# CHEMISTRY (PG)
## (Final)

1. The correct order of electronegativity of hybridized orbitals is

   (A) $sp > sp^2 > sp^3$      (B) $sp < sp^2 < sp^3$
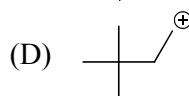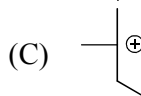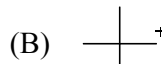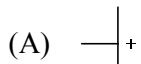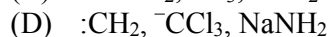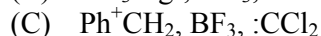   (C) $sp^3 > sp > sp^2$      (D) $sp^3 < sp < sp^2$
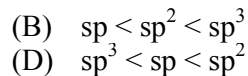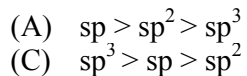
2. The carbocation resulting from the heterocyclic cleavage of neopentyl chloride is

   

3. Among the following, the set consisting of only electrophiles is

   (A) $CH_3ONa$, $CH_3{}^+CO$, $:CCl_2$
   (B) $CH_3MgI$, $NH_3$, $KOH$
   (C) $Ph^+CH_2$, $BF_3$, $:CCl_2$
   (D) $:CH_2$, $^-CCl_3$, $NaNH_2$
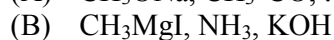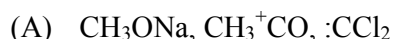
4. Which of the following has the lowest dipole moment?

   (A) $CH_2{=}CH{-}C{\equiv}CH$      (B) $CH_3{-}CH_2{-}C{\equiv}CH$

   (C)       (D) $CH_3{-}C{\equiv}C{-}CH_3$
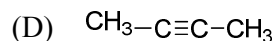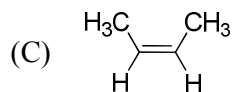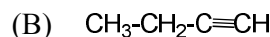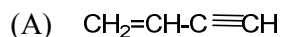
5. Which C-C single bond is shortest in length among the following?

   (A) $CH_3{-}CN$      (B) $CH{\equiv}C{-}CN$
   (C) $CH_2{=}CH{-}CN$      (D) $CH_3{-}CH_3$
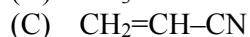
6. The electron density at $C_4$ of toluene is greater than the electron density at $C_4$ of t-butylbenzene due to

   (i) Hyperconjugation      (ii) Inductive effect
   (iii) No-bond resonance      (iv) Baker-Nathan effect

   (A) (i), (iii), (iv)      (B) (i), (ii), (iii)
   (C) (i), (ii)      (D) (i)
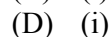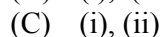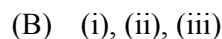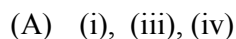
7.    The increasing order of stability of following carbocations is

i        ii       iii       iv  

(A)   ii < iii < i < iv                    (B)   iii < ii < i < iv
(C)   iv < ii < I < iii                    (D)   i < iii < ii < iv

8.    The product of the following reaction is

   + HOCl  $\longrightarrow$  X

(A)                      (B)  

(C)                      (D)  
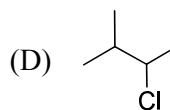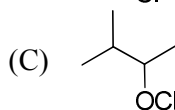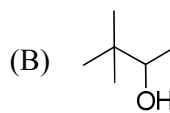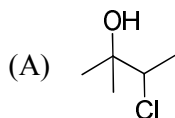
9.    The compound (X) ($C_5H_9Cl_3$) on hydrolysis with aq. NaOH gives a product Y which on heating with sodalime gives an alkane (Z). The compound X is

(A)                      (B)  

(C)                      (D)  
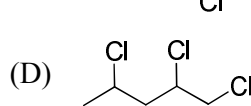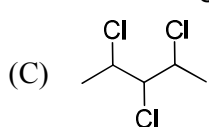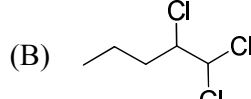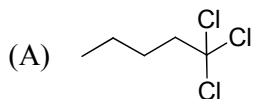
10.   The repeated Hofmann exhaustive methylation of 3,5-dimethylpiperidine followed by the reaction with moist silver oxide and then heating to give an unsaturated hydrocarbon (X).  The more stable unsaturated hydrocarbon X is

(A)   2,4-Dimethyl-pent-1-ene
(B)   4-Methyl-hex-1,3-diene
(C)   2,4-Dimethyl-pent-1,3-diene
(D)   2,4-Dimethyl-pent-1,4-diene

11.   The ozonolysis of hydrocarbon (A) gives 2,5-hexanedione as one of the products. Hydrocarbon (A) may be
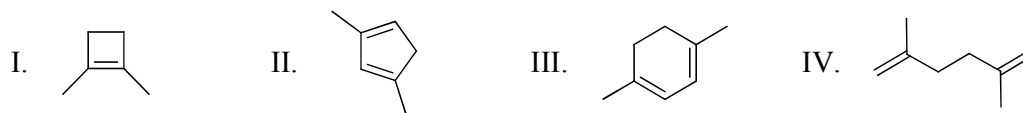
I.       II.       III.       IV.  

