
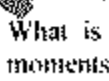


# CHEMISTRY

1. An electron moves freely along a straight line (in the  $x$ -direction) of length ( $l$ ), being restricted to the range  $x = 0$  to  $x = l$ . Its ground state wave function is
- $$\psi(x) = \sqrt{2/l} \sin\left(\frac{\pi x}{l}\right)$$
- What is the probability of finding the electron at the mid-point of the line?
- $2/l$
  - $\sqrt{2/l}$
  - $1/2$
  - $1/l$
2. What is the ratio of the ground state energy of an electron moving in  $\text{Be}^+$  to that of one moving in  $\text{Li}$ ? (Presume that both behave like hydrogen atom)
- $4/3$
  - $\sqrt{4/3}$
  - $16/9$
  - $9/16$
3. Match List-I with List-II and select the correct answer using the code given below the lists
- List-I  
(IUPAC Symbol)
- $U_{\text{at}}$
  - $U_{\text{np}}$
  - $U_{\text{m}}$
  - $U_{\text{pp}}$
- List-II  
(Atomic Number)
- 10
  - 11
  - 12
  - 13
- Code
- A2, B1, C3, D4
  - A3, B4, C2, D1
  - A2, B4, C3, D1
  - A3, B1, C2, D4
4. Which pair of ionic solids has the same Madelung constant?
- $\text{NaCl}$  and  $\text{CaF}_2$
  - $\text{NaCl}$  and  $\text{CaF}_2$
  - $\text{ZnS}$  and  $\text{MgO}$
  - $\text{NaCl}$  and  $\text{MgO}$
5. Which one of the following lanthanides is colourless?
- $\text{Pr}^{3+}$
  - $\text{Ce}^{3+}$
  - $\text{Sm}^{3+}$
  - $\text{Eu}^{3+}$
6. Two metal atoms in a binuclear complex are on  $x$ -axis. The orientation of  $d$  orbital is suitable for which one of the following?
- $\pi$ -bond overlap
  - $\sigma$ -bond overlap
  - $\delta$ -bond overlap
  - No overlap
7. For obtaining  $\text{NO}$  from  $\text{NO}_2$ , electron from which one of the following MOs is most easily removed?
- $\sigma_{1s}$
  - $\sigma_{2s}$
  - $\pi_{2p}$
  - $\pi_{2p}^*$
8. According to VSEPR theory, what are the bond angles in  $\text{NH}_3$ ,  $\text{H}_2\text{O}$  and  $\text{SF}_6$  respectively?
- $107^\circ 48'$ ,  $104^\circ 27'$ ,  $90^\circ$
  - $109^\circ 28'$ ,  $107^\circ 48'$ ,  $90^\circ$
  - $104^\circ 27'$ ,  $109^\circ 28'$ ,  $84^\circ 30'$
  - $104^\circ 27'$ ,  $107^\circ 48'$ ,  $84^\circ 30'$
9. What is the geometry of nitrogen atom in  $\text{NH}_3$ ,  $\text{N}(\text{CH}_3)_3$  and  $\text{N}(\text{Si}(\text{CH}_3)_3)_3$  molecules?
- Trigonal planar in all three cases
  - Trigonal pyramidal in all three cases
  - Trigonal pyramidal in  $\text{NH}_3$  and  $\text{N}(\text{CH}_3)_3$ , while trigonal planar in  $\text{N}(\text{Si}(\text{CH}_3)_3)_3$
  - Trigonal planar in  $\text{NH}_3$  and  $\text{N}(\text{Si}(\text{CH}_3)_3)_3$ , while trigonal pyramidal in  $\text{N}(\text{CH}_3)_3$
10. What is the  $E$  value at the equivalent point of titration of  $\text{Fe}^{2+}$  against  $\text{KMnO}_4$ ?
- ( $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.77 \text{ V}$  and  $E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.52 \text{ V}$ )
- Much less than  $0.77 \text{ V}$
  - Much greater than  $1.52 \text{ V}$
  - Between  $0.77 \text{ V}$  and  $1.52 \text{ V}$
  - $= 1.52 \text{ V}$
11. Consider the following statements:

