NEET 2026
WORK BOOK

CHEMISTRY

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WORK BOOK

Chapter 01

SOME BASIC CONCEPTS OF CHEMISTRY

QUESTIONS

Classification of matter and Laws of chemical combinations

1. "If a chemical reaction takes place in a sealed vessel, that permits no matter to enter or escape the mass of the vessel and its contents after the reaction will be identical to its earlier mass". This statement is related to

1) Law of conservation of mass
2) Law of definite proportions
3) Law of multiple proportions
4) Avogadros law

2. The formation of PbO, PbO_2 and Pb_3O_4, reveals that the masses of oxygen combined with 1 g of Pb is a simple whole number ratio. This illustrates

1) Law of conservation of mass
2) Law of definite proportions
3) Law of constant proportions
4) Law of multiple proportions

3. The percentage of copper and oxygen in samples of CuO obtained by different methods were found to be the same. This illustrates the law of

1) Constant proportions
2) multiple proportions
3) reciprocal proportions
4) Conservation of mass

4. In the reaction $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$, the ratio of volumes of $N_{2(g)}$, $H_{2(g)}$ and $NH_{3(g)}$ is 1 : 3 : 2. These figures illustrate the law of

1) constant proportions
2) Gay-Lussac
3) Multiple proportions
4) Conservation of mass

5. Given below are two statements:

Statement I : For a reaction between 10L $H_2(g)$ and 10 L $O_2(g)$, only 10 L of liquid water is obtained, under the same conditions of pressure and temperature.

Statement II : When gases combine or are produced in a chemical reaction they do so in a simple ratio by volume as their stoichiometric coefficients, provided all gases are present under the same conditions of pressure and temperature.

In the light of the above statements, choose the most appropriate answer from the options given below :

1) Statement - I and II both are correct
2) Statement - I is correct while II is incorrect
3) Both Statement - I and II are incorrect
4) Statement - I is incorrect and II is correct

6. Among the following, which is not a postulate of Dalton's atomic theory?

1) Matter is formed of indivisible atoms

2) Under identical conditions of pressure and temperature, gases combines and give gaseous products in simple volume ratio

3) During chemical reactions atoms remains conserved and only pass through rearrangement

4) Same atoms have same properties including atomic mass

MOLE CONCEPT

7. Which of the following is the standard for atomic mass ?

1) $^{1}_{1}H$

2) $^{12}_{6}C$

3) $^{16}_{8}O$

4) $^{14}_{7}N$

8. 1 amu is equal to

1) 12 g

2) 1.66056×10^{-24} kg

3) 1.66056×10^{-24} g

4) 1.66056×10^{-24} amu

9. Boron has two stable isotopes, ^{10}B (19%) and ^{11}B (81%). The atomic mass that should appear for boron in the periodic table is :

1) 10.81 2) 10.2

3) 11.2 4) 10.0

10. The molecular mass of x is 28. x cannot be

1) CO 2) N_2

3) C_2H_4 4) O_2

11. Mass of one molecule of water is $\frac{18}{6.022\times10^{23}}$ g.

The mass of one mole of water is

1) 18 amu 2) 18 g

3) 1.8 amu 4) 1.8 g

12. Volume of 17 g of NH_3 at NTP will be

1) 2.24 L 2) 22.4 L

3) 4.48 L 4) 44.8 L

13. Which of the following has more number of atoms ?

1) 1 mole of neon gas

2) 1 mole of oxygen gas

3) 1 mole of ozone

4) 1 mole of carbon monoxide

14. 20 L of H_2 gas at STP weigh about

1) 44.8 g 2) 12.2 g

3) 1.8 g 4) 20 g

15. Gram atomic mass of silicon is 28 g. How many silicon atoms are there in 1.00 g of silicon ?

1) 2.14×10^{22} atoms

2) 1.75×10^{25} atoms

3) 1 atom

4) 0.0356 atoms

16. 1g urea (NH_2CONH_2), 1 g acetic acid (CH_3COOH) and 1g of formaldehyde (HCHO) will have H-atoms in the ratio.

1) 2 : 2 : 1

2) 1 : 1 : 2

3) 1 : 1 : 1

4) 1 : 2 : 1

17. The number of water molecules is maximum in

1) 18 molecules water 2) 1.8 g of water

3) 18 g of water 4) 18 moles of water

18. Number of moles of urea (NH_2CONH_2) in 6 g of urea is same as that present in

1) 6 g of glucose ($C_6H_{12}O_6$)

2) 6 g of acetic acid (CH_3COOH)

3) 6 g of sucrose ($C_{12}H_{22}O_{11}$)

4) All the above

19. Number of atoms of oxygen present in 10.6 g of Na_2CO_3 will be

1) 6.02×10^{22}

2) 12.04×10^{22}

3) 1.806×10^{23}

4) 31.80×10^{28}

20. The number of oxygen atoms in 4.4 g of CO_2 is

1) 1.2×10^{23} 2) 6×10^{22}

3) 6×10^{23} 4) 12×10^{23}

21. The number of atoms present in 1 molecule of H_2SO_4 is

1) 7 N_A 2) 7

3) 98 4) 49

22. The maximum number of molecules is present in

1) 15 L of H_2 gas at STP

2) 5L of N_2 gas at STP

3) 0.5 g of H_2 gas

4) 10g of O_2 gas

23. How many years it would take to count Avogadro's number of rupees at the rate 10 lakhs per second?

1) 10^{10} years

2) 1.8×10^9 years

3) 1.9×10^{10} years

4) 1.9×10^9 years

24. 10g of $CaCO_3$ contains

1) 10 moles of $CaCO_3$

2) 0.1 g atom of Ca

3) 6×10^{23} atoms of Ca

4) 1 mol Ca

25. Which has maximum number of molecules?

1) 7 g N_2 2) 2 g H_2

3) 16 g NO_2 4) 16 g O_2

26. Number of atoms in 558.5 g Fe (atomic mass 55.85) is

1) 6.022×10^{22}

2) half in 8 g He

3) twice that in 60 g carbon

4) $558.5 \times N_A$

27. 7.5 g of a gas occupy 5.6 litres of volume at STP. The gas is

1) NO 2) N_2O

3) CO 4) CO_2

28. A mixture of gases contains H_2 and O_2 in the ratio of 1 : 4 (w/w). What is the mole ratio of the two gases in the mixture?

1) 16 : 1 2) 2 : 1

3) 1 : 4 4) 4 : 1

29. Given below are two statements:

Statement I : 1g each of O_2 and O_3 contains $\frac{N_A}{32}$ and $\frac{N_A}{48}$ atoms respectively.

Statement II : 1g each of O_2 and O_3 contains same number of molecules.

In the light of the above statements, choose the most appropriate answer from the options given below :

1) Statement - I and II both are correct
2) Statement - I is correct while II is incorrect
3) Both Statement - I and II are incorrect
4) Statement - I is incorrect and II is correct

30. Given below are two statements:

Statement I : A molecule of butane, C_4H_{10} has a molecular mass of 58

Statement II : one mole of butane contains 6.022×10^{23} molecules and has a mass of 58 g.

In the light of the above statements, choose the most appropriate answer from the options given below :

1) Statement - I and II both are correct
2) Statement - I is correct while II is incorrect
3) Both Statement - I and II are incorrect
4) Statement - I is incorrect and II is correct

31. Given below are two statements:

Statement I : Both 12 g of carbon and 27 g of Aluminium will have 6.02×10^{23} atoms.

Statement II : Gram atomic mass of an element contains Avogadro's number of atoms.

In the light of the above statements, choose the most appropriate answer from the options given below :

1) Statement - I and II both are correct
2) Statement - I is correct while II is incorrect
3) Both Statement - I and II are incorrect
4) Statement - I is incorrect and II is correct

32. Gram atomic mass of C is

1) 12 u
2) $\frac{12}{N_A}$ g
3) $12 \times 1.66056 \times 10^{-24}$ g
4) 12 g

33. What mass of copper will contain 3.22×10^{24} atoms of copper? (At. mass of Cu = 63.5)

1) 170 g
2) 180 g
3) 410 g
4) 340 g

34. Match the column.

Column-I		Column-II	
A)	Mass of 20 mol H_2SO_4	P)	20 N_A
B)	Number of mol of H_2O in 540 g	Q)	6.02×10^{13}
C)	Number of atoms in 10^{-10} g H_2	R)	30
D)	Number of atoms in 224 L H_2 at NTP	S)	1960 g

1) (A)→(S), (B)→(R), (C)→(Q), (D)→(P)
2) (A) → (P),(B) → (R), (C) → (S),(D)→(Q)
3) (A)→ (R), (B) → (S), (C)→ (P), (D) → (Q)
4) (A) → (P), (B) → (R), (C)→ (Q), (D) → (S)

35. The sample containing same number of Na atoms as there are Na atoms in 5.3 g of $Na_2CO_3$is

(A) 4g of NaOH

(B) 5.85 g of NaCl

(C) 0.25 mol of Na_2SO_4

(D) 5.6g of Na_3PO_4

1) A & C both are correct

2) B & D both are correct

3)) A & B both are correct

4) C&D both are correct

36. Match the column.

Column-I		Column-II	
A)	8g atoms of hydrogen	P)	2 moles of C_3H_4
B)	6g atoms of carbon	Q)	3 moles of CH_3COOH
C)	6g atoms of oxygen	R)	4 moles of N_2H_2
D)	4g molecules of nitrogen	S)	2 moles N_2O_3

1) (A)- (P, Q), (B)- (R, S), (C)- (P, S), (D)- (P)

2) (A)- (P, R), (B)- (P, Q), (C)-(Q, S), (D)- (R)

3) (A)- (P, R), (B)- (P, Q), (C)- (Q, S), (D)- (S)

4) (A)- (R, S), (B)- (P, S), (C)- (Q, R), (D)- (Q)

37. The number of water molecules present in a drop of water weighing 0.018 g is

1) 6.02×10^{26} 2) 6.02×10^{23}

3) 6.02×10^{20} 4) 6.02×10^{19}

38. 34.2 g of sucrose ($C_{12}H_{22}O_{11}$) are dissolved in 90 g of water in a glass. The number of oxygen atoms in the solution are

1) 3.66×10^{26} 2) 6.6×10^{23}

3) 3.66×10^{24} 4) 6.0×10^{22}

39. Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0.1 mole of XY_2 weighs 10 g and 0.05 mole of X_3Y_2 weighs 9 g, the atomic weights of X and Y are

1) 30, 20 2) 40, 30

3) 60, 40 4) 20, 30

40. The number of atoms of oxygen present in 11.2 L of ozone at N.T.P are

1) 3.01×10^{22} 2) 6.02×10^{23}

3) 9.03×10^{23} 4) 1.20×10^{24}

41. 80 g of oxygen contain as many atoms as in

1) 10 g of Hydrogen

2) 5 g of Hydrogen

3) 800 g of Hydrogen

4)1 g of Hydrogen

42. Suppose the chemists would have chosen 10^{20} as the number of particles in a mole, the mass of 1 mole of oxygen gas would be

1) 5.32×10^{-43} g 2) 5.32×10^{-3} g

3) 5.32×10^{-23} g 4) 5.32×10^{3} g

STOICHIOMETRY AND LIMITING REAGENT

43. When 22.4 L of $H_2(g)$ is mixed with 11.2 L of $Cl_2(g)$, each at STP, the moles of HCl(g) formed is equal to

1) 1 mole of HCl(g)

2) 2 moles of HCl(g)

3) 0.5 mole of HCl(g)

4) 1.5 moles of HCl(g)

44. In the reaction $4A + 2B + 3C \rightarrow A_4B_2C_3$, what will be the number of moles of product formed, starting from one mole of A, 0.6 mole of B and 0.72 mole of C?

1)0.25 2)0.3

3)0.24 4)2.32

45. The volume at STP of pure O_2 necessary for the complete combustion of 12 g of magnesium of atomic weight 24 is:

1) 22.4 dm^3 2) 11.2 dm^3

3) 5.6 dm^3 4) 12 dm^3

46. The volume of O_2 required at STP for the complete combustion of 39 g of benzene (C_6H_6)

1) 0.84 L 2) 8.4 L

3) 84 L 4) 22.4 L

47. 20 kg of N_2 and 3 kg of H_2 are mixed to produce NH_3 gas. The amount of NH_3 formed is

1) 17 kg 2) 23 kg

3) 34 kg 4) 56 kg

48. 2 moles of A and 3 moles of B react to form AB. $A + B \rightarrow AB$

Identify the limiting reagent in the reaction ?

1) A 2) B

3) A as well as B 4) None

49. If 0.50 mol of $BaCl_2$ is mixed with 0.20 mol of Na_3PO_4, the maximum number of moles of $Ba_3(PO_4)_2$ formed is

1) 0.25 2) 0.1

3) 0.40 4) 0.50

50. The volume of H_2 evolved at STP when 0.9 g of Al (molar mass : 27 g mol^{-1}) is dissolved in excess of dilute H_2SO_4 is

1) 0.58 L 2) 1.12 L

3) 2.40 L 4) 2.9 L

51. 6.0 g sample of $CaCO_3$ reacts with 20 g solution of HCl having 20% by mass of HCl (density = 1.10 g/mL). Calculate percentage purity of $CaCO_3$ sample.

1) 9.13% 2) 91.33%

3) 54.8% 4) 5.48%

52. Amount of water produced by the combustion of 16 g of methane is

1) 34 g 2) 32 g

3) 30 g 4) 36 g

53. If 27 g of water is formed during complete combustion of pure propene (C_3H_6), the mass of propene burnt will be

1) 42 g 2) 21 g

3) 14 g 4) 56 g

54. Given below are two statements:

Statement I : In the reaction, $2A + 3B \rightarrow C$ $\frac{4}{3}$ moles of 'C' are produced when 3 moles of 'A' is mixed with 4 moles of 'B'.

Statement II : 'A' is the limiting reagent.

In the light of the above statements, choose the most appropriate answer from the options given below :

1) Statement - I and II both are correct

2) Statement - I is correct while II is incorrect

3) Both Statement - I and II are incorrect

4) Statement - I is incorrect and II is correct

55. 50 g $CaCO_3$ is allowed to react with 49 g H_3PO_4 according to the given reaction,

$$3CaCO_3 + 2H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 3H_2O + 3CO_2$$

Then pick out the correct option

A) 51.67 g of salts is formed

B) Amount of unreacted reagent = 32.67 g

C) Moles of CO_2 formed = 0.5 moles

D) Mass of H_2O formed = 27g

1) A and C both are correct

2) B and D both are incorrect

3) A, C and D are correct

4) A and B both are correct

56. Select the incorrect statement –

(A) 1g molecule of any substance contains equal number of atoms

(B) If 2g of $H_{2(g)}$ completely reacts with 71g of $Cl_{2\,(g)}$ then 36.5 g of HCl is produced

(C) Reactant with minimum number of moles acts as limiting reagent

(D) During a chemical reaction, number of total moles may increase, decrease or remain constant

1) A,B C 2) B,C,D

3) A,B,C,D 4) A,C,D

57. A mixture of CH_4 and C_2H_4 in the volume ratio X : Y has total volume 30 ml. On complete combustion it gave 40 ml CO_2. If the ratio in the original mixture has been Y : X instead of X : Y, the volume of CO_2 would have been produced on combustion will be

1) 40 ml 2) 60 ml

3) 50 ml 4) 30 ml

58. 20.0 g of a magnesium carbonate sample decomposes on heating to give carbondioxide and 8.0 g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample?

1) 60 2) 84

3) 75 4) 96

59. The compound $Na_2CO_3.x\,H_2O$ has 50% H_2O by mass. The value of x is

1) 4 2) 5

3) 6 4) 7

EMPIRICAL AND MOLECULAR FORMULA

60. Caffein has molecular weight of 194. It contain 28.9% by mass of nitrogen. Number of atoms of nitrogen in one molecule of it is

1) 2 2) 3

3) 4 4) 5

61. Cortisone is a molecular substance containing 21 atoms of carbon per molecule. The mass percentage of carbon in cortisone is 69.98%. It's molar mass is

1) 176.5 $gmol^{-1}$ 2) 252.2 $gmol^{-1}$

3) 287.6 $gmol^{-1}$ 4) 360.1 $gmol^{-1}$

62. Which of the following represents the formula of a compound which contains 26 % nitrogen and 74 % oxygen ?

1) N_2O 2) NO

3) NO_2 4) N_2O_5

63. A hydrocarbon contains 92.3 % carbon by mass. Vapour density with respect to hydrogen is 13. The molecular formula of hydrocarbon is

1) C_2H_2 2) C_3H_6

3) C_2H_4 4) C_4H_8

64. An oxide of Iodine (I = 127 amu) contain 42.3 g of Iodine and 8 g of oxygen. Its formula could be

1) I_2O_5 2) I_2O_3

3) I_2O_7 4) I_2O

65. Compound A contains 8.7% hydrogen, 74.0% carbon and 17.3% nitrogen by mass. Molecular formula of the compound if molar mass of the compound is 162 g mol^{-1} is

1) $C_4H_6N_2$ 2) C_2H_3N

3) C_5H_7N 4) $C_{10}H_{14}N_2$

66. A gaseous hydrocarbon X, was burnt in excess of oxygen. A 0.112 dm^3 sample of X, at STP gave 0.88g CO_2. How many C-atoms are there in one molecule of X?

