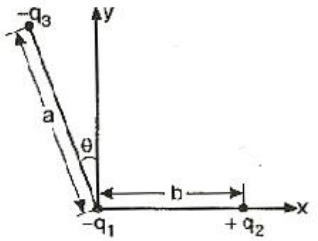
65. If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{2+} is :
(a) 30.6 eV (b) 13.6 eV
(c) 3.4 eV (d) 122.4 eV

66. A body is moved along a straight line by a machine delivering a constant power. The distance moved by the body in time t is proportional to :
(a) $t^{3/4}$ (b) $t^{3/2}$
(c) $t^{1/4}$ (d) $t^{1/2}$

67. A rocket with a lift-off mass 3.5×10^4 kg is blasted upwards with an initial acceleration of 10 m/s^2. Then the initial thrust of the blast is :
(a) 3.5×10^5 N (b) 7.0×10^5 N
(c) 14.0×10^5 N (d) 1.75×10^5 N

68. To demonstrate the phenomenon of interference we require two sources which emit radiations of :
(a) nearly the same frequency
(b) the same frequency
(c) different wavelength
(d) the same frequency and having a definite phase relationship

69. Three charges $-q_1$, $+q_2$ and $-q_3$ are placed as shown in the figure. The x-component of the force on $-q_1$ is proportional to :



(a) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\cos\theta$ (b) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\sin\theta$
(c) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\cos\theta$ (d) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\sin\theta$

70. A 220 V, 1000 W bulb is connected across a 110 V mains supply. The power consumed will be :
(a) 750 W (b) 500 W
(c) 250 W (d) 1000 W

71. The image formed by an objective of a compound microscope is :
(a) virtual and diminished
(b) real and diminished
(c) real and enlarged
(d) virtual and enlarged

72. The earth radiates in the infra-red region of the spectrum. The spectrum is correctly given by :
(a) Rayleigh Jeans law
(b) Planck's law of radiation
(c) Stefan's law of radiation
(d) Wien's law

73. To get three images of a single object, one should have two plane mirrors at an angle of :
(a) 60° (b) 90°
(c) 120° (d) 30°

74. According to Newton's law of cooling, the rate of cooling of a body is proportional to $(\Delta\theta)^n$, where $\Delta\theta$ is the difference of the temperature of the body and the surroundings, and n is equal to :
(a) 2 (b) 3
(c) 4 (d) 1

75. The length of a given cylindrical wire is increased by 100%. Due to the consequent decrease in diameter the change in the resistance of the wire will be :
(a) 200% (b) 100%
(c) 50% (d) 300%

Chemistry

76. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inner-orbit jumps of the electron for Bohr orbits in an atom of hydrogen ?
(a) $3 \rightarrow 2$ (b) $5 \rightarrow 2$
(c) $4 \rightarrow 1$ (d) $2 \rightarrow 5$

77. The de-Broglie wavelength of a tennis ball of mass 60g moving with a velocity of 10 m/s is approximately :
(Planck's constant, $h = 6.63 \times 10^{-34}$ Js)
(a) 10^{-33} m (b) 10^{-31} m
(c) 10^{-16} m (d) 10^{-25} m

78. The orbital angular momentum for an electron revolving in an orbit is given by $\sqrt{l(l+1)}\,\frac{h}{2\pi}$. This momentum for an s-electron will be given by :
(a) $+\frac{1}{2}\cdot\frac{h}{2\pi}$ (b) zero
(c) $\frac{h}{2\pi}$ (d) $\sqrt{2}\cdot\frac{h}{2\pi}$

79. How many unit cells are present in a cube shaped ideal crystal of NaCl of mass 1.00 g ?
[Atomic masses : Na = 23, Cl = 35.5]
(a) 2.57×10^{21} (b) 5.14×10^{21}
(c) 1.28×10^{21} (d) 1.71×10^{21}