1. Conc.  $\text{HNO}_3$  is a base in conc.  $\text{H}_2\text{SO}_4$  medium.
  2. According to Lewis theory,  $\text{H}_2\text{SO}_4$  is rather an acid-base adduct than an acid.
  3.  $\text{BF}_3 + \text{KF} \rightarrow \text{KBF}_4$  can be regarded as an acid-base reaction.
- Which of the statements given above are correct?
- a. 1 and 2 only
  - b. 1 and 3 only
  - c. 2 and 3 only
  - d. 1, 2 and 3
12. Which one of the following reactions is not expected to occur on HSAB principle?
- a.  $\text{NaF} + \text{HCl} \rightarrow \text{NaCl} + \text{HF}$
  - b.  $\text{CaCl}_2 + 2\text{F}^- \rightarrow \text{CaF}_2 + 2\text{Cl}^-$
  - c.  $\text{HgCl}_2 + 2\text{F}^- \rightarrow \text{HgF}_2 + 2\text{Cl}^-$
  - d.  $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2$
13. Which one of the following chemical species can behave both as a Bronsted-Lowry acid and a base?
- a.  $\text{H}_3\text{O}^+$
  - b.  $\text{HCO}_3^-$
  - c.  $\text{NO}_3^-$
  - d.  $\text{SO}_4^{2-}$
14. What is the freezing point of heavy water?
- a.  $-4^\circ\text{C}$
  - b.  $-382^\circ\text{C}$
  - c.  $0^\circ\text{C}$
  - d.  $382^\circ\text{C}$
15.  $\text{B}_{10}\text{C}_7\text{H}_{12}$  is isoelectronic with which one of the following?
- a.  $\text{B}_{12}\text{H}_{12}^{2-}$
  - b.  $\text{B}_5\text{H}_{11}$
  - c.  $\text{B}_5\text{H}_5^-$
  - d.  $\text{B}_{17}\text{H}_{17}^{3-}$
16. Consider the following statements:
1. The structure of diborane ( $\text{B}_2\text{H}_6$ ) is similar to that of ethane ( $\text{C}_2\text{H}_6$ ).
  2. Boron nitride has a graphite like layer structure and is a lubricant.
  3. The electrical conductivity of boron nitride is same as that of graphite.
- Which of the statements given above is/are correct?
- a. 1 only
  - b. 1 and 3
  - c. 2 and 3
  - d. 2 only
17. Solid crystalline  $\text{PCl}_5$  has which of the following?
- a. Bi-pyramidal moieties
  - b. Octahedral moieties
  - c. Square-pyramidal moieties
  - d. Pentagonal moieties
18. What is the role of phosphate ion detergent?
- a. It reduces the pH of the water.
  - b. It increases the pH of the water.
  - c. It removes the  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions from water that cause hardness.
  - d. It increases its solubility in water.
19. Which one of the following reactions will not occur spontaneously?
- a.  $\text{F}_2 + 2\text{Cl}^- \rightarrow 2\text{F}^- + \text{Cl}_2$
  - b.  $\text{I}_2 + 2\text{Br}^- \rightarrow 2\text{I}^- + \text{Br}_2$
  - c.  $\text{Br}_2 + 2\text{I}^- \rightarrow 2\text{Br}^- + \text{I}_2$
  - d.  $2\text{I}^- + \text{Cl}_2 \rightarrow 2\text{Cl}^- + \text{I}_2$
20. Which one of the following sets of orbitals is involved in the hybridization to explain the formation of the compounds of Xe?
- a. 4d-5s-5p
  - b. 5d-6s-5p
  - c. 5d-5s-5p
  - d. 4d-5p-6s
21. In an octahedral complex if ligands on one axis are displaced little away from their ideal positions, the crystal field splitting of d-orbitals for this complex is as given below
- a.  $d_{xy}$
  - b.  $d_{yz}$
  - c.  $d_{xz}$
  - d.  $d_{xy}, d_{yz}$
- The ligands are displaced on which axis/axes?
- a. x and y
  - b. y only
  - c. x only
  - d. z only
22. Which one of the following compounds has tetrahedral geometry?
- a.  $[\text{Ni}(\text{CN})_4]^{2-}$
  - b.  $[\text{NiCl}_4]^{2-}$
  - c.  $[\text{PdCl}_4]^{2-}$
  - d.  $[\text{Pd}(\text{CN})_4]^{2-}$

23. Which one of the following lanthanide ions has the highest magnetic moment?
- $Dy^{3+}$
  - $Gd^{3+}$
  - $Sr^{2+}$
  - $Tb^{3+}$
24. Why does aqueous  $Fe(III)$  ion develop intense red colour when it reacts with  $SCN^-$  ion while  $Fe(II)$  ion does not?
- $Fe(III)$  ion forms a charge transfer complex with  $SCN^-$  ions.
  - $Fe(III)$  is reduced to  $Fe(II)$  which is deep red in colour.
  - $SCN^-$  ion oxidizes to  $CN^-$  ion and that forms red complex with  $Fe(II)$  ion.
  - $SCN^-$  ion does not form any complex with  $Fe(II)$  ion.
25. The intense blue colour of prussian blue salt arises from which one of the following?
- d-d transition
  - inter valence electron transfer
  - ligand to metal charge transfer
  - metal to ligand charge transfer
26. Which one of the following is the correct order of the wavelengths of absorption for complexes
- $[Ni(H_2O)_6]^{2+}$ ,  $[Ni(NH_3)_6]^{2+}$ ,  $[Ni(NO_2)_6]^{4-}$
  - $A - B < C$
  - $B - A < C$
  - $C - B < A$
  - $C - A < B$
27. What are the spin-only magnetic moments (in BM) for  $Ni^{2+}$  ion in square-planar and octahedral complexes, respectively?
- 0 and 2.8
  - 2.8 and 2.83
  - 1.73 and 0
  - 0 and 0
28.  $Li^+$  and  $Et^-$  are the equivalent weights of  $LiOH$  in acidic and alkaline media respectively, what is the value of  $E_1/E_2$ ?
- 0.5
  - 0.6
  - 1.0
  - 1.66
29. Which one of the following processes is used in the extraction of magnesium?
- Self reduction
30. In which one of the following minerals, is aluminium not present?
- Cryolite
  - Alta
  - Feldspar
  - Fluorspar
- An impure metal is allowed to react with carbon monoxide at  $50^\circ C$  and the volatile gas thus formed is collected and heated further to about  $200^\circ C$ . This procedure gives the metal of 99.9% purity. What is the metal?
- Fe
  - Cr
  - Cu
  - Ni
32. Consider the following reaction:
- $$M + H_2 \rightarrow MH_2 + nH$$
- (Given the masses:  $H = 2.014$ ,  $H_2 = 3.016$ ,  $M = 4.003$ ,  $n = 1.009$  a.m.u.)
- What is the energy released in the nuclear reaction given above?
- 16.76 MeV
  - 16.76 X MeV
  - 0.18 MeV
  - 0.018 MeV
33. The highest binding energy per nucleon is for which of the following?
- Nuclei with mass numbers around 60
  - Nuclei with mass numbers below 20
  - Nuclei with mass numbers much above 120, but below 200
  - Nuclei with mass numbers above 200
34. Which one of the following is the IUPAC name of  $K_4[Fe(CN)_6]$ ?
- Potassium ferrocyanide
  - Potassium hexacyano ferrate (III)
  - Tripotassium hexacyano ferrate
  - Potassium ferricyanide
35. What is the correct IUPAC name of the compound  $[Ni(C_6H_5)_2PCH_2CH_2P(C_6H_5)_2(N_3)]_2$ ?
- bis (1, 2-diphenyl phosphino ethane)-bis (dinitrido) molybdenum (IV)
  - bis (1, 2-diphenyl phosphino ethane)-di (dinitrido) molybdenum (IV)
  - bis (1, 2-diphenyl phosphino ethane)-di (nitrogen) molybdenum (IV)