1) 1 2) 2

3) 3 4) 4

67. A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g carbon dioxide, 0.690 g of water and no other products. A volume of 10.0 L (measured at STP) of this welding gas is found to weigh 11.6 g. Find the molecular formula of the gas.

1) C_2H_2 2) C_2H_4

3) C_6H_6 4) CH_4

68. Haemoglobin contains 0.25% iron by weight. The mol wt. of haemoglobin is 89600. The no. of iron atoms per molecule is (At. wt of iron = 55.84):

1) 40 2) 25

3) 1 4) 4

69. 6.5 g of a hydrocarbon measures 5600 mL at STP. Then the hydrocarbon may be

1) CH_4 2) C_2H_6

3) C_2H_2 4) C_2H_4

EQUIVALENT MASS

70. Equivalent mass of a monovalent atom if its atomic mass is 35.5 is

1) 35.5 2) 17.25

3) 1 4) 5.6

71. If one gram of a metal carbonate gave 0.56g of its oxide on heating, then equivalent weight of the metal will be

1) 30 2) 40

3) 25 4) 20

72. W_1 g of an element combines with oxygen forming W_2 g of its oxide. The equivalent wt of the element is

1) $[W_1 / W_2] \times 8$ 2) $\left[\frac{W_1}{W_2 - W_1}\right] \times 8$

3) $\left[\frac{W_2 - W_1}{W_1}\right] \times 8$ 4) $\left[\frac{W_1}{W_1 - W_2}\right] \times 8$

CONCENTRATION OF SOLUTIONS

73. How many moles of NaCl should be dissolved in 100 ml of water to get 0.2 M solution ?

1) 0.2 2) 0.02

3) 0.01 4) 0.1

74. The density of 18 M H_2SO_4 solution is 1.8g mL^{-1}. The molality of this solution is

1) 36 2) 200

3) 18 4) 500

75. A 6.90 M solution of KOH in water has 30% by mass of KOH. Calculate density of solution.

1) 1.33 g mL^{-1} 2) 1.288 g mL^{-1}

3) 1.66 g mL^{-1} 4) 1.44 g mL^{-1}

76. Find molarity of water at room temperature

1) 18 M 2) 55.55 M

3) 35 M 4) 48 M

77. A solution contains 4 g NaOH and 16.2 g of water. The mole fraction of solute and solvent respectively are

1) 0.2, 0.8 2) 0.1, 0.9

3) 0.05, 0.5 4) 0.4, 0.6

78. Number of moles of NaOH required for the complete neutralisation of 50 mL 0.1 M HCl is

1) 5×10^{-3} mol 2) 10^{-4} mol

3) 5×10^{-4} mol 4) 5 mol

79. The molality of an H_2SO_4 solution is 9. The weight of the solute in 1 kg H_2SO_4 solution is:

1) 900.0 g 2) 469 g

3) 882.0 g 4) 9.0 g

80. To make 2.5 kg of 0.25 molal aqueous solution, determine the mass of urea (NH_2CONH_2) that is required

1) 37.5 g 2) 37 g

3) 36.2 g 4) 38 g

81. Calculate the concentration of nitric acid in moles per litre. The sample has a density, 1.41 g mL^{-1} and mass percentage 69%

1) 15.44 M 2) 11.8 M

3) 19 M 4) 8 M

82. Common salt obtained from sea-water contains 95% NaCl by mass. The approximate number of formula units present in 10 g salt is:

1) 10^{21} 2) 10^{22}

3) 10^{23} 4) 10^{24}

83. In 1200 g solution, 12 g urea (NH_2CONH_2) is present. If density of the solution is 1.2 g/ml then molarity if the solution is xM . Value of X will be

1) 0.1 2) 0.2

3) 0.3 4) 0.4

84. Number of gram equivalents present in 0.1 N 100 mL oxalic acid solution is

1) 10 2) 1

3) 0.1 4) 0.01

85. The amount of benzoic acid required for preparing 250 mL of 0.15 M solution in methanol is

1) 3.6 g 2) 4.6 g

3) 5.3 g 4) 8.0 g

86. Density of a 2.05 M solution of acetic acid in water is 1.02 g / ml. The molality of the solution is

1) 0.44 mol kg^{-1} 2) 1.14 mol kg^{-1}

3) 3.28 mol kg^{-1} 4) 2.28 mol kg^{-1}

87. 4L of water is added to 2Lof 6 M HCl. The molarity of the final solution is

1) 4M 2) 2M

3) 1M 4) 0.5M

88. The moles of sodium chloride in 250 cm^3 of 0.50 M NaCl are :

1) 0.250 mol 2) 2 mol

3) 0.125 mol 4) 1.0 mol

89. One kilogram of a sea water sample contains 6 mg of dissolved O_2. The concentration of O_2 in the sample in ppm is

1) 0.6 2) 6.0

3) 60.0 4) 16.0

90. The molarity of 98% H_2SO_4 (d= 1.8g/mL) by weight is

1) 6M 2) 18M

3) 10M 4) 4M

91. The number of Cl^- ions in 100 mL of 0.001M HCl solution is

1) 6.022×10^{23} 2) 6.022×10^{20}

3) 6.022×10^{19} 4) 6.022×10^{24}

92. 2.46 g of sodium hydroxide (Molar mass = 40) are dissolved in water and the solution is made to 100 cm^3 in a volumetric flask. Calculate the molarity of the solution

1) 0.615 M 2) 0.5848M

3) 0.432 M 4) 0.333 M

93. Calculate the normality of solution containing 31.5 g of hydrated oxalic acid ($H_2C_2O_4.2H_2O$) in 1250 mL of solution

1) 0.2N 2) 0.4N

3) 0.6N 4)1.0 N

94. How many grams of Na_2CO_3 should be dissolved to make 100 cm^3 of 0.15 M of Na_2CO_3Solution?

1) 1.23g 2)1.59g

3)1.71g 4)1.98g

95. A sample of $NaNO_3$ weighing 0.38 g is placed in a 250 mL volumetric flask. The flask is then filled with water to the mark on the neck. What is the molarity of the solution?

1) 0.008M

2) 0.081M

3) 0.018M

4) 0.08M

96. Calculate the volume of 0.015 M HCl solution required to prepare 250 mL of a 5.25×10^{-3} M HCl solution

1) 100 mL 2)87.5 mL

3)66.5mL 4)50 mL

97. What is the molality of a solution of methanol in water in which the mole fraction of methanol is 0.25?

1) 3.6m 2)10.1m

3)14.5m 4)18.5m

98. 250 mL of 1.5 M solution of sulphuric acid is diluted by adding 5L of water. What is the molarity of the diluted solution?

1) 0.0520M 2)0.071M

3)0.092M 4)0.1890M

99. Which of the following concentration term is temperature independent?

1) Molarity

2) Normality

3) Mass by Volume percentage

4) Mole fraction

100. Sum of Mole fractions of all the components in solution is

1) 0 2) 1

3) 2 4) 4

SAMPLE QUESTIONS

1. Which of the following substances cannot be separated into its constituents by physical methods?

1) Sugar and water solution

2) Salt and sugar

3) Solid glucose

4) Both 1 and 2

2. Which of the following pair of substances contain element and compound within a pair?

A) O_2, CH_4

B) H_2, O_2

C) N_2, CO_2

D) Na, CO

1) A, C, D 2) B only

3) C and D 4) All of these

3. Which of the following statements about a compound is incorrect?

1) A molecule of a compound has atoms of different elements

2) A compound cannot be separated into its constituent elements by physical methods of separation

3) A compound retains the physical properties of its constituent elements

4) The ratio of atoms of different elements in a compound is fixed

4. Choose the correct combination

	Element	Com-pound	Mixture
1)	Ammonia	Sodium	Air
2)	Water	Sugar	Aqueous sug-ar solution
3)	Hydrogen	Oxygen	Water
4)	Silver	Water	Air

5. Which one of these is not a pure compound?

1) SO_3 2) H_2O_2

3) H_2O 4) Sucrose solution

6. The unit J Pa^{-1} is equivalent to

1) m^3 2) cm^3

3) dm^3 4) None of these

7. 20 g of $CaCO_3$ on heating gave 8.8 g of CO_2 and 11.2 g of CaO. This is in accordance with

1) The law of conservation of mass

2) The law of constant composition

3) The law of reciprocal proportion

4) The law of multiple proportion

8. Which of the following is the best example of law of conservation of mass?

1) 12 g of carbon combines with 32 g of oxygen to form 44 g of CO_2

2) When 12 g of carbon is heated in a vacuum there is no change in mass

3) A sample of air increase in volume when heated at constant pressure but its mass remains unsaltered

4) The weight of a piece of platinum is the same before and after heating in air

9. In an experiment 4.2 g of $NaHCO_3$ is added to a solution of acetic acid weighing 10.0 g, it is observed that 2.2 g of CO_2 is released into the atmosphere. The residue left behind is found to weigh 12.0 g

The above observations illustrate

1) law of definite proportions

2) law of conservation of mass

3) law of multiple proportions

4) Law of reciprocal proportion

10. In one experiment, 4g of H_2 combine with 32 g of O_2 to form 36 g of H_2O. In another experiment, when 50 g of H_2 combine with 400 g of O_2 then 450 g of H_2O is formed. Above two experiments follow

1) The law of conservation of mass

2) The law of constant composition

3) Both 1 and 2

4) Neither 1 or 2

11. Irrespective of the source, pure sample, of water always yields 88.89 % mass of oxygen and 11.11% mass of hydrogen. This is explained by the law of

1) conservation of mass

2) multiple proportions

3) constant composition

4) constant volume

12. The law of definite proportions was given by:

1) John Dalton

2) Humphry Davy

3) Proust

4) Michael Faraday

13. Which one of the following pairs of compounds illustrate the law of multiple proportions?

1) H_2O and Na_2O 2) MgO and Na_2O

3) Na_2O and BaO 4) $SnCl_2$ and $SnCl_4$

14. Two samples of lead oxide were separately reduced to metallic lead by heating in a current of hydrogen. The weight of lead from one oxide was half the weight of lead obtained from the other oxide. The data illustrates

1) law of reciprocal proportions

2) law of constant proportions

3) law of multiple proportions

4) law of equivalent proportions

15. The molecular weight of O_2 and SO_2 are 32 and 64 respectively. At 15^0C and 150 mm Hg pressure, one litre of O_2 contains 'N' molecules. The number of molecules in two litres of SO_2 under the same conditions of temperature and pressure will be:

1) N/2 2) 1N

3) 2N 4) 4N

16. 10 dm^3 of N_2 gas and 10 dm^3 of gas X at the same temperature contain the same number of molecules, the gas X is

1) CO_2 2) CO

3) H_2 4) NO

17. Equal volumes of two gases A and B are kept in a container at the same temperature and pressure. Avogadro's law is invalid if

1) the gases are reactive

2) the gases are non-reactive

3) gas A has more number than gas B

4) None of these

18. Molecular mass is defined as the

1) mass of one atom compared with the mass of one molecule

2) mass of one atom compared with the mass of one atom of hydrogen

3) mass of one molecule of any substance compared with the mass of one atom of C-12

4) None of the above

19. The percentage weight of Zn in white vitriol [$ZnSO_4.7H_2O$] is approximately equal to (Zn = 65, S = 32, O = 16 and H = 1)

1) 33.65 % 2) 32.56 %

3) 23.65 % 4) 22.65 %

20. The average atomic mass of neon based on following data is:

Isotope	Relative abundance
^{20}Ne	0.9051
^{21}Ne	0.0027
^{22}Ne	0.0922

1) 0.33 u 2) 20.187 u

3) 6.729 u 4) 18.058 u

21. What is the mass of an atom of oxygen (in gm)?

1) 2.656×10^{-23} 2) 1.567×10^{-22}

3) 2.0×10^{-22} 4) 3.5×10^{-23}

22. What is the mass of 1 molecule of CO?

1) 2.325×10^{-23} 2) 4.65×10^{-23}

3) 3.732×10^{-23} 4) 2.895×10^{-23}

23. At STP the density of CCl_4 vapours in g/L will be nearest to:

1) 6.87 2) 3.42

3) 10.26 4) 4.57

24. Which has maximum number of molecules?

1) 7 g N_2 2) 2 g H_2

3) 16 g NO_2 4) 16 g O_2

25. The number of molecules in 16 g of methane is

1) 3.0×10^{23} 2) $\frac{16}{6.02} \times 10^{23}$

3) 6.02×10^{23} 4) $\frac{16}{3.0} \times 10^{23}$

26. The number of moles of oxygen in one litre of air containing 21% oxygen by volume, under standard conditions are

1) 0.0093 mole 2) 0.21 mole

3) 2.10 mole 4) 0.186 mole

27. One mole of CO_2 contains:

1) 3 g atom of CO_2

2) 18.1×10^{23} molecules of CO_2

3) 6.02×10^{23} atoms of O

4) 6.02×10^{23} atoms of C

28. Volume of a gas at NTP is 1.12×10^{-7} cm^3. The number of molecules in it is:

1) 3.01×10^{12}

2) 3.01×10^{24}

3) 3.01×10^{23}

4) 3.01×10^{20}

29. How many atoms are contained in one mole of sucrose ($C_{12}H_{22}O_{11}$)?

1) $20 \times 6.02 \times 10^{23}$ atoms/mol

2) $45 \times 6.02 \times 10^{23}$ atoms/mol

3) $5 \times 6.02 \times 10^{23}$ atoms/mol

4) None of these

30. Number of moles of NaOH present in 2 litre of 0.5 M NaOH is:

1) 1.5 2) 2.0

3) 1.0 4) 2.5

31. In the reaction

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(\ell)$$

When 1 mole of ammonia and 1 mole of O_2 are made to react to completion,

1) 1.0 mole of H_2O is produced

2) 1.0 mole of NO will be produced

3) all the oxygen will be consumed

4) all the ammonia will be consumed

32. The molar solution of H_2SO_4 is equal to:

1) N/2 solution

2) N solution

3) 2N solution

4) 3N solution

33. Give the correct order of initials T or F for following statements. Use T if statement is true and F if it is false.

i) Gay-Lussac's law of gaseous volumes is actually the law of definite proportion by volume.

ii) Law of conservation of mass is true for physical change, but not for chemical change.

iii) The percentage of oxygen in H_2O_2 is different from that in H_2O. Hence, it violates law of definite proportions.

iv) Fixed mass of A reacts with two different masses of B (say x and y), then the ratio of x/y can be any positive integer.

v) At STP, 5 mL of N_2 and H_2 have different number of molecules.

1) TTFTF

2) FTTFT

3) TFFTF

4) TFTTF

34. Match the columns.

Column - I		Column - II	
A)	88 g of CO_2	p)	0.25mol
B)	6.022×10^{23} molecules of H_2O	q)	2 mol
C)	5.6 litres of O_2 at STP	r)	1 mol
D)	96 g of O_2	s)	6.022×10^{23} molecules
E)	1 mol of any gas	t)	3 mol

1) A-q, B-r, C-p, D-t, E-s

2) A-r, B-q, C-p, D-t, E-s

3) A-q, B-p, C-r, D-t, E-s

4) A-q, B-r, C-p, D-s, E-t

35. Match the columns.

Column-I (Physical quantity)		Column-II (Unit)	
A)	Molarity	p)	mol
B)	Mole fraction	q)	Unitless
C)	Mole	r)	mol L^{-1}
D)	Molality	s)	mol kg^{-1}

1) A-r, B-q, C-s, D-p

2) A-r, B-p, C-q, D-s

3) A-r, B-q, C-p, D-s

4) A-q, B-r, C-p, D-s

36. **Assertion** : The empirical mass of ethene is half of its molecular mass.

Reason : The empirical formula represents the simplest whole number ratio of various atoms present in a compound.

1) Assertion is correct, reason is correct; reason is a correct explanation for assertion

2) Assertion is correct, reason is correct; reason is not a correct explanation for assertion

3) Assertion is correct, reason is incorrect

4) Assertion is incorrect, reason is correct

37. 1 cc N_2O at NTP contains:

1) $\frac{1.8}{224} \times 10^{22}$ atoms

2) $\frac{6.02}{22400} \times 10^{23}$ molecules

3) $\frac{1.32}{224} \times 10^{23}$ electrons

4) All of the above

38. Which one of the following is the lightest?

1) 0.2 mole of hydrogen gas

2) 6.023×10^{22} molecules of nitrogen

3) 0.1 g of silver

4) 0.1 mole of oxygen gas

39. A gaseous hydrocarbon gives upon combustion 0.72 g of water and 3.08 g of CO_2. The empirical formula of the hydrocarbon is:

1) C_2H_4

2) C_3H_4

3) C_6H_5

4) C_7H_8

40. Liquid benzene (C_6H_6) burns in oxygen according to the equation $2C_6H_{6(\ell)} + 15O_{2(g)} \rightarrow 12CO_{2(g)} + 6H_2O_{(g)}$

How many litres of O_2 at STP are needed to complete the combustion of 39 g of liquid benzene? (Molecular weight of O_2 = 32, C_6H_6 = 78)

1) 74 L

2) 11.2 L

3) 22.4 L

4) 84 L

41. The mass of $BaCO_3$ produced when excess CO_2 is bubbled through a solution of 0.205 mol $Ba(OH)_2$ is: (Atomic mass of Ba = 137)

1) 81 g

2) 40.5 g

3) 20.25 g

4) 162 g

42. For the reaction $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$, the volume of carbon monoxide required at STP to reduce one mole of ferric oxide is

1) 67.2 dm^3

2) 11.2 dm^3

3) 22.4 dm^3

4) 44.8 dm^3

43. 10 mL of 2(M) NaOH solution is added to 200 mL of 0.5 (M) of NaOH solution. What is the final concentration?