80. Glass is a :
(a) micro-crystalline solid
(b) super-cooled liquid
(c) gel
(d) polymeric mixture

81. Which one of the following statements is correct ?
(a) Manganese salts give a violet borax- bead test in the reducing flame
(b) From a mixed precipitate of AgCl and AgI, ammonia solution dissolves only AgCl
(c) Ferric ions give a deep green precipitate on adding potassium ferrocyanide solution
(d) On boiling a solution having K^+, Ca^{2+} and HCO_3^- ions we get a precipitate of $K_2Ca(CO_3)_2$

82. According to the periodic law of elements, the variation in properties of elements is related to their :
(a) atomic masses
(b) nuclear masses
(c) atomic numbers
(d) nuclear neutron-proton number ratios

83. Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behaviour is that graphite :
(a) is a non-crystalline substance
(b) is an allotropic form of diamond
(c) has molecules of variable molecular masses like polymers
(d) has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interplate bonds

84. The IUPAC name of $CH_3COCH(CH_3)_2$ is :
(a) isopropylmethyl ketone
(b) 2-methyl-3-butanone
(c) 4-methylisopropyl ketone
(d) 3-methyl-2-butanone

85. When $CH_2=CH-COOH$ is reduced with $LiAlH_4$, the compound obtained will be :
(a) CH_3-CH_2-COOH
(b) $CH_2=CH-CH_2OH$
(c) $CH_3-CH_2-CH_2OH$
(d) CH_3-CH_2-CHO

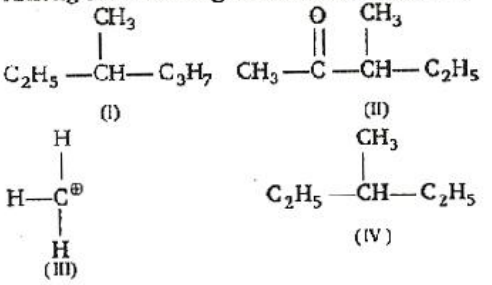
86. According to the kinetic theory of gases, in an ideal gas, between two successive collisions a gas molecule travels :
(a) in a circular path
(b) in a wavy path
(c) in a straight line path
(d) with an accelerated velocity

87. Which of the following group of transition metals is called coinage metals ?
(a) Cu, Ag, Au
(b) Ru, Rh, Pd
(c) Fe, Co, Ni
(d) Os, Ir, Pt

88. The general formula $C_nH_{2n}O_2$ could be for open chain :
(a) diketones
(b) carboxylic acids
(c) diols
(d) dialdehydes

89. An ether is more volatile than an alcohol having the same molecular formula. This is due to :
(a) dipolar character of ethers
(b) alcohols having resonance structures
(c) inter-molecular hydrogen bonding in ethers
(d) inter-molecular hydrogen bonding in alcohols

90. Among the following four structures I to IV :



(I) (II) (III) (IV)

It is true that :
(a) all four are chiral compounds
(b) only I and II are chiral compounds
(c) only III is a chiral compound
(d) only II and IV are chiral compounds

91. Which one of the following processes will produce hard water ?
(a) Saturation of water with $CaCO_3$
(b) Saturation of water with $MgCO_3$
(c) Saturation of water with $CaSO_4$
(d) Addition of Na_2SO_4 to water

92. Which one of the following compounds has the smallest bond angle in its molecule ?
(a) SO_2 (b) OH_2
(c) SH_2 (d) NH_3

93. Which one of the following pairs of molecules will have permanent dipole moments for both members ?
(a) SiF_4 and NO_2 (b) NO_2 and CO_2
(c) NO_2 and O_3 (d) SiF_4 and CO_2

94. Which one of the following groupings represents a collection of isoelectronic species ? (At. numbers : Cs-55, Br-35)
(a) Na^+, Ca^{2+}, Mg^{2+} (b) N^{3-}, F^-, Na^+
(c) Be, Al^{3+}, Cl^- (d) Ca^{2+}, Cs^+, Br