- c. bis (1, 2-diphenyl phosphino ethane)-bis (dinitrogen) molybdenum (0)
- d. bis (dinitrogen) — bis (1, 2-diphenyl phosphino ethane) molybdenum (0)
36. How many stereoisomers are possible for the complex  $[\text{Pt}(\text{Cl})(\text{Br})(\text{I})(\text{NO}_2)(\text{NH}_3)(\text{H}_2\text{O})]$ ?
- 15
  - 30
  - 12
  - 6
37. To prepare *cis*- $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ , which pair of chemicals is needed?
- $[\text{Pt}(\text{NH}_3)_4]^{2+}$  and  $\text{KCl}$
  - $[\text{Pt}(\text{NH}_3)_4]^{2+}$  and  $\text{NH}_4\text{Cl}$
  - $[\text{PtCl}_4]^{2-}$  and  $\text{NH}_4\text{Cl}$
  - $[\text{PtCl}_4]^{2-}$  and  $\text{NH}_3$
38. What is the Crystal Field Stabilisation Energy (CFSE) of a free  $\text{Co}(\text{II})$  ion on forming the tetrahedral chloro complex,  $[\text{CoCl}_4]^{2-}$  (in the units of  $\Delta_0$ )?
- 0.6
  - 1.2
  - 1.8
  - 2.4
39. "Minamata disease" is caused by which one of the following?
- Tetramethyl lead
  - Methyl thallium
  - Methane
  - Methyl mercury
40. Consider the following organic compounds shown below as I, II, III and IV.
- I  $\text{CH}_3$
- II  $(\text{CH}_3)_3\text{NO}$
- III 
- IV 
- What is the correct order of their dipole moments?
- IV < I < II < III
  - III < I < II < IV
  - IV < II < I < III
  - III < II < I < IV
41. Which amongst the following are carbon acids?

- Phenol
- Benzene sulphonic acid
- Benzoic acid
- Ethyl aceto acetate
- Acetylene

Select the correct answer using the code given below:

- 1, 2 and 3
- 2, 4 and 5
- 2 and 3 only
- 4 and 5 only

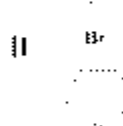
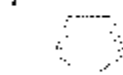
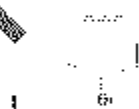
42. Consider the following carbocations

- Neopentyl
- Benzyl
- Ethyl
- Phenyl

Which one of the following is the correct order of their stability?

- 1 > 4 > 2 > 3
- 1 > 3 > 2 > 4
- 2 > 4 > 1 > 3
- 2 > 3 > 1 > 4

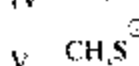
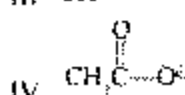
43. Consider the following compounds:



What is the correct sequence of the compounds given above in decreasing order of their  $S_N1$  reactivity?

- I > II > III
- I > III > II
- II > III > I
- III > I > II

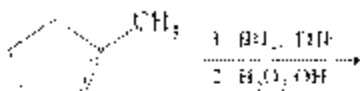
44. Consider the following species:



What is the correct sequence of the species given above in decreasing order of nucleophilicity in an aqueous solution?

- V>III>I>IV>II
- IV>II>III>I>V
- V>II>I>IV>III
- IV>III>II>I>V

45. What is/are the product(s) for the following reaction?



- 
- 
- Equal amounts of (a) and (b)
- 

46. Peroxide effect is a very important feature of the chemistry of alkenes and comes into effect during the addition of which one of the following?

- HBr
- Br-OH
- HCl
- H<sub>2</sub>

47. Match List-I with List-II and select the correct answer using the code given below the lists

List-I

(Compound)

- tert-butyl peroxide
- benzoquinone
- carbon tetrachloride
- High boiling solvent

List-II

(Function)

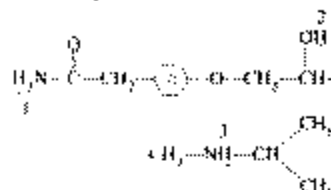
- Chain transfer agent
- Free-radical initiator
- Plasticizer
- Antioxidant

Code:

- A2, B3, C1, D4

- A1, B4, C2, D3
- A2, B4, C1, D3
- A1, B3, C2, D4

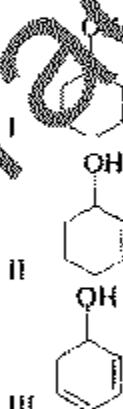
48. Tenormin is a drug used in the treatment of high blood pressure, angina and abnormal heart rhythms.



What is the correct order of the acidity of marked hydrogens of the above compound in decreasing order?

- 2 > 1 > 3
- 3 > 2 > 1
- 3 > 1 > 2
- 1 > 2 > 3

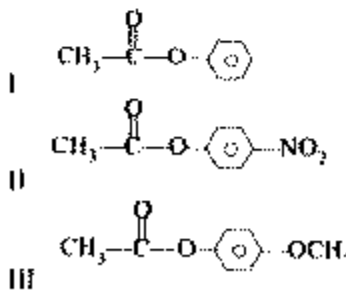
- 49.



For the alcohols given above, what is the increasing order of reactivity towards dehydration?

- I < III < II
- I < III < II
- II < III < I
- III < II < I

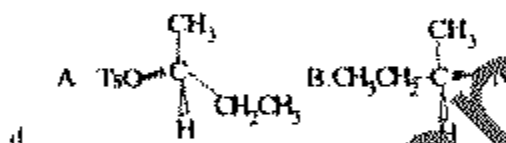
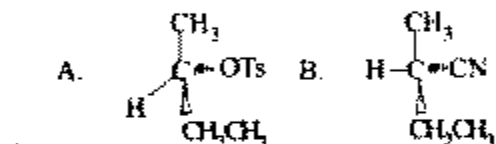
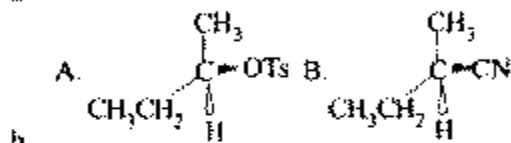
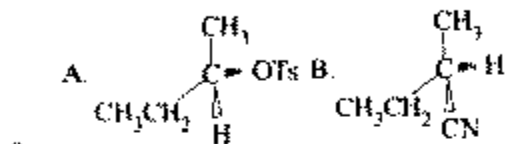
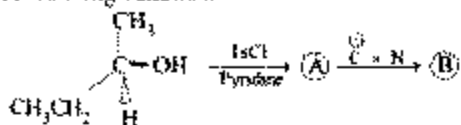
- 50.



