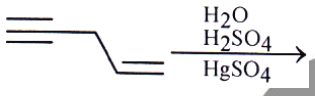
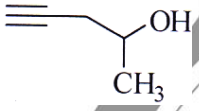
DU M.SC. ENTRANCE CHEMISTRY 2013

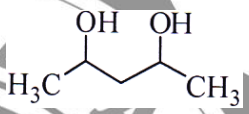
1. Which of the following is not a crystalline substance?

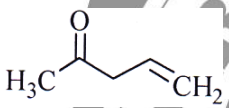
(a) Charcoal (b) Graphite (c) Diamond (d) C_{60}

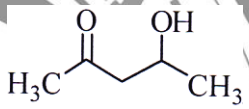
2. The major product expected from the following reaction is



(a) 

(b) 

(c) 

(d) 

3. Consider the equilibrium $X \rightleftharpoons 2Y$ with equilibrium constant, $K_c = 3.6\ M$ at 25°C. If the initial concentrations are $[X]_0 = 1.0\ M$ and $[Y]_0 = 0.0\ M$, the equilibrium concentration of X at 25°C, $[X]_{eq}$ is

(a) 0.33 M (b) 0.36 M (c) 0.40 (d) 0.60 M

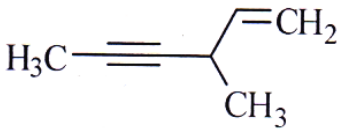
4. The sides of a triangle are of length 3.0, 4.0 and 5.0 cm. If the side with length 5.0 cm is the base, what is the height of the tiangle?

(a) 2.4 cm (b) 2.8 cm (c) 3.4 cm (d) 4.0 cm

5. Which one among the following chlorides is dissociated to the least extent in aqueous solution?

(a) $ZnCl_2$ (b) $HgCl_2$ (c) BaCl2 (d) $AlCl_3$

6. The IUPAC name for the following compound is



(a) 4-vinyl-2-pentyne (b) 4-methylhex-2-yn-5-ene

(c) 3-methylhex-4-yn-1-ene (d) 3-methylhex-1-en-4-yne

7. X-ray diffraction study of a crystal with a simple cubic lattice structure shows diffraction from the (110) plane appearing at the Bragg angle $\theta = 20°$. The angel at which the diffraction from the (220) plane will appear is

(a) $9.8°$ (b) $10°$ (c) $40°$ (d) $43°$

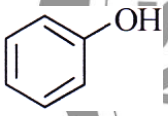
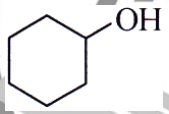
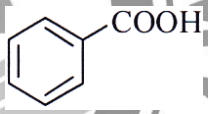
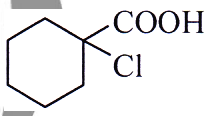
8. Consider the plot of the function $y = 1/x$. The tangent to this curve drawn at the point $(1,1)$ will cut the x-axis at

(a) $(1,0)$ (b) $(\sqrt{2},0)$ (c) $(1,\sqrt{2})$ (d) $(2,0)$

9. A sample of water contains 200ppm of Ca^{2+}. What is the molality of the solution with respect to Ca^{2+}? Atomic weight of Ca is 40.

(a) 0.2 m (b) 2 m (c) 5×10^{-3} m (d) 0.05 m

10. The strongest Bronsted acid among the following is

(a)  (b)  (c)  (d) 

11. Which of the following is necessary for a process to be spontaneous $(\Delta S = \text{change in entropy})$

(a) $\Delta S_{system} > 0$ (b) $\Delta S_{system} < 0$ (c) $\Delta S_{universe} > 0$ (d) $\Delta S_{surrounding} < 0$

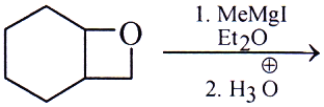
12. If two vertices of a cube chosen randomly are painted black and the remaining are painted white, what is the probability that the black vertices are adjacent i.e. connected by an edge?

