on moistening smells of ammonia, the metal is
 (A) Na (B) Fe (C) Mg (D) Al
- Which of the following oxides possesses highest melting point?
 (A) MgO (B) BeO (C) CaO (D) SrO
- In the electrolysis of alumina, cryolite is added to
 (A) Lower the solubility of alumina
 (B) Increase the electrical conductivity
 (C) Remove impurities from alumina
 (D) Minimize anodic effect
- On the addition of mineral acid to an aqueous solution of borax, the compound formed is
 (A) Orthoboric acid (B) Pyroboric acid
 (C) Metaboric acid (D) Boron hydride

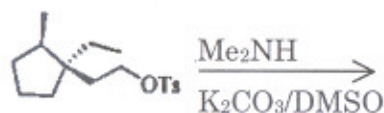
11. Number of M-M bonds in $[\text{Re}_2\text{Cl}_8]^{2-}$ is
 (A) 2 (B) 4 (C) 6 (D) 1
12. Which one is the correct statement
 (A) MOT explains the spectroscopic properties of the metal complexes
 (B) VBT explains the spectroscopic properties of the metal complexes
 (C) VSEPRT explains the spectroscopic properties of the metal complexes
 (D) None
13. The order of d orbital splitting in the O_h metal complexes is
 (A) eg, t_{2g} (B) dxz, dyz, dz^2 (C) t_{2g}, eg (D) t_{1u}, eg, t_{2g}
14. Kinetic stability is related to labile and inert
 (A) No (B) Related to geometry
 (C) Yes (D) Thermodynamic
15. Cu (I) complexes are
 (A) Diamagnetic (B) Ferromagnetic
 (C) Not exist (D) None
16. Relativistic effect present in
 (A) Lanthanides (B) H
 (C) Kr (D) p - block elements
17. FeCp_2 is an example for
 (A) Inert complex (B) Stable complex
 (C) Standard complex (D) Sandwich complex
18. Spin only formula can be used to calculate
 (A) Heat of reaction for metal complexes
 (B) Formation constant for metal complexes
 (C) Spectral properties of transition metal complexes
 (D) Magnetic moment of transition metal complexes
19. Chelate effect is favored because
 (A) Addition reaction (B) Substitution reaction
 (C) $\Delta S = +ve$ (D) $\Delta S = -ve$

20. d-d transition is
 (A) Not favorable (B) Favorable
 (C) Spin allowed (D) None
21. In PCl_2F_3 the chlorine atoms occupy the
 (A) Equatorial position of Trigonal bipyramid
 (B) Axial position of Trigonal bipyramid
 (C) Equatorial position of square pyramid
 (D) Axial, equatorial position of square pyramid
22. Aluminium is used in thermite process owing to its high
 (A) Metallic nature (B) Oxygen affinity
 (C) Ductile nature (D) Thermal resistance
23. Thallous fluoride (TlF) is highly soluble in water compared to its Iodide analogue because the former has
 (A) Lower hydration energy (B) Lower lattice energy
 (C) Higher lattice energy (D) Higher hydration energy
24. The Lewis acidity of BMe_3 , BH_3 , BF_3 , BBr_3 , BI_3 are in the order of
 (A) $\text{BMe}_3 > \text{BH}_3 > \text{BF}_3 > \text{BBr}_3 > \text{BI}_3$ (B) $\text{BMe}_3 > \text{BF}_3 > \text{BBr}_3 > \text{BI}_3 > \text{BH}_3$
 (C) $\text{BH}_3 > \text{BI}_3 > \text{BF}_3 > \text{BBr}_3 > \text{BMe}_3$ (D) $\text{BI}_3 > \text{BBr}_3 > \text{BF}_3 > \text{BH}_3 > \text{BMe}_3$
25. Silyl chloride on reduction with metallic sodium yields
 (A) SiH_2Cl_2 (B) SiH_3Na
 (C) Si_2H_6 (D) SiH_4
26. Ruby, a sparkling red gemstone is made from corundum (Al_2O_3) by replacing Al^{3+} with
 (A) Ir^{3+} (B) Cr^{3+} (C) V^{3+} (D) Fe^{3+}
27. The stability of MBr_4 among carbon family is $\text{CBr}_4 > \text{SiBr}_4 > \text{GeBr}_4 > \text{SnBr}_4 > \text{PbBr}_4$; the reason for the observed trend is due to _____ of M^{4+} ions
 (A) Increasing oxidizing nature (B) Increasing reducing nature
 (C) Decreasing oxidizing nature (D) Decreasing reducing nature
28. Wj's reagent used in determination of Iodine number of fats and oil is
 (A) $\text{I}_2/\text{acetic acid}$ (B) $\text{ICl}/\text{acetic acid}$
 (C) $\text{Br}_2/\text{n-propanol}$ (D) Alkaline KMnO_4