95. In the anion $HCOO^-$ the two carbon-oxygen bonds are found to be of equal length. What is the reason for it ?

(a) Electronic orbits of carbon atom are hybridised

(b) The C = O bond is weaker than the C — O bond

(c) The anion $HCOO^-$ has two resonating structures

(d) The anion is obtained by removal of a proton from the acid molecule

96. The pair of species having identical shapes for molecules of both species is :

(a) CF_4, SF_4 (b) XeF_2, CO_2

(c) BF_3, PCl_3 (d) PF_5, IF_5

97. The atomic numbers of vanadium (V), chromium (Cr), manganese (Mn) and iron (Fe) are respectively 23, 24, 25 and 26. Which one of these may be expected to have the highest second ionization enthalpy ?

(a) V (b) Cr

(c) Mn (d) Fe

98. Consider the reaction equilibrium :

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$;

$\Delta H^\circ = -198$ kJ

On the basis of Le-Chatelier's principle, the condition favourable for the forward reaction is :

(a) lowering of temperature as well as pressure

(b) increasing temperature as well as pressure

(c) lowering the temperature and increasing the pressure

(d) any value of temperature and pressure

99. What volume of hydrogen gas, at 273K and 1 atm pressure will be consumed in obtaining 21.6g of elemental boron (atomic mass = 10.8) from the reduction of boron trichloride by hydrogen ?

(a) 89.6 L (b) 67.2 L

(c) 44.8 L (d) 22.4 L

100. For the reaction equilibrium,

$N_2O_4(g) \rightleftharpoons 2NO(g)$

the concentrations of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and 1.2×10^{-2} mol L^{-1} respectively. The value of K_c for the reaction is :

(a) 3.3×10^{2} mol L^{-1} (b) 3×10^{-1} mol L^{-1}

(c) 3×10^{-3} mol L^{-1} (d) 3×10^{3} mol L^{-1}

101. The solubility in water of a sparingly soluble salt AB_2 is 1.0×10^{-5} mol L^{-1}. Its solubility product number will be :

(a) 4×10^{-15} (b) 4×10^{-10}

(c) 1×10^{-15} (d) 1×10^{-10}

102. When during electrolysis of a solution of $AgNO_3$, 9650 coulombs of charge pass through the electroplating bath, the mass of silver deposited on the cathode will be :

(a) 1.08 g (b) 10.8 g

(c) 21.6 g (d) 108 g

103. For the redox reaction

$Zn(s) + Cu^{2+}\ (0.1\ M) \rightarrow Zn^{2+}\ (1M) + Cu(s)$

taking place in a cell, E°_{cell} is 1.10 volt. E_{cell} for the cell will be : $\left(2.303\frac{RT}{F} = 0.0591\right)$

(a) 2.14 V (b) 1.80 V

(c) 1.07 V (d) 0.82 V

104. In a 0.2 molal aqueous solution of a weak acid HX, the degree of ionisation is 0.3. Taking K_f for water as 1.85, the freezing point of the solution will be nearest to :

(a) – 0.480°C (b) – 0.360°C

(c) – 0.260°C (d) + 0.480°C

105. The rate law for a reaction between the substances A and B is given by rate $= k[A]^n[B]^m$. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as :

(a) $\frac{1}{2^{m+n}}$ (b) $(m + n)$

(c) $(n - m)$ (d) $2^{(n-m)}$

106. 25mL of a solution of barium hydroxide on titration with 0.1 molar solution of hydrochloric acid gave a titre value of 35 mL. The molarity of barium hydroxide solution was :

(a) 0.07 (b) 0.14

(c) 0.28 (d) 0.35

107. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant K_c is :

(a) $\Delta G = RT \ln K_c$ (b) $-\Delta G = RT \ln K_c$

(c) $\Delta G^\circ = RT \ln K_c$ (d) $-\Delta G^\circ = RT \ln K_c$

108. If at 298K the bond energies of C—H, C—C, C = C and H—H bonds are respectively 414, 347, 615 and 435 kJ mol^{-1}, the value of enthalpy change for the reaction

