

# A

16104

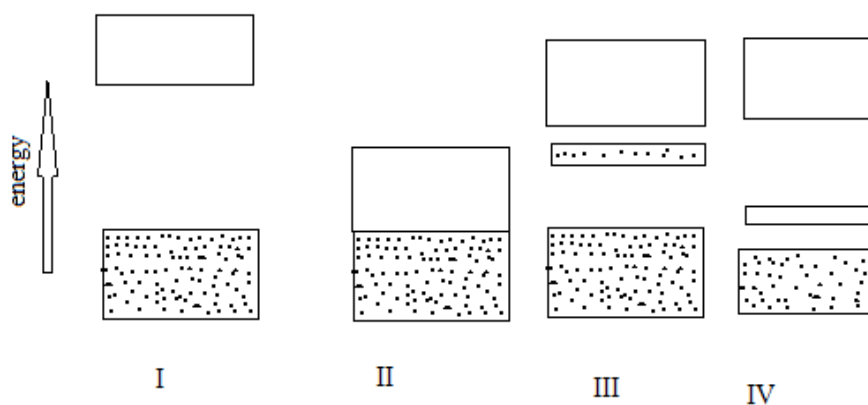
120 MINUTES

---

- In a molecule of phosphorous (V) oxide, there are
  - 4 P - P, 10 P - O and 4 P = O bonds
  - 4 P - O and 2 P = O bonds
  - 6 P - P, 12 P - O and 4 P = O bonds
  - 12 P - O and 4 P = O bonds
- Which of the following elements has the highest third ionization energy?
  - Mg
  - Al
  - Si
  - P
- Which among the following element has the lowest electron affinity?
  - N
  - Li
  - Be
  - Cl
- A radioactive material has a half-life of 1386 years. Its average life is
  - 1000 years
  - 13860 years
  - 20000 years
  - 2000 years
- What is Nitrolium?
  - CaCN<sub>2</sub>
  - CaC<sub>2</sub>
  - CaCN<sub>2</sub> + C
  - CaC + CaCN<sub>2</sub>
- Which of the following is/ are saline carbide?  
(i) CaC<sub>2</sub>, (ii) Al<sub>4</sub>C<sub>3</sub>, (iii) KC<sub>8</sub>, (iv) SiC
  - (i) only
  - (i) & (ii) only
  - (i), (ii) & (iii) only
  - All of these
- Which of the following transition metal exhibits highest oxidation state?
  - Mn
  - Os
  - Cr
  - Ti
- Horn silver is
  - AgCl
  - Ag<sub>2</sub>S
  - AgSb<sub>2</sub>S<sub>5</sub>
  - AgNO<sub>3</sub>
- Which among the lanthanides does not occur in nature?
  - Pr
  - Pm
  - Gd
  - Eu
- Which among the following lanthanide ion is colourless?
  - Pr<sup>3+</sup>
  - Nd<sup>3+</sup>
  - Gd<sup>3+</sup>
  - Eu<sup>3+</sup>
- The geometries of NiCl<sub>4</sub><sup>2-</sup> and Ni(CN)<sub>4</sub><sup>2-</sup> respectively are
  - Square planar & square planar
  - Tetrahedral & tetrahedral
  - Square planar & tetrahedral
  - Tetrahedral & square planar

12. Covalent nature of metal-ligand bond in complexes is not explained by  
A) VB theory                      B) Crystal field theory  
C) Ligand field theory          D) MO theory
13.  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  and  $[\text{CoCl}_4]^{2-}$  show magnetic moments of 5.0 and 4.4 BM, respectively, because  
A) The latter has lesser number of unpaired electrons  
B) Of the quenching of the orbital contribution to the magnetic moment in the latter  
C) Of antiferromagnetic property of the latter  
D) Of spin-cross over phenomenon in the latter
14. The ground term symbol of a transition metal ion is  $^4F$ . Thus the values of L and S are  
A)  $L=3, S=3$                       B)  $L=3, S=3/2$   
C)  $L=2, S=3/2$                   D)  $L=3, S=1$
15. The red colour of HgS is due to  
A) LMCT                              B) MLCT  
C) d-d transition                  D)  $\sigma-\sigma^*$  transition
16. The asymmetric nature of the UV visible spectrum of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  is due to  
A) Charge transfer transition      B) Spin forbidden transition  
C) p- d transition                  D) Jahn-Teller effect
17. At Neel temperature ( $T_N$ ) a paramagnetic material is changed into  
A) Diamagnetic                      B) Ferromagnetic  
C) Antiferromagnetic              D) Ferrimagnetic
18. The number of bridging carbonyls and M-M bonds in  $\text{Co}_4(\text{CO})_{12}$  are respectively  
A) 3 & 6              B) 6 & 4              C) 6 & 6              D) 4 & 4
19. When back donation from metal to CO in metal carbonyl increases, then  
A) Both M-C and C-O bond lengths become shorter.  
B) M-C bond becomes stronger and C-O bond becomes weaker  
C) Both M-C and C-O bonds become weaker  
D) Both M-C and C-O bonds become stronger
20. Which among the following complexes does not obey 18 electron rule?  
A)  $\text{Ni}(\text{CO})_4$                       B)  $\text{Mn}_2(\text{CO})_{10}$   
C)  $\text{V}(\text{CO})_6$                       D)  $\text{Co}_2(\text{CO})_8$
21. The hapticity( $\eta$ ) of the ligand Cp in the following sandwich compounds (i)  $\text{Fe}(\text{C}_5\text{H}_5)_2$  and (ii)  $\text{Be}(\text{C}_5\text{H}_5)_2$  are respectively  
A) 5 & 5 in (i), 5 & 5 in (ii)      B) 5 & 5 in (i), 5 & 1 in (ii)  
C) 5 & 1 in (i), 5 & 5 in (ii)      D) 5 & 5 in (i), 4 & 4 in (ii)

