71. When *npn* transistor is used as an amplifier :
(a) electrons move from base to collector
(b) holes move from emitter to base
(c) electrons move from collector to base
(d) holes move from base to emitter

72. For a transistor amplifier in common emitter configuration for load impedance of 1 kΩ (h_{fe} = 50 and h_{oe} = 25 μ A/V), the current gain is :
(a) – 5.2 (b) – 15.7
(c) – 24.8 (d) – 48.78

73. A piece of copper and another of germanium are cooled from room temperature to 77 K, the resistance of :
(a) each of them increases
(b) each of them decreases
(c) copper decreases and germanium increases
(d) copper increases and germanium decreases

74. The manifestation of band structure in solids is due to :
(a) Heisenberg's uncertainty principle
(b) Pauli's exclusion principle
(c) Bohr's correspondence principle
(d) Boltzmann's law

75. When *p-n* junction diode is forward biased, then :
(a) the depletion region is reduced and barrier height is increased
(b) the depletion region is widened and barrier height is reduced
(c) both the depletion region and barrier height are reduced
(d) both the depletion region and barrier height are increased

Chemistry

76. Which of the following sets of quantum numbers is correct for an electron in 4*f* orbital ?
(a) $n = 4, l = 3, m = +4, s = +1/2$
(b) $n = 4, l = 4, m = -4, s = -1/2$
(c) $n = 4, l = 3, m = +1, s = +1/2$
(d) $n = 3, l = 2, m = -2, s = +1/2$

77. Consider the ground state of Cr atom (Z = 24). The numbers of electrons with the azimuthal quantum numbers, l = 1 and 2 are, respectively :
(a) 12 and 4 (b) 12 and 5
(c) 16 and 4 (d) 16 and 5

78. Which one of the following ions has the highest value of ionic radius ?
(a) Li^+ (b) B^{3+}
(c) O^{2-} (d) F^-

79. The wavelength of the radiation emitted, when in a hydrogen atom electron falls from infinity to stationary state 1, would be (Rydberg constant $= 1.097 \times 10^7\ m^{-1}$) :
(a) 91 nm (b) 192 nm
(c) 406 nm (d) 9.1×10^{-8} nm

80. The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is :
(a) $H_2S < SiH_4 < NH_3 < BF_3$
(b) $NH_3 < H_2S < SiH_4 < BF_3$
(c) $H_2S < NH_3 < SiH_4 < BF_3$
(d) $H_2S < NH_3 < BF_3 < SiH_4$

81. Which one of the following sets of ions represents the collection of isoelectronic species ?
(a) $K^+, Ca^{2+}, Sc^{3+}, Cl^-$
(b) $Na^+, Ca^{2+}, Sc^{3+}, F^-$
(c) $K^+, Cl^-, Mg^{2+}, Sc^{3+}$
(d) $Na^+, Mg^{2+}, Al^{3+}, Cl^-$
(Atomic numbers F = 9, Cl = 17, Na = 11, Mg = 12, Al = 13, K = 19, Ca = 20, Sc = 21)

82. Among Al_2O_3, SiO_2, P_2O_3 and SO_2 the correct order of acid strength is :
(a) $SO_2 < P_2O_3 < SiO_2 < Al_2O_3$
(b) $SiO_2 < SO_2 < Al_2O_3 < P_2O_3$
(c) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$
(d) $Al_2O_3 < SiO_2 < P_2O_3 < SO_2$

83. The bond order in NO is 2.5 while that in NO^+ is 3. Which of the following statements is true for these two species ?
(a) Bond length in NO^+ is greater than in NO
(b) Bond length in NO is greater than in NO^+
(c) Bond length in NO^+ is equal to that in NO
(d) Bond length is unpredictable

84. The formation of the oxide ion $O^{2-}(g)$ requires first an exothermic and then an endothermic step as shown below
$O(g) + e^- = O^-(g)$; $\Delta H° = -142\ kJ\ mol^{-1}$
$O(g)^- + e^- = O^{2-}(g)$; $\Delta H° = 844\ kJ\ mol^{-1}$