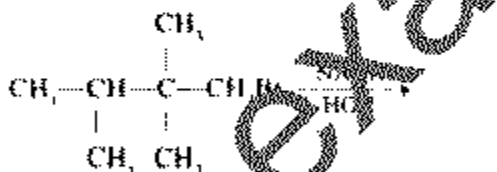
For the esters given above what is the correct order of decreasing reactivity towards alkaline hydrolysis?

- a. II > III > I  
 b. I > III > II  
 c. III > I > II  
 d. II > I > III

51. What are the products A and B in the following reaction?



52



Consider the following statements for the reaction given above:

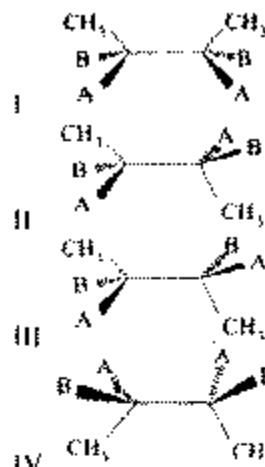
- The reaction is  $S_N1$
- The reaction intermediate is carbocation
- The major product will be 2, 3-dimethyl-3-pentanol

The major product has one stereogenic centre

Which of the statements given above are correct?

- a. 1, 2 and 3 only  
 b. 2, 3 and 4 only  
 c. 1 and 4 only  
 d. 1, 2, 3 and 4

53.



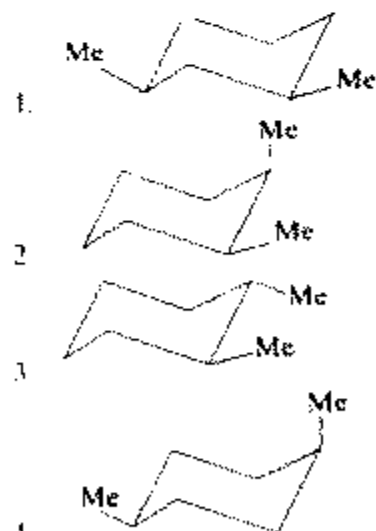
Consider the above stereo-isomers and their relationship as given in the following statements

- Stereoisomers I and II represent meso
- Stereoisomers II and III are diastereomers
- Stereoisomers I and IV are enantiomers

Which of the statements given above are correct?

- a. 1 and 2 only  
 b. 2 and 3 only  
 c. 1 and 3 only  
 d. None of (a), (b), (c)

What is the correct order of the following dimethylcyclohexanes in decreasing order of their relative stability on the basis of butane gauche interactions?

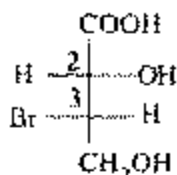


Select the correct answer using the code given below

- a. 1 > 3 > 4 > 2  
 b. 1 > 4 > 3 > 2  
 c. 2 > 3 > 4 > 1

d.  $2 > 4 > 3 > 1$ 

55.



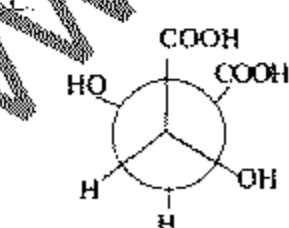
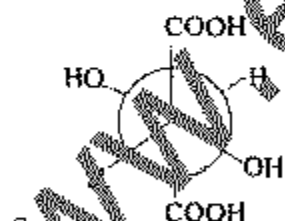
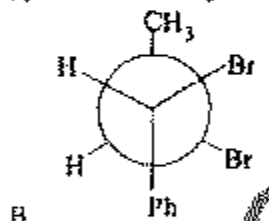
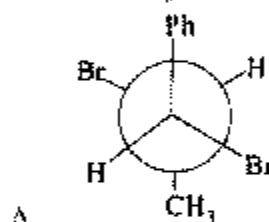
What is the absolute configuration of chiral centres 2 and 3 of the compound given above?

- 2R, 3R
- 2R, 3S
- 2S, 3R
- 2S, 3S

56. Match List-I with List-II and select the correct answer using the code given below the lists

List-I

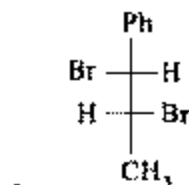
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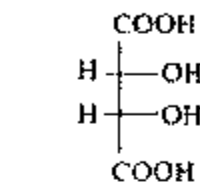
D.

List-II

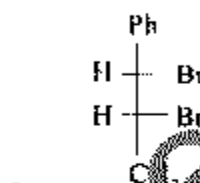
(Fischer Projection)



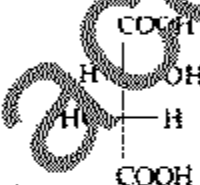
I



2.



3.



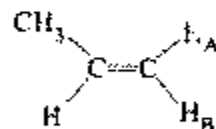
4.

Code:

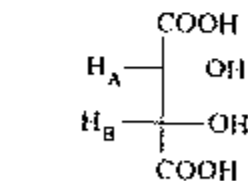
- A1, B3, C2, D4
- A3, B1, C2, D4
- A1, B3, C4, D2
- A3, B1, C4, D2

57.

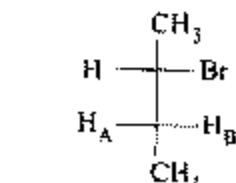
Consider the hydrogen atoms labelled as  $H_A$  and  $H_B$  in the following molecules



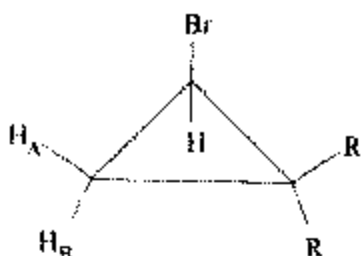
1.



2.