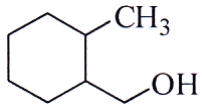
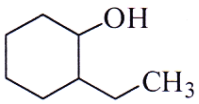
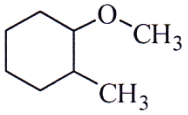
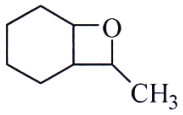
(a) $\frac{1}{2}$ (b) $\frac{3}{7}$ (c) $\frac{2}{7}$ (d) $\frac{3}{28}$

13. CuI_2 is unstable and it readily decomposes to

(a) Cu and I^- (b) Cu and I_2 (c) CuI and I_2 (d) CuI and I^-

14. The major product of the following reaction is



(a)  (b)  (c)  (d) 

15. The nickel-cadmium cell has a standard potential of +1.20 V. The cell reaction is

$$2NiO(OH)(s)+Cd(s)+2H_2O(l)\rightarrow 2Ni(OH)_2(s)+Cd(OH)_2(s)$$

What is the standard free energy change for this reaction?

(a) –116 kJ (b) –38.7 kJ (c) –232 kJ (d) –46.3 kJ

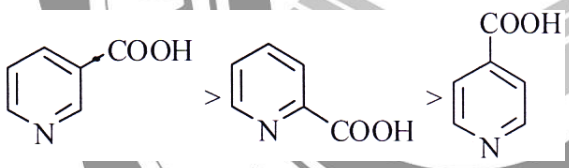
16. If Cos $A = x$; then cos 4A =

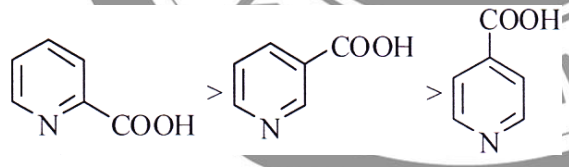
(a) 4x (b) $8x^4-8x^2+1$ (c) $4x^4-4x^2+1$ (d) $2x^2+1$

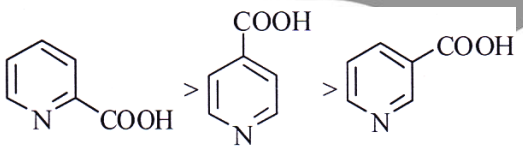
17. The packing efficiency in the hcp, bcc and simple cubic (sc) lattices are in the order

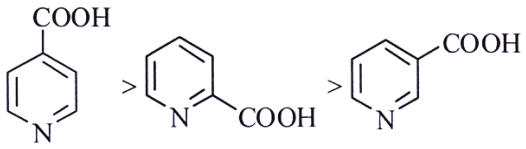
(a) $bcc > hcp > sc$ (b) $hcp > bcc > sc$ (c) $hcp > sc > bcc$ (d) $sc > hcp > bcc$

18. The rate of decarboxylation of isomeric carboxylic acids is

(a) 

(b) 

(c) 

(d) 

19. Doubling all the coefficients in the equation for a cell reaction

(a) doubles E°, but does not change ΔG°

(b) doubles ΔG°, but does not change E°

(c) does not change E° or ΔG°

(d) doubles both E° and ΔG°

20. The value of $(1)^i$ is

(a) –1 (b) i (c) $e^{-\pi}$ (d) e^{-2x}

21. The compounds ZnO and FeO show

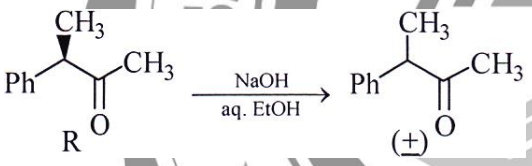
(a) Stoichiometric and metal excess defects, respectively

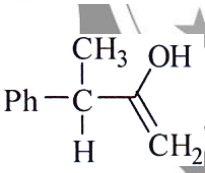
(b) metal excess and metal deficiency defects, respectively

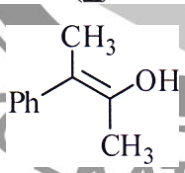
(c) metal deficiency and metal excess defects, respectively

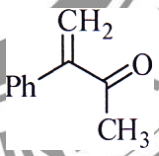
(d) metal excess and stoichiometric defects, respectively

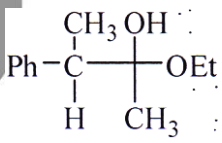
22. An intermediate in racemization of (R)-3-phenyl-2-butanone is



(a) 

(b) 

(c) 

(d) 