This is because :
(a) oxygen is more electronegative
(b) oxygen has high electron affinity
(c) O^- ion will tend to resist the addition of another electron
(d) O^- ion has comparatively larger size than oxygen atom

85. The states of hybridization of boron and oxygen atoms in boric acid (H_3BO_3) are respectively :
(a) sp^2 and sp^2 (b) sp^2 and sp^3
(c) sp^3 and sp^2 (d) sp^3 and sp^3

86. Which one of the following has the regular tetrahedral structure ?
(a) XeF_4 (b) SF_4
(c) BF_4^- (d) $[Ni(CN)_4]^{2-}$
(Atomic numbers B = 5, S = 16, Ni = 28, Xe = 54)

87. Of the following outer electronic configurations of atoms, the highest oxidation state is achieved by which one of them ?
(a) $(n-1)d^8ns^2$ (b) $(n-1)d^5ns^1$
(c) $(n-1)d^3ns^2$ (d) $(n-1)d^5ns^2$

88. As the temperature is raised from 20°C to 40°C, the average kinetic energy of neon atoms changes by a factor of which of the following ?
(a) 1/2 (b) $\sqrt{313/293}$
(c) 313/293 (d) 2

89. The maximum number of 90° angles between bond pair-bond pair of electrons is observed in :
(a) dsp^3 hybridization
(b) sp^3d hybridization
(c) dsp^2 hybridization
(d) sp^3d^2 hybridization

90. Which one of the following aqueous solutions will exhibit highest boiling point ?
(a) 0.01 M Na_2SO_4
(b) 0.01 M KNO_3
(c) 0.015 M urea
(d) 0.015 M glucose

91. Which among the following factors is the most important in making fluorine the strongest oxidizing agent ?
(a) Electron affinity
(b) Ionization enthalpy
(c) Hydration enthalpy
(d) Bond dissociation energy

92. In van der Waals' equation of state of the gas law, the constant 'b' is a measure of :
(a) intermolecular repulsions
(b) intermolecular attraction
(c) volume occupied by the molecules
(d) intermolecular collisions per unit volume

93. The conjugate base of $H_2PO_4^-$ is :
(a) PO_4^{3-} (b) P_2O_5
(c) H_3PO_4 (d) HPO_4^{2-}

94. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of urea solution is :
(a) 0.001 M (b) 0.01 M
(c) 0.02 M (d) 0.1 M
(Avogadro constant, $N_A = 6.02\times10^{23}$ mol^{-1})

95. To neutralise completely 20 mL of 0.1M aqueous solution of phosphorous acid (H_3PO_3), the volume of 0.1M aqueous KOH solution required is :
(a) 10 mL (b) 20 mL
(c) 40 mL (d) 60 mL

96. For which of the following parameters the structural isomers C_2H_5OH and CH_3OCH_3 would be expected to have the same values ? (Assume ideal behaviour) :
(a) Heat of vaporisation
(b) Vapour pressure at the same temperature
(c) Boiling points
(d) Gaseous densities at the same temperature and pressure

97. Which of the following liquid pairs shows a positive deviation from Raoult's law ?
(a) Water — hydrochloric acid
(b) Benzene — methanol
(c) Water — nitric acid
(d) Acetone — chloroform

98. Which one of the following statements is false ?
(a) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction
(b) The osmotic pressure (π) of a solution is given by the equation $\pi = MRT$, where M is the molarity of the solution
(c) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ sucrose
(d) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression

99. What type of crystal defect is indicated in the diagram below ?

$Na^+, Cl^-, Na^+, Cl^-, Na^+, Cl^-$

Cl^- □ Cl^- Na^+ □ Na^+

Na^+ Cl^- □ Cl^-, Na^+ Cl^-

Cl^- Na^+ Cl^- Na^+ □ Na^+

(a) Frenkel defect
(b) Schottky defect
(c) Interstitial defect
(d) Frenkel and Schottky defects