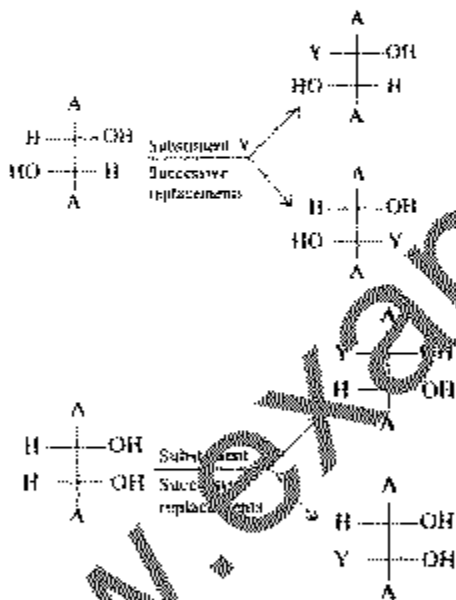
3.



4. In which of the above are  $H_A$  and  $H_B$  diastereotopic?

- 1, 2 and 3
- 2, 3 and 4
- 1, 3 and 4
- 1, 2 and 4

58. To decide about the topicity of hydrogens in the stereoisomers I and II, the hydrogen atoms were successively replaced by a substituent Y as shown below



I and II were drawn as the following stereoisomers is given in

1. The hydrogens are homotopic in I and stereotopic in II

2. The hydrogens are diastereotopic in I and enantiotopic in II

3. The hydrogens are homotopic in I and enantiotopic in II

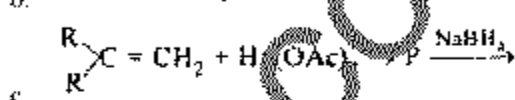
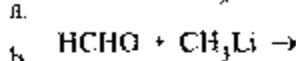
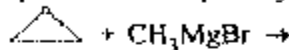
Which of the statements given above is correct?

- 1 only
- 2 only
- 3 only
- None of the above

59. An  $S_N2$  reaction at an asymmetric carbon of a compound always gives which one of the following?

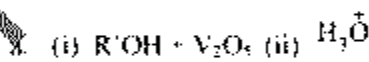
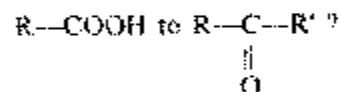
- An enantiomer of the substrate
- A product with opposite optical rotation
- A mixture of diastereomers
- A single stereoisomer

60. In which one of the following reactions, final product is not a primary alcohol?



where B is the intermediate product.

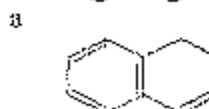
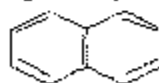
61. Which one of the following sets of reagents will convert



62. Which one of the following compounds cannot be synthesized by the acetoacetic ester synthesis?

- 3,3-dimethyl-2-butanone
- 3-methyl-2-pentanone
- 4-methyl-2-pentanone
- 2-hexanone

63. Among the following, which one will have the highest dipole moment?





64. Which one of the following is aromatic?
- c
- d

- a
- b
- c
- d
65. Match List-I with List-II and select the correct answer using the code given below the lists

List-I

- A  $\text{NH}_3^{\oplus}$   
 B  $-\text{CCl}_3$   
 C  $-\text{CH}_3$   
 D  $-\text{NH}_2$

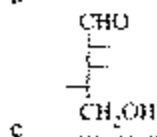
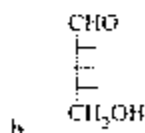
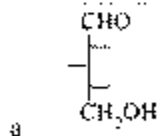
List-II

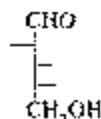
- 1 o, p-director due to resonance  
 2 m, m-director due to inductive effect  
 3 o, p-director due to hyper conjugation  
 4 p-director due to reverse hyper conjugation

Code

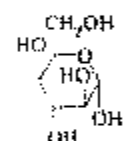
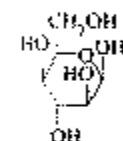
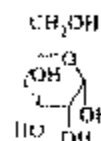
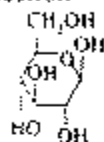
- a A2, B4, C1, D3  
 b A2, B4, C3, D1  
 c A4, B2, C3, D1  
 d A4, B2, C1, D3
66. When nitrobenzene is heated with Zn dust,  $\text{NH}_4\text{Cl}$  in ethanol, what is the major product formed?

- a
- b
- c
- d
67. Which one of the following compounds would be produced when 4-nitro-1-aminobenzene is reacted with trifluoroperoxyacetic acid?
- a 4-fluorobenzene  
 b 1,4-difluorobenzene  
 c 1,3-dinitrobenzene  
 d nitrobenzene
68. What is the correct sequence of the following compounds in the increasing order of reactivity towards ring nitration?
- a Benzene < bromobenzene < nitrobenzene < toluene  
 b Toluene < benzene < bromobenzene < nitrobenzene  
 c Nitrobenzene < bromobenzene < benzene < toluene  
 d Nitrobenzene < bromobenzene < toluene < benzene
69. Which one of the following compounds is a D-sugar giving an optically active pentitol on reduction?





70. Which one of the following is the correct figure of  $\beta$ -D-glucopyranose in Haworth projection?



71. Consider the following synthetic methods
1. Strecker
  2. Rosenmund
  3. Gabriel
  4. Williamson

Amino acids cannot be synthesized by which of the above?

- a. 1 and 3  
 b. 1 and 2  
 c. 2 and 4  
 d. 3 and 4
72. Which one of the following molecules is easily detectable by IR spectrum?

- a. CO  
 b. CCl<sub>4</sub>  
 c. CO<sub>2</sub>

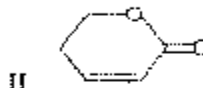
73. Consider the following statements
1.  $n \rightarrow \pi^*$  transition is a forbidden transition
  2. 1, 2-Diphenylethene absorbs UV light at a shorter wavelength, than its trans-isomer

3. In more polar solvents  $n \rightarrow \pi^*$  transitions experience a red shift but  $\pi \rightarrow \pi^*$  transitions show blue shift

Which of the statements given above is/are correct?