23. Predict the sign of ΔS for both of the following process

I. $2C(\text{graphite}) + O_2(g) \rightarrow 2CO_2(g)$

II. $C_4H_{10}(g) \rightarrow C_4H_{10}(l)$

(a) ΔS should be negative for I and positive for II

(b) ΔS should be negative for I and negative for II

(c) ΔS should be positive for I and positive for II

(d) ΔS should be positive for I and negative for II

24. The remainder of $\frac{x^4+x^3+x^2+x+1}{x-1}$ is

(a) 1 (b) 3 (c) 5 (d) 7

25. Which two colours of light cause the highest rate of photosynthesis

(a) Red and green (b) Blue and green

(c) Red and blue (d) Green and yellow

26. Assuming the additivity of covalent radii $\left[C\,0.77\,\mathring{A}, Br\,1.14\,\mathring{A}\right]$, and assuming the distance between adjacent carbon atoms in the ring as $1.40\,\mathring{A}$, the distance between the centres of bromine atoms in 1, 2-dibromobenzene is

(a) $3.31\,\mathring{A}$ (b) $3.42\,\mathring{A}$ (c) $4.20\,\mathring{A}$ (d) $2.28\,\mathring{A}$

27. The number of stereoisomers for $CHD=CH-CH=CHD$ is

(a) 4 (b) 8 (c) 2 (d) 6

28. The entropy change associated with the expansion of one mole of an ideal gas from an initial volume of V to a final volume of 2.50 V at constant temperature is $(R = \text{gas constant})$

(a) $\Delta S = -R\ln 2.50$ (b) $\Delta S = -2.50\,R\ln\left(V_f/V_i\right)$

(c) $\Delta S = 2.50\,R\ln\left(V_f/V_i\right)$ (d) $\Delta S = R\ln 2.50$

29. The smallest among the following integrals is

(a) $\int_0^1 e^{-x}dx$ (b) $\int_0^1 e^{-x^2}dx$ (c) $\int_0^1 e^{-x^3}dx$ (d) $\int_0^1 e^{-x^4}dx$

30. The quaternary structure of human hemoglobin is a

(a) dimer of two myoglobin dimers (b) tetramer of identical subunits

(c) tetramer of four different subunits (d) tetramer of two different subunits

31. The number of isomers having non-zero dipole moment for PCl_2F_3 in the trigonal bipyramidal geometry is

(a) 2 (b) 3 (c) 1 (d) 0

32. The most appropriate reagent for the conversion of RCOOMe into RCH_2OH is

(a) $NaBH_4$ (b) $LiBH_4$ (c) NaH (d) Pd/C and H_2

33. Which of the following statements must be true for the entropy of a pure solid to be zero?

(I) The temperature must be 0K

(II) The solid must be crystalline, not amorphous

(III) The solid must be perfectly ordered

(IV) The solid must be an element.

(a) I, II and III (b) I and II (c) I (d) I, II, III and IV

34. The function with exactly two minima and one maximum, among the following is

(a) $x^4 - x^2 - x$ (b) $x + x^2 - x^4$ (c) $x^3 - x^2 - x$ (d) $x + x^2 - x^3$

35. Collager is

(a) an α-helical structural protein (b) a coiled coil protein found in hair

(c) a cross-linked globular protein (d) a triple-halical fibrous protein

36. Given that ^{18}F undergoes 90% radioactive decay in 366 min., the half life $(t_{1/2})$ for ^{18}F is

(a) 220 min (b) 3473 min (c) 154 min (d) 110 min

37. The phenolic compound among the following is

(a) Ibubrufen (b) Paracetamol (c) Penicillin (d) Camphor

38. What is the hydroxide ion concentration of a solution that has a pH of 11.20?

(a) 6.31×10^{-12} M (b) 11.20 M (c) 1.58×10^{-3} M (d) 2.80 M

39. For all values of x which determinant among the following is zero?

(a) $\begin{vmatrix} x & 1 \\ 1 & x \end{vmatrix}$ (b) $\begin{vmatrix} 1 & x \\ x & x^2 \end{vmatrix}$ (c) $\begin{vmatrix} 1 & x \\ x & 1 \end{vmatrix}$ (d) $\begin{vmatrix} 1 & x^2 \\ x & 1 \end{vmatrix}$