1) 0.57 (M)

2) 5.7 (M)

3) 11.4 (M)

4) 1.14 (M)

44. One kilogram of a sea water sample contains 6 mg of dissolved O_2. The concentration of O_2 in the sample in ppm is

1) 0.6 2) 6.0

3) 60.0 4) 16.0

45. Choose the correct option based on following statements. Here 'T' stands for true and 'F' stands for false statement.

i) Molecular mass of cane sugar ($C_{12}H_{22}O_{11}$) is 182 amu

ii) 1 mole of cane sugar contains 6.022×10^{23} molecules of cane sugar

iii) 34.20 g of cane sugar contains 6.022×10^{21} molecules of cane sugar

1) TTF

2) TFT

3) FTF

4) FTT

ANSWER KEY

1.	1	21.	2	41.	2	61.	4	81.	1
2.	4	22.	1	42.	2	62.	4	82.	3
3.	1	23.	3	43.	1	63.	1	83.	2
4.	2	24.	2	44.	3	64.	2	84.	4
5.	4	25.	2	45.	3	65.	4	85.	2
6.	2	26.	3	46.	3	66.	4	86.	4
7.	2	27.	1	47.	1	67.	1	87.	2
8.	3	28.	4	48.	1	68.	4	88.	3
9.	1	29.	3	49.	2	69.	3	89.	2
10.	4	30.	1	50.	2	70.	1	90.	2
11.	2	31.	1	51.	2	71.	4	91.	3
12.	2	32.	4	52.	4	72.	2	92.	1
13.	3	33.	4	53.	2	73.	2	93.	2
14.	3	34.	1	54.	2	74.	4	94.	2
15.	1	35.	3	55.	1	75.	2	95.	3
16.	3	36.	2	56.	1	76.	2	96.	2
17.	4	37.	3	57.	3	77.	2	97.	4
18.	2	38.	3	58.	2	78.	1	98.	2
19.	3	39.	2	59.	3	79.	2	99.	4
20.	1	40.	3	60.	3	80.	2	100.	2

SAMPLE QUESTIONS

1.	3	10.	3	19.	4	28.	1	37.	4
2.	1	11.	3	20.	2	29.	2	38.	3
3.	3	12.	3	21.	1	30.	3	39.	4
4.	4	13.	4	22.	2	31.	3	40.	4
5.	4	14.	3	23.	1	32.	1	41.	2
6.	1	15.	3	24.	2	33.	3	42.	1
7.	1	16.	2	25.	3	34.	1	43.	1
8.	1	17.	4	26.	1	35.	3	44.	2
9.	2	18.	3	27.	4	36.	1	45.	3

WORK BOOK

Chapter 02

STRUCTURE OF ATOM

QUESTIONS

1. Rutherford's α-particle scattering experiment proved that atom has:

1) Electrons 2) Neutrons

3) Nucleus 4) Orbitals

2. A and B are two elements which have same atomic weight and are having atomic number 27 and 30 respectively. If the atomic weight of A is 57 then number of neutron in B is:

1) 27 2) 33

3) 30 4) 40

3. Find out the atoms which are isotones:

1) ${}^{14}_{6}C, {}^{15}_{7}N, {}^{17}_{9}F$ 2) ${}^{12}_{6}C, {}^{14}_{7}N, {}^{19}_{9}F$

3) ${}^{14}_{6}C, {}^{14}_{7}N, {}^{17}_{9}F$ 4) ${}^{14}_{6}C, {}^{14}_{7}N, {}^{19}_{9}F$

4. Species which are isoelectronic to one another are

a) CN^- b) OH^-

c) CH_3^+ d) N_2

e) CO

Correct answer is:

1) a, b, c 2) a, c, d

3) a, d, e 4) b, c, d

5. For any anion X^{-3}, the mass number is 14. If anion has 10 electrons, then number of neutrons in X_2 nucleus:

1) 10 2) 14

3) 7 4) 5

6. Which of the following pairs is correctly matched:

1) Isotopes ${}^{40}_{20}Ca, {}^{40}_{19}K$

2) Isotones ${}^{30}_{14}Si, {}^{31}_{15}P, {}^{32}_{16}S$

3) Isobars ${}^{16}_{8}O, {}^{17}_{8}O, {}^{18}_{8}O$

4) Isoelectronic N^{-3}, O^{-2}, Cr^{+3}

7. In ${}^{14}_{7}N$ if mass attributed to electrons were doubled & the mass attributed to protons were halved, the atomic mass would become approximately:

1) Halved 2) Doubled

3) Reduced by 25% 4) Remain same

8. The ratio of the "e/m" (specific charge) values of an proton and an α-particle is:

1) 2 : 1 2) 1 : 1

3) 1 : 2 4) None of these

9. If threshold wavelength (λ^0) for ejection of electron from metal is 330 nm, then work function for the photoelectronic emission is:

1) 1.2×10^{-18} J 2) 1.2×10^{-20} J

3) 6×10^{-19} J 4) 6×10^{-12} J

10. Light of wavelength λ shines on a metal surface with intensity x and the metal emits y electrons per second average energy, z. What will happen to y and z if x is doubled?

1) y will be doubled and z will become half

2) y will remain same and z will be doubled

3) both y and z will be doubled

4) y will be doubled but z will remain same

11. The MRI (magnetic resonance imaging) body scanners used in hospitals operate with 400 MHz radio frequency. The wavelength corresponding to this radio frequency is:

1) 0.75 m 2) 0.75 cm

3) 1.5 m 4) 2cm

12. The value of planck's constant is 6.63×10^{-34} Js. The velocity of light is 3.0×10^{8} ms^{-1}. Which value is closest to the wavelength in metres of a quantum of light with frequency of 8×10^{15} s^{-1}?

1) 3×10^{7} 2) 2×10^{-25}

3) 5×10^{-18} 4) 3.75×10^{-8}

13. If change in energy $(\Delta E) = 3 \times 10^{-8}$ J, h = 6.64 $\times 10^{-34}$ J-s and c = 3×10^{8} m/s, then wavelength of the light is:

1) 6.64×10^{3} $\overset{0}{A}$ 2) 6.64×10^{5} $\overset{0}{A}$

3) 6.64×10^{-8} $\overset{0}{A}$ 4) 6.64×10^{18} $\overset{0}{A}$

BOHR'S ATOMIC MODEL

14. Which statement is wrong about Bohr's theory?

1) orbit is a three dimensional area where probability of finding electron is maximum

2) Orbit is a two dimensional track in which electron moves

3) Atom has definite boundary

4) Energies and angular momentum of orbits are qunantized

15. Angular momentum in second Bohr orbit of H-atom is x. Then find out angular momentum in Ist excited state of Li^{+2} ion:

1) 3x 2) 9x

3) $\frac{x}{2}$ 4) x

16. Orbital angular momentum of p-subshell electron is:

1) $\frac{3h}{\pi}$ 2) Zero

3) $\frac{\sqrt{2}h}{2\pi}$ 4) None

17. The emission spectra is observed by the consequence of transition of electron from higher energy state to ground state of He^{+1} ion. Six photons are observed in the emission spectra. The minimum wavelength during transition is

1) $\frac{4}{27R_H}$ 2) $\frac{4}{15R_H}$

3) $\frac{15}{16R_H}$ 4) $\frac{16}{15R_H}$

18. The kinetic and potential energy (in eV) of an electron present in 3rd Bohr's orbit of hydrogen atom are respectively?

1) –1.51, – 3.02 2) 1.51, –3.02

3) –3.02, 1.51 4) 1.51, –1.51

19. The energy of second Bohr orbit of the hydrogen atom is –328 kJ mol^{-1}, hence the energy of fourth Bohr orbit would be:

1) –41 kJ mol^{-1} 2) –1312 kJ mol^{-1}

3) –164 kJ mol^{-1} 4) –82 kJ mol^{-1}

20. In hydrogen spectrum, the different lines of Lyman series are present in:

1) UV field 2) IR field

3) Visible field 4) Far IR field

21. The wavelength of the spectral line when the electron in the hydrogen atom undergoes a transition from energy level 4 to energy level 2 is:

1) 486 nm 2) 486 m

3) 486 $\overset{0}{A}$ 4) 486 cm

22. Product of electron velocity and radius of an orbit in an atom is:

1) Proportional to mass of electron

2) Proportional to square of mass of electron

3) Inversely proportional to mass of electron

4) Does not depend upon mass of electron

23. The radius of an orbit of H-atom is 4.761 $\overset{0}{A}$.

The value of n is:

1) 3 2) 9

3) 5 4) 4

24. In Bohr's atomic model, radius of Ist orbit of hydrogen is 0.053 nm then radius of 3rd orbit of Li^{+2} is:

1) 0.159 nm 2) 0.053 nm

3) 0.023 nm 4) 0.026 nm

25. The radius ratio of first three Bohr orbits of an atom is

1) 1 : 0.5 : 0.5 2) 1 : 2 : 3

3) 1 : 4 : 9 4) 1 : 8 : 27

26. For Li^{+2} ion, $r_2 : r_5$ will be:

1) 9 : 25 2) 4 : 25

3) 25 : 4 4) 25 : 9

27. The ratio of the radii of two Bohr orbits of H-atom is 4 : 1, The orbits are

1) K & L 2) L & K

3) N & L 4) 2 & 3 both

28. The velocity of electron in third excited state of Be^{3+} ion will be:

1) $\frac{3}{4}\left(2.188\times10^{8}\right)ms^{-1}$

2) $\frac{3}{4}\left(2.188\times10^{6}\right)ms^{-1}$

3) $2.188 \times 10^{6}\ ms^{-1}$

4) $2.188 \times 10^{3}\ ms^{-1}$

29. The Bohr radius of hydrogen atom (n = 1) is approximately 0.530 $\overset{0}{A}$. The radius of its first excited state (n = 2) will be:

1) 0.13 $\overset{0}{A}$ 2) 1.0 $\overset{0}{A}$

3) 4.77 $\overset{0}{A}$ 4) 2.12 $\overset{0}{A}$

30. According to Bohr theory, the radius (r) and velocity (v) of an electron vary with the increasing principal quantum number 'n' as:

1) r increases, v decreases

2) r and v both increases

3) r and v both decreases

4) r decreases, v increases

31. The spectral lines corresponding to the radiation emitted by an electron jumping from higher orbits to first orbit belong to:

1) Paschen series

2) Balmer series

3) Lyman series

4) Brackett series

32. The frequency of one of the lines in Paschen series of hydrogen atom is 2.340×10^{14} Hz. The quantum number n_2 which produces this transition is:

1) 6 2) 5

3) 4 4) 3

33. A photon was absorbed by a hydrogen atom in its ground state and the electron was promoted to the fifth orbit. When the excited atom returned to its ground state, visible quantum were emitted when electron made transition is

1) $5 \rightarrow 2$ 2) $2 \rightarrow 1$

3) $3 \rightarrow 1$ 4) $4 \rightarrow 3$

34. The first emission line in the atomic spectrum of hydrogen in the Balmer series appear it:

1) $\frac{9R}{400} cm^{-1}$ 2) $\frac{7R}{144} cm^{-1}$

3) $\frac{3R}{4} cm^{-1}$ 4) $\frac{5R}{36} cm^{-1}$

35. The wave number of the spectral line in the emission spectrum of hydrogen will be equal to $\frac{8}{9}$ times the Rydberg's constant if the electron jumps from ———

1) n = 3 to n = 1

2) n = 10 to n = 1

3) n = 9 to n = 1

4) n = 2 to n = 1

36. Which of the following statements is not correct?

1) The shape of an atomic orbital depends on the azimuthal quantum number

2) The orientation of an atomic orbital is given by magnetic quantum number

3) The energy of an electron in an atomic orbital of multi-electron atom depends on the principal quantum number only

4) The number of degenerate atomic orbitals of one type depends on the values of azimuthal and magnetic quantum numbers

37. Two electrons occupying the same orbital are distinguished by:

1) Spin quantum number

2) Principal quantum number

3) Magnetic quantum number

4) Azimuthal quantum number

38. Which among the following statement is wrong

1) 1st line of Brackett seriesd is from $5 \rightarrow 4$

2) Balmer series belongs to IR

3) The wave number of limitting line in the Balmer series is $\frac{R_H}{4}$

4) Restriction of any property to discrete value is called quantisation

39. In a hydrogen atom, if energy of an electron in ground state is – 13.6 eV, then energy in the 2nd excited state is:

1) – 1.51 eV

2) – 3.4 eV

3) – 6.04 eV

4) – 13.6 eV

40. The ratio between kinetic energy and the total energy of the electron of hydrogen atom according to Bohr's model is:

1) 2 : 1 2) 1 : 1

3) 1 : – 1 4) 1 : 2

41. Potential energy is – 27.2 eV in second orbit of He^+, then calculate double of total energy in first excited state of hydrogen atom:

1) – 13.6 eV 2) – 54.4 eV

3) – 6.8 eV 4) – 27.2 eV

42. The energy levels for $_zA^{(+z-1)}$ can be given by:

1) E_n for $A^{(+z-1)} = Z^2 \times E_n$ for H

2) E_n for $A^{(+z-1)} = Z \times E_n$ for H

3) E_n for $A^{(+z-1)} = \frac{1}{Z^2} \times E_n$ for H

4) E_n for $A^{(+z-1)} = \frac{1}{Z} \times E_n$ for H

43. Going from K-shell to N-shell in case of H-atom:

1) Kinetic energy decreases

2) Total energy decreases

3) Potential energy decreases

4) All of these

44. Maximum frequency of emission is obtained for the transition:

1) n = 2 to n = 1 2) n = 6 to n = 2

3) n = 1 to n = 2 4) n = 2 to n = 6

45. If the ionization energy of hydrogen is 313.8 kcal per mole, then the energy of the electron in 2nd excited state will be:

1) –113.2 kcal/mole

2) –78.45 kcal/mole

3) –313.8 kcal/mole

4) –35 kcal/mole

46. Which of the following electron transition will require the largest amount of energy in a hydrogen atom:

1) From n = 1 to n = 2

2) From n = 2 to n = 3

3) From n = ∞ to n = 1

4) From n = 3 to n = 5

47. If the potential energy (PE) of hydrogen electron is –3.02 eV then in which of the following excited level is electron present:

1) Ist 2) 2nd

3) 3rd 4) 4th

48. The radiation of low frequency will be emitted in which transition of hydrogen atom:

1) n = 1 to n = 4 2) n = 2 to n = 5

3) n = 3 to n = 1 4) n = 5 to n = 4

49. A single electron orbits a stationary nucleus (z = 5). The energy required to excite the electron from third to fourth Bohr orbit will be:

1) 4.5 eV 2) 8.53 eV

3) 25 eV 4) 16.53 eV

SPECTRUM AND SPECTRAL LINES

50. The spectrum of He is expected to be similar to that of:

1) H 2) Na

3) He^+ 4) Li^+

51. Third line of Balmer series is produced by which transition in spectrum of H-atom

1) 5 to 2 2) 5 to 1

3) 4 to 2 4) 4 to 1

52. Which one of the following electron transitions between energy levels produces the line of shortest wavelength in hydrogen spectrum?