- a. 1 and 2 only  
 b. 2 and 3 only  
 c. 1 only  
 d. 1, 2 and 3

74. Consider the following compound

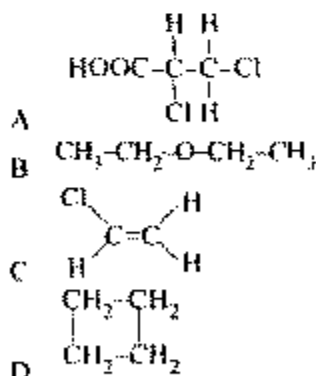


What is the correct sequence of the compounds given above in the decreasing order of  $\nu_{C=O}$  absorption frequency (in cm<sup>-1</sup>) in the IR spectrum?

- a. I > II > III  
 b. I > III > II  
 c. III > I > II  
 d. III > II > I

Match List-I with List-II and select the correct answer-using the code given below the lists

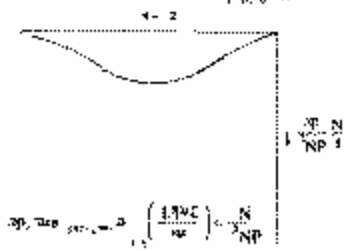
List-I  
 (Compound)



List-II  
 (Number of PMR Signals)

1. 1  
 2. 2  
 3. 3  
 4. 4

Code



- a.  $c \rightarrow 2a$  plays a dominant role in vicinity of  $c \rightarrow \theta$  only
- b.  $c$  plays a dominant role as  $c \rightarrow \infty$  while  $a$  plays a dominant role as  $c \rightarrow \theta$
- c.  $c$  plays a dominant role as  $c \rightarrow \infty$  while  $a$  plays a dominant role as  $c \rightarrow \theta$
- d.  $c$  plays a dominant role as  $c \rightarrow \infty$  while  $a$  plays a dominant role as  $c \rightarrow \theta$

What will be the average collision rate of oxygen at 200 K for the mean free path of oxygen is  $10^{-10}$  m?

a. It is halved

b. It is doubled

c. It is tripled

d. It remains unchanged

Which one of the following gives the expression for the constant (B(T)) for a van der Waal gas?

a.  $b + \frac{RT}{a}$

b.  $b - \frac{RT}{a}$

c.  $\frac{RT}{a} - b$

d.  $\frac{RT}{a} + b$

At which values of  $\left(\frac{dp}{dp}\right)_{T,c}$  and  $\left(\frac{dV}{dV}\right)_{T,c}$  respectively, the critical point is a point of inflection in the gas isotherm?

a. 0, 0

b. 0, +ve

c. +ve, 0

d. +ve, +ve

Which one of the following is correct as per accompanied diagram?

a. 1 and 3

b. 2 and 3

c. 3 only

d. 2 only

The  $^{11}\text{B}$ -nuclear magnetic resonance spectrum of 1, 2, 3-trichloropropane exhibits which of the following?

a. Two signals, a doublet and a quartet

b. Three signals, two doublets and a quartet

c. Two signals, a triplet and a doublet

d. Five signals, four doublets and a quintet

On which method is the automatically programmed machine for polypeptide synthesis based?

a. Van Slyke method

b. Sanger method

c. Merrifield method

d. Edman degradation

The virial equation of state is written as

$$P = RT \left[ \frac{1}{V_m} + \frac{B(T)}{V_m^2} + \dots \right]$$

Which one of the following gives the expression for the constant (B(T)) for a van der Waal gas?

a.  $b + \frac{RT}{a}$

b.  $b - \frac{RT}{a}$

c.  $\frac{RT}{a} - b$

d.  $\frac{RT}{a} + b$

At which values of  $\left(\frac{dp}{dp}\right)_{T,c}$  and  $\left(\frac{dV}{dV}\right)_{T,c}$  respectively, the critical point is a point of inflection in the gas isotherm?

a. 0, 0

b. 0, +ve

c. +ve, 0

d. +ve, +ve

Which one of the following is correct as per accompanied diagram?

a. 1 and 3

b. 2 and 3

c. 3 only

d. 2 only

A. DU  
B. BH  
C. DA  
D. DG

Last II

1.  $V dp = SdT$
2.  $T dS = pdV$
3.  $-p dV = SdT$
4.  $T dS = V dp$

Code:

- a. A2, B4, C3, D1
- b. A1, B3, C4, D2
- c. A2, B3, C4, D1
- d. A1, B4, C3, D2

For  $H_2O$  (liq.) in equilibrium with  $H_2O$  (ice) at 1 atm,  $\Delta H = 1000 \text{ cal mol}^{-1}$  and  $\Delta S = -5 \text{ cal K}^{-1}$ . What is the value of  $\Delta G$ ?

- a. 0
- b.  $23.5 \text{ cal mol}^{-1}$
- c.  $-23.5 \text{ cal mol}^{-1}$
- d.  $23.5 \text{ cal mol}^{-1}$

(X)

A. Amount is provided with  $100 \text{ cm}^3$  of dry ether for extracting the solute X from its  $100 \text{ cm}^3$  aqueous solution. If the partition coefficient of X between ether and water is 1, what fraction of X is extracted when  $100 \text{ cm}^3$  dry ether is used in two installations of equal volume?

- a. 25
- b. 75
- c. 89
- d. 13

Which of the following statements is correct?

1. The phase diagram of a substance shows the regions of pressure and temperature at which the various phases are kinetically stable.
2. The freezing point when the pressure is 1 bar is called standard freezing point.
3. The normal and standard freezing points are negligibly different for most of the cases.

Select the correct answer using the code given below:

- a. 1 only
- b. 2 and 3
- c. 1 and 3
- d. 2 only

1. It is a state function.

2. It is a path independent function.

3. It is always positive quantity for random processes.

Which of the statements given above are correct?

- a. 1 and 2 only
- b. 2 and 3 only
- c. 1 and 3 only
- d. 1, 2 and 3

85. Consider the following statements

1. The work done in the reversible isothermal expansion of an ideal gas is greater than that for a van der Waal.
2. When an ideal gas undergoes expansion under adiabatic condition in vacuum internal energy increases.

Which of the statements given above is/are correct?

- a. 1 only
- b. 2 only
- c. Both 1 and 2
- d. Neither 1 nor 2

86.