29. Super acid is stronger than 100%
 (A) HNO_3 (B) H_2SO_4
 (C) HF (D) H_3PO_4
30. The coordination number of fluoride ion in SrF_2 and CsF crystal lattices are _____ and _____ respectively
 (A) 8, 8 (B) 4, 6 (C) 6, 6 (D) 4, 8
31. Triphenylmethanol on reaction with HCl produces triphenylmethyl chloride. The reaction is an example for
 (A) $\text{S}_{\text{N}}1$ (B) $\text{S}_{\text{N}}2$ (C) $\text{S}_{\text{N}}2'$ (D) $\text{S}_{\text{N}}\text{i}$
32. Which one of the following halides does not undergo substitution reaction with NaCN ?
 (A) Benzyl chloride (B) 3-Chlorocyclohexene
 (C) Vinyl chloride (D) Ethyl bromide
33. Reaction of benzoic acid with 2-methyl-propene in presence of sulfuric acid produces
 (A) 3- t Butylbenzoic acid (B) 3,5-di- t butylbenzoic acid
 (C) t Butyl phenyl ketone (D) t Butyl benzoate
34. The relative solvolysis rates of the bridge head bromides I, II, III is in the following order



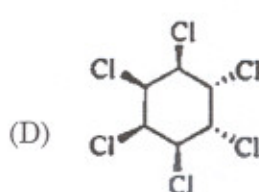
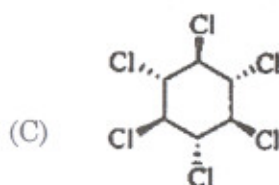
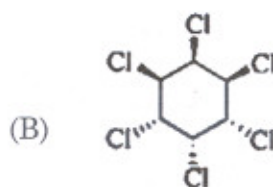
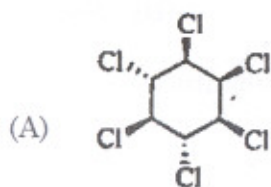
- (A) $\text{I} > \text{II} > \text{III}$ (B) $\text{I} > \text{III} > \text{II}$
 (C) $\text{III} > \text{I} > \text{II}$ (D) $\text{II} > \text{I} > \text{III}$
35. Predict the product formed in the following reaction



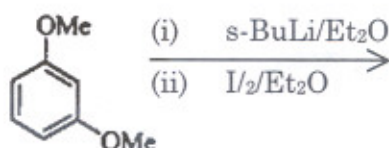
- (A)  (B) 
 (C)  (D) 

36. Predict the product formed in the following transformation $\text{trans-2-Phenylcyclohexyl tosylate} + t\text{-BuO}^- \rightarrow$
- (A) *trans*-2-Phenylcyclohexyl *t*-butyl ether
 (B) 3-Phenylcyclohexene
 (C) 1-Phenylcyclohexene
 (D) *cis*-2-Phenylcyclohexyl *t*-butyl ether