100. An ideal gas expands in volume from 1×10^{-3} m^3 to 1×10^{-2} m^3 at 300K against a constant pressure of 1×10^5 Nm^{-2}. The work done is :

(a) – 900 J (b) –900 k J
(c) 270 k J (d) 900 k J

101. In a hydrogen-oxygen fuel cell, combustion of hydrogen occurs to :

(a) generate heat
(b) create potential difference between the two electrodes
(c) produce high purity water
(d) remove adsorbed oxygen from electrode surfaces

102. In a first order reaction, the concentration of the reactant, decreases from 0.8 M to 0.4 M in 15 min. The time taken for the concentration to change from 0.1 M to 0.025 M is :

(a) 30 min (b) 15 min
(c) 7.5 min (d) 60 min

103. What is the equilibrium expression for the reaction

$$P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s) \text{ ?}$$

(a) $K_c = \dfrac{[P_4O_{10}]}{[P_4][O_2]^5}$ (b) $K_c = \dfrac{[P_4O_{10}]}{5[P_4][O_2]}$

(c) $K_c = [O_2]^5$ (d) $K_c = \dfrac{1}{[O_2]^5}$

104. For the reaction,
$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$, the K_p / K_c is equal to :

(a) $1/RT$ (b) RT
(c) $\sqrt{RT}$ (d) 1.0

105. The equilibrium constant for the reaction

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

at temperature T is 4×10^{-4}. The value of K_c for the reaction :

$NO(g) \rightleftharpoons \frac{1}{2} N_2(g) + \frac{1}{2} O_2(g)$ at the same temperature is :

(a) 2.5×10^2 (b) 50
(c) 4×10^{-4} (d) 0.02

106. The rate equation for the reaction $2A + B \rightarrow C$ is found to be :

$$\text{rate} = k[A][B]$$

The correct statement in relation to this reaction is that the :

(a) unit of k must be s^{-1}
(b) $t_{1/2}$ is a constant
(c) rate of formation of C is twice the rate of disappearance of A
(d) value of k is independent of the initial concentrations of A and B

107. Consider the following $E°$ values :

$$E°_{Fe^{3+}/Fe^{2+}} = +0.77 \text{ V}$$

$$E°_{Sn^{2+}/Sn} = -0.14 \text{ V}$$

Under standard conditions the potential for the reaction

$Sn(s) + 2Fe^{3+}(aq) \rightarrow 2Fe^{2+}(aq) + Sn^{2+}(aq)$ is :

(a) 1.68 V (b) 1.40 V
(c) 0.91 V (d) 0.63 V

108. The molar solubility (in $mol\ l^{-1}$) of a sparingly soluble salt MX_4 is 's'. The corresponding solubility product is K_{sp}. s is given in terms of K_{sp} by the relation :

(a) $s = (K_{sp}/128)^{1/4}$ (b) $s = (128\ K_{sp})^{1/4}$

(c) $s = (256\ K_{sp})^{1/5}$ (d) $s = (K_{sp}/256)^{1/5}$

109. The standard emf of a cell, involving one electron change is found to be 0.591 V at 25°C. The equilibrium constant of the reaction is ($F = 96{,}500$ C mol^{-1}, :

(a) 1.0×10^1 (b) 1.0×10^5
(c) 1.0×10^{10} (d) 1.0×10^{30}

110. The enthalpies of combustion of carbon and carbon monoxide are –393.5 and –283k J mol^{-1} respectively. The enthalpy of formation of carbon monoxide per mole is :

(a) 110.5 k J (b) 676.5 k J
(c) – 676.5 k J (d) – 110.5 k J

111. The limiting molar conductivities Λ^c for NaCl, KBr and KCl are 126, 152 and 150 S cm^2 mol^{-1} respectively. The $\Lambda°$ for NaBr is :