A bubble of 2 mol of monoatomic ideal gas expands to a certain size when submerged in water at a certain depth where water as well as the gas bubble undergo a temperature increase of  $10^\circ\text{C}$  at constant pressure. How much heat is added to the gas during the expansion (Given gas constant  $8.31 \text{ J K}^{-1} \text{ mol}^{-1}$ )

- a. 11.8 kJ
- b. 7.1 kJ
- c. 5.55 kJ
- d. 2.35 kJ

87.

(one mole) of an ideal gas is expanded isothermally at  $(m) \text{ K}$  from volume  $10 \text{ dm}^3$  to  $1 \text{ dm}^3$  and finally returns to the initial range of the system and that of surroundings respectively ( $R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$  and  $\ln 10 = 2.303$ )?

- a.  $-4.6 \text{ cal K}^{-1}$  and  $-4.6 \text{ cal K}^{-1}$
- b.  $+4.6 \text{ cal K}^{-1}$  and  $-1.8 \text{ cal K}^{-1}$
- c.  $-1.8 \text{ cal K}^{-1}$  and  $-4.6 \text{ cal K}^{-1}$
- d.  $-1.8 \text{ cal K}^{-1}$  and  $-1.8 \text{ cal K}^{-1}$

88.

Match Last-I with Last-II and select the correct answer using the code given below the lists (The symbols have their usual meaning)

Last-I

92. At 303 K, the vapour pressure of benzene is 118 Torr and that of cyclohexane is 122 Torr. Assuming ideal behaviour, what will be the vapour pressure of a solution for which the mole fraction of benzene is 0.25?
- 118 Torr
  - 119 Torr
  - 120 Torr
  - 121 Torr
93. What will be the number of phases, components and degrees of freedom respectively of the azeotropic mixture of water and ethanol at 10 atm at equilibrium?
- 2, 2 and 2
  - 1, 2 and 3
  - 2, 2 and 0
  - 2, 3 and 1
94. What would be the vapour pressure of water at 38°C in 10% aqueous solution of glucose (given vapour pressure of water at 38°C is 31.8 mm)?
- 32.4 mm
  - 32.2 mm
  - 31.8 mm
  - 31.4 mm
95. Calcium nitrate ionizes in water as
- $$\text{Ca}(\text{NO}_3)_2 \rightleftharpoons \text{Ca}^{2+} + 2\text{NO}_3^-$$
- Elevation of boiling point measurement shows its observed molar mass to be 1.6 against its normal molar mass of 164. What will be the degree of ionization of calcium nitrate?
- 0.25
  - 0.50
  - 0.75
  - 1.00
96. What is the molarity of a solution containing 5 g of sodium hydroxide in 250 ml of solution?
- 2.0
  - 0.5
  - 0.1
97. What is the concentration of oxygen at 20°C and a partial pressure of 0.21 atm applying Henry's law equation? (Given that Henry's constant  $k = 1.38 \times 10^{-3}$  moles  $\text{L}^{-1} \text{atm}^{-1}$ )
- $2.0 \times 10^{-3}$  M
  - $2.9 \times 10^{-4}$  M
  - $3.0 \times 10^{-3}$  M
  - $1.0 \times 10^{-4}$  M
98. The molar conductivity of 0.01 M  $\text{CH}_3\text{COOH}(\text{ac})$  at 298 K is  $1.65 \text{ mS m}^2 \text{mol}^{-1}$ . What is the  $K$  of the acid? (Given  $\Lambda^\infty = 39.1 \text{ mS m}^2 \text{mol}^{-1}$ )
- $1.84 \times 10^{-5}$
  - $1.84 \times 10^{-4}$
  - $1.84 \times 10^{-2}$
  - None of the above
99. What is the electrode potential of  $\text{Cu}^{2+}|\text{Cu}$  electrode in which concentration of  $\text{Cu}^{2+}$  ions is  $2.0 \text{ M}$ ? [Given that the standard electrode potential of  $\text{Cu}^{2+}|\text{Cu}$  is 0.34 V ( $\log_{10} 2 = 0.3010$ )]
- 0.322 V
  - 0.349 V
  - 0.361 V
  - 0.372 V
100. Which salt of mercury (Hg) is used to prepare standard electrode?
- Mercuric nitrate
  - Mercuric chloride
  - Mercurous nitrate
  - Mercurous chloride
101. A current of 3 A passing through silver nitrate solution for 20 minutes, deposits 4 g of silver. What is the electrochemical equivalent of silver in  $\text{gm C}^{-1}$ ?
- $1.11 \times 10^{-7}$
  - $1.11 \times 10^{-4}$
  - $1.11 \times 10^{-4}$
  - $1.11 \times 10^{-7}$
102. The emf of the cell,  $\text{Zn}|\text{Zn}^{2+} (0.1 \text{ M})||\text{Mg}^{2+} (0.1 \text{ M})|\text{Mg}$  is found to increase by  $0.001 \text{ V K}^{-1}$ . If emf of this cell at 25°C is 1.6 V, what would be enthalpy of the cell reaction?
- 366314 J
  - 366314 J
  - 251286 J
  - 251286 J
103. In the hydrogen-oxygen fuel cell, which catalyst is used in anode vessel?
- Finely divided platinum or palladium
  - Mixture of  $\text{CoO}$  and platinum
  - Mixture of  $\text{CuO}$  and palladium
  - No catalyst is required
104. The rate equation on the basis of following data for a gaseous reaction  $\text{A}_2 + 2\text{B} \rightarrow 2\text{AB}$  is

photons per second. What is the quantum yield of the reaction?

- a.  $15 \times 10^{12}$
- b.  $1.0 \times 10^{12}$
- c.  $2.0 \times 10^{11}$
- d.  $1.0 \times 10^{13}$

Consider the following statements

1. The free energy change ( $\Delta G$ ) of chemical reaction changes in the presence of a catalyst.
2. In an enzyme catalyzed reaction,  $[S]$  (the order of reaction is zero).

Which of the statements given above is/are correct?

- a. 1 only
- b. 2 only
- c. Both 1 and 2
- d. Neither 1 nor 2

The Michaelis-Menten rate for enzyme catalyzed reaction is given by

$$R = \frac{R_{max}[S]}{[S] + K_m}$$

If the initial rate is equal to one-half of the initial rate, then what is  $K_m$  equal to?