40. The conductivity of sodium dodecyl sulfate (SDS) solution exhibits a sharp transition around 8 mM concentration. This is because:

(a) SDS precipitates beyond 8 mM concentration

(b) SDS forms micelles above 8 mM concentration

(c) SDS forms a gel above 8 mM concentration

(d) SDS undergoes hydrolysis above 8 mM concentration

41. According to the equation $2Fe^{3+} + 2I^- \rightarrow I_2 + 2Fe^{2+}$

how many grams of iodine can be produced by reacting 7.4 moles of Fe^{3+} and 7.0 moles of I^-? $[\text{At. Wt. of iodine is } 127]$

(a) 8.9×10^2 g (b) 9.1×10^2 g (c) 9.4×10^2 g (d) 17.8×10^2 g

42. The most appropriate spectroscopy for the identification of a nitrile group is

(a) IR (b) ^{1}H NMR (c) UV (d) ESR

43. If the units for rate are $M\,s^{-1}$, what are the units for the rate constant, k, for a zeroth-order reaction?

(a) s^{-1} (b) $M^{-1}\,s^{-1}$ (c) $M\,s^{-1}$ (d) M^{-1}

44. The function with a finite range is

(a) e^x (b) e^{x^2} (c) e^{x^3} (d) e^{-x^2}

45. How many grams of copper will be produced when 27 g of aluminium is added to excess cupric sulphate solution? $[\text{At. wts.; Al} = 27, \text{Cu} = 63.5]$

(a) 63.50 (b) 90.50 (c) 95.25 (d) 122.25

46. The two strands of double helical DNA are associated by hydrogen bonds between adenine (A) and thymine (T), and between guanine (G) and cytosine (C). The numbers of hydrogen bonds between A-T and G-C pairs, respectively are:

(a) one, two (b) two, two (c) two, three (d) three, two

47. The intermediate involved in Curtius rearrangement is

(a) Carbenium ion (b) carbanion (c) nitrene (d) carbene

48. An organic compound on decomposition at $500°C$ and 1 atm pressure released 2 mL each of carbon monoxide, nitrogen and water vapour. The empirical formula of the molecule is

(a) CHNO (b) CH_2NO (c) CH_2N_2O (d) $CH_2N_2O_2$

49. $\frac{d}{dt}\exp\left[t^2\right] =$

(a) $1/t^2$ (b) $\exp\left(t^2\right)$ (c) $2t\exp\left(t^2\right)$ (d) $(1/2t)\exp\left(t^2\right)$

50. Nessler's reagent is prepared by mixing a solution of KI with a solution of 'X' and then adding KOH solution. Here 'X' is

(a) $ZnCl_2$ (b) $HgCl_2$ (c) $AlCl_3$ (d) $TiCl_4$

51. The intermediate acid involved in the following reaction is

$NH_4(CNO) \xrightarrow{\Delta} NH_2CONH_2$

(a) uric acid (b) cyanuric acid (c) thiocyanic acid (d) cyanic acid

52. 50 mL of 0.04 M HCl solution was mixed with 50 mL of 0.02 M $AgNO_3$ solution, stirred and filtered. The pH of the filtered solution is

(a) 1 (b) 2 (c) 3 (d) 4

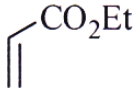
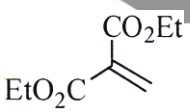
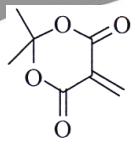
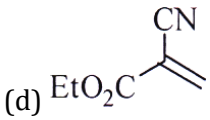
53. $(1+2i)^{-1}$ is equal to

(a) 1–2i (b) $(1/5)-(2/5)i$ (c) $(1/3)-(2/3)i$ (d) $-(1/3)+(2/3)i$

54. Which of the following fluorides is angular?

(a) BeF_2 (b) ZnF_2 (c) SnF_2 (d) XeF_2

55. The more reactive dienophile among the following for the reaction with cyclopentadiene is

(a)  (b)  (c)  (d) 