37. Which one of the following hexachlorocyclohexane is the least reactive in dehydrohalogenation reaction?

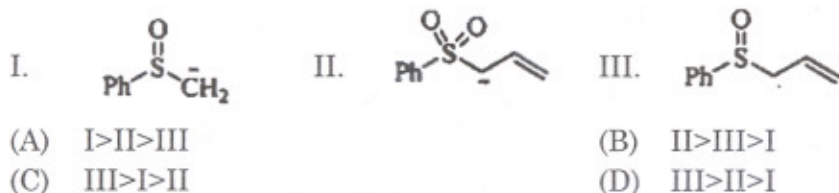


38. Major product formed in the reaction of 4-pentene-1-ol with dilute sulfuric acid is
- (A) 2-Methyl-tetrahydrofuran (B) Tetrahydropyran
 (C) 1,3-Pentadiene (D) 1-Pentanol
39. One of the following pair of substrates undergo substitution reaction under both S_N1 and S_N2 mechanism
- (A) Benzyl bromide and *n*-butyl bromide
 (B) Benzyl bromide and *t*-butyl bromide
 (C) Allyl bromide and benzyl bromide
 (D) Allyl bromide and *t*-butyl bromide
40. Identify the major product formed in the following reaction

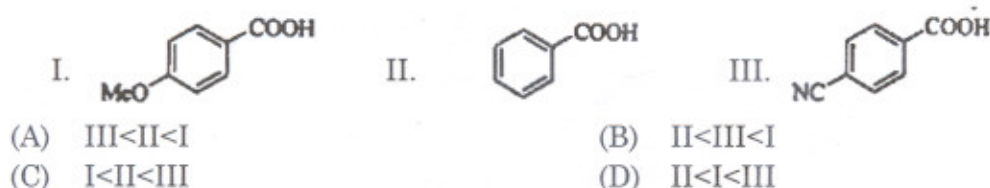


- (A) 1,3-Diiodobenzene (B) 1,3-Dimethoxy-2-iodo benzene
 (C) 1,3-Diiodo-4,6-dimethoxy benzene (D) Resorcinol

41. Reaction of benzamide with Lawesson's reagent yields
 (A) Benzothiazole (B) Thiobenzamide
 (C) Benzyl thiocarbamate (D) Thiophenol
42. How many ^{13}C signals would be observed for 1,3-dimethylbenzene?
 (A) 3 (B) 4 (C) 2 (D) 5
43. An intense band appears at 1715 cm^{-1} indicates the presence of
 (A) Alcohol (B) 2° amine
 (C) Ketone (D) Nitro group
44. Aniline shows _____ shift, while measuring the UV spectra at lower pH.
 (A) Blue shift (B) Red shift
 (C) Green shift (D) Yellow shift
45. Arrange the following anions in the increasing order of stability



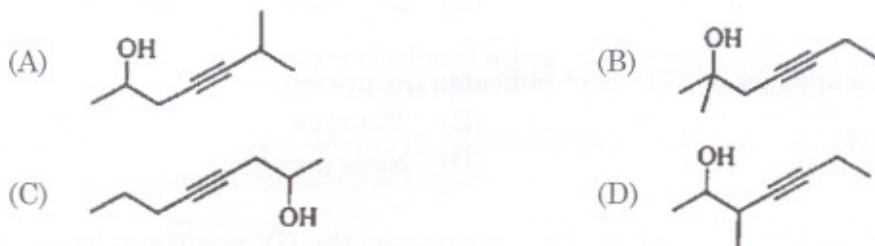
46. Primary alcohol can be converted to aldehyde selectively using
 (A) Sulfuric acid / Potassium dichromate
 (B) Potassium hydroxide / Potassium permanganate
 (C) Osmium tetroxide / N-methylmorpholine-N-oxide
 (D) Oxalyl chloride/dimethyl sulphoxide/triethylamine
47. Arrange the following substrate in the increasing order of acidity