(A)   I, II, III, IV                    (B)   I, II, III
(C)   I, III, IV                        (D)   IV

12. Kolbe's electrolysis of sodium salt of adipic acid results in the formation of

    (A) Butane                          (B) Cyclohexane
    (C) Hexane                          (D) Cyclobutane

13. 2-Butyne on reduction with Na/liq. $NH_3$ followed by Diels-Alder reaction with butadiene gives

    (A)                                 (B)

    (C)                                 (D)

14. Which of the following alkenes will react fastest with $H_2$ under catalytic hydrogenation?

    (A)                                 (B)

    (C)                                 (D)

15. A hydrocarbon A contains 88.9% of C. It gives red ppt with ammoniacal cuprous chloride and its isomer B reacts with bromine to form 1,4-dibromo-2-butene. The compounds A and B respectively are

    (A)        and                      (B)        and

    (C)        and                      (D)        and
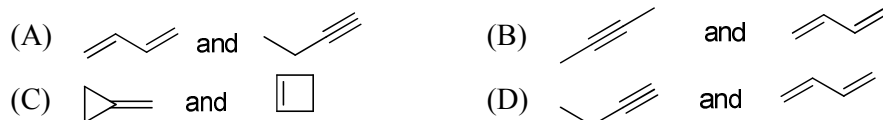
16. If the organic substance contains both nitrogen and sulphur, the SE gives blood red coloration with $FeCl_3$. The blood red coloration is due to

    (A) Ferric thiocyanate              (B) Sodium thiocyanate
    (C) Ferric ferrocyanide             (D) Sodium ferrocyanide

17. The IUPAC name for the following compound is
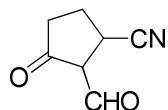
    (A) 2-Cyano-5-oxocyclopentanecarbaldehyde
    (B) 3-Cyano-2-formylcyclopentan-1-one
    (C) 2-Formyl-3-oxocyclopentanecarbonitrile
    (D) 2,3-Dioxocyclopentanecarbonitrile

18. The number of sp-hybridised carbon atoms in the molecule
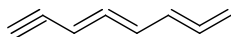


    (A) Two                    (B) Three
    (C) Four                    (D) One

19. The compound with a degree of unsaturation of three has five carbon atoms, one nitrogen atom and one oxygen atom in a molecule. The number of hydrogen atoms per molecule is

    (A) 4                      (B) 5
    (C) 6                      (D) 7

20. The acetal in the following is

    (A)             (B) 

    (C)             (D) 
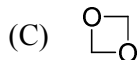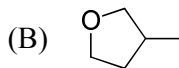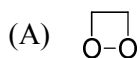
21. Alkanediones and alkanedials have the general formula

    (A) $C_nH_{2n}O$               (B) $C_nH_{2n}O_2$
    (C) $C_nH_{2n-2}O_2$           (D) $C_nH_{2n+2}O_2$

22. Which of the following will give a satisfactory yield of ketone on reaction with a Grignard reagent and subsequent hydrolysis?

    (A) An aldehyde          (B) Acarboxylic acid
    (C) An ester               (D) A nitrile

23. The product Y in the reaction is



    (A)             (B) 

    (C)             (D) 
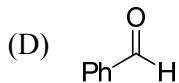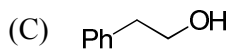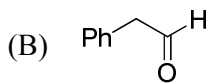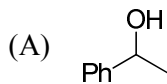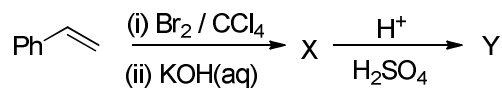
24. Active species in Fehling's solution is

    (A) Sodium ammonium tartarate     (B) Cuprous ion
    (C) Sulphate ion                (D) Cupric ion

25. Which of the following will not respond positively to the iodoform test?

    (A) $CH_3CHOHCOOH$            (B) $CH_3COCOOH$

    (C) $ICH_2COCH_2CH_3$         (D) $(CH_3)_2CCH_2COOH$ with OH on the central carbon
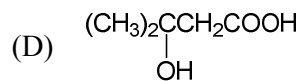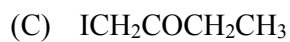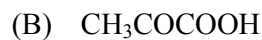
26. In the following reaction, the product B is mainly

    cyclohexanone $\xrightarrow[\text{Heat}]{PCl_5}$ A $\xrightarrow{\text{alc. KOH}}$ B

    (A) 1-chloro-1-hydroxycyclohexane

    (B) 1-hydroxy-1-ethoxycyclohexane

    (C) cyclohexyne

    (D) 1-chlorocyclohexene
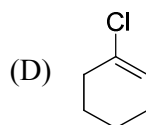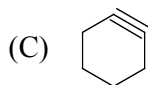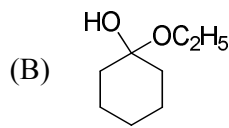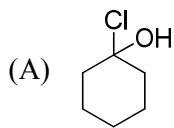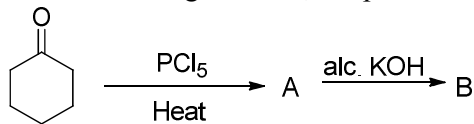
27. In Cannizzaro's reaction, the intermediate that will be the best hydride donor is

    (A) para-$^-$O substituted benzaldehyde hydrate dianion

    (B) benzaldehyde hydrate dianion

    (C) para-methoxy benzaldehyde hydrate anion (O$^-$ and OH)

    (D) para-$O_2N$ benzaldehyde hydrate anion (O$^-$ and OH)
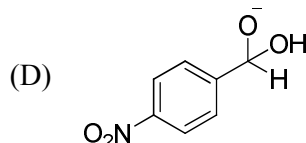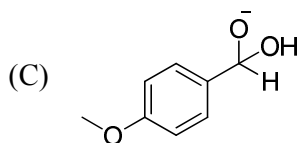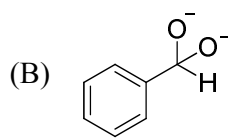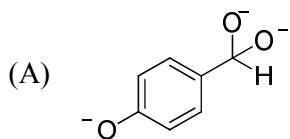
28. Which of the following structures is enantiomeric with the molecule (a) given below?