1) $n_2 \rightarrow n_1$ 2) $n_3 \rightarrow n_1$

3) $n_4 \rightarrow n_1$ 4) $n_4 \rightarrow n_3$

53. Which series have highest energy in hydrogen spectrum:

1) Balmer 2) Bracket

3) Pfund 4) Lyman

54. The ratio of minimum frequency of Lyman & Balmer series will be:

1) 1.25 2) 0.25

3) 5.4 4) 10

55. Which transition emits photon of maximum frequency:

1) second spectral line of Balmer series

2) second spectral line of Paschen series

3) fifth spectral line of Humphery series

4) first spectral line of Lyman series

56. Which one of the following species will give a series of spectral lines similar to that of Mg^{2+}:

1) Al^{3+} 2) Na

3) Mg^{+} 4) F

57. The wavelength of photon obtained by electron transition between two levels in H-atom and singly ionised He are λ_1 and λ_2 respectively, then:

1) $\lambda_2 = \lambda_1$ 2) $\lambda_2 = 2\lambda_1$

3) $\lambda_2 = \lambda_1 / 2$ 4) $\lambda_2 = \lambda_1 / 4$

58. Find out ratio of following for photon

$(\nu_{max.})_{Lyman} : (\nu_{max})_{Brakett}$

1) 1 : 16 2) 16 : 1

3) 4 : 1 4) 1 : 4

59. The ratio of wavelengths of first line of Lyman series in Li^{+2} and first line of Lyman series in deuterium $\left({}^{2}_{1}H\right)$ is:

1) 1 : 9 2) 9 : 1

3) 1 : 4 4) 4 : 1

60. In an electronic transition atom cannot emit:

1) Visible light 2) γ-rays

3) Infra red light 4) Ultra violet light

61. The first Lyman transition in the hydrogen spectrum has $\Delta E = 10.2\,eV$. The same energy change is observed in the second Balmer tranistion of:

1) Li^{2+} 2) Li^{+}

3) He^{+} 4) Be^{3+}

62. The limiting line in Balmer series will have a frequency of:

1) 3.65×10^{14} sec^{-1}

2) 3.29×10^{15} sec^{-1}

3) 8.22×10^{14} sec^{-1}

4) -8.22×10^{14} sec^{-1}

63. If the shortest wavelength of Lyman series of H atom is x,then the wave length of first line of Balmer series of H atom will be:

1) $\frac{9x}{5}$ 2) $\frac{36x}{5}$

3) $\frac{5x}{9}$ 4) $\frac{5x}{36}$

64. The first emission line in the H-atom spectrum in the Balmer series will have wave number:

1) $\frac{5R}{36} cm^{-1}$ 2) $\frac{3R}{4} cm^{-1}$

3) $\frac{7R}{144} cm^{-1}$ 4) $\frac{9R}{400} cm^{-1}$

65. What transition in He^{+} will have the same λ as the Ist line in Balmer series of H-atom:

1) $5 \rightarrow 3$ 2) $3 \rightarrow 2$

3) $6 \rightarrow 4$ 4) $4 \rightarrow 2$

66. In H-atom, electron transits from 6th orbit to 2nd orbit in multi step. Then total spectral lines (without Balmer series) will be:

1) 6 2) 10

3) 4 4) 0

67. An atom has x energy level, then total number of lines in its spectrum are:

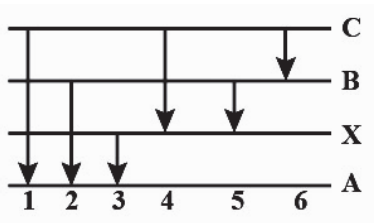
1) 1 + 2 + 3 ..... (x + 1)

2) 1 + 2 + 3 .....(x^2)

3) 1 + 2 + 3 .....(x – 1)

4) (x + 1) (x + 2) (x + 4)

68. The figure indicates the energy level diagram for the origin of six spectral lines in emission spectrum (e.g. line no. 5 arises from the transition from level B to X) which of the following spectral lines will not occur in the absorption spectrum:



1) 1, 2, 3 2) 3, 2

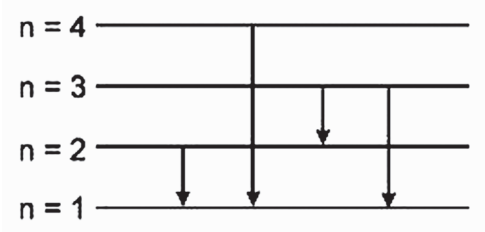
3) 4, 5, 6 4) 3, 2, 1

69. A certain electronic transition from an excited state to ground state of the H atom in one or more step gives rise to four lines in the ultra violet region of the spectrum. How many lines does this transition produce in the infrared region of the spectrum:

1) 1 2) 2

3) 3 4) 4

70. Suppose that a hypothetical atom gives a red, green, blue and violet line spectrum. Which jump according to figure would give off the red spectral line.



1) 3 → 1 2) 2 → 1

3) 4 → 1 4) 3 → 2

71. The ratio of the frequency corresponding to the third line in Lyman series of hydrogen atomic spectrum to that of the first line in Balmer series of Li^{2+} spectrum is:

1) $\frac{4}{5}$ 2) $\frac{5}{4}$

3) $\frac{4}{3}$ 4) $\frac{3}{4}$

72. The longest wavelength of He^+ when its electron to third Bohr orbit is 'm' then shortest wavelength of Be^{3+} in the corresponding transition series in terms of 'm' is:

1) $\frac{7}{64}$m 2) $\frac{5}{36}$m

3) $\frac{64}{7}$m 4) $\frac{53}{8}$m

DE-BROGLIE CONCEPT AND HEISENBERG PRINCIPLE

73. An electron has a kinetic energy of 2.8×10^{-23} J. de-Broglie wavelength will be nearly:

($m_e = 9.1 \times 10^{-31}$ kg)

1) 9.28×10^{-24} m 2) 9.28×10^{-7} m

3) 9.28×10^{-8} m 4) 9.28×10^{-10} m

74. What is the de-Broglie wavelength associated with the hydrogen electron in its third orbit:

1) 9.96×10^{-10} cm 2) 9.96×10^{-8} cm

3) 9.96×10^{4} cm 4) 9.96×10^{8} cm

75. If the de-Broglie wavelength of the fourth Bohr orbit of hydrogen atom is 4 $\overset{0}{A}$, the circumference of the orbit will be:

1) 4 $\overset{0}{A}$ 2) 4 nm

3) 16 $\overset{0}{A}$ 4) 16 nm

76. Number of waves in fourth orbit:

1) 4 2) 5

3) 0 4) 1

77. What is the ratio of the de-broglie wavelengths for electrons accelerated through 200 volts and 50 volts:

1) 1 : 2 2) 2 : 1

3) 3 : 10 4) 10 : 3

78. For a valid Bohr orbit, its circumfrence should be

1) = $n\lambda$ 2) = $(n-1)\lambda$

3) > $n\lambda$ 4) < $n\lambda$

79. A particle X moving with a certain velocity has a debroglie wavelength of 1 $\overset{0}{A}$. If particle Y has a mass of 25% that of X and velocity 75% that of X, de-Broglie wavelength of Y will be:

1) 3 $\overset{0}{A}$ 2) 5.33 $\overset{0}{A}$

3) 6.88 $\overset{0}{A}$ 4) 48 $\overset{0}{A}$

QUANTUM NUMBERS

80. In a multi-electron atom, which of the following orbitals described by the three quantum numbers will have the same energy in the absence of magnetic field:

i. n = 1, l = 0, m = 0

ii. n = 2, l = 0, m = 0

iii. n = 2, l = 1, m = 1

iv. n = 3, l = 2, m = 1

v. n = 3, l = 2, m = 0

1) i and ii 2) ii and iii

3) iii and iv 4) iv and v

81. The following quantum number are possible for how many orbitals n = 3, l = 2, m = +2?

1) 1 2) 2

3) 3 4) 4

82. Number of possible orbitals (all types) in n = 3 energy level is:

1) 1 2) 3

3) 4 4) 9

83. Which sub-shell is not permissible:

1) 2d 2) 4f

3) 6p 4) 3s

84. Nodal plane is found in which orbital:

1) n = 2, l = 0 2) n = 3, l = 0

3) n = 2, l = 1 4) n = 1, l = 0

85. Number of nodal surface in 2s orbital:

1) 0 2) 1

3) 2 4) 3

86. Number of orbitals in h sub-shell is

1) 11 2) 15

3) 17 4) 19

87. How many quantum numbers are required to specify the position of electron:

1) 1 2) 2

3) 3 4) 4

88. Which of the following is correct for a 4d-electron

1) n = 4, l = 2, s = + $\frac{1}{2}$

2) n = 4, l = 2, s = 0

3) n = 4, l = 3, s = 0

4) n = 4, l = 3, s = + $\frac{1}{2}$

89. In an atom, for how many electrons, the quantum numbers will be n = 3, l = 2, m = +2, s = + $\frac{1}{2}$:

1) 18 2) 6

3) 24 4) 1

90. Which orbital is represented by the complete wave function ψ_{420}:

1) 4d 2) 3d

3) 4p 4) 4s

91. An electron is in one of 4d orbital. Which of the following orbital quantum number value is not possible:

1) 4 2) 1

3) 1 4) 2

92. A neutral atom of an element has 2K, 8L, 11 M and 2 N electrons. The number of s-electron in the atom are

1) 2 2) 8

3) 10 4) 6

93. If ℓ = 3 then type and number of orbital is:

1) 3p, 3 2) 4f, 14

3) 5f, 7 4) 3d, 5

94. Any nf-orbital can accommodate upto:

1) 14 electron

2) six electrons

3) two electrons with parallel spin

4) two electrons with opposite spin

95. n, ℓ and m values of an electron in $3p_y$ orbital are:

1) n = 3, ℓ = 1 and m = 1

2) n = 3, ℓ = 1 and m = –1

3) Both 1 and 2 are correct

4) None of these

96. $_{36}Kr$ has the electronic configuration ($_{18}Ar$) $4s^2$ $3d^{10}$ $4p^6$. The 39th electron will go into which one of the following sub-levels:

1) 4f 2) 4d

3) 3p 4) 5s

97. The maximum probability of finding an electron in the d_{xy} orbital is:

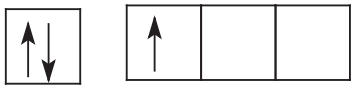
1) Along the x-axis

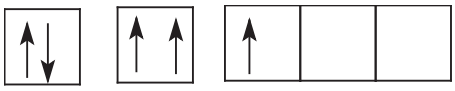
2) Along the y-axis

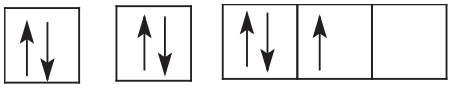
3) At an angle of 45^0 from the x and y axis

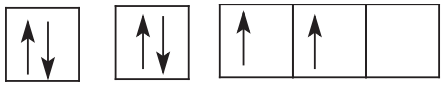
4) At an angle of 90^0 from the x and y axis

98. Which configuration does not obey pauli's exclusion principle:

1) 

2) 

3) 

4) 

99. The incorrect statement among the following

1) Energy of electron in hydrogen atom depends only on 'n'

2) Energy of electron in multi electron atom depends on n and ℓ

3) Energy of orbital in same subshell decrease with increase in atomic number

4) Higher the value of $(n+\ell)$ for an orbital lower in its energy

100. Magnetic moment of X^{n+} (Z = 26) is $\sqrt{24}$ B.M.

Hence number of unpaired electrons and value of n respectively are

1) 4, 2 2) 2, 4

3) 3, 1 4) 0, 2

SAMPLE QUESTIONS

1. Which orbital has two angular nodal planes:

1) s 2) p

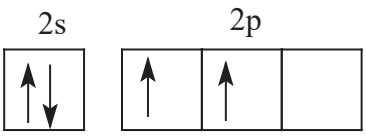
3) d 4) f

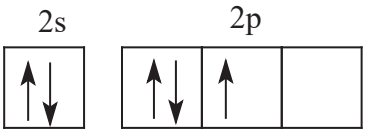
2. An orbital with $\ell = 0$ is symmetrical about the:

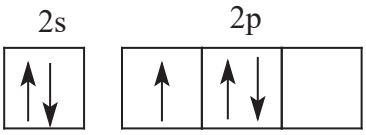
1) x-axis only 2) y-axis only

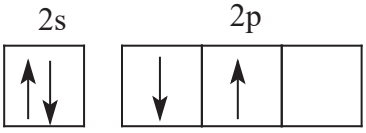
3) z-axis only 4) the nucleus

3. Which of the following configuration follows the Hund's rule:

1) [He] 

2) [He] 

3) [He] 

4) [He] 

4. The basis of three unpaired electrons present in the configuration of nitrogen is:

1) Aufbau principle 2) Pauli's principle

3) Hund's principle 4) Uncertainty principle

5. The orbital with maximum energy is:

1) 3d 2) 5p

3) 4s 4) 6d

6. n and ℓ values of an orbital 'A' are 3 and 2 and for another orbital 'B' are 5 and 0. The energy of:

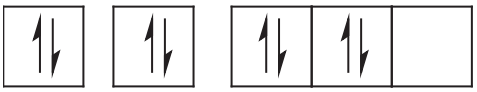
1) B is more than A

2) A is more than B

3) A and B are of same energy

4) None

7. Electronic configuration



has violated:

1) Hund's rule 2) Pauli's principle

3) Aufbau principle 4) $(n+\ell)$ rule

8. The total spin resulting from a d^9 configuration is:

1) $\frac{1}{2}$ 2) 2

3) 1 4) $\frac{3}{2}$

9. Two electrons occupying the same orbital is distinguished by

1) spin quantum number

2) principle quantum number

3) magnetic quantum number

4) azimuthal quantum number

10. The number of nodal planes in P_x orbital is

1) one 2) two

3) three 4) zero

11. The number of spherical nodes, angular nodes and nodal planes of $3p_z$ in proper order are

1) 3, 1, 0 2) 1,1, 1

3) 2, 0, 1 4) 2, 1, 1

12. "The square of the wave function at a point gives the probability density of the electron at that point". This is proposed by

1) Schrodinger 2) Heisenberg

3) Max Born 4) Max Plank

13. The nodes present in 5p-orbital are

1) 1 planar, 5 spherical

2) one planar, four spherical

3) one planar, three spherical

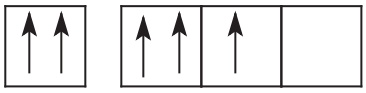
4) four spherical

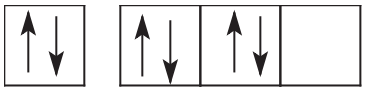
14. The orbital angular momentum of an electron in a Bohr orbit is:

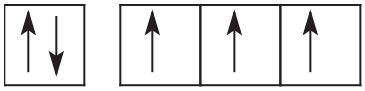
1) $\sqrt{\ell(\ell+1)}\frac{h}{2\pi}$ 2) $\sqrt{s(s+1)}\frac{h}{2\pi}$

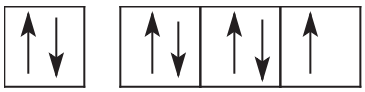
3) $m\frac{h}{2\pi}$ 4) $n\frac{h}{2\pi}$

15. The orbital diagram in which both Pauli exclusion principle and Hund's rule are violated is:

1) 

2) 

3) 

4) 

16. When azimuthal quantum number $\ell = 1$, the shape of the orbital will be:

1) spherical 2) dumb bell

3) double dumb bell 4) doughnut

17. If velocity of an electron in first orbit of H atom is V, what will be the velocity of electron in third orbit of Li^{+2}

1) V 2) V/3

3) 3V 4) 9V

18. If two particles A and B having masses in the ratio 1 : 4 are moving with same velocity, the ratio of wavelengths associated with them will be in the ratio

1) 1 : 4 2) 4 : 1

3) 2 : 1 4) 1 : 2

19. The number of possible orientations of an electron in an atom is given by its

1) spin quantum number

2) spin angular momentum

3) magnetic quantum number

4) orbital angular momentum

20. The significance of ψ_{420} is designated as

1) n = 4, ℓ = 1, $m_\ell = 0, (4p_z)$

2) n = 4, $\ell = 2, m_\ell = 0, (4d_{xy})$

3) n = 4, $\ell = 2, m_\ell = 0, (4d_{xy})$

4) n = 4, $\ell = 2, m_\ell = 0, (4d_{z^2})$

21. A compound of vanadium has a magnetic moment (μ) of 1.73 BM. If the vanadium ion in the compound is present as V^{x+}, then the value of x is: (Atomic number of V = 23)

1) 1 2) 2

3) 3 4) 4

22. The change in orbital angular momentum when an electron jumps from 3p orbital to 5f orbital theoretically is:

1) $\frac{3h\left(\sqrt{6}-1\right)}{\sqrt{2}\pi}$

2) $\frac{h\left(\sqrt{6}-1\right)}{\sqrt{2}\pi}$

3) $\frac{\sqrt{h\left(\sqrt{3}+1\right)}}{2\pi}$

4) $\frac{h-2\sqrt{\pi}}{3}$

23. A metal in its dipositive state has the electronic configuration 2, 8, 14 and has the atomic weight equal to 56. Number of neutrons in its nucleus would be

1) 30 2) 32

3) 34 4) 28

24. Radius of third orbit of Li^{+2} ion is 'X' cm. The de-Brogile wavelength of electron in the first orbit in the same species is

1) $\frac{2\pi X}{3}$ cm 2) $6\pi X$ cm

3) $3\pi X$ cm 4) $\frac{2\pi X}{6}$ cm

25. If a radiation of wavelength $4000\,\overset{0}{A}$ is used to break the iodine molecule, then the percentage of energy converted into kinetic energy of iodine atoms is (Given : bond dissociation energy of iodine molecule is 246.5 kJ/mol)

1) 8% 2) 12%

3) 17% 4) 25%

26. If the energy of H-atom in the ground state is '–E', the velocity (v) of photoelectron emitted when a photon having energy 'E_p' strikes a stationary Li^{2+} ion in the ground state is given by

(m = mass of electron)

1) $v=\sqrt{\frac{2\left(E_p-E\right)}{m}}$ 2) $v=\sqrt{\frac{2\left(E_p+9E\right)}{m}}$

3) $v=\sqrt{\frac{2\left(E_p-9E\right)}{m}}$ 4) $v=\sqrt{\frac{2\left(E_p-3E\right)}{m}}$

27. An electron in a single electron atomic species jumps in such a way that its kinetic energy changes from x to x/4. The change in potential energy will be

1) $+\frac{3}{2}x$ 2) $-\frac{3}{8}x$

3) $+\frac{3}{4}x$ 4) $-\frac{3}{4}x$

28. The angular momentum of an electron in a Bohr's orbit of He^+ is 3.1652×10^{-34} kg m^2sec^{-1}. What is the wave number in terms of Rydberg constant (R) of the spectral line emitted when an electron falls from this level to the first excited state?