56. The magnetic quantum number of the last electron in the atom with atomic number 21 is

(a) 4 (b) 3 (c) 2 (d) 1

57. If the number e^{9i} is marked as a point on the complex plane, what is the distance of the point from the origin?

(a) 1 (b) 3 (c) 9 (d) $\tan^{-1}9$

58. What is the electronic configuration of V^{3+} ?

(a) $[Ar]3d^2$ (b) $[Kr]3d^2$ (c) $[Ar]3d^3$ (d) $[Kr]3d^3$

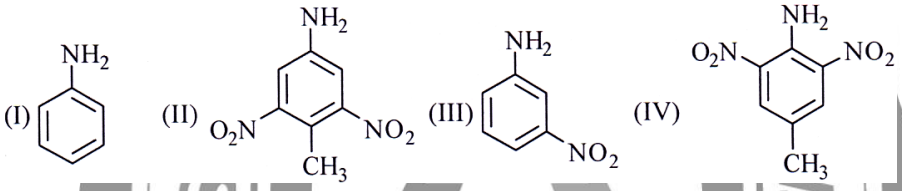
59. The hybridization that is common for at least one of the carbon atoms in hydrogen cyanide, carbon disulfide, allene and carbon monoxide s

(a) sp (b) sp^2 (c) sp^3 (d) dsp^3

60. Which one among the given functions has the smallest slope at $x = 1$

(a) $2x^2 - 3$ (b) $2x^2 - 1$ (c) $2x^2 - 2x$ (d) $2x^2 - x$

61. The order of basicity of the following substituted anilines is



(a) $I > II > III > IV$ (b) $IV > I > III > II$ (c) $IV > II > I > III$ (d) $IV > III > I > II$

62. According to crystal field theory, the 9th electron of the metal centre in square planar $\left[Cu(NH_3)_4\right]^{2+}$ resides in

(a) d_{xy} (b) $d_{x^2-y^2}$ (c) d_{z^2} (d) d_{xz}

63. The rotation of pure $R(+)$-Limonene is $+123.0°$. Calculate the % of the $(+)$ isomer in a sample showing a rotation of $+109°$?

(a) 8.6 (b) 77.2 (c) 94.3 (d) 82.9

64. An ideal gas undergoes isothermal and reversible expansion from its initial volume to some final volume at 300 K drawing in 90 kJ of heat. The change in the Gibbs free energy of the gas is

(a) 300 J (b) 150 J (c) 0 J (d) –300 J

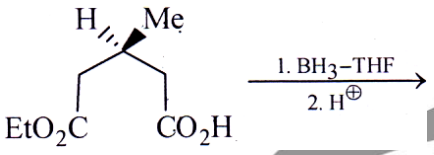
65. For $0 \le x \le 1, \lim_{n\to\infty} \int_0^1 nxe^{-nx^2} dx =$

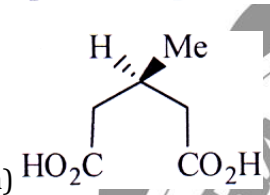
(a) 0 (b) ∞ (c) $\frac{1}{2}$ (d) 2

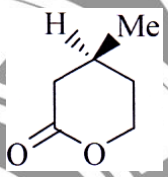
66. An extensive property of a thermodynamic system among the following is

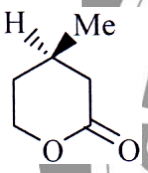
(a) Pressure (b) Temperature (c) Volume (d) Concentration

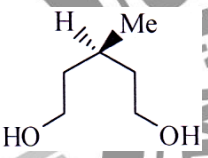
67. The product obtained in the following transformation is



(a) 

(b) 

(c) 

(d) 

68. The number of unpaired electrons in the complex ion is in the order

(a) $CuCl_4^{2-} < NiCl_4^{2-} < ZnCl_4^{2-} < CoCl_4^{2-}$ (b) $ZnCl_4^{2-} < CuCl_4^{2-} < CoCl_4^{2-} < NiCl_4^{2-}$

(c) $ZnCl_4^{2-} < CoCl_4^{2-} < NiCl_4^{2-} < CuCl_4^{2-}$ (d) $ZnCl_4^{2-} < CuCl_4^{2-} < NiCl_4^{2-} < CoCl_4^{2-}$

69. If $F(x) = x^{1/x}$ then $\lim_{x\to\infty} F(x) =$

(a) 0 (b) 1 (c) ∞ (d) e

70. The metal ion involved in the water oxidation process at the active site of photosystem II is

(a) Mn (b) Mg (c) Mo (d) Fe

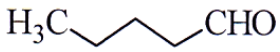
71. The oxidation number of carbon in dimethyl ether is