(a) 128 S cm^2 mol^{-1} (b) 176 S cm^2 mol^{-1}
(c) 278 S cm^2 mol^{-1} (d) 302 S cm^2 mol^{-1}

112. In a cell that utilises the reaction

$Zn(s) + 2H^+(aq) \longrightarrow Zn^{2+}(aq) + H_2(g)$

addition of H_2SO_4 to cathode compartment, will :

(a) lower the E and shift equilibrium to the left
(b) lower the E and shift the equilibrium to the right
(c) increase the E and shift the equilibrium to the right
(d) increase the E and shift the equilibrium to the left

113. Which one of the following statements regarding helium is incorrect ?

(a) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable
(b) It is used as a cryogenic agent for carrying out experiments at low temperatures
(c) It is used to produce and sustain powerful superconducting magnets
(d) It is used in gas-cooled nuclear reactors

114. Identify the correct statement regarding enzymes :

(a) Enzymes are specific biological catalysts that can normally function at very high temperatures ($T \sim 1000$ K).
(b) Enzymes are normally heterogeneous catalysts that are very specific in their action
(c) Enzymes are specific biological catalysts that cannot be poisoned
(d) Enzymes are specific biological catalysts that possess well defined active sites.

115. One mole of magnesium nitride on the reaction with an excess of water gives :

(a) one mole of ammonia
(b) one mole of nitric acid
(c) two moles of ammonia
(d) two moles of nitric acid

116. Which one of the following ores is best concentrated by froth-floatation method ?

(a) Magnetite (b) Cassiterite
(c) Galena (d) Malachite

117. Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in :

(a) exhibiting maximum covalency in compounds
(b) forming polymeric hydrides
(c) forming covalent halides
(d) exhibiting amphoteric nature in their oxides

118. Aluminium chloride exists as dimer, Al_2Cl_6 in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives :

(a) $Al^{3+} + 3Cl^-$
(b) $[Al(H_2O)_6]^{3+} + 3Cl^-$
(c) $[Al(OH)_5]^{3-} + 3HCl$
(d) $Al_2O_3 + 6HCl$

119. The soldiers of Napolean army while at Alps during freezing winter suffered a serious problem as regards to the tin buttons of their uniforms. White metallic tin buttons got converted to grey powder. This transformation is related to :

(a) a change in the crystalline structure of tin
(b) an interaction with nitrogen of the air at very low temperatures
(c) a change in the partial pressure of oxygen in the air
(d) an interaction with water vapour contained in the humid air

120. The $E^\circ_{M^{3+}/M^{2+}}$ values for Cr, Mn, Fe and Co are -0.41, $+1.57$, $+0.77$ and $+1.97$ V respectively. For which one of these metals the change in oxidation state from $+2$ to $+3$ is easiest ?

(a) Cr (b) Mn
(c) Fe (d) Co

121. Excess of KI reacts with $CuSO_4$ solution and then $Na_2S_2O_3$ solution is added to it. Which of the statements is incorrect for this reaction ?

(a) Cu_2I_2 is formed
(b) CuI_2 is formed
(c) $Na_2S_2O_3$ is oxidised
(d) Evolved I_2 is reduced

122. Among the properties (A) reducing (B) oxidising (C) complexing, the set of properties shown by CN^- ion towards metal species is :

(a) A, B (b) B, C
(c) C, A (d) A, B, C

123. The co-ordination number of a central metal atom in a complex is determined by :

(a) the number of ligands around a metal ion bonded by sigma bonds
(b) the number of ligands around a metal ion bonded by pi-bonds
(c) the number of ligands around a meral ion bonded by sigma and pi-bonds both
(d) the number of only anionic ligands bonded to the metal ion

124. Which one of the following complexes is an outer orbital complex ?

(a) $[Fe(CN)_6]^{1-}$ (b) $[Mn(CN)_6]^{4-}$

(c) $[Co(NH_3)_6]^{3+}$ (d) $[Ni(NH_3)_6]^{2+}$

(Atomic numbers Mn – 25, Fe = 26, Co = 27, Ni = 28)

125. Co-ordination compounds have great importance in biological systems. In this context which of the following statements is incorrect ?