[Use h = 6.626×10^{-34} Js]

1) 3R

2) $\frac{5R}{9}$

3) $\frac{3R}{4}$

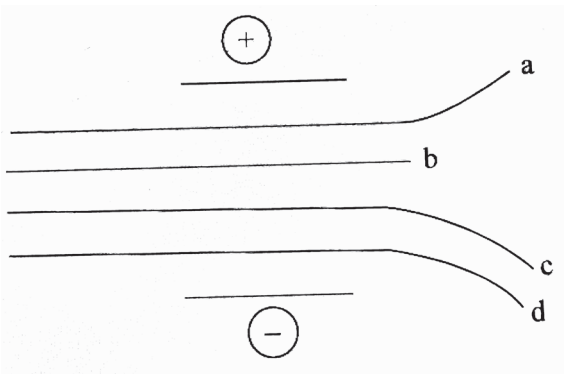
4) $\frac{4R}{3}$

29. The deBroglie wavelength (λ) associated with a photoelectron varies with the frequency (ν) of the incident radiation as, [ν_0 is threshold frequency]

1) $\lambda \propto \frac{1}{(\nu-\nu_0)^{3/2}}$ 2) $\lambda \propto \frac{1}{(\nu-\nu_0)^{1/2}}$

3) $\lambda \propto \frac{1}{(\nu-\nu_0)^{1/4}}$ 4) $\lambda \propto \frac{1}{(\nu-\nu_0)}$

30. Path of e, p, n α particles are shown



a,b,c,d are respectively are

1) e, p n, α 2) p, n, α, e

3) e, n, α, p 4) e, n, p, α

31. The number of photons emitted by a 10 watt bulb in 10 seconds, if the wavelength of light is 1000 A^0 is

1) 1.01×10^{20} 2) 3.03×10^{16}

3) 5×10^{19} 4) 7×10^{14}

32. The dimensions of Planck's constant are the same and that of

1) energy 2) angular momentum

3) work 4) power

33. A dye, when dissolved in water, has its maximum light absorption at 4530 A^0 and the maximum fluorescence emission of 5080 A^0. The number of fluorescence quanta is an average 53% of the number of quanta absorbed. What percentage of absorbed energy is emitted as fluorescence

1) 100 2) 47

3) 36 4) 12

34. Mark the incorrect statement regarding the photoelectric effect

1) There is no time lag between the striking of light beam and the ejection of electrons from the metal surface

2) The number of electrons ejected in inversily proportional to the intensity of light

3) Photo electric effect is not observed below threshold energy

4) K.E of the electrons increases with increase in frequency of light used

35. The work function of metal is 5 eV. What is the kinetic energy of the photoelectron ejected from the metal surface if the energy of the incident radiation is 6.2 eV? (1 eV = 1.6×10^{-19}J)

1) 6.626×10^{-19} J

2) 8.01×10^{-19}J

3) 1.92×10^{-19} J

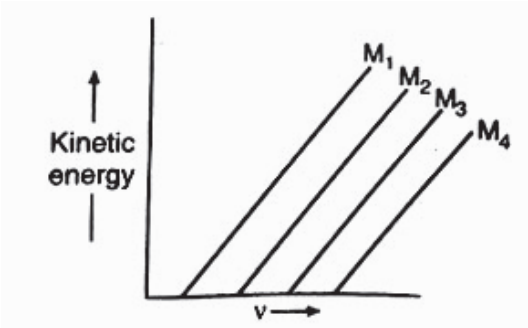
4) 8.010×10^{-18} J

36. The threshold frequency of a metal corresponds to a wavelength of x nm. In two separate experiments A and B incident radiations of wavelength $\frac{1}{2}$x nm and $\frac{1}{4}$x nm respectively are used. The ratio of kinetic energy of the released electrons in experiment B to than in experiment A is

1) $\frac{1}{3}$ 2) 2

3) 4 4) 3

37. A plot of the kinetic energy $\left(\frac{1}{2}mv^2\right)$ Radiation for four alkali metals (M_1, M_2, M_3, M_4) is given below.



The alkali metals (M_1, M_2, M_3, M_4) are respectively

1) Li, Na, K and Rb
2) Rb, K, Na and Li
3) Na, K, Li and Rb
4) Rb, Li, Na and K

38. A 250 W electric bulb of 80% efficiency emits a light of 6626 A^0 wavelength. The number of photons emitted per second by the lamp is

($h = 6.626 \times 10^{-34}$ Js)

1) 1.42×10^{17}
2) 2.18×10^{16}
3) 6.66×10^{20}
4) 2.83×10^{16}

39. In the hydrogen atomic spectrum, the emission of least energetic photon takes place during the transition from

1) $4 \rightarrow 3$
2) $3 \rightarrow 2$
3) $5 \rightarrow 2$
4) $4 \rightarrow 2$

40. In a sample of hydrogen atoms, electrons jump from 10^h excited state to ground state. If X are the number of different ultraviolet radiations Y are the number of different visible radiations and Z are the possible number of different infrared radiations. The value Z – (X + Y) is (Assuming all the Balmer lines lie with in visible region)

1) 17
2) 18
3) 19
4) 36

41. Which of the following transition has the same wavelength as the third line in Paschen series of Li^{2+}

1) 4 to 2 in Be^{3+}
2) 3 to 1 in H atom
3) 4 to 2 in He^+
4) 4 to 2 in He atom

42. The ratio of the frequency corresponding to the third line in Lyman series of hydrogen atomic spectrum to that of the first line in Balmer series of Li^{2+} spectrum is

1) $4/5$
2) $5/4$
3) $4/3$
4) $3/4$

43. Highest energy line of Balmer series among the following is

1) $5 \rightarrow 2$
2) $3 \rightarrow 2$
3) $6 \rightarrow 2$
4) $\infty \rightarrow 2$

44. The wavelength of limiting line (ie, of shortest wavelength) in Balmer series of H-atom is

1) 4758 A^0
2) 3644 A^0
3) 2435 A^0
4) 4634 A^0

45. Electromagnetic radiation of wavelength 242 nm is just sufficient to ionise the sodium atom. Ionisation energy of sodium in kJ mol^{-1}.

1) 460
2) 380
3) 495
4) 370

ANSWER KEY

1.	3	21.	1	41.	3	61.	3	81.	1
2.	1	22.	3	42.	1	62.	3	82.	4
3.	1	23.	1	43.	1	63.	2	83.	1
4.	3	24.	1	44.	1	64.	1	84.	3
5.	2	25.	3	45.	2	65.	3	85.	1
6.	2	26.	2	46.	1	66.	1	86.	1
7.	3	27.	2	47.	3	67.	3	87.	3
8.	3	28.	3	48.	4	68.	3	88.	1
9.	3	29.	4	49.	1	69.	3	89.	4
10.	4	30.	1	50.	4	70.	4	90.	1
11.	1	31.	3	51.	1	71.	4	91.	1
12.	4	32.	2	52.	3	72.	1	92.	2
13.	3	33.	1	53.	4	73.	3	93.	3
14.	1	34.	1	54.	3	74.	1	94.	4
15.	4	35.	1	55.	4	75.	3	95.	3
16.	3	36.	3	56.	1	76.	1	96.	2
17.	2	37.	1	57.	4	77.	1	97.	3
18.	2	38.	2	58.	2	78.	1	98.	2
19.	4	39.	1	59.	1	79.	2	99.	4
20.	1	40.	3	60.	2	80.	4	100.	1

SAMPLE QUESTIONS

1.	3	10.	1	19.	3	28.	2	37.	2
2.	4	11.	2	20.	4	29.	2	38.	3
3.	1	12.	3	21.	4	30.	3	39.	1
4.	3	13.	3	22.	2	31.	3	40.	1
5.	4	14.	1	23.	1	32.	2	41.	3
6.	1	15.	1	24.	1	33.	2	42.	4
7.	1	16.	2	25.	3	34.	2	43.	4
8.	1	17.	1	26.	3	35.	3	44.	2
9.	1	18.	2	27.	1	36.	4	45.	3

WORK BOOK

Chapter 03

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

QUESTIONS

GENESIS OF PERIODIC CLASSIFICATION

1. Which of the following is not a Dobereiner triad?

1) Cl, Br, I 2) N, O, F

3) Li, Na, K 4) Ca, Sr, Ba

2. Select the incorrect statement for Lother Meyer's curve:

1) Curve is plotted between atomic weight and atomic volume

2) Alkali metals occupy maxima of curve

3) Halogens occupy descending portions of the curve

4) Transition metals occupy bottom portions of the curve

3. Which is not anomalous pair of elements in the Mendeleev's periodic table?

1) Ar and K 2) Co and Ni

3) Te and I 4) Al and Si

4. Which is not similar characteristic(s) about the electronic configuration of Mg, Ca & Sr?

1) All the atoms have a pair of s-electrons in their outermost energy level

2) All the atoms contains a pair of p-electrons in their outermost energy level

3) All are alkaline earth metals

4) All are of second group of the periodic table

5. Elements of atomic numbers 113 and 118 are officially named as

1) 113-Bhorium (Bh), 118-Hassium (Hs)

2) 113-Nihonium (Nh), 118-Tennessine (Ts)

3) 113-Roentgenium (Rg), 118-Copernicium (Cn)

4) 113-Nihonium (Nh), 118-Oganesson (Og)

6. The electronic configuration of four elements are

I) $[Kr]5s^1$

II) $[Rn]5f^{14}6d^17s^2$

III) $[Ar]3d^{10}4s^24p^5$

IV) $[Ar]3d^64s^2$

Consider the following statements

I) I shows variable oxidation state

II) II is a d-block element

III) The compound formed between I and III is covalent

IV) IV shows single oxidation state

Which statement is True (T) or False (F)

1) FTFF 2) FTFT

3) FFTF 4) FFFF

7. The element Eka Aluminium and Eka Silicon predicted by Mendeleev are respectively

1) Gallium and Germanium

2) Gallium and Indium

3) Germanium and tin

4) Thallium and Germanium

8. Elements from atomic number 58 to 71 are placed in

1) 5th period and 13th group

2) 6th period and 3rd group

3) 6th period and 13th group

4) 7th period and 3rd group

9. The element Z = 114 has been discovered recently. It belongs to which of the family/group and electronic configuration?

1) Carbon family; [Rn] $5f^{14}6d^{10}7s^{2}7p^{2}$

2) Oxygen family; [Rn] $5f^{14}6d^{10}7s^{2}7p^{4}$

3) Nitrogen family; [Rn] $5f^{14}6d^{10}7s^{2}7p^{3}$

4) Halogen family; [Rn] $5f^{14}6d^{10}7s^{2}7p^{5}$

10. Which among the following is an inner transition element?

1) Tl 2) U

3) Db 4) Zn

MODERN PERIODIC LAEW AND PERIODIC TABLE

11. Representative elements belong to

1) s- and p-block

2) d-block

3) d and f block

4) f-block

12. True statements is:

1) All the trans uranic elements are synthetic elements

2) Elements of third period are called transition elements

3) Element of $[Ar]3d^{10}4s^{2}$ configuration is placed in II A group

4) Electronic configuration of elements of a group is same

13. Which of the following match is correct?

1) Last natural element - Uub

2) General electronic configuration of IA group- ns^{2}

3) Inert gas elements lies between 2nd - 6th period

4) Typical elements - 3rd period elements

14. The electronic configuration of elements X and Z are $1s^{2}\ 2s^{2}\ 2p^{6}\ 3s^{2}\ 3p^{5}$ and $1s^{2}\ 2s^{2}\ 2p^{5}$ respectively. What is the position of element X with respect to position of Z in the periodic table?

1) Just below element Z

2) Just above Z

3) Left to the Z

4) Right to the Z

15. Choose the s-block element from the following:

1) $1s^{2}, 2s^{2}, 2p^{6}, 3s^{2}, 3p^{6}, 3d^{5}, 4s^{1}$

2) $1s^{2}, 2s^{2}, 2p^{6}, 3s^{2}, 3p^{6}, 3d^{10}, 4s^{1}$

3) $1s^{2}, 2s^{2}, 2p^{6}, 3s^{2}, 3p^{6}, 4s^{1}$

4) all of the above

16. False statement for periodic classification of element is

1) The properties of the elements are periodic function of their atomic numbers

2) Number of non-metallic elements is less than the number of metallic elements

3) First ionization energy of elements does not increase regularly with the increase in atomic number in a period

4) d-subshell is filled by final electron with increasing atomic number of inner transition elements

17. If each orbital can hold a maximum of three electrons, the number of elements in 9th period of periodic table (long form) will be

1) 48 2) 162

3) 50 4) 75

18. The electronic configuration of an element is $1s^2\,2s^2\,2p^6 3s^2\,3p^4$. The atomic number and the group number of the element 'X' which is just below the above element in the periodic table are respectively.

1) 24 & 6 2) 24 & 15

3) 34 & 16 4) 34 & 8

19. The number of paired electrons in oxygen atom is:

1) 6 2) 16

3) 8 4) 32

20. Which of the following has the maximum number of unpaired electrons?

1) Mg^{2+} 2) Ti^{3+}

3) V^{3+} 4) Fe^{2+}

21. The non-metal that does not exhibit positive oxidation state is:

1) Oxygen 2) Fluorine

3) Iodine 4) Chlorine

22. The group having isoelectronic species is:

1) O^{2-}, F^-, Na^+, Mg^{2+}

2) O^-, F^-, Na^+, Mg^+

3) O^{2-}, F^-, Na, Mg^{2+}

4) O^-, F^-, Na^+, Mg^{2+}

23. The elements with atomic number 117 and 120 are yet to be discovered. In which group would you place these elements, when discovered?

1) 17, 2 2) 16, 4

3) 15, 3 4) 18, 2

24. The outer electronic structure of lawrencium (atomic number 103) is

1) [Rn] $5f^{13}\,7s^2\,7p^2$

2) [Rn] $5f^{13}\,6d^1\,7s^1\,7p^2$

3) [Rn] $5f^{14}\,7s^1\,7p^2$

4) [Rn] $5f^{14}\,6d^1\,7s^2$

25. The elements with the lowest atomic number that has a ground state electronic configuration of $(n-1)d^6\,ns^2$ is located in the:

1) fifth period 2) sixth period

3) fourth period 4) third period

26. Which of the following sets of atomic numbers corresponds to elements of group 16?

1) 8, 16, 32, 54 2) 16, 34, 54, 86

3) 8, 16, 34, 52 4) 10, 16, 32, 50

27. The atomic numbers of the metallic and non-metallic elements which are liquid at room temperature respectively are:

1) 55, 87 2) 33, 87

3) 35, 80 4) 80, 35

28. Transition metals are not characterized by:

1) fixed valency

2) coloured compound

3) high melting and boiling points

4) tendency to form complexes

29. According to modern periodic law the properties of elements repeat at regular intervals when the elements are arranged in order of:

1) decreasing atomic number

2) increasing atomic weight

3) increasing atomic number

4) decreasing atomic weights

30. In the fourth period of the periodic table, how many elements have one or more 4d electrons?

1) 2 2) 18

3) 0 4) 6

31. Choose the correct statement regarding transition elements

1) Transition elements has low melting points

2) Transition elements do not have catalytic activity

3) Transition elements exhibit variable oxidation states

4) Transition elements exhibit inert pair effect

32. The element having electronic configuration $[Kr]4d^{10}\ 4f^{14}\ 5s^2\ 5p^6\ 6s^2$ belongs to:

1) s-block 2) p-block

3) d-block 4) f-block

33. An element whose IUPAC name is ununtrium (Uut) belongs to:

1) s-block element 2) p-block element

3) d-block element 4) Transition element

34. Which of the following is not a representative element?

1) Tellurium 2) Tantalum

3) Thallium 4) Astatine

35. The period number and group number of "Tantalum" (Z = 73) are respectively:

1) 5, 7 2) 6, 13

3) 6, 5 4) None of these

36. Consider the following electronic configuration of an element(P):

$[Xe]\ 4f^{14}\ 5d^1\ 6s^2$

Then correct statement about element 'P' is:

1) It belongs to 6th period and 1st group

2) It belongs to 6th period and 2nd group

3) It belongs to 6th period and 3rd group

4) None of these

37. If IUPAC name of an element is "unununium" then correct statement regarding element is:

1) It is a inner transition element

2) It belongs to 8th period in periodic table

3) It is transition element

4) It is a non-transition element

ATOMIC AND IONIC RADIUS

38. The size of the following species increases in the order:

1) $Mg^{2+} < Na^+ < F^-$ 2) $F^- < Na^+ < Mg^{2+}$

3) $Mg^{2+} < F^- < Na^+$ 4) $Na^+ < F^- < Mg^{2+}$

39. Highest size will be of

1) Br^- 2) I

3) I^- 4) I^+

40. Element Cu has two oxidation states +1 & +2. The right order of radii of the ions, Cu^+ and Cu^{2+} is

1) $Cu^{+1} > Cu^{+2}$ 2) $Cu^{+2} > Cu^{+1}$

3) $Cu^{+1} = Cu^{+2}$ 4) $Cu^{+2} \geq Cu^{+1}$

41. The correct order of increasing atomic size of element N, F, Si & P is

1) N < F < Si < P 2) N < F < P < Si

3) F < N < P < Si 4) F < N < Si < P

42. The correct order of atomic or ionic size is

1) N < Li < B 2) Cl < Mg < Ca

3) $Ca^{+2} < S^{-2} < Cl^-$ 4) $Na^+ < Mg^{+2} < Cl^-$

43. In isoelectronic species, largest difference between size is observed in

N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}:

1) N^{3-}, Mg^{2+} 2) N^{3-}, O^{2-}

3) Mg^{2+}, Na^+ 4) F^-, Na^+

44. Mg, Mg^{2+}, Al and Al^{3+} are arranged in decreasing order of size 1 > 2 > 3 > 4. Species which are present at 1 and 4 position respectively are:

1) Al, Mg^{2+} 2) Mg, Al^{3+}

3) Mg^{2+}, Al 4) Al^{3+}, Mg

45. Moving from right to left in a periodic table, the atomic size is:

1) Increased 2) Decreased

3) Remains constant 4) None of these

46. The decreasing size of K^+, Ca^{2+}, Cl^- & S^{2-} follows the order:

1) $K^+ > Ca^{+2} > S^{-2} > Cl^-$

2) $K^+ > Ca^{+2} > Cl^- > S^{-2}$

3) $Ca^{+2} > K^+ > Cl^- > S^{-2}$

4) $S^{-2} > Cl^- > K^+ > Ca^{+2}$

47. Which of the following factors may be regarded as the main cause of lanthanide contraction?

1) poor shielding of one of 4f electron by another in the subshell

2) effective shielding of one of 4f electrons by another in the subshell

3) poorer shielding of 5d electrons by 4f electrons

4) greater shielding of 5d electrons by 4f electrons

48. The set representing the correct order of ionic radius is:

1) $Na^+ > Mg^{2+} > Li^+ > Be^{2+}$

2) $Mg^{2+} > Be^{2+} > Li^+ > Na^+$

3) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$

4) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$

49. The ionic radii (in A^0) of N^{3-}, O^{2-} and F^- respectively are

1) 1.71, 1.36, 1.40 2) 1.36, 1.40, 1.71

3) 1.36, 1.71, 1.40 4) 1.71, 1.40, 1.36

50. The order of increasing sizes of atomic radii among the elements O, S, Se and As is:

1) As < S < O < Se

2) O < S < As < Se

3) Se < S < As < O

4) O < S < Se < As

IONIZATION ENTHALPY

51. In which of the following electronic configuration, ionisation energy will be maximum in

1) [Ne] $3s^2\ 3p^1$ 2) [Ne] $3s^2\ 3p^2$

3) [Ne] $3s^2\ 3p^3$ 4) [Ar] $3d^{10}\ 4s^2\ 4p^3$

52. The correct order of second ionisation potential of C, N, O and F is:

1) C > N >O > F
2) O > N > F > C
3) O > F >N > C
4) F > O > N > C

53. The ionization energy will be maximum for which process?

1) $Ba \rightarrow Ba^+$
2) $Be \rightarrow Be^+$
3) $Cs \rightarrow Cs^+$
4) $Li \rightarrow Li^+$

54. Amongst the following, the incorrect statement is

1) IE_1 (Al) < IE_1 (Mg)
2) IE_1 (Na) < IE_1 (Mg)
3) IE_2 (Mg) > IE_2 (Na)
4) IE_3 (Mg) > IE_3 (Al)

55. Decreasing ionization potential for K, Ca & Ba is

1) Ba > K > Ca
2) Ca > Ba > K
3) K > Ba > Ca
4) K > Ca > Ba

56. Alkaline earth metals always form dipositive ions due to

1) $IE_2 - IE_1 > 10$ eV
2) $IE_2 - IE_1 = 17$ eV
3) $IE_2 - IE_1 < 10$ eV
4) None of these

57. The correct order of second ionisation enthalpy is

1) Na < Mg > Al < Si
2) Na > Mg < Al > Si
3) Na > Mg > Al < Si
4) Na > Mg > Al > Si

58. One element has atomic weight 39. Its electronic configuration is $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^1$. The true statement for that element is:

1) High value of IE
2) Transition element
3) Alkali metal
4) Bigger than Cs

59. 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?

1) Cr
2) Mn
3) Fe
4) V

60. The increasing order of the first ionization enthalpies of the elements B, P, S and F (lowest first) is:

1) F < S < P < B
2) P < S < B < F
3) B < P < S < F
4) B < S < P < F

61. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar?

1) Ca < S < Ba < Se < Ar
2) S < Se < Ca < Ba < Ar
3) Ba < Ca < Se < S < Ar
4) Ca < Ba < S < Se < Ar

62. Which of the following atoms has the highest first ionization energy?

1) Sc
2) Rb
3) Na
4) K

63. The electronic configuration with the highest ionization enthalpy is:

1) [Ar] $3d^{10}$ $4s^2$ $4p^3$
2) [Ne] $3s^2$ $3p^1$
3) [Ne] $3s^2$ $3p^2$
4) [Ne] $3s^2$ $3p^3$

64. Consider the following ionization enthalpies of two elements 'A' and 'B':

Element	Ionization enthalpy (kJ/mol)		
	1st	2nd	3rd
A	899	1757	14847
B	737	1450	7731

Which of the following statements is correct?

1) Both A and B belong to group-2 where A comes below B

2) Both A and B belong to group-1 where A comes below B

3) Both A and B belong to group-1 where B comes below A

4) Both A and B belong to group-2 where B comes below A

65. Sodium generally does not show oxidation state of +2, because of its:

1) high first ionization potential

2) High second ionization potential

3) Large ionic radius

4) High electronegativity

ELECTRON GAIN ENTHALPY

66. The process requires absorption of energy is

1) $F \rightarrow F^-$

2) $Cl \rightarrow Cl^-$

3) $O^- \rightarrow O^{2-}$

4) $H \rightarrow H^-$

67. Of the following elements, which possesses the highest electron affinity?

1) As 2) O

3) S 4) Se

68. Electron affinities of O, F, S and Cl are in the order.

1) O < S < Cl < F

2) O < S < F < Cl

3) S < O < Cl < F

4) S < O < F < Cl

69. Increasing order of electro affinity for following configuration

a) $1s^2, 2s^2, 2p^6, 3s^1$

b) $1s^2, 2s^2, 2p^5$

c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

d) $1s^2, 2s^2, 2p^3$

1) d < a < b < c 2) d < a < c < b

3) a < b < c < d 4) a < b < d < c

70. Highest electron affinity is shown by

1) F^- 2) Cl^-

3) Li^+ 4) Na^+

71. Which of the following statements is not true?

1) F atom can hold additional electron more tightly than Cl atom

2) Cl atom can hold additional electron more tightly than F atom

3) The incoming electron encounters greater repulsion for F atom than for Cl atom

4) It is easier to remove an electron from F^- than Cl^-

72. The formation of the oxide ion O^{2-} (g) requires first an exothermic and then an endothermic step as shown below:

$$O_{(g)} + e^- = O^-_{(g)},\ \Delta H^0 = -142\ kJ\ mol^{-1}$$
$$O^-_{(g)} + e^- = O^{2-}_{(g)},\ \Delta H^0 = 844\ kJ\ mol^{-1}$$

This is because:

1) O^- ion will tend to resist the addition of another electron

2) Oxygen has high electron affinity

3) Oxygen is more electronegative

4) O^- ion has comparitively larger size than oxygen atom

73. The correct order of electron gain enthalpy (magnitude only) of F, Cl, Br and I, having atomic number 9, 17, 35 and 53 respectively, is:

1) I > Br > Cl > F

2) F > Cl > Br > I

3) Cl > F > Br > I

4) Br > Cl >I > F

74. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be:

1) – 2.55 eV 2) – 5.1 eV

3) – 10.2 eV 4) + 2.55 eV

75. Electron gain enthalpy with negative sign of fluorine is less than that of chlorine due to:

1) smaller size of chlorine atom

2) bigger size of 2p orbital of fluorine

3) high ionization enthalpy of fluorine

4) smaller size of fluorine atom

76. When the first electron gain enthalpy $(\Delta_{eg}H)$ of oxygen is – 141 kJ/mol, its second electron gain enthalpy is

1) Almost the same as that of the first

2) A more negative value than the first

3) Negative, but less negative than the first

4) A positive value

77. In which case the energy released is minimum?

1) $Cl \rightarrow Cl^-$ 2) $P \rightarrow P^-$

3) $N \rightarrow N^-$ 4) $C \rightarrow C^-$

ELECTRONEGATIVITY

78. The outermost electronic configuration of most electronegative element amongst the following is:

1) $ns^2\ np^3$ 2) $ns^2\ np^4$

3) $ns^2\ np^5$ 4) $ns^2\ np^6$

79. In the following, which is the correct representation?

1) $\overset{\delta+}{C}-\overset{\delta-}{F}$ 2) $\overset{\delta+}{C}-\overset{\delta+}{Cl}$

3) $\overset{\delta+}{F}-\overset{\delta-}{Cl}$ 4) $\overset{\delta-}{O}-\overset{\delta+}{F}$

80. On the Pauling's electronegativity scale, which element is next to F?

1) Cl 2) O

3) Br 4) Ne

81. Which one is not a correct order of electronegativity?

1) F > Cl > Br > I 2) Si > Al > Mg > Na

3) Cl > S > P > Si 4) None of these

82. The increasing order of acidic nature of Li_2O, BeO, B_2O_3

1) $Li_2O > BeO > B_2O_3$

2) $Li_2O < BeO < B_2O_3$

3) $Li_2O < BeO > B_2O_3$

4) $Li_2O > BeO > B_2O_3$

83. The lowest electronegativity of the element from the following atomic number is

1) 37 2) 55

3) 9 4) 35

84. Electronegativity of the element (A) is E_1 and ionisation potential is E_2. Hence electron affinity will be according to Mulliken is

1) $2E_1 - E_2$ 2) $E_1 - E_2$

3) $E_1 - 2E_2$ 4) $(E_1 + E_2)/2$

85. The electronegativity of aluminium is similar to

1) Beryllium 2) Carbon

3) Lithium 4) Boron

86. The correct option with respect to the Pauling electronegativity values of the elements is

1) Si < Al 2) P > S

3) Te > Se 4) Ga < Ge

87. Which of the following order is incorrect against the property indicated:

1) Mg < Ar < Na (2nd ionisation enthalpy)

2) Be < F < Cl ($|\Delta_{eg}H|$)

3) Rb < Na < K > Ca (atomic radius)

4) P < S < N (electronegativity)

88. Which of the following element has highest metallic character?

Element	Ionisation Potential
1) P	17 eV
2) Q	2 eV
3) R	10 eV
4) S	13 eV

89. In which of the following arrangements, the order is NOT according to the property indicated below?

1) $Al^{3+} < Mg^{2+} < Na^{1+} < F^-$ - increasing ionic size

2) B < C < N < O - increasing first ionization enthalpy

3) I < Br < F < Cl - increasing electron gain enthalpy (with negative sign)

4) Li < Na < K < Rb - increasing metallic radius

90. Which of the following series correctly represents relations between the elements from X to Y?

$$X \rightarrow Y$$

1) $_{18}Ar \rightarrow {}_{54}Xe$ - Noble character increases

2) $_{3}Li \rightarrow {}_{19}K$- ionization enthalpy increases

3) $_{6}C \rightarrow {}_{32}Ge$ - Atomic radii increases

4) $_{9}F \rightarrow {}_{35}Br$ - Electron gain enthalpy with negative sign increases

CHEMICAL REACTIVITY

91. Which of the following oxides is amphoteric in character?

1) SnO_2

2) SiO_2

3) CO_2

4) CaO

92. In which of the following arrangements, the sequence is not strictly according to the property written against it?

1) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidising power

2) Al < Ga < Tl < B : increasing first ionisation enthalpy

3) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing basic strength

4) HF < HCl < HBr < HI : increasing acid strength

93. In the following reactions, ZnO is respectively acting as a/an:

a) $ZnO + Na_2O \rightarrow Na_2ZnO_2$

b) $ZnO + CO_2 \rightarrow ZnCO_3$

1) base and acid

2) base and base

3) acid and acid

4) acid and base

94. The most electropositive element possesses the electronic configuration:

1) [He] $2s^1$

2) [Ne] $3s^2$

3) [Xe] $6s^1$

4) [Xe] $6s^2$

95. Which one of the following elements shows both positive and negative oxidation states?

1) Cesium

2) Fluorine

3) Iodine

4) Xenon

96. In the periodic table, metallic character of the elements shows one of the following trend:

1) Decreases down the group and increases across the period

2) Increases down the group and decreases across the period

3) Increases across the period and also down the group

4) Decreases across the period and also down the group

97. Nucleus of an element contains 9 protons.It's valency would be:

1) 1 2) 2

3) 3 4) 5

98. Zn and Cd metals do not show variable valency because:

1) They have only two electrons in the outermost subshell

2) Their d-subshells are completely filled

3) Their d-subshells are partially filled

4) They are relatively soft metals

99. Consider the following information about element P and Q:

	Period number	Group number
P	2	15
Q	3	2

Then formula of the compound formed by P and Q element is:

1) QP 2) Q_2P_3

3) Q_3P_2 4) Q_2P

100. The chemistry of lithium is very similar to that of magnesium even though they are placed in different groups. Its reason is:

1) Both are found together in nature

2) Both have nearly the same size

3) Both have similar electronic configurations

4) The ratio of their charge to size is nearly the same

SAMPLE QUESTIONS

1. Newland's law of octaves applies to which of the following set of elements

1) Be, Mg, Ca
2) As, K, Ca
3) B, N, C
4) All of these

2. The number of elements that are known at present including the recently discovered and officially named man made element is

1) 106
2) 103
3) 116
4) 118

3. Which of the following pairs consists of metalloid elements?

1) Na and K
2) F and Cl
3) Ca and Mg
4) As and Si

4. Which of the following is not a transition element?

1) Sc
2) Cu
3) Ag
4) Zn

5. The IUPAC symbol of the element 119

1) Uue
2) Unp
3) Une
4) Uee

6. More than 78% of all the known elements are

1) metals
2) non metals
3) gases
4) metalloids

7. The element with atomic number Z = 100 is a/an

1) Transition metal
2) Inner transition metal
3) Alkaline earth metal
4) Alkali metal

8. Which of the following processes involves absorption of energy?

1) $S_{(g)} + e^- \rightarrow S^-_{(g)}$
2) $S^-_{(g)} + e^- \rightarrow S^{2-}_{(g)}$
3) $Cl_{(g)} + e^- \rightarrow Cl^-_{(g)}$
4) $H_{(g)} + e^- \rightarrow H^-_{(g)}$

9. The types of elements preset in sixth period of long form of periodic table is

1) s-block and p-block
2) s-block, p-block and d-block
3) s-block, p-block, d-block and f-block
4) p-block, d-block and f-block

10. Which of the following ion is largest in size?

1) Li^+
2) Cs^+
3) Na^+
4) K^+

11. Total number of elements accommodated in period 6 and group 3 are respectively

1) 32 and 32
2) 32 and 18
3) 32 and 4
4) 18 and 18

12. Element with atomic number Z = 63 is in

1) Period 6; group 3
2) Period 7; group 3
3) Period 6; group 9
4) Period 7; group 9

13. Which of the following contains atomic number of only s-block ?

1) 55, 12, 18, 53

2) 13, 33, 54, 83

3) 3, 20, 55, 87

4) 22, 33, 55, 66

14. **Statement I** : Valence for an element placed in group 17 are 1 and 7

Statement II : Group 17 elements are coloured

In the light of the above statements, choose the most appropriate option.