22. Myoglobin and oxymyoglobin respectively are  
 A) Diamagnetic & diamagnetic B) Paramagnetic & paramagnetic  
 C) Diamagnetic & paramagnetic D) Paramagnetic & diamagnetic
23. Metalloenzymes responsible for the removal of  $H_2O_2$  are  
 A) Carboxypeptidase & peroxidase  
 B) Carbonic anhydrase & Catalase  
 C) Peroxidase & Catalase  
 D) Ascorbate oxidase & cytochrome oxidase
24. Which among the following is an ore of titanium?  
 A) Monozite B) Ilmanite C) Malachite D) Calamine
25. The type of steel used for handling acids is  
 A) Silicon steel B) Chromium steel  
 C) Nickel steel D) Manganese steel
26. Silicon used in electronic industry must be ultrapure. Which among the following method is used for the purification of silicon?  
 A) Van Arkel de Boer process B) Electrolytic refining  
 C) Zone refining D) Fractional crystallization
27. The catalyst and cocatalyst used in Wacker process respectively are  
 A)  $Pd(PPh_3)_4$  &  $CuCl$  B)  $CuCl_2$  &  $Pd$   
 C)  $[PtCl_4]^{2-}$  &  $CuCl_2$  D)  $PdCl_2$  &  $CuCl_2$
28. Enantioselective hydrogenation of prochiral alkenes are done by  
 A) Wilkinson's catalyst B) Zeigler- Natta catalyst  
 C) Raney Ni D) Monsanto process
29. The co-ordination numbers of  $Zn^{2+}$  and  $S^{2-}$  in zinc blende are respectively  
 A) 6, 6 B) 4, 6 C) 4, 4 D) 8, 8
30. The band structure of a p-type semiconductor is



- A) I B) II C) III D) IV

31. An example of a solid electrolyte is  
 A) NaCl                      B)  $\alpha$ - AgI                      C) FeO                      D) Al<sub>2</sub>O<sub>3</sub>
32. The Miller indices of a crystal plane which cuts the three crystallographic axes at 3a, 2b and -2c are  
 A)  $3\ 2\ \bar{2}$                       B)  $2\ 2\ \bar{3}$                       C)  $2\ 3\ \bar{3}$                       D)  $3\ 2\ \bar{3}$
33. Match the following
- | <u>Column I</u>                      | <u>Column II</u>   |
|--------------------------------------|--------------------|
| (a) ZnFe <sub>2</sub> O <sub>4</sub> | (i) Perovskite     |
| (b) MnCr <sub>2</sub> O <sub>4</sub> | (ii) Antifluorite  |
| (c) CaTiO <sub>3</sub>               | (iii) Spinel       |
| (d) Na <sub>2</sub> S                | (iv) Fluorite      |
|                                      | (v) Inverse spinal |
- A) a-v, b-iii, c-i, d- ii                      B) a-iii, b-iv, c-i, d- ii  
 C) a-iii, b-v, c-iv, d- i                      D) a-iii, b-i, c-ii, d- iv
34. Classify the following unit cell into a proper crystal system: a = 1.08 nm, b = 0.947 nm and c = 0.52 nm;  $\alpha = 41^\circ$ ,  $\beta = 82^\circ$  and  $\gamma = 95^\circ$   
 A) Triclinic                      B) Monoclinic  
 C) Orthorhombic                      D) Hexagonal
35. If 5 litres of H<sub>2</sub>O<sub>2</sub> produce 100 litres of oxygen at STP, the volume strength of H<sub>2</sub>O<sub>2</sub> is  
 A) 5V                      B) 10V                      C) 20V                      D) 100V
36. If 0.5 mole of BaCl<sub>2</sub> is mixed with 0.2 mole of Na<sub>3</sub>PO<sub>4</sub>, the maximum number of moles of barium phosphate that can be formed is  
 A) 0.2                      B) 0.5                      C) 0.3                      D) 0.1
37. A suitable reagent for the gravimetric estimation of lead is  
 A) Dimethylglyoxime                      B) KCNS  
 C) K<sub>2</sub>CrO<sub>4</sub>                      D) HCl
38. Which among the following is/are metal ion indicators?  
 (i) Eriochrome blackT, (ii) Benzidine, (iii) Xylenol orange, (iv) Murexide  
 A) (i) , (ii) only                      B) (i), (iii) & (iv) only  
 C) (i), (ii) & (iii) only                      D) All of these
39. The proper no. of significant figures in 0.126; 20.9; 400.0; 0.0780 are respectively  
 A) Three; three; four; three                      B) Four; three; one; three  
 C) Three; two; one; three                      D) Four; three; four; five

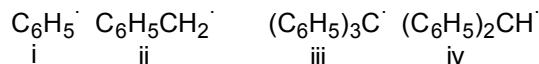
40. In the estimation of  $\text{Ca}^{2+}$  ions using EDTA and Solochrome Black, substitution method is used. Why?
- A)  $\text{Ca}^{2+}$  ions form less stable complexes than  $\text{Mg}^{2+}$  ions with the indicator, but more stable complex with EDTA
- B)  $\text{Ca}^{2+}$  ions form more stable complexes than  $\text{Mg}^{2+}$  ions with the indicator, but less stable complex with EDTA
- C)  $\text{Ca}^{2+}$  ions get precipitated as  $\text{Ca}(\text{OH})_2$
- D) No suitable buffer solution for maintaining the pH is available.