$H_2C = CH_2(g) + H_2(g) \longrightarrow H_3C - CH_3(g)$

at 298K will be :

(a) + 250 kJ (b) – 250 kJ

(c) + 125 kJ (d) – 125 kJ

109. The enthalpy change for a reaction does not depend upon the :
(a) physical state of reactants and products
(b) use of different reactants for the same product
(c) nature of intermediate reaction steps
(d) difference in initial or final temperatures of involved substances

110. A pressure cooker reduces cooking time for food because :
(a) heat is more evenly distributed in the cooking space
(b) boiling point of water involved in cooking is increased
(c) the higher pressure inside the cooker crushes the food material
(d) cooking involves chemical changes helped by a rise in temperature

111. If liquids *A* and *B* form an ideal solution, the :
(a) enthalpy of mixing is zero
(b) entropy of mixing is zero
(c) free energy of mixing is zero
(d) free energy as well as the entropy of mixing are each zero

112. For the reaction system :

$$2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$$

volume is suddenly reduced to half its value by increasing the pressure on it. If the reaction is of first order with respect to O_2 and second order with respect to NO; the rate of reaction will :
(a) diminish to one-fourth of its initial value
(b) diminish to one-eighth of its initial value
(c) increase to eight times of its initial value
(d) increase to four times of its initial value

113. For a cell reaction involving a two-electron change, the standard emf of the cell is found to be 0.295 V at 25°C. The equilibrium constant of the reaction at 25°C will be :
(a) 1×10^{-10} (b) 29.5×10^{-2}
(c) 10 (d) 1×10^{10}

114. In an irreversible process taking place at constant T and P and in which only pressure-volume work is being done, the change in Gibbs free energy (dG) and change in entropy (dS), satisfy the criteria :
(a) $(dS)_{V,E} < 0, (dG)_{T,P} < 0$
(b) $(dS)_{V,E} > 0, (dG)_{T,P} < 0$
(c) $(dS)_{V,E} = 0, (dG)_{T,P} = 0$
(d) $(dS)_{V,E} = 0, (dG)_{T,P} > 0$

115. Which one of the following characteristics is not correct for physical adsorption ?
(a) Adsorption on solids is reversible
(b) Adsorption increases with increase in temperature
(c) Adsorption is spontaneous
(d) Both enthalpy and entropy of adsorption are negative

116. In the respect of the equation $k = Ae^{-E_a/RT}$ in chemical kinetics, which one of the following statements is correct ?
(a) k is equilibrium constant
(b) A is adsorption factor
(c) E_a is energy of activation
(d) R is Rydberg constant

117. Standard reduction electrode potentials of three metals *A*, *B* and *C* are + 0.5V, – 3.0 V and –1.2V respectively. The reducing power of these metals are :
(a) $B > C > A$ (b) $A > B > C$
(c) $C > B > A$ (d) $A > C > B$

118. Which one of the following substances has the highest proton affinity ?
(a) H_2O (b) H_2S
(c) NH_3 (d) PH_3

119. Which one of the following is an amphoteric oxide ?
(a) ZnO (b) Na_2O
(c) SO_2 (d) B_2O_3

120. A red solid is insoluble in water. However it becomes soluble if some KI is added to water. Heating the red solid in a test tube results in liberation of some violet coloured fumes and droplets of a metal appear on the cooler parts of the test tube. The red solid is :
(a) $(NH_4)_2Cr_2O_7$ (b) HgI_2
(c) HgO (d) Pb_3O_4

121. Concentrated hydrochloric acid when kept in open air sometimes produces a cloud of white fumes. The explanation for it is that :
(a) concentrated hydrochloric acid emits strongly smelling HCl gas all the time
(b) oxygen in air reacts wtih the emitted HCl gas to form a cloud of chlorine gas
(c) strong affinity of HCl gas for moisture in air results in forming of droplets of liquid solution which appears like a cloudy smoke
(d) due to strong affinity for water, concentrated hydrochloric acid pulls moisture of air towards itself. This moisture forms droplets of water and hence the cloud