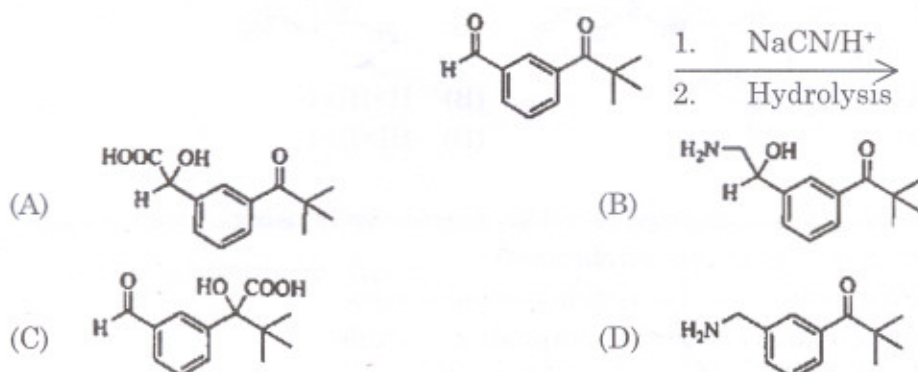
48. Identify the strongest base from the list of following molecules



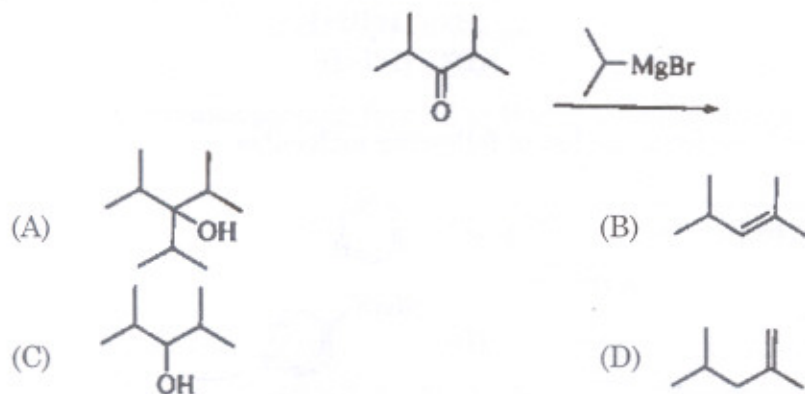
49. One of the following sulfur reagent can exist as chiral compound
 (A) PhSCH_3 (B) PhSO_2OH
 (C) PhSOCH_3 (D) PhSO_2CH_3
50. Identify the appropriate structure, which corresponds to the name 2-methyl-4-heptyn-2-ol



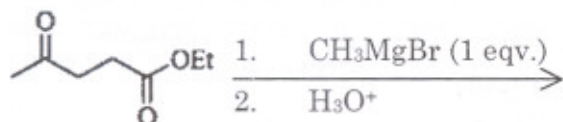
51. Which one of the following species possesses the tetrahedral bond angle?
 (A) H_3C^+ (B) NH_4^+
 (C) H_2N^- (D) BF_3
52. Identify the product formed in the following reaction


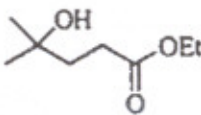

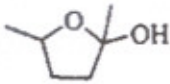


53. 4-Chloronitrobenzene gives the following ^1H -NMR signals
 (A) 2 doublets (B) 1 doublet and 1 singlet
 (C) 1 triplet (D) 4 singlets
54. Predict the product formed in the following reaction



55. Reaction of alkyl lithium with carbon dioxide gives
 (A) Carboxylic acid (B) Aldehyde
 (C) Ketone (D) Ester
56. Identify the product formed in the following transformation



- (A)  (B) 
- (C)  (D) 
57. Reaction of one mole of benzyl benzoate with lithium aluminum hydride gives
 (A) 1 Mole of benzyl alcohol + 1 mole of benzaldehyde
 (B) 1 Mole of benzyl alcohol + 1 mole of benzoic acid
 (C) 2 Moles of benzaldehydes
 (D) 2 Moles of benzyl alcohols
58. Reaction of 1,6-dibromohexane with ethyl acetoacetate in presence of excess sodium ethoxide followed by hydrolysis at higher temperature gives
 (A) Cyclohexanecarboxylic acid (B) Cyclopentanecarboxylic acid
 (C) Cyclohexyl methyl ketone (D) Cyclopentyl methyl ketone
59. Which of the following compounds exchanges the largest number of hydrogens for deuterium when treated with KOD in D₂O?
 (A) 3-Methyl-1,2-cycloheptanedione (B) 2-Methyl-1,3-cycloheptanedione
 (C) 5-Methyl-1,3-cycloheptanedione (D) 6-Methyl-1,4-cycloheptanedione
60. An organic compound exhibited the following resonances in ¹H NMR spectrum. A triplet at δ 125, a singlet at 2.0 and a quartet at 4.1 ppm. The compound is
 (A) H₃CCH₂COOCH₃ (B) H₃CCOOCH₂CH₃
 (C) H₃CCOCH₂OCH₃ (D) H₃CCH₂COCH₃
61. The efficiency of Carnot's heat engine is the fraction of heat absorbed to converted by it
 (A) Energy (B) Work
 (C) Pressure (D) Chemical change