41. Match List I (Reaction) with List II (intermediates)

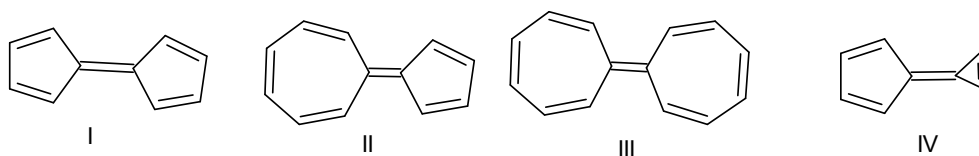
List I	List II
a) Dieckmann condensation	i) Carbene
b) Friedel-Crafts alkylation	ii) Nitrene
c) Curtius rearrangement	iii) Carbocation
d) Riemer –Tiemann reaction	iv) Carbanion

- A) a-iv, b-iii, c-ii, d- i                      B) a-iii, b-iv, c-i, d- ii
- C) a-iii, b-ii, c-iv, d- i                      D) a-iv, b-i, c-ii, d- iii
42. The stability order of carbocations
- A)  $\text{C}_6\text{H}_5^+ < \text{C}_6\text{H}_5\text{CH}_2^+ < \text{p-ClC}_6\text{H}_4\text{-CH}_2^+$                       B)  $\text{C}_6\text{H}_5\text{CH}_2^+ < \text{p-ClC}_6\text{H}_4\text{CH}_2^+ < \text{C}_6\text{H}_5^+$
- C)  $\text{C}_6\text{H}_5^+ < \text{p-ClC}_6\text{H}_4\text{-CH}_2^+ < \text{C}_6\text{H}_5\text{CH}_2^+$                       D)  $\text{C}_6\text{H}_5\text{CH}_2^+ < \text{C}_6\text{H}_5^+ < \text{p-ClC}_6\text{H}_4\text{CH}_2^+$

43. The stability order of the following free radicals is

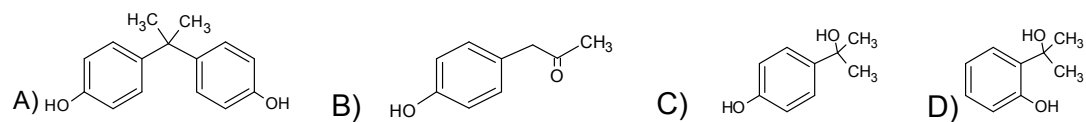
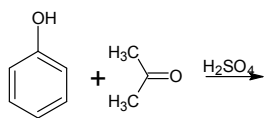


- A) i < ii < iii < iv                      B) iv < ii < i < iii
- C) iv < iii < i < ii                      D) i < ii < iv < iii
44. Which among the following can have permanent dipole moment?

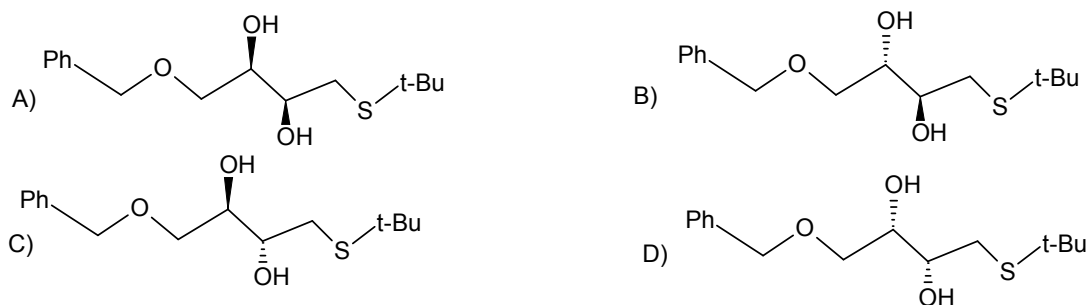
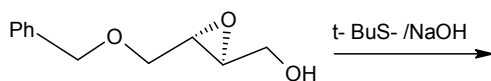


- A) I, II & III                      B) II, III & IV                      C) II & IV                      D) I & IV

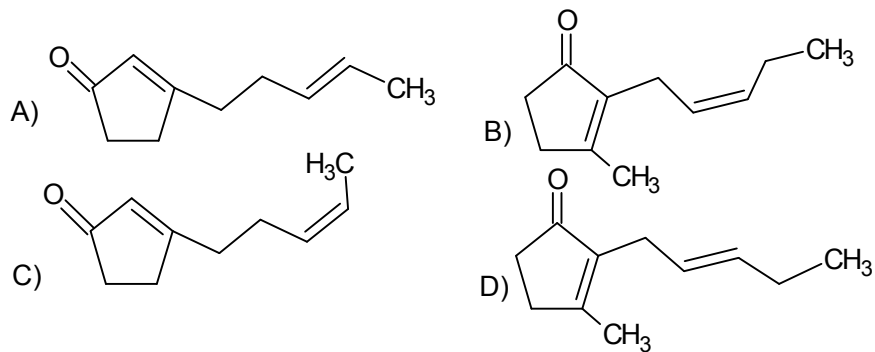
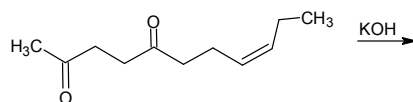
45. The major product in the following reaction is



46. The major product of the following reaction is

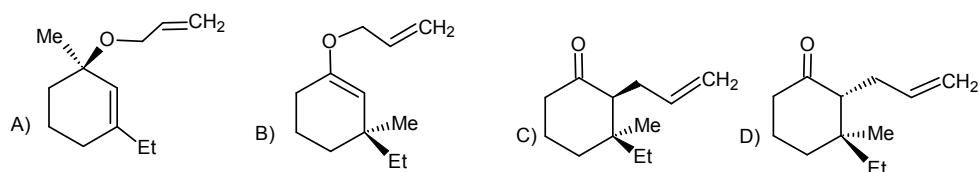
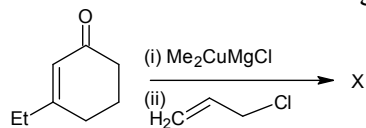


47. The major product of the following reaction is



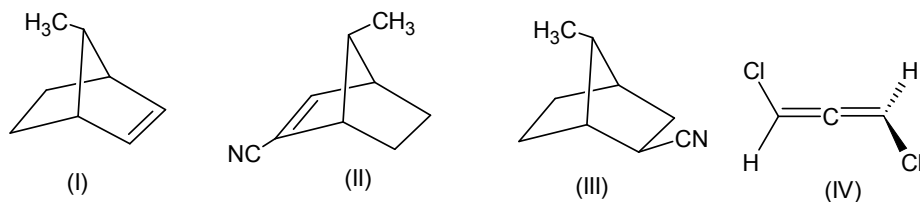
48. Intramolecular Claisen condensation is called  
 A) Michael Addition                      B) Robinson annulation  
 C) Perkin Condensation                  D) Dieckmann Condensation