(a) Chlorophylls are green pigments in plants and contain calcium

(b) Haemoglobin is the red pigment of blood and contains iron

(c) Cyanocobalamin is vitamin B_{12} and contains cobalt

(d) Carboxypeptidase-A is an enzyme and contains zinc

126. Cerium ($Z = 58$) is an important member of the lanthanides. Which of the following statements about cerium is incorrect ?

(a) The common oxidation states of cerium are + 3 and + 4

(b) The +3 oxidation state of cerium is more stable than the + 4 oxidation state

(c) The + 4 oxidation state of cerium is not known in solutions

(d) Cerium (IV) acts as an oxidising agent

127. Which one of the following has largest number of isomers ?

(a) $[Ru(NH_3)_4Cl_2]^+$

(b) $[Co(NH_3)_5Cl]^{2+}$

(c) $[Ir(PR_3)_2H(CO)]^{2+}$

(d) $[Co(en)_2Cl_2]^+$

(R = alkyl group, en = ethylenediamine)

128. The correct order of magnetic moments (spin only values in BM) among the following is :

(a) $[MnCl_4]^{2-} > [CoCl_4]^{2-} > [Fe(CN)_6]^{4-}$

(b) $[MnCl_4]^{2-} > [Fe(CN)_6]^{4-} > [CoCl_4]^{2-}$

(c) $[Fe(CN)_6]^{4-} > [MnCl_4]^{2-} > [CoCl_4]^{2-}$

(d) $[Fe(CN)_6]^{4-} > [CoCl_4]^{2-} > [MnCl_4]^{2-}$

(Atomic numbers Mn = 25, Fe = 26, Co = 27)

129. Consider the following nuclear reactions :

$^{238}_{92}M \rightarrow {}^{x}_{y}N + 2\,{}^{4}_{2}He$; ${}^{x}_{y}N \rightarrow {}^{A}_{B}L - 2\beta^+$

The number of neutrons in the element L is :

(a) 142 (b) 144

(c) 140 (d) 146

130. The half-life of a radioisotope is four hours. If the initial mass of the isotope was 200g, the mass remaining after 24 hours undecayed is :

(a) 1.042 g (b) 2.084 g

(c) 3.125 g (d) 4.167 g

131. The compound formed in the positive test for nitrogen with the Lassaigne solution of an organic compound is :

(a) $Fe_4[Fe(CN)_6]_3$

(b) $Na_3[Fe(CN)_6]$

(c) $Fe(CN)_3$

(d) $Na_4[Fe(CN)_5NOS]$

132. The ammonia evolved from the treatment of 0.30g of an organic compound for the estimation of nitrogen was passed in 100 mL of 0.1 M sulphuric acid. The excess of acid required 20 mL of 0.5 M sodium hydroxide solution for complete neutralization. The organic compound is :

(a) acetamide (b) benzamide

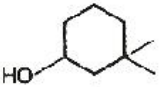
(c) urea (d) thiourea

133. Which one of the following has the minimum boiling point ?

(a) n-butane (b) 1-butyne

(c) 1-butene (d) Isobutene

134. The IUPAC name of the compound



is :

(a) 3,3-dimethyl-1-hydroxy cyclohexane

(b) 1,1-dimethyl-3-hydroxy cyclohexane

(c) 3,3-dimethyl-1-cyclohexanol

(d) 1,1-dimethyl-3-cyclohexanol

135. Which one of the following does not have sp^2 hybridised carbon ?

(a) Acetone (b) Acetic acid

(c) Acetonitrile (d) Acetamide

136. Which of the following will have a meso-isomer also ?

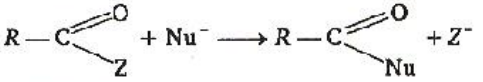
(a) 2-chlorobutane

(b) 2,3-dichlorobutane

(c) 2,3-dichloropentane

(d) 2-hydroxypropanoic acid

137. Rate of the reaction



is fastest when Z is :