    $C_2H_5-C$ with H, CH$_3$, Br (a)

    (A) $H_3C-C$ with H, C$_2$H$_5$, Br

    (B) $Br-C$ with CH$_3$, H, C$_2$H$_5$

    (C) $H_3C-C$ with H, Br, C$_2$H$_5$

    (D) $C_2H_5-C$ with Br, H, CH$_3$

29. Which of the following reagents can be used to oxidize primary alcohols to aldehydes?

    i.    $CrO_3$ in anhydrous medium
    ii.   $KMnO_4$ in acidic medium
    iii.  Pyridinium chlorochromate
    iv.   Heat in the presence of Cu at 573K

    (A)  i, ii, iii, iv          (B)  i, iii, iv
    (C)  i, ii, iii             (D)  ii, iii, iv

30. Hoffmann bromamide degradation reaction is shown by

    (A)  $ArNH_2$              (B)  $ArCONH_2$
    (C)  $ArNO_2$              (D)  $ArCH_2NH_2$

31. Which of the following amines can be prepared by Gabriel Synthesis?

    (i)   Isobutylamine        (ii)  2-phenylethylamine
    (iii) N-methylbenzylamine  (iv)  Aniline

    (A)  (i), (ii)             (B)  (i), (ii), (iii)
    (C)  (iii), (iv)           (D)  (iv)

32. Which of the following reactions belong to electrophilic aromatic substitution?

    (i)   Bromination of acetanilide
    (ii)  Coupling reaction of aryldiazonium salts
    (iii) Diazotization of aniline
    (iv)  Acylation of aniline

    (A)  (i), (ii)             (B)  (i), (ii), (iii), (iv)
    (C)  (iii), (iv)           (D)  (i), (ii), (iii)

33. In nucleic acids, between which carbon atoms of pentose sugars of nucleotides are linked?

    (A)  5' and 3'             (B)  1' and 5'
    (C)  5' and 5'             (D)  3' and 3'

34. Which of the following B group vitamins can be stored in our body?

    (A)  Vitamin $B_1$         (B)  Vitamin $B_2$
    (C)  Vitamin $B_6$         (D)  Vitamin $B_{12}$

35. Which of the following reactions of glucose can be explained only by its cyclic structure?

   (A) Glucose forms pentacetate
   (B) Glucose reacts with hydroxylamine to form an oxime
   (C) Pentacetate of glucose doesnot react with hydroxylamine
   (D) Glucose is oxidized by nitric acid to gluconic acid

36. In fibrous proteins, polypeptide chains are held together by

   (i)    Van der Waals forces
   (ii)   Disulphide linkage
   (iii)  Electrostatic forces of attraction
   (iv)   Hydrogen bonds

   (A) (i), (ii), (iii)              (B) (ii), (iv)
   (C) (i), (iv)                     (D) (i), (ii), (iii), (iv)

37. Which of the following are not used as food preservatives?

   (i)    Table salt
   (ii)   Sodium hydrogen carbonate
   (iii)  Cane sugar
   (iv)   Benzoic acid

   (A) (i), (ii), (iii), (iv)        (B) (i), (ii)
   (C) (i), (iii)                    (D) (i), (iv)

38. The component of blood which functions for blood clotting is

   (A) Globulins                     (B) Albumins
   (C) Fibrinogen                    (D) WBC

39. Stephen reduction converts cyanides to

   (A) Amines                        (B) Aldehydes
   (C) Ketones                       (D) Acids

40. Nitrous acid has no action on

   (A) $C_6H_5CONH_2$                (B) $CH_3CH_2NO_2$
   (C) $C_6H_5N(CH_3)_2$             (D) $CH_3CH_2COOH$

41. The product of reaction of alcoholic silver nitrite with ethyl bromide is

   (A) Ethane                        (B) Nitroethane
   (C) Ethyl nitrile                 (D) Ethyl isocyanide

42. Compound $C_4H_{10}O$ reacts with sodium metal to liberate hydrogen gas. It does not react with bromine in $CS_2$ but produces immediate cloudiness with Lucas reagent. The compound

    (A) n-butyl alcohol          (B) sec-butyl alcohol
    (C) iso-butyl alcohol        (D) tert-butyl alcohol

43. Compound A $C_4H_8Cl_2$ is hydrolyzed to compound B, $C_4H_8O$ which gives an oxime and a negative Tollen's test. The structure of A is

    (A) $CH_3CH_2CH_2CHCl_2$          (B) $CH_3CH_2C(Cl_2)CH_3$
    (C) $CH_3CH(Cl)CH(Cl)CH_3$       (D) $CH_3CH(Cl)CH_2CH_2Cl$

44. Which of the following does not obey Huckel rule?

    (A)           (B) 

    (C)           (D) 
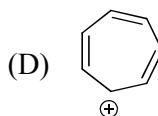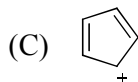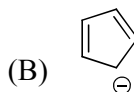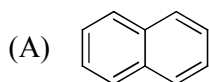
45. Glycerol on heating with excess of HI gives