49. The major product X formed in the following reaction is



50. When alkyl halides react with  $\text{OH}^-$  ions depending on solvent polarity the rate of  
 A) Reaction is not influenced by the solvent  
 B)  $\text{S}_{\text{N}}1$  reaction increased with solvent polarity  
 C)  $\text{S}_{\text{N}}2$  reaction is increased with solvent polarity  
 D)  $\text{S}_{\text{N}}1$  reaction decreased with solvent polarity

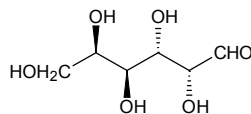
51. Which of the following molecules are optically active?



- A) I, II, & III only                      B) II & IV only  
 C) II, III, & IV only                    D) All the four

52. The compound  $\text{CH}_3(\text{CHBr})_5\text{CH}_3$  has  
 A) 32 stereoisomers with 4 meso forms  
 B) 16 optical isomers and 4 meso forms  
 C) 16 optical isomers with no meso form  
 D) 12 optically active and 4 meso forms

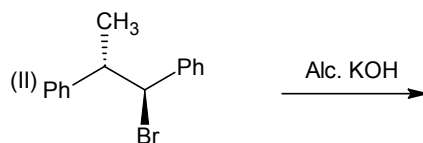
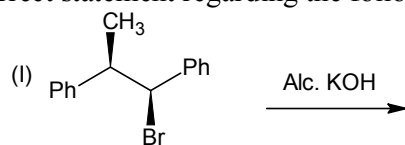
53. The absolute configuration of the aldohexose given below is



- A) 2R, 3S, 4R, 5R                      B) 2R, 3S, 4S, 5R  
 C) 2S, 3R, 4R, 5S                      D) 2S, 3S, 4R, 5S

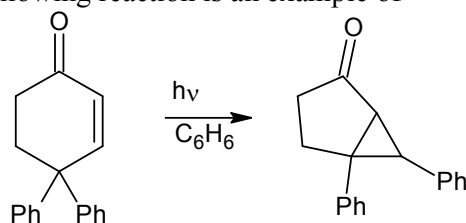
54. If the specific rotation of a pure *R*- enantiomer is  $-13.5^\circ$  and another sample of the same compound showed a specific rotation of  $+2.7^\circ$ . The ratio of the amounts of *R*- and *S*- enantiomers present in the sample is  
 A) R: S = 3: 2                      B) R: S = 3: 4                      C) R: S = 2: 3                      D) R: S = 4: 3

55. The correct statement regarding the following reactions is



- A) (I) gives E-alkene & (II) gives Z-alkene and both reactions are stereospecific.  
 B) (I) gives Z-alkene & (II) gives E-alkene and both reactions are stereospecific.  
 C) Both (I) & (II) give E-alkene and both reactions are stereo selective  
 D) Both (I) & (II) give Z-alkene and both reactions are stereo selective

56. The following reaction is an example of

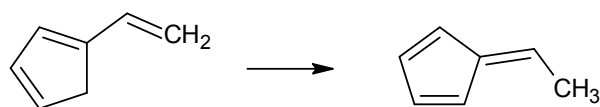


- A) Norrish Type II reaction      B) Di- $\pi$ -methane rearrangement  
 C) Lumiketone rearrangement      D) Paterno-Buchi reaction

57. The reaction of hexa-1,3,5-triene to give cyclohexa-1,3-triene is an example of

- A) Diels Alder reaction      B) Sigmetropic reaction  
 C) Electro cyclic reaction      D) None of the above

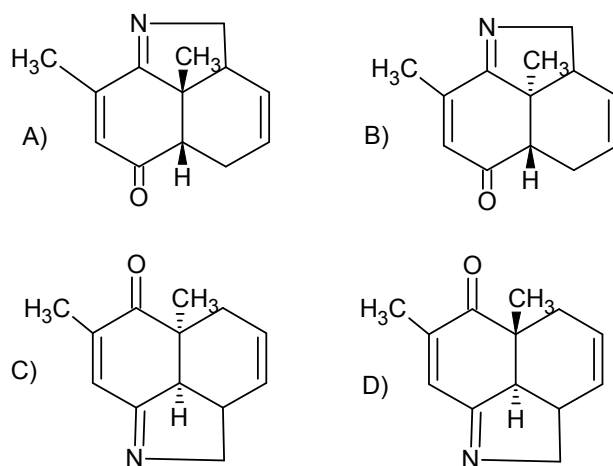
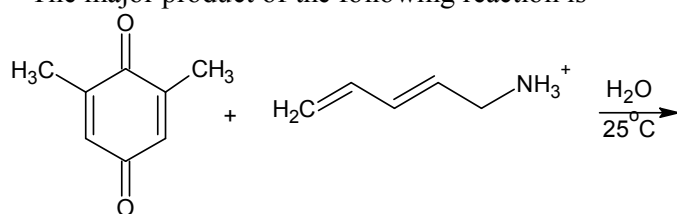
58. The correct statement of the following transformation is



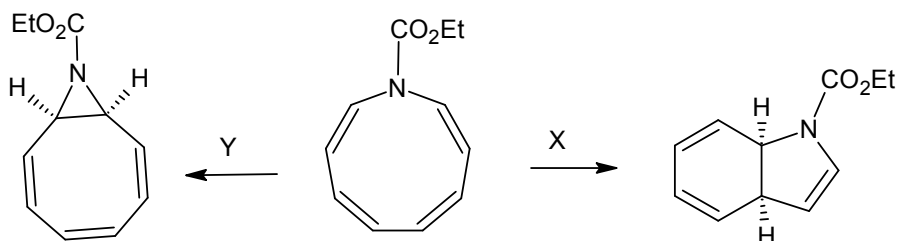
- A) Photochemical antarafacial [1, 7]H shift  
 B) Photochemical suprafacial [1, 7]H shift  
 C) Thermal antarafacial [1, 5]H shift  
 D) Photochemical suprafacial [1, 5]H shift