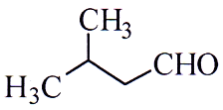
(a) –2 (b) –1 (c) 1 (d) 2

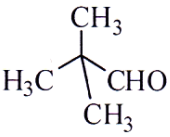
72. The complex number $-2-2\sqrt{3}i$ in polar form is given by

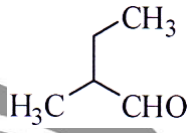
(a) $2e^{\frac{i2\pi}{3}}$ (b) $4e^{\frac{i2\pi}{3}}$ (c) $4e^{\frac{i3\pi}{2}}$ (d) $4e^{\frac{i4\pi}{3}}$

73. Compound I gives a strong infrared absorption at $1730\,cm^{-1}$. ^1H NMR spectrum indicates that it has two types of hydrogen atoms; one H atom appearing as singlet at $\delta = 9.7$ ppm and 9 H atoms appearing as a singlet at $\delta = 1.2\,ppm.$ The structure of I is

(a) 

(b) 

(c) 

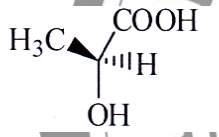
(d) 

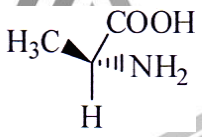
74. In a titration experiment, the end point indicates

(a) neutralization point (b) completion of precipitation

(c) apparent equivalence point (d) exact equivalence point

75. The structures I and II, shown below, correspond to

(I) 

(II) 

(a) S-lactic acid and S-alanine (b) S-lactic acid and R-alanine

(c) R-lactic acid and S-alanine (d) S-lactic acid and R-alanine

76. The heat of reaction of both the reactions $2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$ and $Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$ is –27.2 kcal. Hence the heat of reaction of $3Ca(OH)_2 + 2H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6H_2O$ would be

(a) –13.6 kcal/mol (b) –27.2 kcal/mol (c) –81.6 kcal/mol (d) –68.0 kcal/mol

77. The standard equation of a circle passing through the points $u(3,8), v(9,6)$ and $w(13,-2)$ is

(a) $(x-3)^2 + (y+2)^2 = 100$ (b) $(x+3)^2 + (y+2)^2 = 100$

(c) $(x-2)^2 + (y+3)^2 = 100$ (d) $(x-2)^2 + (y-3)^2 = 100$

78. Acid is used in the standardization titration of $KMnO_4$ against sodium oxalate because

(a) It helps in dissolving $KMnO_4$

(b) it stabilizes permanganate ion

(c) it facilitates the reduction of Mn^{7+} to Mn^{2+}

(d) it helps in dissolving the MnO_2 formed during titration.

79. Which of the following covalent compounds does not have any formally charged atom?

(a) $(CH_3)_3NO$ (b) CH_2N_2 (c) CH_3ONO (d) CH_3CNO

80. The two radial nodes in the 3s radial function of H atom occur at the distances R1 and R2 from the nucleus. The three radial nodes in the 4s orbital occur at R3, R4 and R5. The order of these distances is given by

(a) $R3 < R1 < R4 < R2 < R5$ (b) $R1 < R3 < R4 < R2 < R5$

(c) $R3 < R1 < R2 < R4 < R5$ (d) $R3 < R1 < R4 < R5 < R2$

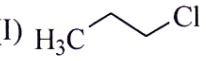
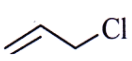
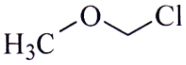
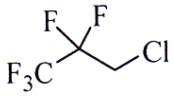
81. The graph of the equation $4(x^2 - 4x) - 9(y^2 - 2y) - 29 = 0$ represents a

(a) parabola (b) ellipse (c) circle (d) hyperbola

82. Using Wade's rule predict the structure of B_5H_9

(a) closo (b) nido (c) arachno (d) scorpionato

83. In the S_N1 solvolysis of the following primary alkyl chlorides in aqueous ethanol, the order of decreasing reactivity is