    (A) Allyl iodide          (B) 1,2,3-triodopropane
    (C) Propene               (D) Isopropyl iodide

46. The geometrical isomerism is shown by

    (A)           (B) 

    (C)           (D) 
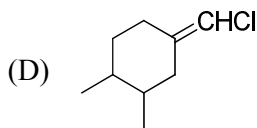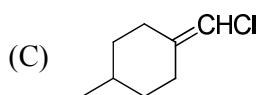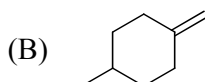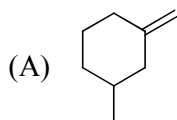
47. Correct configuration of the following is
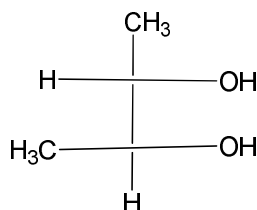
    

    (A) 1S, 2S          (B) 1S, 2R
    (C) 1R, 2S          (D) 1R, 2R

48. The secondry structure of a protein refers to

    (A) α-helical backbone
    (B) Hydrophobic interactions
    (C) Sequence of α-amino acids
    (D) Fixed configuration of the polypeptide backbone

49. The relative resonance energies of thiophene, pyrrole and furan

    (A) Furan > Pyrrole > Thiophene
    (B) Pyrrole > Furan > Thiophene
    (C) Thiophene > Pyrrole > Furan
    (D) Thiophene > Furan > Pyrrole

50. The major product X in the following reaction is



(A) 

(B) 

(C) 
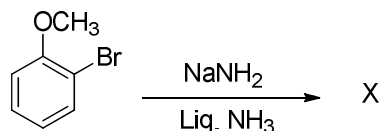
(D) Mixture of (A) and (B)

51. $KMnO_4$ reacts with oxalic acid according to the equation
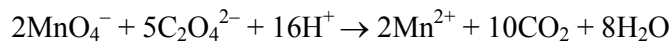
$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$
So, 20 mL of 0.1 M $KMnO_4$ requires

    (A) 20 mL of 0.1 M oxalic acid    (B) 50 mL of 0.1 M oxalic acid
    (C) 20 mL of 0.5 M oxalic acid    (D) 50 mL of 0.5 M oxalic acid

52. 2.5 g of an iron compound upon suitable treatment gave 0.358 g of ferric oxide. The percentage of iron in the compound is (Atomic masses: Fe = 55.85; O = 16)

    (A) 10.01    (B) 20.02
    (C) 15.01    (D) 2.5

53. The amount (in grams) of potassium dichromate (MW = 294) present in 200 mL of 0.25M aqueous solution is

    (A) 147    (B) 14.7
    (C) 1.47    (D) 0.147

54. Ilmenite, cassiterite and hematite are, respectively, the ores of

   (A)  iron, tin and titanium          (B)  tin, titanium and iron
   (C)  titanium, iron and tin          (D)  titanium, tin and iron

55. An aqueous solution of a compound $MCl_2$ (where M is first row transition metal) produces bright red precipitate with ethanolic solution of dimethylglyoxime.  The compound is

   (A)  $FeCl_2$                        (B)  $CoCl_2$
   (C)  $NiCl_2$                        (D)  $CuCl_2$

56. From a solution  mixture of  $Zn^{2+}$, $Cd^{2+}$, $Mn^{2+}$ and $Hg^{2+}$ ions, $H_2S$ in acidic medium will not precipitate

   (A)  $Hg^{2+}$ and $Cd^{2+}$         (B)  $Mn^{2+}$ and $Cd^{2+}$
   (C)  $Zn^{2+}$ and $Cd^{2+}$         (D)  $Zn^{2+}$ and $Mn^{2+}$

57. Sodium salts of pseudohalogens, X and Y, give colourless solutions in water. Solution of X produces intense red colour with $Fe^{3+}$ ions, while solution of Y gives intense blue colour with ferrous and ferric ion mixture. The pseudohalides X and Y are respectively

   (A)  $CN^-$ and $SCN^-$             (B)  $N_3^-$ and $SCN^-$
   (C)  $N_3^-$ and $CN^-$             (D)  $SCN^-$ and $CN^-$

58. The molecular shapes of $CF_4$ and $SF_4$ are, respectively

   (A)  tetrahedral and tetrahedral
   (B)  tetrahedral and square planar
   (C)  square planar and square planar
   (D)  tetrahedral and see-saw

59. The number of $90^o$ and $180^o$ F-P-F bonds in $PF_5$ are respectively

   (A)  6 and 1                        (B)  6 and 2
   (C)  3 and 1                        (D)  1 and 1

60. Identify the pair which has the identical number of lone pairs

   (A)  $XeF_4, ClF_3$                 (B)  $XeF_4 , XeO_2F_2$
   (C)  $XeO_4, ICl_4^-$               (D)  $XeO_4, ClF_3$

61. Among Ti(IV), Cr(III), Zn(II) and Cu(II) ions, the species which have partially filled d-orbitals are

   (A)  Cr(III), Zn(II)                (B)  Ti(IV), Zn(II)
   (C)  Cr(III), Cu(II)                (D)  Ti(IV), Cu(II)

62.  Separation of lanthanide ions, $Lu^{3+}$, $Yb^{3+}$, $Dy^{3+}$ and $Eu^{3+}$ can be effected by using a cation exchange resin using an appropriate eluent.  The order in which the ions will be separated is