- a.  $[S]$
- b.  $2[S]$
- c.  $(1/2)[S]$
- d.  $4[S]$

Match List-I with List-II and select the correct answer using the code given below the lists

- List-I
- A. The catalyst is in a different physical phase from the reactants
  - B. The phenomenon of one of the products of a reaction itself acts as catalyst
  - C. The phenomenon when a catalyst reduces the rate of the reaction
  - D. When the catalyst is in the same phase as the reactants
- List-II
- 1. Autocatalysis
  - 2. Negative catalysis
  - 3. Heterogeneous catalysis
  - 4. Homogeneous catalysis

- a. A2, B4, C3, D1
- b. A3, B1, C2, D4
- c. A2, B1, C3, D4

Rate of disappearance (mol L <sup>-1</sup> s <sup>-1</sup> )	A <sub>1</sub> (mol L <sup>-1</sup> )	B <sub>1</sub>
$1.2 \times 10^{-1}$	0.10	0.01
$4.8 \times 10^{-1}$	0.10	0.04
$2.4 \times 10^{-1}$	0.20	0.01

- a.  $-d[A_1]/dt = k[A_2][B_1]^2$
- b.  $-d[A_1]/dt = k[A_2][B_1]$
- c.  $-d[A_1]/dt = k[A_1]^2[B_1]$
- d.  $-d[A_1]/dt = k[A_1][B_1]^2$

In a 1 L vessel at 300 K, it is found that the specific reaction rate of ammonia synthesis is  $0.001 \text{ mol L}^{-1} \text{ s}^{-1}$ . What is the rate of formation of ammonia?

- a.  $0.1 \text{ mol s}^{-1}$
- b.  $0.01 \text{ mol s}^{-1}$
- c.  $0.001 \text{ mol s}^{-1}$
- d.  $1 \text{ mol s}^{-1}$

A first order decomposition reaction completes its 50% in 20 minutes. In what time does it complete its 87.5%?

- a. 35 minutes
- b. 40 minutes
- c. 50 minutes
- d. 60 minutes

The rate law for a reaction  $A \rightarrow \text{products}$  is  $-\frac{d[A]}{dt} = k[A]^n$ .

For a given initial concentration  $[A]_0$ , what is the ratio of the time for  $[A]$  to fall to  $\frac{1}{2}$  of the initial concentration to fall to  $\frac{1}{10}$  of the above?

- a. 5
- b. 8
- c. 9
- d. 10

What is non-radiative transition between states with different spin angular momenta called?

- a. Internal conversion
- b. Intersystem crossing
- c. Fluorescence
- d. Phosphorescence

When a substance 'A' is exposed to light for 10 minutes, 0.001 mole of it is reacted. In the same time 'A' absorbed  $10 \times 10^6$

- d. A3, B4, C2, D1
- 113 The coagulation of 100 ml of colloidal solution of gold is completely prevented by the addition of 0.25 g of X to it before addition of 1 ml of 10% NaCl solution. What is the gold number of X?
- 0.25
  - 250
  - 2.5
  - 25
- 114 Assertion (A)  $\text{SiCl}_4$  has lower boiling point than  $\text{CCl}_4$ .  
Reason (R) There is a  $p_x-d_x$  overlap between Cl and Si, thus making Si-Cl bond less polar.
- Both A and R are individually true and R is the correct explanation of A
  - Both A and R are individually true and R is the correct explanation of A
  - A is true but R is false
  - A is false but R is true
- 115 Assertion (A) Dissolution of some secondary and tertiary alcohols in cold concentrated  $\text{H}_2\text{SO}_4$  results in gradual separation of an insoluble liquid of high boiling point.  
Reason (R) Secondary and tertiary alcohols easily form alkenes which undergo acid catalysed polymerisation to form high boiling insoluble liquids.
- Both A and R are individually true and R is the correct explanation of A
  - Both A and R are individually true and R is the correct explanation of A
  - A is true but R is false
  - A is false but R is true
- 116 Assertion (A)  $\alpha$ -Amino acids show unusual high solubility in polar solvents and high melting points.  
Reason (R) The zwitterion behaves like a salt.
- Both A and R are individually true and R is the correct explanation of A
  - Both A and R are individually true and R is the correct explanation of A
  - A is true but R is false
  - A is false but R is true
- 117 Assertion (A) The boiling point of 0.1 M urea solution is less than that of 0.1 M KCl solution.

Reason (R) Elevation of boiling point is inversely proportional to the numbers of species present in the solution.

- Both A and R are individually true and R is the correct explanation of A
  - Both A and R are individually true and R is the correct explanation of A
  - A is true but R is false
  - A is false but R is true
- 118 Assertion (A) Calomel electrode acts as a reference electrode and consists of Hg, sparingly soluble salt of Hg and a solution of a soluble salt of the same ion.  
Reason (R) The calomel electrode is reversible with respect to the reaction.
- Both A and R are individually true and R is the correct explanation of A
  - Both A and R are individually true and R is the correct explanation of A
  - A is true but R is false
  - A is false but R is true
- 119 Assertion (A) Hydrolysis of ethyl acetate in presence of acid is a reaction of first order whereas in presence of alkali, it is a reaction of second order.  
Reason (R) Acid only acts as a catalyst whereas alkali acts as one of the reactants.
- Both A and R are individually true and R is the correct explanation of A
  - Both A and R are individually true and R is the correct explanation of A
  - A is true but R is false
  - A is false but R is true
- 120 Assertion (A) For the following photochemical decomposition of HI
- $$\text{HI} \xrightarrow{h\nu} \text{H} + \text{I}$$
- $$\text{H} + \text{HI} \rightarrow \text{H}_2 + \text{I}$$
- $$\text{I} + \text{I} \rightarrow \text{I}_2$$
- the quantum yield is only 2.  
Reason (R) I atom is relatively unreactive and does not participate in the chain propagation step.
- Both A and R are individually true and R is the correct explanation of A
  - Both A and R are individually true and R is the correct explanation of A
  - A is true but R is false
  - A is false but R is true