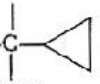
(a) Cl (b) NH_2

(c) OC_2H_5 (d) $OCOCH_3$

138. Amongst the following compounds, the optically active alkane having lowest molecular mass is :

(a) $CH_3-CH_2-CH_2-CH_3$

(b) $CH_3-CH_2-\underset{CH_3}{\underset{|}{CH}}-CH_3$

(c) $CH_3-\underset{C_2H_5}{\underset{|}{\overset{H}{\overset{|}{C}}}}$ 

(d) $CH_3-CH_2-C\equiv CH$

139. Consider the acidity of the carboxylic acids :

(i) PhCOOH

(ii) o-$NO_2C_6H_4COOH$

(iii) p-$NO_2C_6H_4COOH$

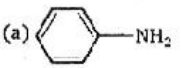
(iv) m-$NO_2C_6H_4COOH$

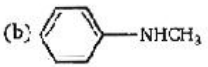
Which of the following order is correct ?

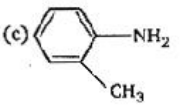
(a) i > ii > iii > iv (b) ii > iv > iii > i

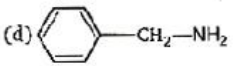
(c) ii > iv > i > iii (d) ii > iii > iv > i

140. Which of the following is the strongest base ?

(a) 

(b) 

(c) 

(d) 

141. Which base is present in RNA but not in DNA ?

(a) Uracil (b) Cytosine

(c) Guanine (d) Thymine

142. The compound formed on heating chlorobenzene with chloral in the presence of concentrated sulphuric acid is :

(a) gammexane (b) DDT

(c) freon (d) hexachloroethane

143. On mixing ethyl acetate with aqueous sodium chloride, the composition of the resultant solution is :

(a) $CH_3COOC_2H_5 + NaCl$

(b) $CH_3COONa + C_2H_5OH$

(c) $CH_3COCl + C_2H_5OH + NaOH$

(d) $CH_3Cl + C_2H_5COONa$

144. Acetyl bromide reacts with excess of CH_3MgI followed by treatment with a saturated solution of NH_4Cl gives :

(a) acetone

(b) acetamide

(c) 2-methyl-2-propanol

(d) acetyl iodide

145. Which one of the following is reduced with zinc and hydrochloric acid to give the corresponding hydrocarbon ?

(a) Ethyl acetate (b) Acetic acid

(c) Acetamide (d) Butan-2-one

146. Which one of the following undergoes reaction with 50% sodium hydroxide solution to give the corresponding alcohol and acid ?

(a) Phenol (b) Benzaldehyde

(c) Butanal (d) Benzoic acid

147. Among the following compounds which can be dehydrated very easily ?

(a) $CH_3CH_2CH_2CH_2CH_2OH$

(b) $CH_3CH_2CH_2\underset{OH}{\underset{|}{C}}HCH_3$

(c) $CH_3CH_2\underset{OH}{\underset{|}{C}}CH_2CH_3$

(d) $CH_3CH_2CH\underset{CH_3}{\underset{|}{C}}H_2CH_2OH$

148. Which of the following compounds is not chiral ?

(a) 1-chloropentane

(b) 2-chloropentane

(c) 1-chloro-2-methyl pentane

(d) 3-chloro-2-methyl pentane

149. Insulin production and its action in human body are responsible for the level of diabetes. This compound belongs to which of the following categories ?

(a) A co-enzyme (b) A hormone

(c) An enzyme (d) An antibiotic

150. The smog is essentially caused by the presence of :

(a) O_2 and O_3

(b) O_2 and N_2

(c) oxides of sulphur and nitrogen

(d) O_3 and N_2