(A)   $Lu^{3+}$, $Yb^{3+}$, $Dy^{3+}$, $Eu^{3+}$
(B)   $Eu^{3+}$, $Dy^{3+}$, $Yb^{3+}$, $Lu^{3+}$
(C)   $Yb^{3+}$, $Dy^{3+}$, $Eu^{3+}$, $Lu^{3+}$
(D)   $Dy^{3+}$, $Yb^{3+}$, $Lu^{3+}$, $Eu^{3+}$

63.  The pair of lanthanides having the highest third ionization energy is

(A)   Eu, Gd
(B)   Eu,Yb
(C)   Dy, Yb
(D)   Yb, Lu

64.  The order of Lewis acidity of boron halides is

(A)   $BF_3 < BCl_3 < BBr_3$
(B)   $BCl_3 < BF_3 < BBr_3$
(C)   $BBr_3 < BCl_3 < BF_3$
(D)   $BF_3 < BBr_3 < BCl_3$

65.  The reaction of $BCl_3$ with $NH_4Cl$ at $140°C$ followed by treatment with $NaBH_4$ gives

(A)   $Cl_3B_3N_3H_3$
(B)   $B_3N_3H_6$
(C)   $B_3N_3H_3$
(D)   $B_3N_3H_{12}$

66.  In the following reactions
(i)     $Cl^- + nH_2O \rightarrow [Cl(H_2O)_n]^-$
(ii)    $Fe^{2+} + 6\ H_2O \rightarrow [Fe(H_2O)_6]^{2+}$
Water behaves as

(A)   an acid in both (i) and (ii)
(B)   a base in both (i) and (ii)
(C)   an acid in  (i) and  a base in (ii)
(D)   a base  in  (i) and  an acid in (ii)

67.  Ozone in the upper atmosphere protects life on earth

(A)   due to its diamagnetic nature
(B)   due to its blue colour
(C)   due to absorption of radiation of  $\lambda = 255$ nm
(D)   by destroying chlorofluorocarbons

68.  Identify the statement which is not true for diborane

(A)   It contains two bridging-and four terminal hydrogens
(B)   All the B-H bonds are of equal length
(C)   The bridging and terminal hydrogens are in mutually perpendicular plane
(D)   Diborane is very air sensitive

69. Metal-metal quadruple bonds are known to exist in

   (A) $Fe_3(CO)_{12}$                (B) $Co_2(CO)_8$
   (C) $K_2Re_2Cl_8$               (D) $Cu_2(CH_3COO)_4$

70. The reactions of water with $CaC_2$ and $Al_4C_3$ yield

   (A) methane in both
   (B) ethyne in both
   (C) methane in the first and ethyne in the second
   (D) ethyne in the first and methane in the second

71. Among the pentahalides of group 15, the one which is unlikely to exist due to "inert pair" effect is

   (A) $PCl_5$                     (B) $AsCl_5$
   (C) $SbCl_5$                    (D) $BiCl_5$

72. The first ionization energy increases in the sequence

   (A) $Be < B < C < N$            (B) $Be > B < C < N$
   (C) $Be > B > C < N$            (D) $Be > B > C > N$

73. When a double bond is formed between two atoms, one of the bonds is a sigma bond and the other is a pi-bond. The pi-bond is created by the overlap of

   (A) $sp^3$ hybrid orbitals       (B) $sp^2$ hybrid orbitals
   (C) sp hybrid orbitals          (D) p-orbitals

74. Among the pairs of elements (i) Sc, Y, (ii) Zr, Hf (iii) La, Lu and (iv) Mo, W, the pairs having almost the same covalent radii are

   (A) (i), (ii) and (iii)         (B) (i), (ii) and (iv)
   (C) (ii) and (iii)              (D) (ii), and (iv)

75. The O–O stretching frequencies were observed at 810, 1100 and 1580 $cm^{-1}$ for the three dioxygen species – $O_2$, $O_2^-$ and $O_2^{2-}$, but not necessarily in the same order. The correct correlation between them is

   (A) $O_2$, 810; $O_2^-$, 1100 ; $O_2^{2-}$, 1580   (B) $O_2$, 1100; $O_2^-$, 810 ; $O_2^{2-}$, 1580
   (C) $O_2$, 1580; $O_2^-$, 1100 ; $O_2^{2-}$, 810   (D) $O_2$, 810; $O_2^-$, 1580 ; $O_2^{2-}$, 1100

76. The magnetic properties of $O_2$ and $O_2^{2-}$ are, respectively

   (A) paramagnetic and paramagnetic
   (B) diamagnetic and diamagnetic
   (C) diamagnetic and paramagnetic
   (D) paramagnetic and diamagnetic

77.  The type of interaction that holds layers of graphite together is

(A)  covalent bonding          (B)  van der Waals forces
(C)  hydrogen bonding          (D)  ionic bonding

78.  Consider the following characteristics of the blue solution of sodium in liquid ammonia
(i) diamagnetic          (ii) reducing in nature          (iii) conducts electricity

Which of them are true?