62. The integrated form of Vant' Hoff isochore is
 (A) $\ln [K_{c_1} / K_{c_2}] = \Delta E/R [1/T_1 - 1/T_2]$ (B) $\ln [K_{c_2}/K_{c_1}] = \Delta E/RM [1/T_1 - 1/T_2]$
 (C) $\ln [K_{c_2} / K_{c_1}] = \Delta E/R [1/T_1 - 1/T_2]$ (D) $\ln [K_{c_2}/K_{c_1}] = \Delta E/R [1/T_2 - 1/T_1]$
63. Consider a simple eutectic system, in which the following statement is wrong.
 (A) the two components are completely miscible in liquid state
 (B) they do not form any compound
 (C) this is useful in the study of alloys in metallurgy
 (D) they form a new compound
64. What is the emf of the cell ; $\text{Ag}/\text{AgNO}_3(\text{C}_1)//\text{sat. NH}_4\text{NO}_3/\text{AgNO}_3(\text{C}_2)/\text{Ag}$ $\text{C}_1 = 0.01\text{ N}$;
 $\text{C}_2 = 0.001\text{ N}$ and $RT/nF [\log_e 10] = 0.059$ at 25°C .
 (A) -0.059 V (B) 0.059 V (C) 0.118 V (D) -0.118 V
65. According to the theory of heterogeneous catalysis a reaction taking place on a surface is not supposed to consist of the following consecutive step
 (A) Diffusion of gases to the surface
 (B) Adsorption of gases on the surface
 (C) Reaction on the surface
 (D) Desorption and diffusion of products from bulk to the surface
66. The coordination numbers of hexagonal close packing and body centered cubic arrangement respectively are
 (A) 12 and 12 (B) 8 and 8 (C) 12 and 8 (D) 8 and 12
67. The selection rule for rotational Raman spectra is
 (A) $\Delta J = 0, \pm 1$ (B) $\Delta J = 0, \pm 2$ (C) $\Delta J = \pm 1$ (D) $\Delta J = \pm 2$
68. Calculate the initial concentration of the reactant in zero order reaction, in which the concentration after half an hour is 0.04 moles/litre , ($k_0 = 0.28\text{ (moles/litre)hour}^{-1}$).
 (A) 0.6 moles/litre (B) 0.06 moles/litre
 (C) 0.3 moles/litre (D) 0.03 moles/litre
69. The permitted energy values for the energy for a rigid diatomic molecule is given by the following expression.
 (A) $E_r = [h^2 / 8 \pi^2 \mu] J(J+1)\text{ ergs}$ (B) $E_r = [h^2 / 8 \pi^2 I] J(J+1)\text{ ergs}$
 (C) $E_r = [\mu^2 / 8 \pi^2 I] J(J+1)\text{ ergs}$ (D) $E_r = [h^2 / 8 \pi I^2] J(J+1)\text{ ergs}$