59. The major product of the following reaction is



60. In the following reactions, the conditions X and Y are

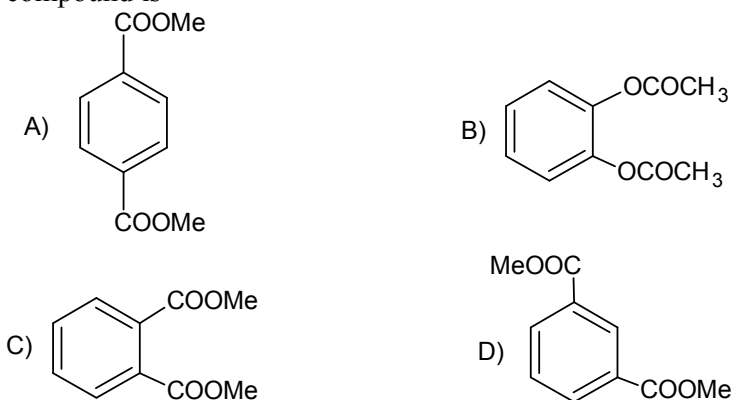


- A) X =  $h\nu$ , Y =  $\Delta$                       B) X =  $\Delta$ , Y =  $h\nu$   
 C) X =  $h\nu$ , Y =  $h\nu$                       D) X =  $\Delta$ , Y =  $\Delta$

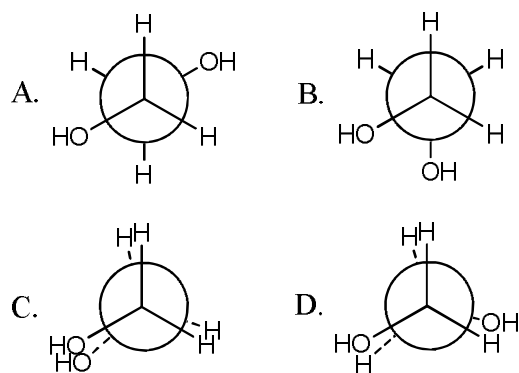
61. The IR stretching frequencies of C=O group in RCOOH, RCOCl, (RCO)<sub>2</sub>O and RCONH<sub>2</sub> varies as

- A) RCOCl < RCOOH < (RCO)<sub>2</sub>O < RCONH<sub>2</sub>  
 B) (RCO)<sub>2</sub>O < RCONH<sub>2</sub> < RCOCl < RCOOH  
 C) RCONH<sub>2</sub> < RCOCl < RCOOH < (RCO)<sub>2</sub>O  
 D) RCONH<sub>2</sub> < RCOOH < (RCO)<sub>2</sub>O < RCOCl

62. A compound with molecular formula  $C_{10}H_{10}O_4$  showed a strong IR band at  $1685\text{ cm}^{-1}$ . The  $^1\text{H NMR}$  spectrum showed two doublets and one singlet. The compound is



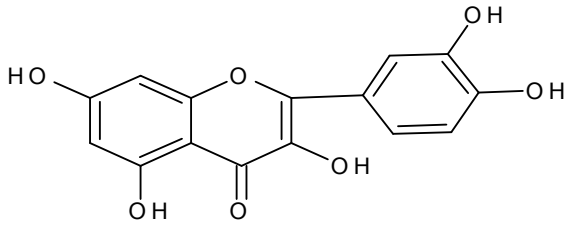
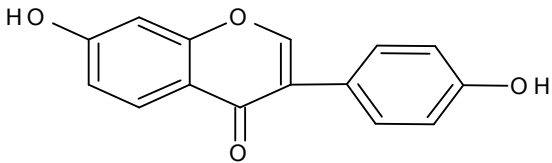
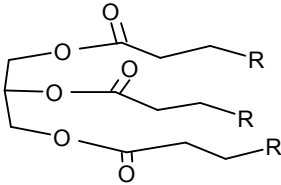
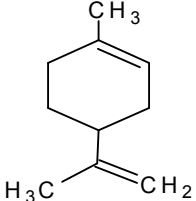
63. The most stable conformation of ethylene glycol is



64. In the mass spectrum of  $\text{CHBr}_3$ , ratio of the peaks at  $M/z$  250, 252, 254, 256 respectively is  
 A) 1:3:3:1      B) 1:3:2:1      C) 3:1:1:3      D) 9:6:3:1
65. In the broad band decoupled  $^{13}\text{C NMR}$  spectrum, the number of signals in anthracene and phenanthrene respectively are  
 A) Seven and seven      B) Four and four  
 C) Seven and four      D) Four and seven
66. When  $\alpha$ -pinene is treated with ethanolic sulphuric acid it is converted to  
 A)  $\beta$ -pinene      B)  $\delta$ -pinene      C)  $\alpha$ -terpineol      D) pinol
67. Which among the following statements about camphor is/are true?  
 (I) Camphor has two different asymmetric centres, but only one pair of enantiomers exists.  
 (II) The cyclohexane ring in camphor is in the chair conformation.  
 (III) The cyclohexane ring in camphor is in boat conformation and there is a gem dimethyl bridge.  
 A) I only      B) I & III only      C) III only      D) I and II only

68. The number of heterocyclic nitrogen bases and the no. of chiral centres present in the alkaloid quinine are respectively  
 A) 2 & 5      B) 2 & 4      C) 1 & 5      D) 1 & 4

69. Match the following structures with the class of compounds

Column I	Column II
(I) 	a) monoterpene
(II) 	b) lipid
(III) 	c) flavone
(IV) 	d) isoflavone