(A)  (i), (ii) and (iii)        (B)  (i) and (ii)
(C)  (i) and (iii)             (D)  (ii) and (iii)

79.  For tetrahedral complexes which always exhibit high spin states, the maximum CFSE is

(A)  −8Dq                     (B)  −12 Dq
(C)  −16Dq                    (D)  −6 Dq

80.  In general, the magnetic susceptibilities of paramagnetic complexes varies with temperature as

(A)  $T^2$                    (B)  T
(C)  $T^{-2}$                 (D)  $T^{-1}$

81.  The structures of the complexes, $[Cu(NH_3)_4](ClO_4)_2$ and $[Cu(NH_3)_4](ClO_4)$ are, respectively

(A)  square planar and tetrahedral
(B)  square planar and square planar
(C)  octahedral  and square pyramidal
(D)  octahedral and trigonal bipyramidal

82.  The d-electron configuration of $[Fe(CN)_6]^{3-}$ ion and its magnetic moment in B.M. are

(A)  $d^5$ and $\sqrt{5(5+2)}$        (B)  $d^5$ and $\sqrt{1(1+2)}$
(C)  $d^5$ and $\sqrt{5(5+1)}$        (D)  $d^5$ and $\sqrt{1(1+1)}$

83.  Among  $V(CO)_6$ ,  $Cr(CO)_6$ , $Fe(CO)_5$ and $Ni(CO)_4$, the compounds which obey EAN rule are

(A)  $V(CO)_6$, $Cr(CO)_6$ and $Fe(CO)_5$     (B)  $V(CO)_6$ , $Fe(CO)_5$ and $Ni(CO)_4$
(C)  $Cr(CO)_6$, $Fe(CO)_5$ and $Ni(CO)_4$     (D)  only $V(CO)_6$  and $Cr(CO)_6$

84.  In the compounds, $MeCo(CO)_4$ and $NaCo(CO)_4$, the formal oxidation number and the coordination number of Co are respectively:

(A)  +1, 5 and +1, 5          (B)  +1, 4 and +1, 4
(C)  +1, 5 and −1, 4          (D)  −1, 5 and +1, 4

85. The true statement about $[Cu(NH_3)_6]^{2+}$ ion is

   (A) all the Cu-N distances are equal
   (B) all the Cu-N distances are unequal
   (C) the equatorial bonds are longer than the axial bonds
   (D) the equatorial bonds are shorter than the axial bonds

86. The octahedral crystal field splitting ($\Delta o$) of $d$ orbital energies of the following metal ions decreases in the order

   (A) $Co^{2+} > Co^{3+} > Rh^{3+}$
   (B) $Rh^{3+} > Co^{3+} > Co^{2+}$
   (C) $Rh^{3+} > Co^{2+} > Co^{3+}$
   (D) $Co^{3+} > Co^{2+} > Rh^{3+}$

87. Ignoring the pairing energy, the CFSE of an octahedral high spin $Co^{2+}$ complex is

   (A) $-20Dq$
   (B) $+20Dq$
   (C) $+8Dq$
   (D) $-8Dq$

88. The crystal field splitting energy $\Delta_o$ and pairing energy, P values (in $cm^{-1}$) of octahedral energy complexes of $Fe^{2+}$ are : $\Delta_o = 10400$ for 6 $H_2O$ and 33000 for 6 $CN^-$; P = 17600.
   Then the spin states of the complexes would be

   (A) both high spin
   (B) both low spin
   (C) high spin aqua complex and low spin cyanido complex
   (D) low spin aqua complex and high spin cyanido complex

89. $Ni^{2+}(aq) + 3\ en(aq) \rightleftharpoons [Ni(en)_3]^{2+}(aq)$
   $Ni^{2+}(aq) + 6\ NH_3(aq) \rightleftharpoons [Ni(NH_3)_6]^{2+}(aq)$
   The equilibrium constant for the formation of $[Ni(en)_3]^{2+}(aq)$ (where en = ethylenediamine) is about $10^{10}$ times higher than that for $[Ni(NH_3)_6]^{2+}(aq)$. The primary explanation for this large difference is

   (A) Jahn-Teller effect
   (B) Macrocyclic effect
   (C) Chelate effect
   (D) Crystal field effect

90. Among $CN^-$, $Cl^-$, $CO$ and $CH_3^-$, the ligand with only sigma bonding character is

   (A) $CN^-$
   (B) $Cl^-$
   (C) $CO$
   (D) $CH_3^-$

91. Consider the complexes, $[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5(ONO)]Cl_2$. The type of isomerism exhibited by the complexes is

   (A) coordination isomerism
   (B) ionization isomerism
   (C) linkage isomerism
   (D) optical isomerism

92. An Au-Cu alloys crystallizes in a cubic lattice with gold atoms occupying the corners of the cube and the copper atoms at the centers of the cubic faces. The empirical formula of the alloy is

(A) $Au_8Cu_6$      (B) $AuCu_3$
(C) $Au_2Cu_3$      (D) $Au_3Cu$

93. The lattice energies of potassium halides follow the order

(A) KF < KCl < KBr < KI      (B) KI < KCl < KF < KBr
(C) KF < KBr < KCl < KI      (D) KI < KBr < KCl < KF

94. Band theory predicts magnesium to be an insulator, but in practice it is a good conductor. This is due to

(A) presence of filled 3s orbital
(B) overlap of filled 2p and filled 3s orbitals
(C) overlap of filled 3s and empty 3p orbital
(D) presence of unfilled 3p orbital

95. The electrical conductivity of a metal

(A) increases with increasing temperature
(B) decreases with increasing temperature
(C) is independent of temperature
(D) shows oscillatory behaviour with temperature

96. In 'carbon-dating' applications of radioisotopes, $^{14}C$ emits

(A) α particle      (B) β particle
(C) γ radiation      (D) positrons

97. A β-particle followed by an α-particle emission from $^{214}_{83}Bi$, the number of neutrons present in the daughter nucleus is

(A) 130      (B) 128
(C) 127      (D) 129

98. The correct set of biologically essential elements is

(A) Fe, Cu, Zn, Ag      (B) Fe, Cu, Zn, Mg
(C) Cu, Mn, Co, Pt      (D) Mg, Fe, Co, Ti

99. The enzyme involved in hydration of metabolic carbon dioxide and the metal present in it are

(A) cytochrome c, Fe      (B) hemocyanin, Cu
(C) carboxypeptidase, Zn      (D) carbonic anhydrase, Zn

100. Redox enzymes involve metal ions which could exist in two different stable oxidation states. Which of the following is likely to be found in the redox enzyme systems?