122. The substance used in Holmes signals of the ship is a mixture of :
(a) $CaC_2 + Ca_3P_2$ (b) $Ca_3(PO_4)_2 + Pb_3O_4$
(c) $H_3PO_4 + CaCl_2$ (d) $NH_3 + HOCl$

123. The number of *d*-electrons retained in Fe^{2+} (At. no. Fe = 26) ions is :
(a) 3 (b) 4
(c) 5 (d) 6

124. What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid ?
(a) Cr^{3+} and $Cr_2O_7^{2-}$ are formed
(b) $Cr_2O_7^{2-}$ and H_2O are formed
(c) CrO_4^{2-} is reduced to + 3 state of Cr
(d) None of the above

125. In the co-ordination compound, $K_4[Ni(CN)_4]$, the oxidation state of nickel is :
(a) – 1 (b) 0
(c) + 1 (d) + 2

126. Ammonia forms the complex ion $[Cu(NH_3)_4]^{2+}$ with copper ions in the alkaline solutions but not in acidic solutions. What is the reason for it ?
(a) In acidic solutions hydration protects copper ions
(b) In acidic solutions protons co-ordinate with ammonia molecules forming NH_4^+ ions and NH_3 molecules are not available
(c) In alkaline solutions insoluble $Cu(OH)_2$ is precipitated which is soluble in excess of any alkali
(d) Copper hydroxide is an amphoteric substance

127. One mole of the complex compound $Co(NH_3)_5Cl_3$, gives 3 moles of ions on dissolution in water. One mole of the same complex reacts with two moles of $AgNO_3$ solution to yield two moles of $AgCl(s)$. The structure of the complex is :
(a) $[Co(NH_3)_5Cl]Cl_2$
(b) $[Co(NH_3)_3Cl_2] \cdot 2NH_3$
(c) $[Co(NH_3)_4Cl_2]Cl \cdot NH_3$
(d) $[Co(NH_3)_4Cl]Cl_2 \cdot NH_3$

128. The radius of La^{3+} (Atomic number of La = 57) is 1.06 Å. Which one of the following given values will be closest to the radius of Lu^{3+} (Atomic number of Lu = 71)?
(a) 1.60 Å (b) 1.40 Å
(c) 1.06 Å (d) 0.85 Å

129. The radionuclide $^{234}_{90}Th$ undergoes two successive β-decays followed by one α-decay. The atomic number and the mass number respectively of the resulting radionuclide are :
(a) 92 and 234 (b) 94 and 230
(c) 90 and 230 (d) 92 and 230

130. The half-life of a radioactive isotope is 3 h. If the initial mass of the isotope were 256 g, the mass of it remaining undecayed after 18 h would be :
(a) 4.0 g (b) 8.0 g
(c) 12.0 g (d) 16.0 g

131. Several blocks of magnesium are fixed to the bottom of a ship to :
(a) keep away the sharks
(b) make the ship lighter
(c) prevent action of water and salt
(d) prevent puncturing by under sea rocks

132. In curing cement plasters water is sprinkled from time to time. This helps in :
(a) keeping it cool
(b) developing interlocking needle-like crystals of hydrated silicates
(c) hydrating sand and gravel mixed with cement
(d) converting sand into silicic acid

133. Which one of the following statements is not true ?
(a) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}
(b) pH + pOH = 14 for all aqueous solutions
(c) The pH of 1×10^{-8} M HCl is 8
(d) 96,500 coulombs of electricity when passed through a $CuSO_4$ solution deposit 1g equivalent of copper at the cathode

134. The correct order of increasing basic nature for the bases NH_3, CH_3NH_2 and $(CH_3)_2NH$ is :
(a) $CH_3NH_2 < NH_3 < (CH_3)_2NH$
(b) $(CH_3)_2NH < NH_3 < CH_3NH_2$
(c) $NH_3 < CH_3NH_2 < (CH_3)_2NH$
(d) $CH_3NH_2 < (CH_3)_2NH < NH_3$