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

(a) $I > II > III > IV$ (b) $II > I > III > IV$ (c) $IV > III > II > I$ (d) $III > II > I > IV$

84. A solution of sulfuric acid contains 86 g of H_2SO_4 per litre of solution. The normality of the solution is

(a) 1.8 N (b) 0.9 N (c) 2.0 N (d) 1.0 N

85. The equation of the normal line to $y = x^3 - 2x^2 + 4$ at $(2, 4)$ is

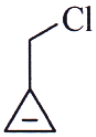
(a) $y = -\frac{1}{4}x + \frac{9}{2}$ (b) $y = 9x + 4$ (c) $y = -4x + \frac{9}{2}$ (d) $y = -9x + \frac{1}{4}$

86. Which one of the following statements do not apply to interhalogen compounds?

(a) Could be neutral (b) could be cationic

(c) could be anionic (d) Always obey octet rule

87. The product obtained by the reaction of one equivalent of 1-bromo-3-chlorocyclobutane and two equivalents of Na is

(a)  (b)  (c)  (d) 

88. Which of the following pair has the lowest interfacial tension?

(a) n-decane/water (b) n-butane/water

(c) air/water (d) n-octyl alcohol/water

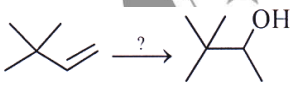
89. The gas pressure in an aerosol container is 1.5 atm at $25°C$. Assuming an ideal behavior of the gas, if the container is heated to $450°C$, the pressure would be close to

(a) 1.023 atm (b) 1.234 atm (c) 3.639 atm (d) 2.639 atm

90. The order of increasing dipole moment among H_2S, H_2O and BF_3 is

(a) $BF_3 < H_2S < H_2O$ (b) $H_2O < H_2S < BF_3$ (c) $H_2S < H_2O < BF_3$ (d) $BF_3 < H_2O < H_2S$

91. The best method for the following transformation is



(a) acid mediated hydration (b) hydroboration-oxidation

(c) oxymercuration-demercuration (d) ozonolysis-reduction

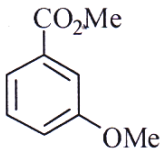
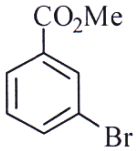
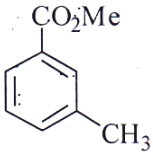
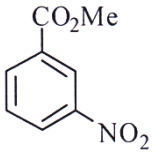
92. The concentration of Ba^{2+} in saturated $BaSO_4$ solution at $27°C$ is 1.04×10^{-5} M. What is the solubility product (K_{sp}) for $BaSO_4$ at this temperature?

(a) 1.04×10^{-10} M (b) 1.08×10^{-10} M (c) 0.52×10^{-10} M (d) 2.08×10^{-5} M

93. What is the hybridization of sulfur in SF_4?

(a) sp^2 (b) sp^3 (c) sp^3d (d) sp^2d^2

94. The ester that undergoes acid hydrolysis most readily is

(a)  (b)  (c)  (d) 

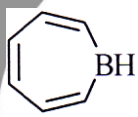
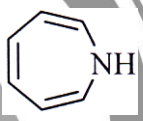
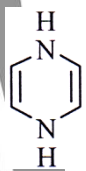
95. If the half-life of a reaction is independent of its initial concentration, then the reaction may be categorized as

(a) zeroth order (b) first order (c) second order (d) bimolecular

96. How many milliliters of 2M NaCl solution are required to make one litre of 0.4 NaCl solution by adding water?

(a) 5000 ml (b) 800 ml (c) 200 ml (d) 20 ml

97. Which of the following compounds is aromatic?

(a)  (b)  (c)  (d) 

98. A 0.01 M solution of a compound transmits 20% of visible light when the absorbing path length is 1.5 cm. What is the molar extinction co-efficient of the substance? Solvent is assumed to be completely transparent.

(a) $46.6\ M^{-1}cm^{-1}$ (b) $50.3\ M^{-1}cm^{-1}$ (c) $22.3\ M^{-1}cm^{-1}$ (d) $43.6\ M^{-1}cm^{-1}$

99. Which of the following atoms has the highest number of unpaired electrons in its ground state?

(a) C (b) N (c) O (d) F

100. Which of the following compounds has the highest boiling point?

(a) Mesitylene (b) Benzene (c) Toluene (d) Cyclohexane