1) Statement I & II both are correct

2) Statement I is correct but II is incorrect

3) Statement I is incorrect but II is correct

4) Both statement I & II are incorrect

15. The correct order of ionisation enthalpy of an element is

1) $IE_1 > IE_2 > IE_3$

2) $IE_1 < IE_2 < IE_3$

3) $IE_1 = IE_2 = IE_3$

4) $IE_1 = IE_2 < IE_3$

16. General electron filling of elements of period 6 follows the order

1) $ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$

2) $ns \rightarrow np \rightarrow (n-1)d \rightarrow (n-2)f$

3) $ns \rightarrow (n-1)d \rightarrow (n-2)f \rightarrow np$

4) $ns \rightarrow np \rightarrow (n-2)f \rightarrow (n-1)d$

17. Vander waal radius is

1) Twice the bond length between two atoms of the same element

2) Half of bond length between two atoms of the same element

3) Almost equal to bond length between two atoms of the same element

4) Half the distance between nuclei of two non bonded atoms of the same element in closest distance

18. The element in each period having greater than expected atomic radius is a/an

1) Lanthanide

2) Actinide

3) Noble gas

4) Halogen

19. Which pair of elements among the following have atomic radii very close to each other?

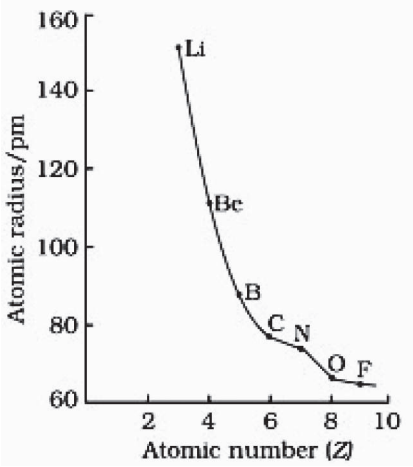
1) Li and Na

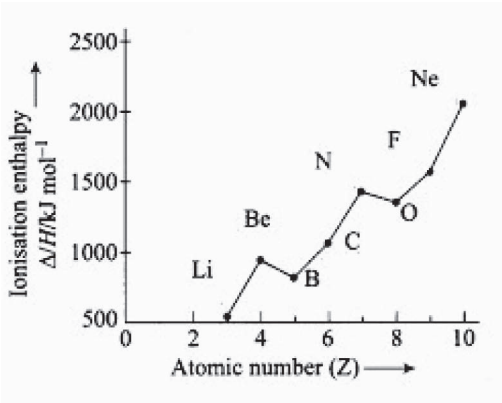
2) Ti and Zr

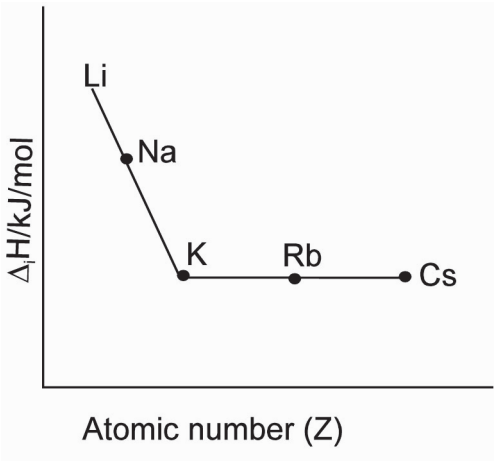
3) Zr and Hf

4) La and Hf

20. Which among the following graph is incorrect?

1) 

2) 

3) 

4) All are incorrect

21. In which of the following pair, radii of second species is smaller than that of first species ?

1) Li, Na 2) Na^+, F^-

3) Mn^{7+}, Mn^{4+} 4) N^{3-}, Al^{3+}

22. The distance between two adjacent copper atoms in solid copper is 256 pm; hence the metallic radius of copper is assigned a value of

1) 256 pm 2) 512 pm

3) 128 pm 4) 627 pm

23. Large sized lanthanoid and small sized actinoid respectively are

1) La, Lr 2) Ce, Th

3) La, Ac 4) Ce, Lr

24. **Assertion** : Ga is smaller than Al

Reason : Poor shielding effect of 3d electrons present in Ga

1) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

2) Assertion is correct statement but reason is wrong statement.

3) Assertion and reason both are correct statements and reason is correct explanation for assertion.

4) Assertion and reason both are wrong statements.

25. **Statement I** : Actinoid contraction is greater from element to element than lanthanoid contraction.

Statement II : In actinoid contraction, 5f subshell is filled before 6 d.

In the light of the above statements, choose the most appropriate option.

1) Statement I & II both are correct

2) Statement I is correct but II is incorrect

3) Statement I is incorrect but II is correct

4) Both statement I & II are incorrect

26. A sudden jump between the values of second and third ionisation enthalpies of an element would be associated with the electronic configuration

1) $1s^2\ 2s^2\ 2p^6\ 3s^1$ 2) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

3) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ 4) $1s^2\ 2s^2\ 2p^6\ 3s^2$

27. The element having highest difference between first and second ionisation energies is

1) Ca 2) Sc

3) Ba 4) K

28. Which of the following is the most basic oxide?

1) SeO_2 2) Al_2O_3

3) Sb_2O_3 4) Bi_2O_3

29. Which of the following process require largest amount of energy?

1) $Al_{(g)} \rightarrow Al^{+} + 1e^{-}$

2) $Al^{2+}{}_{(g)} \rightarrow Al^{3+} + 1e^{-}$

3) $Al^{+}_{(g)} \rightarrow Al^{2+} + 1e^{-}$

4) All require same amount of energy

30. **Assertion** : Generally, ionisation enthalpy increases from left to right in a period.

Reason : Ionisation process is always exothermic.

1) Assertion is correct statement and reason is wrong statement.

2) Assertion and reason both are correct statements and reason is correct explanation of assertion.

3) Assertion and reason both are wrong statements.

4) Assertion is wrong statement and reason is correct statement.

31. Which of the following are the characteristics of isotopes of an element?

i) Isotopes of an element have same masses

ii) isotopes of an element have same atomic number

iii) Isotopes of an element show same physical properties

iv) Isotopes of an element show same chemical properties

1) i, iii and iv 2) ii, iii and iv

3) ii and iii 4) ii and iv

32. An element X has mass number 40 and contains 21 neutrons in its atom. To which group of the periodic table does it belong?

1) Group 1 2) Group 4

3) Group 2 4) Group 3

33. In group 16, the correct order of variation of negative value of electron gain enthalpy $\left(\Delta_{eg}H_1\right)$ is

1) S > Se > Te > Po > O

2) O > S > Se > Te > Po

3) S > O > Se > Te > Po

4) Se > Te > Po > O > S

34. Match the correct ionisation enthalpies and electron gain enthalpies of the following elements.

Elements		ΔH_1		ΔH_2	$\Delta_{eg}H$
i)	Most reactive non metal	A	419	3051	-48
ii)	Most reactive metal	B	1681	3374	-328
iii)	Least reactive element	C	738	1451	-40
iv)	Metal forming binary halides	D	2372	2515	+48

1) i - B, ii - A, iii - D, iv - C

2) i - A, ii - B, iii - D, iv - C

3) i - B, ii - A, iii - C, iv - D

4) i - D, ii - A, iii - B, iv - C

35. Electronic configuration of some elements is given in Column I and their electron gain enthalpies are given in Column II. Match the electronic configuration with electron gain enthalpy.

Column-I Electronic configuration		Column-II Electron gain enthalpy/kJ mol^{-1}	
A)	$1s^2 2s^2 2p^6$	i	-53
B)	$1s^2 2s^2 2p^6 3s^1$	ii	-328
C)	$1s^2 2s^2 2p^5$	iii	-141
D)	$1s^2 2s^2 2p^4$	iv	+116

1) A - iii , B - ii, C - i, D - iv

2) A - iv , B - i, C - ii, D - iii

3) A - iv , B - iii, C - i, D - iv

4) A - i , B - ii, C - iii, D - iv

36. Which of the following is/are related to electro negativity of an element?

i) Basic/acidic nature of oxides and hydroxides

ii) Oxidising /reducing ability of an element

iii) Ionic character of a bond

iv) Bond angle

1) i & ii

2) iv

3) i, ii & iv

4) i, ii, iii & iv

37. On Mullicken scale , the electro negativity value of an element 'X' is 11.2. The value of its electron negativity on Pauling scale would be nearly

1) 2 2) 3.5

3) 2.7 4) 4

38. Which of the following properties does not match element of the halogen family?

1) They have seven electrons in their valence shell

2) They are highly reactive

3) They are metallic in nature

4) They are diatomic in their molecular form

39. Match the following

Column-I		Column-II	
a)	Cl > Ar	p)	Atomic size
b)	S > O	q)	Ionisation enthalpy
c)	Mg > Al	r)	Electron affinity
d)	Zn > Cu	s)	Electronegativity

1) a → r,s; b → p, c → p, q; d → s

2) a → r, s; b → p, r; c → p, q; d → p, q

3) a → s; b → r; c → p, q; d → p, q, r

4) a → p, q; b → r, s; c → r, s; d → s

40. Penetrating power order of various electron is in the order of

1) s > p > d > f 2) s > f > p > d

3) f > d > p > s 4) s > p > d = f

41. Diagonally related pair of elements is

1) Na and Mg

2) B & Al

3) Be & Al

4) Si & As

42. The maximum co-valency exhibited by nitrogen is

1) 3 2) 4

3) 5 4) 6

43. First member of each of the groups 1, 2, 13-17 differ in many respects from other members of their respective groups because of

i) small size

ii) high electronegativity

iii) absence of d-orbitals in valence shell

iv) absence of isotopes

1) i & ii 2) iii

3) i, ii & iii 4) i, ii, iii & iv

44. The covalency of P in PCl_5 is :

1) 3 2) 5

3) 2 4) 0

45. The elements A, B and C belong to group 1,14 and 17 respectively of the periodic table. Which two elements will form ionic compounds?

1) A and B 2) A and C

3) B and C 4) None

46. **Assertion** : $[BF_4]^-$ exist but $[AlF_6]^{3-}$ does not

Reason : B has vacant d-orbitals

1) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

2) Assertion and reason both are correct statements and reason is correct explanation for assertion.

3) Assertion and reason both are wrong statements.

4) Assertion is wrong statement but reason is correct statement.

47. **Statement I** : Lithium and Magnesium exhibit diagonal relations

Statement II : Size and electronegativity values of Li and Mg are almost equal

In the light of the above statements, choose the most appropriate option.

1) Statement I & II both are correct

2) Statement I is correct but II is incorrect

3) Statement I is incorrect but II is correct

4) Both statement I & II are incorrect

48. Which one of the following orders presents the correct sequence of the increasing basic nature of the given oxides?

1) $Na_2O < K_2O < MgO < Al_2O_3$

2) $K_2O < Na_2O < Al_2O_3 < MgO$

3) $Al_2O_3 < MgO < Na_2O < K_2O$

4) $MgO < K_2O < Al_2O_3 < Na_2O$

49. Among the following oxides, which is least acidic?

1) Al_2O_3 2) B_2O_3

3) CO_2 4) NO_2

50. An element which forms an amphoteric oxide is

1) Ca 2) Ba

3) B 4) Be

ANSWER KEY

1.	2	21.	2	41.	3	61.	3	81.	4
2.	3	22.	1	42.	2	62.	1	82.	2
3.	4	23.	1	43.	1	63.	4	83.	2
4.	2	24.	4	44.	2	64.	4	84.	1
5.	4	25.	3	45.	1	65.	2	85.	1
6.	4	26.	3	46.	4	66.	3	86.	4
7.	1	27.	4	47.	3	67.	3	87.	3
8.	2	28.	1	48.	4	68.	2	88.	2
9.	1	29.	3	49.	4	69.	1	89.	2
10.	2	30.	3	50.	4	70.	3	90.	3
11.	1	31.	3	51.	3	71.	1	91.	1
12.	1	32.	4	52.	3	72.	1	92.	3
13.	4	33.	2	53.	2	73.	3	93.	4
14.	1	34.	2	54.	3	74.	2	94.	3
15.	3	35.	3	55.	2	75.	4	95.	3
16.	4	36.	3	56.	3	76.	4	96.	2
17.	4	37.	3	57.	2	77.	3	97.	1
18.	3	38.	1	58.	3	78.	3	98.	2
19.	1	39.	3	59.	1	79.	1	99.	3
20.	4	40.	1	60.	4	80.	2	100.	4

SAMPLE QUESTIONS

1.	1	11.	1	21.	4	31.	4	41.	3
2.	4	12.	1	22.	3	32.	1	42.	2
3.	4	13.	3	23.	4	33.	1	43.	3
4.	4	14.	1	24.	3	34.	1	44.	2
5.	1	15.	2	25.	1	35.	2	45.	2
6.	1	16.	1	26.	4	36.	4	46.	3
7.	2	17.	4	27.	4	37.	4	47.	1
8.	2	18.	3	28.	4	38.	3	48.	3
9.	3	19.	3	29.	2	39.	2	49.	1
10.	2	20.	3	30.	1	40.	1	50.	4

WORK BOOK

Chapter 04

CHEMICAL BONDING AND MOLECULAR STRUCTURE

QUESTIONS

INTRODUCTION & TYPE OF CHEMICAL BONDS

1. Example of super octet molecule is

1) CO_2 2) BCl_3

3) PCl_5 4) CH_4

2. In which of the following the bond is nondirectional?

1) NCl_3 2) RbCl

3) $BeCl_2$ 4) BCl_3

3. The lattice energy of NaCl is 788 kJ mol^{-1}. This means that 788 kJ of energy is required

1) to separate one mole of solid NaCl into one mole of $Na^+(g)$ and one mole $Cl^-(g)$ of to infinite distance

2) to separate one mole of solid NaCl into one mole of $Na_{(g)}$ and one mole of $Cl_{(g)}$ to infinite distance

3) to convert one mole of solid NaCl into one mole of gaseous NaCl

4) to convert one mole of gaseous NaCl into one mole of solid NaCl

4. In an ionic compound $A^+ X^-$, the degree of covalent bonding is greatest when

1) A^+ and X^- are small

2) A^+ and X^- are of about the same size

3) A^+ is small and X^- is large

4) A^+ is large and X^- is small

5. Which of the following is electron-deficient?

1) SF_6 2) BF_3

3) PH_3 4) $(CH_3)_2$

6. **Assertion (A)**: Sodium chloride formed by the action of chlorine gas on sodium metal is a stable compound.

Reason (R) : This is because sodium and chloride ions acquire octect in sodium chloride formation.

1) Both (A) and (R) are correct and (R) is the correct explanation of (A).

2) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

3) (A) is correct but (R) is not correct.

4) (A) is not correct but (R) is correct.

7. **Statement I** : $FeCl_3$ is more covalent than $FeCl_2$.

Statement II : Greater the charge on the cation, greater is the covalent character.

1) Statement I and II are correct

2) Statement I and II are incorrect

3) Statement I is correct and statement II is incorrect

4) Statement I is incorrect and statement II is correct

VSEPR THEORY , VBT & HYBRIDISATION

8. On decreasing the internuclear distance below the optimum distance (where potential energy is minimum) there is steep increase in potential energy of a molecule due to

1) Increase in force of attraction between electrons and nuclei

2) Increase in stability of the bonded atoms

3) Equal probability of finding bonding electrons near to the either of the nuclei

4) Increase in net repulsions in the molecule

9. In which of the following pairs, both the species are not isostructural?

1) $SiCl_4$, PCl_4^+ 2) $BeCl_2$, XeF_2

3) NH_3, PH_3 4) XeF_4, XeO_4

10. Molecular shapes of SF_4, CF_4 and XeF_4 are

1) the same with 2, 0 and 1 lone pairs of electrons respectivley

2) the same with 1, 1 and 1 lone pairs of electrons respectively

3) different with 0, 1 and 2 lone pairs of electrons respectively

4) different with 1, 0 and 2 lone pairs of electrons respectively

11. In the structure of ClF_3, the number of lone pair of electrons on central atom Cl is

1) One 2) Two

3) Three 4) Four

12. Which is the correct statement?

1) A σ bond has no free rotation around its axis

2) p-orbitals always have only sidewise overlap

3) s-orbitals cannot form π bonds

4) There can be more than one σ bond between two atoms

13. Which of the following species contains three bond pairs and one lone pair around the central atom?

1) H_2O 2) BF_3

3) NH_2^- 4) PCl_3

14. The pair of species having identical shapes for molecules is

1) PF_5, IF_5 2) CF_4, SF_4

3) XeF_2, CO_2 4) BF_3, PCl_3

15. **Assertion** : Though the central atom of both NH_3 and H_2O molecules are sp^3 hybridised, yet H – N – H bond angle is greater than that of H – O – H.

Reason : This is because nitrogen atom has one lone pair and oxygen atom has two lone pairs.