- A) I- b, II- c, III- a, IV- d      B) I- c, II- d, III- b, IV- a  
 C) I- a, II- d, III- b, IV- c      D) I- c, II- d, III- a, IV- b

70. The vitamin which is synthesised from sugar is  
 A) Vitamin A      B) Vitamin K  
 C) Vitamin D      D) Vitamin C
71. Treatment of the Tetrapeptide Gly – Arg – Phe – Ala with the enzyme Trypsin splits the peptide into  
 A) Gly + Arg – Phe – Ala      B) Gly – Arg + Phe – Ala  
 C) Gly – Arg – Phe + Ala      D) Gly + Arg + Phe + Ala
72. The bases which is not present in DNA is  
 A) Adenine      B) Thymine  
 C) Uracil      D) Cytosine

73. The polysaccharide present in animal tissue is  
 A) Glycogen B) Amylopectin  
 C)  $\alpha$ -amylose D) Inulin
74. Which among the following is **not** formed by radical polymerisation?  
 A) Polythene B) PVC C) Polystyrene D) Nylon-6
75. Which among the following are biodegradable polymers?  
 (i) Polyhydroxybutyrate (ii) Polyhydroxyvalerate  
 (iii) Polycaprolactone (iv) Polyvinylalcohol  
 A) (i), (ii) only B) (i), (iii) only  
 C) (i), (ii) & (iv) only D) All of these
76. Match the following  

Column I	Column II
(a) Acrilan	(i) $C_6H_5CH=CH_2$
(b) Plexiglass	(ii) $CF_2=CF_2$
(c) Styrene	(iii) $CH_2=CHCN$
(d) Teflon	(iv) Methyl methacrylate

 A) a-iii, b- iv, c-i, d-ii B) a-ii, b- iv, c-iii, d-i  
 C) a-iv, b- iii, c-i, d-ii D) a-iii, b- iv, c-ii, d-i
77. Which of the following polymer is **not** having cross-linkages?  
 A) Bakelite B) Melmac  
 C) Polythene D) Vulcanised rubber
78. The order of increasing eluting power of the following solvents in column chromatography is  
 A) Chloroform < Benzene < Hexane < Ethanol  
 B) Hexane < Benzene < Chloroform < Ethanol  
 C) Hexane < Chloroform < Benzene < Ethanol  
 D) Hexane < Ethanol < Chloroform < Benzene
79. In the detection of nitrogen, the blue / green colour is due to the formation of  
 A)  $Fe_4[Fe(CN)_6]_3$  B)  $Fe_3[Fe(CN)_6]_2$   
 C)  $Na_3[Fe(CN)_6]$  D)  $Na_4[Fe(CN)_6]$
80. Platinum- salt method is used for the determination of molecular weight of  
 A) Carboxylic acids B) Amines  
 C) Aldehydes D) Phenols
81. The first emission line of Balmer series of  $He^+$  -spectrum has wave no. in  $cm^{-1}$  ( $R_H$  = Rydberg constant)  
 A)  $\frac{3}{4}R_H$  B)  $\frac{5}{36}R_H$  C)  $\frac{5}{9}R_H$  D)  $\frac{1}{4}R_H$

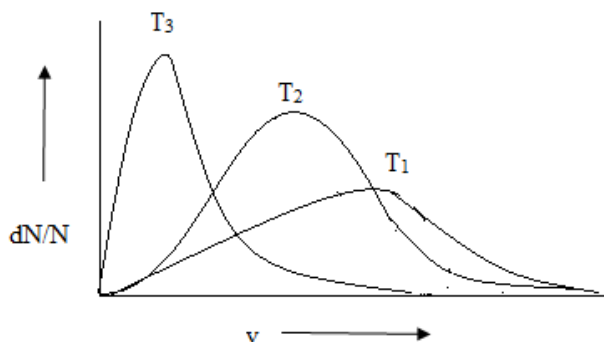
82. Which of the following is an eigen function of the operator  $\hat{P}_x$ ?
- A)  $e^{ikx}$       B)  $xe^{ikx}$       C)  $x^2 + 2x$       D)  $\cos 2x$
83. The angular momentum of an electron in the 4d-orbital is
- A)  $\frac{2h}{\pi}$       B)  $\sqrt{2} \frac{h}{2\pi}$       C)  $\sqrt{3} \frac{h}{2\pi}$       D)  $\sqrt{6} \frac{h}{2\pi}$
84. The average radius of 1s orbital of H-atom is
- A)  $a_0$       B)  $2a_0$       C)  $1.5a_0$       D)  $3a_0$
85. The number of radial nodes present in 4f-orbitals is
- A) Zero      B) One      C) Two      D) Three
86. If a trial wave function is used to calculate the energy of a quantum mechanical system, the calculated energy is always greater than the true energy. This statement is related to
- A) Perturbation theory  
 B) Variation principle  
 C) Born-Oppenheimer approximation  
 D) Heisenberg's uncertainty principle
87. According to MO theory the ground state wave function including spin of H<sub>2</sub> molecule is represented as
- A)  $\frac{1}{\sqrt{2}} \begin{vmatrix} \sigma_g 1s(1)\alpha(1) & \sigma_g 1s(1)\beta(1) \\ \sigma_g 1s(2)\alpha(2) & \sigma_g 1s(2)\beta(2) \end{vmatrix}$       B)  $\frac{1}{\sqrt{2}} \begin{vmatrix} \sigma_u 1s(1)\alpha(1) & \sigma_u 1s(1)\beta(1) \\ \sigma_g 1s(2)\alpha(2) & \sigma_g 1s(2)\beta(2) \end{vmatrix}$
- C)  $\frac{1}{\sqrt{2}} \begin{vmatrix} \sigma_g 1s(1)\alpha(1) & \sigma_g 1s(2)\beta(2) \\ \sigma_g 1s(1)\beta(2) & \sigma_g 1s(2)\alpha(1) \end{vmatrix}$       D)  $\frac{1}{\sqrt{2}} \begin{vmatrix} \sigma_g 1s(1)\alpha(1) & \sigma_u 1s(1)\beta(1) \\ \sigma_g 1s(2)\alpha(2) & \sigma_u 1s(2)\beta(2) \end{vmatrix}$
88. The angle between the two hybrid orbitals  $\psi_1$  and  $\psi_2$  shown below is
- $$\psi_1 = \frac{1}{\sqrt{3}}2s - \frac{1}{\sqrt{6}}2p_x + \frac{1}{\sqrt{2}}2p_y$$
- $$\psi_2 = \frac{1}{\sqrt{3}}2s - \frac{1}{\sqrt{6}}2p_x - \frac{1}{\sqrt{2}}2p_y$$
- A)  $90^\circ$       B)  $109.5^\circ$       C)  $120^\circ$       D)  $180^\circ$
89. The product of  $C_{2(x)} \times C_{2(y)} =$
- A) E      B)  $\sigma_{xy}$       C) i      D)  $C_{2(z)}$
90. Molecules falling in which of the point groups possess a permanent dipole moment?
- A)  $C_i, C_s, C_n, C_{nv}$       B)  $C_{nv}, C_s, C_i, C_{nh}$
- C)  $C_{nv}, C_{nh}, C_s$       D)  $C_i, C_s, D_{nh}$