135. Butene-1 may be converted to butane by reaction with :
(a) Zn-HCl (b) Sn-HCl
(c) Zn-Hg (d) Pd/H_2

136. The solubilities of carbonates decrease down the magnesium group due to a decrease in :
(a) lattice energies of solids
(b) hydration energies of cations
(c) inter-ionic attraction
(d) entropy of solution formation

137. During dehydration of alcohols to alkenes by heating with concentrated H_2SO_4 the initiation step is :
(a) protonation of alcohol molecule
(b) formation of carbocation
(c) elimination of water
(d) formation of an ester

138. Which one of the following nitrates will leave behind a metal on strong heating ?
(a) Ferric nitrate (b) Copper nitrate
(c) Manganese nitrate (d) Silver nitrate

139. When rain is accompanied by a thunderstorm, the collected rain water will have a pH value :
(a) slightly lower than that of rain water without thunderstorm
(b) slightly higher than that when the thunderstorm is not there
(c) uninfluenced by occurrence of thunderstorm
(d) which depends on the amount of dust in air

140. Complete hydrolysis of cellulose gives :
(a) D-fructose (b) D-ribose
(c) D-glucose (d) L-glucose

141. For making good quality mirrors, plates of float glass are used. These are obtained by floating molten glass over a liquid metal which does not solidify before glass. The metal used can be :
(a) mercury (b) tin
(c) sodium (d) magnesium

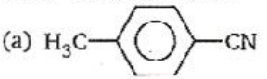
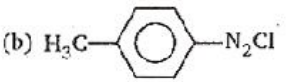
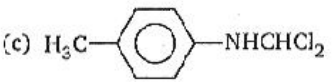
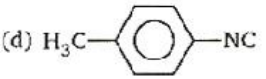
142. The substance not likely to contain $CaCO_3$ is :
(a) a marble statue (b) calcined gypsum
(c) sea shells (d) dolomite

143. The reason for double helical structure of DNA is operation of :
(a) van der Waals' forces
(b) dipole-dipole interaction
(c) hydrogen bonding
(d) electrostatic attractions

144. Bottles containing C_6H_5I and $C_6H_5CH_2I$ lost their original labels. They were labelled *A* and *B* for testing. *A* and *B* were separately taken in a test tube and boiled with NaOH solution. The end solution in each tube was made acidic with dilute HNO_3 and then some $AgNO_3$ solution was added. Substance *B* gave a yellow precipitate. Which one of the following statements is true for this experiment ?
(a) *A* was C_5H_5I
(b) *A* was $C_6H_5CH_2I$
(c) *B* was C_6H_5I
(d) Addition of HNO_3 was unnecessary

145. Ethyl isocyanide on hydrolysis in acidic medium generates :
(a) ethylamine salt and methanoic acid
(b) propanoic acid and ammonium salt
(c) ethanoic acid and ammonium salt
(d) methylamine salt and ethanoic acid

146. The internal energy change when a system goes from state *A* to *B* is 40 k J/mol. If the system goes from *A* to *B* by a reversible path and returns to state *A* by an irreversible path, what would be the net change in internal energy ?
(a) 40 kJ (b) > 40 kJ
(c) < 40 kJ (d) zero

147. The reaction of chloroform with alcoholic KOH and *p*-toluidine form :
(a) 
(b) 
(c) 
(d) 

148. Nylon threads are made of :
(a) polyvinyl polymer
(b) polyester polymer
(c) polyamide polymer
(d) polyethylene polymer

149. On mixing a certain alkane with chlorine and irradiating it with ultraviolet light, it forms only one monochloroalkane. This alkane could be :
(a) propane (b) pentane
(c) isopentane (d) neopentane

150. Which of the following could act as a propellant for rockets ?
(a) Liquid hydrogen + liquid nitrogen
(b) Liquid oxygen + liquid argon
(c) Liquid hydrogen + liquid oxygen
(d) Liquid nitrogen + liquid oxygen