   (A) Ca, Zn                      (B) Na, Mg
   (C) Al, Ga                      (D) Cu, Fe

101. The total number of fundamental movements for a molecule consisting of n atoms

   (A) $3n + 6$                    (B) $3n - 5$
   (C) $3n$                        (D) $3n + 5$

102. $C_2^{\;2} = ?$

   (A) E                           (B) $C_2$
   (C) $\sigma_v$                  (D) $\sigma_v \sigma_v{}'$

103. Principal axis means

   (A) X axis
   (B) Z axis
   (C) The rotational axis with the highest order
   (D) Y axis

104. The order of the point group $C_2$ is

   (A) 2                           (B) 0
   (C) 1                           (D) 3

105. Choose the molecule not belonging to point group $C_{\infty v}$

   (A) HCl                         (B) OCS
   (C) HCN                         (D) $CO_2$

106. Match the following

   | Molecule | Point group |
   |----------|-------------|
   | (I)   $CH_3Cl$ | (i) $D_{\infty h}$ |
   | (II)  $H_2O$   | (ii) $C_{\infty v}$ |
   | (III) $H_2$    | (iii) $C_{2v}$ |
   | (IV)  HCl      | (iv) $C_{3v}$ |

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

107. Match the following

| Region | λ(nm) |
|--------|-------|
| (I) UV | (i) $10^{11}$ |
| (II) Visible | (ii) $1,000 - 10,000$ |
| (III) IR | (iii) 400 - 700 |
| (IV) Radiowave | (iv) $200 - 350$ |

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

108. Unit of reaction rate constant, k for a zero order reaction

(A) $dm^3 \, mol \, s^{-1}$
(B) $s^{-1}$
(C) $dm^3 \, mol^{-1}$
(D) $dm^{-3}.mol \, s^{-1}$

109. A harmonic oscillator obeys

(A) Hooke's law
(B) Boyle's law
(C) Dalton's law
(D) First law of thermodynamics

110. If any two rows or columns are the same, the value of the determinant is

(A) One
(B) Zero
(C) Two
(D) Half

111. $CH_4$ belongs to the point group

(A) $T_d$
(B) $D_{2d}$
(C) $C_{3v}$
(D) $C_{2h}$

112. The number of translational, rotational and vibrational degrees of freedom of HCl are respectively

(A) 3, 3, 3
(B) 3, 2, 4
(C) 3, 2, 1
(D) 1, 1, 1

113. The selection rule in the rigid-rotator approximation is

(A) $\Delta J = \pm 1$
(B) $\Delta J = + 2$
(C) $\Delta J = 0$
(D) $\Delta J = \pm 2$

114. In the Beer – Lambert law, $A = ln\frac{Io}{I} = Kcl$. The units of K are

(A) $m^2$
(B) $m^2.mol^{-1}$
(C) $mol^{-1}$
(D) Dimensionless

115. Triple point of water

    (A)  273.16 K                (B)  760 K
    (C)  0 K                    (D)  100 K

116. Spherical top molecule

    (A)  $I_A = I_B = I_C$          (B)  $I_A \neq I_B \neq I$
    (C)  $I_B = I_C \neq I_A$          (D)  $I_B \neq I_A = I_C$

117. Which is used as a catalyst for the hydrogenation of oils?

    (A)  Ni                 (B)  ZnO
    (C)  C                   (D)  $H_2SO_4$

118. Choose the polar molecule(s)

    (I) OCS        (II) $H_2O$      (III) $CO_2$     (IV) $N_2$

    (A)  (I) and (II)         (B)  (III) and (IV)
    (C)  (III) only          (D)  (IV) only

119. Choose the molecule not having center of inversion

    (A)  $CO_2$              (B)  Benzene
    (C)  Regular octahedron      (D)  $H_2O$

120. de Broglie relation is

    (A)  $p = \dfrac{h}{\lambda}$             (B)  $p = \dfrac{h}{2\pi}$

    (C)  $p = h\lambda$             (D)  $p = \dfrac{\lambda}{h}$

    were p is the linear momentum

121. Match the following

    <u>Quantum number</u>         <u>Function</u>

    (I)   Principal        (i)   Governs the axial angular momentum of the electron
    (II)  Orbital          (ii)  Governs the direction of an orbital
    (III  Magnetic       (iii) Governs the shape of an orbital
    (IV) Spin            (iv) Governs the energy of the orbital

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

122. Match the following

Characteristic Properties                    Instrumental Method

(I)   Electrical resistance              (i)  Isotope dilution method
(II)  Electrical charge                  (ii) Kinetic method
(III) Rate of the reaction               (iii) Coulometery
(IV)  Radioactivity                      (iv) Conductometry