70. One mole of methane releases 94.8 kJ of energy on combustion, calculate the energy released by the combustion of 0.4 g of methane.
 (A) 237 kJ (B) 23.7 kJ
 (C) 2.37 kJ (D) 0.237 kJ
71. The specific heat of solid can be explained by assuming that the atoms in a solid are all independent, and that each atom acts as simple harmonic oscillator with a common frequency. This was proposed by ;
 (A) Einstein (B) Dulong
 (C) Mitchell (D) Oswald
72. Thermal decomposition of acetone; $(\text{CH}_3)_2\text{CO} \longrightarrow \text{CH}_2=\text{C}=\text{O} \longrightarrow 1/2\text{C}_2\text{H}_4 + \text{CO}$ is an example of the following type of reaction
 (A) Parallel reaction (B) Consecutive reaction
 (C) Reversible reaction (D) Fractional order reaction
73. The quantum yield of decomposition of $\text{HI}; 2\text{HI} \longrightarrow \text{H}_2 + \text{I}_2$, using 253 nm photolysis at 27°C is
 (A) 4 (B) 2 (C) 1 (D) 0.5
74. According to Joule-Thompson, every gas has _____ at a given initial pressure. Above this temperature, the gas shows heating effect.
 (A) Inversion temperature (B) Critical temperature
 (C) Specific temperature (D) Constant temperature.
75. Find out the molecule that has definite dipole moment
 (A) CS_2 (B) *trans*- PtCl_4
 (C) HgCl_2 (D) N_2O
76. Calculate the molecular weight of a gas if the pressure of the gas falls to about half of the initial value in a vertical distance of 100 m at 27°C .
 (A) 1.76 (B) 17.6 (C) 3.52 (D) 35.2
77. In a titration reaction between H_2O_2 with KMnO_4 , the following experimental data were observed, what is the order of decomposition of hydrogen peroxide?
- | t (min) | 0 | 10 | 30 | 40 |
|----------------------|----|----|----|----|
| KMnO_4 (ml) | 25 | 20 | 16 | 10 |
- (A) Zero order (B) First order
 (C) Second order (D) Third order

78. The coagulating power of anion on positively charged sols can be made into a series according to activity.
- (A) $\text{Cl}^- > \text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Fe}(\text{CN})_4^{4-}$ (B) $\text{PO}_4^{3-} > \text{Cl}^- > \text{SO}_4^{2-} > \text{Fe}(\text{CN})_4^{4-}$
 (C) $\text{Fe}(\text{CN})_4^{4-} > \text{SO}_4^{2-} > \text{PO}_4^{3-} > \text{Cl}^-$ (D) $\text{Fe}(\text{CN})_4^{4-} > \text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$
79. The phase diagram of sulfur can be represented using
- (A) One component, one phase (B) One component, two phases
 (C) One component, three phases (D) One component, four phases
80. The emf of the cell: Zn (amalgam) (a_1) / ZnSO_4 (solution) / Zn (amalgam) (a_2) can be represented as
- (A) $E = RT/nF [\log_e a_2/a_1]$ (B) $E = R/TnF [\log_e a_1/a_2]$
 (C) $E = RT/nF [\log_e a_1/a_2]$ (D) $E = RT/nF [\log_e a_1 a_2]$
81. In the titration of warm oxalic acid by potassium permanganate:
 $5 \text{C}_2\text{O}_4^{2-} + 2 \text{MnO}_4^- + 16 \text{H}^+ \longrightarrow 2 \text{Mn}^{2+} + 10 \text{CO}_2 + 8 \text{H}_2\text{O}$, first few drops are slowly decolorized but after definite time the decolourization is fast, this is due to
- (A) $\text{C}_2\text{O}_4^{2-}$ (B) MnO_4^- (C) H^+ (D) Mn^{2+}
82. The first order reflection from (100) planes of rock salt and KCl occurred at 5.9° and 5.3° respectively, then the ratio of molecular volume is;
- (A) 1.37 (B) 13.7 (C) 0.137 (D) 0.0137
83. The Gibbs-Helmholtz equation is represented as
- (A) $\Delta G = \Delta H + T [\delta(\Delta G)/\delta T]_v$ (B) $\Delta G = \Delta H + T [\delta(\Delta G)/\delta T]_p$
 (C) $\Delta G = \Delta H + T [\delta(\Delta G)/\delta H]_p$ (D) $\Delta G = \Delta H + T [\delta(\Delta H)/\delta T]_p$
84. The reaction : $\text{H}_2\text{S} + \text{Br}_2 \longrightarrow 2\text{HBr} + \text{S}$ produces
- (A) Sulfur solution (B) Sulfur precipitate
 (C) Sulfur sol (D) Sulfur gel