91. The character table of  $C_{2v}$  point group is given below. The reducible representation of the translational degrees of freedom  $\Gamma_{\text{tran}}$  is

$C_{2v}$	E	$C_2$	$\sigma_{xz}$	$\sigma_{yz}$		
$A_1$	1	1	1	1	z	$x^2, y^2, z^2$
$A_2$	1	1	-1	-1	Rz	xy
$B_1$	1	-1	1	-1	x, Ry	xz
$B_2$	1	-1	-1	1	y, Rx	yz

- A) 3, 1, 1, 1                      B) 3, -1, -1, 1  
 C) 3, -1, -1, -1                  D) 3, -1, 1, 1
92. In the change of  $\text{NO}^+$  to NO the electron is added to  
 A)  $\sigma$  orbital                      B)  $\pi$  orbital  
 C)  $\sigma^*$  orbital                    D)  $\pi^*$ orbital
93. Which of the following molecules are IR active?  
 (i)  $\text{N}_2$ , (ii)  $\text{CO}_2$ , (iii)  $\text{CH}_2=\text{CH}_2$ , (iv)  $\text{CH}_4$   
 A) i & ii only                      B) ii & iii only  
 C) ii, iii & iv only                D) i & iv only
94. The first line of R-branch in the vibration- rotation spectra of HI will occur at ( $\bar{\nu} = 2309 \text{ cm}^{-1}$ ,  $B = 6.61 \text{ cm}^{-1}$ )  
 A)  $2322.22 \text{ cm}^{-1}$                 B)  $2337.66 \text{ cm}^{-1}$   
 C)  $2325.44 \text{ cm}^{-1}$                 D)  $2295.78 \text{ cm}^{-1}$
95. Which of the following would have the highest value?  
 A) Root mean square velocity  
 B) Most probable velocity  
 C) Mean velocity  
 D) Mean square velocity
96. The No. of hyperfine lines in the esr spectrum of  $\dot{\text{C}}\text{D}_2\text{CH}_3$  radical is  
 A) 12                      B) 15                      C) 20                      D) 25
97. The selection rule for rotational Raman spectra of linear rotors is  
 A)  $\Delta J = \pm 1$                       B)  $\Delta J = \pm 1, \pm 2$   
 C)  $\Delta J = 0, \pm 2$                   D)  $\Delta J = 0, \pm 1, \pm 2$

98. The distribution of molecular velocities of a sample at three different temperatures is represented below. The variation of temperatures is



- A)  $T_1 < T_2 < T_3$                       B)  $T_1 > T_2 < T_3$   
 C)  $T_1 < T_2 > T_3$                       D)  $T_1 > T_2 > T_3$
99. Match the following transport properties of perfect gases
- | <u>Column I</u>                                    | <u>Column II</u>                       |
|--|--|
| a. Coefficient of viscosity( $\eta$ )              | (i) $\frac{1}{3}\lambda\bar{c} C_v[A]$ |
| b. Coefficient of thermal conductivity( $\kappa$ ) | (ii) $\frac{1}{3}\lambda\bar{c}$       |
| c. Coefficient of diffusion(D)                     | (iii) $\frac{1}{3}\lambda\bar{c}mN$    |
- A) a-i, b-ii, c - iii                      B) a - ii, b - i, c - iii  
 C) a - iii, b - i, c - ii                      D) a - iii, b - ii, c - i
100. A mixture of hydrogen and oxygen in the 2:1 volume ratio is allowed to diffuse through a porous portion. The composition of gas coming out initially, vol of  $H_2$  : vol of  $O_2$ , is  
 A) 8:1                      B) 4:1                      C) 2:1                      D) 1:1
101. Find out the microstate for  $p^5$   
 A) 6                      B) 7                      C) 8                      D) 9
102.  $\left(\frac{\partial U}{\partial V}\right)_T$  for an ideal gas is  
 A) Zero                      B) Positive  
 C) Negative                      D) Infinity
103. Which of the following may be used to define chemical potential?  
 (i)  $\left(\frac{\partial G}{\partial n_i}\right) T, P, n_j$                       (ii)  $\left(\frac{\partial H}{\partial n_i}\right) S, P, n_j$   
 (iii)  $\left(\frac{\partial A}{\partial n_i}\right) T, V, n_j$                       (iv)  $\left(\frac{\partial U}{\partial n_i}\right) S, V, n_j; i \neq j$
- A) i only                      B) i & ii only  
 C) iii & iv only                      D) i, ii, iii, & iv