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

123. Molar absorptivity is defined as

    (A)  $\dfrac{A}{bc}$                     (B)  Abc

    (C)  $\dfrac{1}{T}$                      (D)  $\dfrac{bc}{A}$

where A is absorbance, T is transmittance, b is path length and c is concentration

124. If the absorbance is 0.0510, then the percent transmittance is equal to

    (A)  51 %                           (B)  11.1 %
    (C)  88.9 %                         (D)  9.45 %

125. C = O Stretching frequency region is

    (A)  $1640 – 1780 \text{ cm}^{-1}$        (B)  $2850 – 2960 \text{ cm}^{-1}$
    (C)  $1350 – 1420 \text{ cm}^{-1}$        (D)  $3590 – 3650 \text{ cm}^{-1}$

126. For a spontaneous reaction, ΔG must be

    (A)  Negative                       (B)  Positive
    (C)  Zero                           (D)  Infinity

127. Choose the isotopes suitable for Mossbauer work
    (I) $^{57}$F    (II) $^{119}$Sn    (III) $^{129}$I    (IV) $^{99}$Ru

    (A)  I and II only                  (B)  All the four
    (C)  None                           (D)  IV only

128. For an adiabatic change $\Delta S_{sur}$ is equal to

    (A)  0                              (B)  <1
    (C)  ∞                              (D)  >1

129.    Ice has a residual entropy of ………….. $JK^{-1} mol^{-1}$

    (A)   15                              (B)   1.0
    (C)   0                               (D)   100

130.    Number of vibrational degrees of freedom for a methane molecule

    (A)   10                              (B)   9
    (C)   15                              (D)   1

131.    What is the zero-point energy of simple harmonic oscillator?

    (A)   $\frac{1}{2}\omega_{osc}$                        (B)   $\omega_{osc}$

    (C)   $\frac{3}{2}\omega_{osc}$                        (D)   Zero

132.    Number of infrared active normal modes of $CO_2$

    (A)   2                               (B)   3
    (C)   1                               (D)   None of the above

133.    Choose the molecule(s) showing rotational Raman spectrum

    (I) $CH_4$        (II) $SF_6$        (III) $CH_3 - CH_3$        (IV) HCl

    (A)   (III) and (IV)                  (B)   (I) and (II)
    (C)   (I) only                        (D)   (II) only

134.    An orthorhombic cell has the parameters, a = 0.82 nm, b = 0.94 nm, c = 0.75 nm. The spacing of the (123) plane is

    (A)   2.1 nm                          (B)   0.21 nm
    (C)   0.11 nm                         (D)   0.44 nm

135.   Which of the following is known as dry ice?

    (A)   Solid $CO_2$                      (B)   Charcoal
    (C)   $NH_3$                            (D)   $H_2O_2$

136.    The root- mean- square velocity (RMS) is given as

    (A)   3kT                             (B)   $3kTm$
    (C)   $\{\frac{3kT}{m}\}^{1/2}$                    (D)   $\frac{m}{3kT}$

137. ………….. region is the spectral region of rotation of polyatomic molecules.

(A) Visible        (B) UV
(C) Microwave       (D) IR

138. If number of protons and number of neutrons are even, then the nuclear spin quantum number, I is equal to

(A) 0        (B) 1
(C) 2        (D) 3

139. Bucky ball is

(A) Pb        (B) $C_{60}$
(C) $^{13}C$        (D) $CH_4$

140. First one to use the term nanotechnology

(A) Sumio        (B) Pauling
(C) Nario Taniguchi       (D) Qurie

141. Number of significant figures in 0.0025

(A) 2        (B) 3
(C) 4        (D) 1

142. The energy of a particle in a cubical box of length 'a' is given as $\dfrac{14h^2}{8ma^2}$. The degeneracy associated with the level is

(A) 1        (B) 2
(C) 3        (D) 6

143. The number of radial nodes for 4f atomic orbital is

(A) 0        (B) 1
(C) 2        (D) 3

144. Which of the following properties does not depend on zeta potential?

(A) Electro osmosis       (B) Electro phoresis
(C) Sedimentation       (D) Donnan membrane equilibrium

145. Which of the following isotherms deals with multilayer adsorption?

(A) Gibbs        (B) Langmuir
(C) BET        (D) Freundlich

146. Unimolecular surface catalysed gas phase reactions follow

    (A) first order kinetics at all pressures
    (B) first order kinetics at low pressures and zero order kinetics at high pressures
    (C) zero order kinetics at all pressures
    (D) zero order kinetics at low pressures and first order kinetics at high pressures

147. The absorbance of a solution is 1.0 at 540 nm. What percentage of radiation is absorbed by the solution?

    (A) 10                              (B) 50
    (C) 90                              (D) 100

148. An aqueous solution of $CuSO_4$ is electrolysed between 2 Pt electrodes. The reaction at anode is

    (A) oxidation of Cu                 (B) oxidation of $H_2O$
    (C) oxidation of sulphate ion       (D) oxidation of $H_2$

149. In Raman spectroscopy the radiation that is analysed is

    (A) scattered                       (B) reflected
    (C) transmitted                     (D) incident

150. Which of the following statements is not true?

    (A) Specific conductance increases with concentration of a strong electrolyte
    (B) Equivalent conductance increases with concentration of a strong electrolyte
    (C) Equivalent conductance decreases with concentration of a strong electrolyte
    (D) Equivalent conductance depends on ionic mobility

***