85. Calculate the parachor value for quinine. (parachors for C = 4.8, H = 17.1, O = 20.1, double bond = 23.1, and six members ring = 6.2).
 (A) 21.91 (B) 219.1 (C) 2.191 (D) 0.2191
86. When ammonium chloride is in equilibrium with ammonia and HCl in a closed vessel, addition of little amount of HCl will make the system
 (A) One component
 (B) Two component
 (C) Three component
 (D) Three component system with compound formation
87. In an adsorption process, if the pressure is kept constant and temperature is varied, the curve between a and T is called;
 (A) Adsorption isotherm (B) Physisorption
 (C) Chemisorption (D) Adsorption isobar
88. In a body centered cubic lattice, the fraction of the total volume occupied the spheres is
 (A) 0.68 (B) 0.068 (C) 0.0068 (D) 0.00068
89. The rotational spectrum in the far infrared region of HI consists series of equidistant lines with spacing 12.7 cm^{-1} , then the bond length is
 (A) 16.3 \AA (B) 1.63 \AA (C) 0.163 \AA (D) 3.26 \AA
90. Hess law states that the enthalpy of sublimation (ΔH_{sub}) can be obtained from enthalpy of fusion (ΔH_f) and enthalpy of vapourization (ΔH_v) as given below
 (A) $(\Delta H_{\text{sub}}) = (\Delta H_f) - (\Delta H_v)$ (B) $(\Delta H_{\text{sub}}) = (\Delta H_f) (\Delta H_v)$
 (C) $(\Delta H_{\text{sub}}) = (\Delta H_f) / (\Delta H_v)$ (D) $(\Delta H_{\text{sub}}) = (\Delta H_f) + (\Delta H_v)$
91. If P and Q are positive integers where $\sqrt{(PQ)} = 8$, which of the following cannot be the value of $(P + Q)$?
 (A) 65 (B) 35 (C) 20 (D) 16
92. The average of 10 scores is 80. When the highest and lowest scores are dropped, then average is 81. If highest score is 92, then lowest score will be
 (A) 80 (B) 78 (C) 76 (D) 60
93. The value of $\int \log x dx$
 (A) $x \log x - 1$ (B) $x(\log x - 1)$ (C) $\log x - x$ (D) $1/x + c$

94. The value of combination, ${}^{n+1}C_r - {}^nC_{(r-1)}$
- (A) ${}^{n+1}C_{r-1}$ (B) ${}^nC_{r+1}$ (C) nC_r (D) 1
95. $\int_0^{\pi/4} (\cos^2 x) dx =$
- (A) $\pi/8 + 1/4$ (B) $\pi/8 - 1/4$ (C) $-\pi/8 - 1/4$ (D) $-\pi/8 + \frac{1}{4}$
96. If $z = \log(x^2 + y^2)$, then $x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y}$ is
- (A) 1 (B) $(x^2 + y^2)$ (C) 2 (D) $2(x^2 + y^2)$
97. The eigenvalues of matrix $\begin{pmatrix} 3 & -1 \\ -1 & 3 \end{pmatrix}$
- (A) 1, 1 (B) 1, 2 (C) 1, 4 (D) 2, 4
98. If $AT = A^{-1}$, then the matrix A is
- (A) Normal matrix (B) Symmetric
- (C) Orthogonal (D) Hermitian matrix
99. Maxima and Minima of the function, $f(x) = 2x^3 - 15x^2 + 36x + 10$
- (A) 3, 2 (B) 1, 3 (C) 1, 4 (D) 3, 4
100. Limit the following series as $x \rightarrow \pi/2$, $f(x) = x - x^3/3! + x^5/5! - x^7/7! + \dots$
- (A) $\pi/3$ (B) $\pi/2$ (C) 0 (D) 1