104. Which among the following is the condition for a reversible process?  
 A)  $\Delta H_{(\text{universe})} < 0$                       B)  $\Delta S_{(\text{universe})} = 0$   
 C)  $\Delta U_{(\text{universe})} < 0$                       D)  $\Delta S_{(\text{universe})} > 0$
105. For the following reaction, the partial pressures of  $\text{CO}_2$  and  $\text{CO}$  are 4 and 8 atm. respectively at equilibrium at 1000K.  $K_p$  for the reaction is  
 $\text{C}_{(\text{s})} + \text{CO}_{2(\text{g})} \rightleftharpoons 2 \text{CO}_{(\text{g})}$   
 A) 32 atm              B) 4 atm              C) 16 atm              D) 2 atm
106. In the pressure temperature diagram of a one component system, the point where the solid- liquid and liquid- vapour curves intersect is  
 A) Critical point                      B) Triple point  
 C) Melting point                      D) Boiling point
107. Internal energy in terms of partition function (Q) is given by  
 A)  $kT^2 \left( \frac{\partial \ln Q}{\partial T} \right)_{V,N}$                       B)  $kT^2 \left( \frac{\partial \ln Q}{\partial T} \right)_{P,N}$   
 C)  $kT \left( \frac{\partial \ln Q}{\partial V} \right)_{T,N}$                       D)  $-kT \ln Q$
108. For the reaction  $2 \text{A} \rightarrow \text{B} + \text{C}$   
 $\frac{-d[\text{A}]}{dt} = k [\text{A}]^2$ ,  $t_{1/2}$  of this reaction is  
 A)  $\frac{1}{k}$                       B)  $\frac{1}{[\text{A}_0]^2 k}$                       C)  $\frac{1}{[\text{A}_0] k}$                       D)  $\frac{1}{[\text{A}_0]^3 k}$
109. A plot of  $\log [\text{A}]$  versus time (t) gives a straight line with a negative slope. The order of the reaction is  
 A) zero                      B) 1                      C) 2                      D) 3
110. The specific reaction rate of decomposition of a compound is represented by  $\ln k = 11.5 - \frac{12510}{T}$ . The energy of activation of the reaction in kJ/mol is  
 A) 250                      B) 125                      C) 85                      D) 104
111. According to absolute reaction rate theory, the molar entropy of activation  $\Delta S^*$  of an elementary bimolecular reaction is  
 A) Zero  
 B) Positive  
 C) Negative  
 D) Positive for endothermic reaction and negative for exothermic reaction
112. The number of electrons lost during electrolysis of 0.355 g of  $\text{Cl}^-$  is  
 A)  $0.001 N_0$                       B)  $0.01 N_0$                       C)  $0.02 N_0$                       D)  $0.01/2 N_0$



113. The Freundlich adsorption isotherm is

- A)  $\theta = c_1 p^{1/c_2}$                       B)  $\theta = c_1 \ln(c_2 p)$   
 C)  $\theta = \frac{Kp}{1+Kp}$                       D)  $Kp = \frac{\theta}{1-\theta}$

114. Match the following

Column I

Column II

- |   |  |     |                         |
|---|--|-----|-------------------------|
| a | Catalyst and reactants in different phase                | i   | Homogeneous catalysis   |
| b | The phenomenon of one of the products acts as a catalyst | ii  | Heterogeneous catalysis |
| c | Catalyst and reactants in the same phase                 | iii | Negative catalysis      |
| d | When the catalyst reduces the speed of the reaction      | iv  | Auto catalysis          |

- A) a-ii, b-iv, c-iii, d-i                      B) a- ii, b-i, c-iv, d-iii  
 C) a-ii, b-iv, c-i, d-iii                      D) a-iii, b-ii, c-iv, d-i

115. The presence of electrical charges on colloidal particles is used in

- A) Ultra filtration                      B) Dialysis  
 C) Brownian movement                      D) Electrophoresis

116. The  $p^H$  of a mixture of 0.01M acetic acid and 0.1M sodium acetate is ( $p^{Ka}$  of acetic acid is 4.76)

- A) 4.46                      B) 5.76                      C) 3.76                      D) 4.76

117. The ionic strength of a 0.05M  $Na_2SO_4$  aqueous solution is

- A) 0.15 M                      B) 0.25 M                      C) 0.025 M                      D) 0.05 M

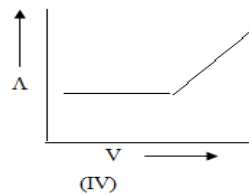
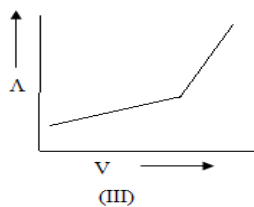
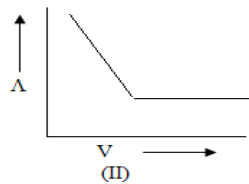
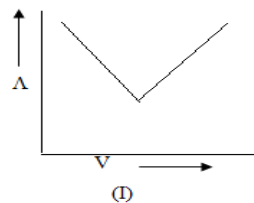
118. Calomel electrode is reversible with respect to

- A)  $Hg^{2+}$                       B)  $(Hg)_2^{2+}$   
 C) Both  $Hg^{2+}$  and  $Cl^-$                       D)  $Cl^-$

119. The emf of the concentration cell  $Pt | H_2 (1atm) | HCl(a_1) || HCl(a_2) | H_2 (1atm) | Pt$  is

- A)  $E = 2t_- \frac{RT}{F} \ln \frac{(a_{\pm})_2}{(a_{\pm})_1}$                       B)  $E = 2t_+ \frac{RT}{F} \ln \frac{(a_{\pm})_2}{(a_{\pm})_1}$   
 C)  $E = 2t_- \frac{RT}{F} \ln \frac{(a_{\pm})_1}{(a_{\pm})_2}$                       D)  $E = 2t_+ \frac{RT}{F} \ln \frac{(a_{\pm})_1}{(a_{\pm})_2}$

120. Which of the following diagrams represent the conductometric titration curve of the precipitation reaction of KCl with  $\text{AgNO}_3$ ?



A) I

B) II

C) III

D) IV

---