1) Assertion is correct but Reason is not correct

2) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion

3) Assertion is not correct but Reason is correct

4) Both Assertion and Reason are correct and Reason is not the correct explanation of Assertion

16. Match List-I and List-II and pick out the correct matching codes

List I (compound)		List II (Shpae)	
a)	ClF_3	1)	Square planar
b)	SF_4	2)	Tetrahedral
c)	IF_5	3)	See saw
d)	SiH_4	4)	Square pyramidal
e)	XeF_4	5)	T shape

	a	b	c	d	e
1)	5	4	3	2	1
2)	5	3	4	2	1
3)	5	3	1	4	2
4)	4	3	5	2	1

17. The geometrical shape of BrF_5 is similar to that of

1) PCl_5 2) XeF_4

3) PCl_4^+ 4) $XeOF_4$

18. Which of the following molecules contains 2 types of bond lengths?

1) PCl_5 2) XeF_4

3) SF_6 4) CF_4

19. Which of the following species is not linear?

1) ICl_2^- 2) I_3^-

3) CO_2 4) ClO_2

20. Which of the following Xenon compound has the same number of lone pairs on central atom as in I_3^- ?

1) XeO_4 2) XeF_4

3) XeF_2 4) XeO_3

21. Predict the correct order of electron repulsion among the following

1) lone pair-lone pair > lone pair-bond pair > bond pair - bond pair

2) lone pair-lone pair > bond pair - bond pair > lone pair - bond pair

3) bond pair - bond pair > lone pair - bond pair > lone pair - lone pair

4) lone pair - bond pair > bond pair - bond pair > lone pair - lone pair

22. Which of the following is not isostructural with $SiCl_4$?

1) SO_4^{2-} 2) PO_4^{3-}

3) NH_4^+ 4) SCl_4

23. Which of the following molecules is planar?

1) SF_4 2) XeF_4

3) NF_3 4) SiF_4

24. Which of the following molecule does not have a linear arrangement of atoms?

1) H_2S 2) C_2H_2

3) BeH_2 4) CO_2

25. In which of the following pairs, both the species have the same hybridisation?

1) SF_4, XeF_4

2) I_3^-, XeF_2

3) ICl_4^+, $SiCl_4$

4) ClO_3^-, ClF_3

26. **Statement I** : Dipole moment is a vector quantity and by convention it is depicted by a small arrow with tail on the negative centre and head pointing towards the positive centre.

Statement II : The crossed arrow of the dipole moment symbolizes the direction of the shift of electron density in the molecules.

1) Both statement I and and statement II are incorrect

2) Both statement I and statement II are correct

3) Statement I is correct but statement II is incorrect

4) Statement I is incorrect but statement II is correct

27. The bent or V shape of molecules can be resulted from the hybridisations

1) sp^3

2) sp^2

3) sp^3d

4) Both 1 and 2

28. Hybridisation of C atom and electron geometry around C atom in benzene are

1) sp^3, pyramidal

2) sp^2, planar trigonal

3) sp, linear

4) sp^3, tetrahedral

29. Which of the following statements is correct for 1 : 1 complex of $(CH_3)_3N$ and BF_3?

1) Geometry around N is pyramidal with sp^3 hybridisation and that around B is planar with sp^2 hybridisation

2) The B–F bond length in the complex is longer than that in BF_3

3) The geometry around N and B both are tetrahedral with sp^3 hybridisation

4) 2 and 3 both

30. Which of the following molecules represents the order of hybridisation sp^2, sp^2, sp, sp from left to right atoms?

1) $HC \equiv C - C \equiv CH$

2) $CH_2 = CH - C \equiv CH$

3) $CH_3 - CH = CH - CH_3$

4) $CH_2 = CH - CH = CH_2$

31. Among the following a T shaped molecule is?

1) ClF_3 2) SO_2

3) XeF_4 4) BrF_5

32. Total number of lone pairs on compound I_3^{-1}

1) 3 2) 12

3) 9 4) 6

33. The ion that has sp^3d^2 - hybridisation for the central atom, is

1) $[ICl_2]^-$ 2) $[BrF_2]^-$

3) $[ICl_4]^-$ 4) $[IF_6]^-$

34. Among the following species, identify the isostructural pairs.

1) $[NF_3, NO_3^-]$ and $[BF_3, H_3O^+]$

2) $[NF_3, N_3H]$ and $[NO_3^-, BF_3]$

3) $[NF_3, H_3O^+]$ and $[NO_3^-, BF_3]$

4) $[NF_3, H_3O^+]$ and $[N_3H, BF_3]$

35. The AsF_5 molecule is trigonal bipyramidal. The hybrid orbitals used by the As atom for bonding are

1) $d_{x^2-y^2}, d_{z^2}, s, p_x, p_y$ 2) d_{xy}, s, p_x, p_y, p_z

3) $s, p_x, p_y, p_z, d_{z^2}$ 4) $d_{x^2-y^2}, s, p_x, p_y, p_z$

36. BF_3 is planar and electron deficient compound. Hybridisation and number of electrons around the central atom, respectively are

1) sp^3 and 6 2) sp^2 and 6

3) sp^2 and 8 4) sp^3 and 4

37. The d orbitals used in the hybrid orbitals of Xe in XeF_4 are

1) dxy and dyz 2) dxz and dz^2

3) dx^2 - y^2 and dz^2 4) dxy and dz^2

38. Which of the following statement is/are incorrect?

1) The hybrid orbitals are more effective in forming stable bonds than pure atomic orbitals

2) Promotion of electron is an essential condition prior to hybridisation

3) The hybrid orbitals are always equivalent in energy and shape

4) It is not necessary that only half filled orbitals participate in hybridisation

39. In a regular octahedral molecule, MX_6 the number of X–M–X bonds at 180°C is

1) three 2) two

3) six 4) four

40. Which one of the following molecules contains only σ bond?

1) H_2O 2) SO_2

3) NO_2 4) CO_2

41. The incorrect statement for SF_4 molecule is

1) It has see saw shape

2) there is 1 lone pair on S in SF_4

3) there is no lone pair on S in SF_4

4) lone pair is arranged equatorially for more stable arrangement

42. The species having $p\pi - d\pi$ bond is

1) CN^- 2) NO_2

3) H_2O 4) PO_4^{3-}

43. Which of the following will result in zero overlap if the molecular axis is X axis?

i. 1s - $2p_x$ ii. 2s - $2p_z$

iii. $2p_x$ - $2p_x$ iv. 1s - $2p_y$

1) i only 2) i and ii

3) ii and iv 4) iii and iv

44. **Statement I** : The VSEPR theory is able to predict geometry of a large number of molecules, especially the compounds of 'p' block elements accurately.

Statement II : BrF_5 molecule is square pyramidal in shape with two lone pairs.

1) Both statement I and statement II are correct.

2) Both statement I and statement II are incorrect.

3) Statement I is correct but statement II is incorrect.

4) Statement I is incorrect but statement II is correct.

BOND PARAMETERS

45. Which of the following set of molecules will have zero dipole moment?

1) Boron trifluoride, hydrogen fluoride, carbon dioxide, 1,3-dichlorobenzene

2) Nitrogen trifluoride, beryllium difluoride, water, 1,3-dichlorobenzene

3) Boron trifluoride, beryllium difluoride, carbon dioxide, 1,4-dichlorobenzene

4) Ammonia, beryllium difluoride, water, 1,4-dichlorobenzene

46. Which of the following bonds will be most polar?

1) N–Cl

2) O–F

3) N–F

4) N–N

47. Which of the following has been arranged in order of decreasing dipole moment?

1) $CH_3Cl > CH_3F > CH_3Br > CH_3I$

2) $CH_3F > CH_3Cl > CH_3Br > CH_3I$

3) $CH_3Cl > CH_3Br > CH_3I > CH_3F$

4) $CH_3F > CH_3Cl > CH_3I > CH_3Br$

48. Which of the following molecules is non-polar in nature?

1) CH_2O 2) $SbCl_5$

3) NO_2 4) $POCl_3$

49. The compound that has the largest H–M–H bond angle (M = N, S, C) is

1) H_2O 2) NH_3

3) H_2S 4) CH_4

50. Which of the following pair of compounds have permanent dipole moment for both the molecules?

1) SiF_4, CO_2 2) SiF_4, NO_2

3) NO_2, CO_2 4) NO_2, O_3

51. Which of the following molecules has polar bonds but zero dipole moment?

1) O_2 2) $CHCl_3$

3) CCl_4 4) O_3

52. Correct order of O–O bond length in O_2, H_2O_2 and O_3 is

1) $H_2O_2 > O_3 > O_2$ 2) $H_2O_2 > O_2 > O_3$

3) $O_2 > O_3 > H_2O_2$ 4) $O_3 > O_2 > H_2O_2$

53. Which is the correct order of bond angle in O_3, NO_2^- and NOF?

1) $NO_2^- > O_3 > NOF$ 2) $NOF > O_3 > NO_2^-$

3) $O_3 > NOF > NO_2^-$ 4) $O_3 > NO_2^- > NOF$

54. The C–H bond distance is longest in

1) C_2H_2 2) C_2H_4

3) $C_2H_2Br_2$ 4) C_2H_6

55. Number of $109^0 28'$ bond angles in CH_4 molecule is

1) 4 2) 5

3) 6 4) 8

56. The highest H–C–H bond angle is present in

1) CH_2F_2 2) CH_4

3) CH_3Cl 4) CH_3F

57. Correct order about bond angles is

1) $H_2O > H_2S > H_2Se > H_2Te$

2) $C_2H_2 > C_2H_4 > CH_4 > NH_3$

3) $SF_6 < NH_3 < H_2O < OF_2$

4) $ClO_2 > H_2O > H_2S > SF_6$

58. The decreasing order of bond energy among F_2, Cl_2, O_2 and N_2 is :

1) $N_2 > O_2 > Cl_2 > F_2$

2) $O_2 > F_2 > Cl_2 > N_2$

3) $F_2 > Cl_2 > O_2 > N_2$

4) $N_2 > O_2 > F_2 > Cl_2$

59. Which one has the highest bond angle?

1) BF_3 2) BeF_2

3) H_2O 4) NH_3

60. **Statement I** : Bond length is defined as the equilibrium distance between the nuclei of two bonded atoms in a molecule.

Statement II : Bond lengths are measured by spectroscopic X-ray diffraction and electron-diffraction techniques.

1) Both statement I and statement II are correct.

2) Both statement I and statement II are incorrect.

3) Statement I is correct but statement II is incorrect.

4) Statement I is incorrect but statement II is correct.

MOLECULAR ORBITAL THEORY

61. Stability of the species Li_2, Li_2^+ and Li_2^- is in the order

1) $Li_2^- < Li_2^+ < Li_2$ 2) $Li_2^- = Li_2^+ < Li_2$

3) $Li_2^+ < Li_2^- < Li_2$ 4) $Li_2 < Li_2^+ < Li_2^-$

62. Which of the following molecular species has unpaired electron (s)?

1) N_2 2) F_2

3) O_2^- 4) O_2^{2+}

63. Identify a molecule which does not exist

1) Li_2 2) C_2

3) O_2 4) He_2

64. Which of the following diatomic molecular species has only π-bonds according to Molecular Orbital Theory?

1) O_2 2) N_2

3) C_2 4) Be_2

65. Which of the following options represents the correct bond order?

1) $O_2^- < O_2 < O_2^+$

2) $O_2^+ < NO^- < NO < NO^+$

3) $NO^- < O_2^+ < NO < NO^+$

4) $NO < NO^+ < O_2^+ < NO^-$

66. The pair of species that has the same bond order in the following is

1) O_2, B_2 2) CO, NO^+

3) NO^-, CN^- 4) O_2, N_2

67. Bond order of 1.5 is shown by

1) O_2^+ 2) O_2^-

3) O_2^- 4) O_2

68. Which one of the following arrangements represents the increasing bond orders of the given species?

1) $NO^+ < NO < NO^- < O_2^-$

2) $O_2^- < NO^- < NO < NO^+$

3) $NO^- < O_2^- < NO < NO^+$

4) $NO < NO^+ < O_2^- < NO^-$

69. The number of anti-bonding electron pairs in O_2^{-2} molecular ion on the basis of molecular orbital theory is. (Atomic number of O is 8)

1) 5 2) 2

3) 3 4) 4

70. Among the following, the molecule expected to be stabilised by anion formation is

1) C_2 2) F_2

3) NO 4) O_2

71. Among the following molecules/ions, $C_2^{2-}, N_2^{2-}, O_2^{2-}, O_2$. Which one is diamagnetic and has the shortest bond length?

1) C_2^{2-} 2) O_2

3) O_2^- 4) N_2^{2-}

72. B_2 molecule will be diamagnetic when

1) s-p mixing is not operative

2) s-p mixing is operative but Hund's rule is violated

3) s-p mixing is operative and Hund's rule is not violated

4) Both 1 and 2

73. Assuming 2s-2p mixing is not operative, the paramagnetic species among the following is

1) Be_2 2) B_2

3) C_2 4) N_2

74. In which of the following pairs of molecules/ ions both the species are not likely to exist?

1) H_2^+, He_2^{2-} 2) H_2^-, He_2^{2-}

3) H_2^{2+}, He_2 4) H_2^-, He_2^{2+}

75. During the change of O_2 to O_2^-, the electron is added to which one of the following orbitals?

1) π^* orbital

2) π orbital

3) σ^* orbital 4) σ orbital

76. Which of the following pairs has the highest bond order?

1) NO^+ and CN^+

2) CN^- and NO^+

3) CN^- and CN^+

4) O_2^- and CN^-

77. Which of the following species is paramagnetic?

1) NO^- 2) O_2^{2-}

3) CN^- 4) CO

78. Decreasing order of stability of O_2, O_2^-, O_2^+ and O_2^{2-} is

1) $O_2^- > O_2^{2-} > O_2^+ > O_2$

2) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

3) $O_2^{2-} > O_2^- > O_2 > O_2^+$

4) $O_2 > O_2^+ > O_2^{2-} > O_2^-$

79. The increasing order of O–O bond energy in O_2, Na_2O_2 and KO_2 is

1) $KO_2 < Na_2O_2 < O_2$

2) $Na_2O_2 < KO_2 < O_2$

3) $Na_2O_2 < O_2 < KO_2$

4) $O_2 < KO_2 < Na_2O_2$

80. Which of the following has unpaired electron in antibonding molecular orbital?

1) O_2 2) N_2

3) C_2 4) B_2

81. Antibonding MO is formed by

1) Addition of atomic orbitals

2) Subtraction of atomic orbitals

3) Multiplication of atomic orbitals

4) None of these

82. Which of the following will be stabilised by the removal of an electron?

1) CN^-

2) N_2

3) B_2

4) O_2

83. Peroxide ion, O_2^{2-}

i) has half filled antibonding molecular orbitals

ii) is diamagnetic

iii) has bond order one

iv) is isoelectronic with Ne_2

Which of these are correct?

1) ii and iii

2) i, ii and iv

3) i, ii and iii

4) i and iv

84. Which of the following species have same bond order and identical magnetic property?

I) O_2^+

II) NO

III) N_2^+

1) I and II 2) I and III

3) I, II and III 4) II and III

85. Which among the following is incorrect statement?

1) O_2^+ ion is diamagnetic

2) The bond order of , O_2^+ O_2, O_2^- and O_2^{2-} are 2.5, 2, 1.5 and 1 respectively

3) C_2 molecules has four electrons in its two degenerate π molecular orbitals

4) H_2^+ ion has one electron

86. N_2 and O_2 are converted into monoanion N_2^- and O_2^- respectively. Which of the following statement is wrong?

1) In N_2^-, N–N bond weakens

2) In O_2^-, O–O bond order increases

3) In O_2^-, O–O bond order decreases

4) N_2^- becomes paramagnetic

RESONANCE AND HYDROGEN BONDING

87. Resonating structures of a molecule may not have

1) Identical bonding

2) Identical arrangement of atoms

3) Nearly the same energy content

4) The same number of unpaired electrons

88. Resonance structures can be written for

1) O_3 2) H_2O

3) CH_4 4) SF_6

89. Which of the following is the correct order of boiling point among HF, HCl, HBr and HI

1) HF < HCl < HBr < HI

2) HCl < HBr < HI < HF

3) HF < HI < HBr < HCl

4) HI < HBr < HCl < HF

90. Inter molecular hydrogen bond is present in the molecule

1) Salicylic acid

2) Para nitrophenol

3) o-hydroxybenzaldehyde

4) o-hydroxybenzoic acid

91. What is the dominant intermolecular force or bond that must be overcome in converting liquid CH_3OH to a gas?

1) Dipole-dipole interaction

2) Covalent bonds

3) London dispersion force

4) Hydrogen bonding

92. Strongest hydrogen bond is shown by

1) Water

2) Ammonia

3) Hydrogen fluoride

4) Hydrogen sulphide

93. HF has highest boiling point among hydrogen halides, because it has

1) Lowest ionic character

2) strongest van der Waal's interactions

3) strongest hydrogen bonding

4) lowest dissociation enthalpy

94. o-nitrophenol shows

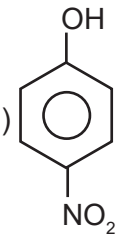
1) Intramolecular H-bonding

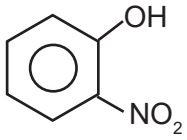
2) Intermolecular H-bonding

3) H-bond between H and F

4) None of the above

95. Out of two compounds shown below, the vapour pressure of II at a particular temperature is expected to be

I) 

II) 

1) higher than that of I

2) lower than that of I

3) same as that of I

4) lower or higher depending on the size of the vessel

SAMPLE QUESTIONS

1. In the given bonds which one is most ionic.

1) Cs – Cl 2) Al – Cl

3) C – Cl 4) H – Cl

2. Which type of bonding exists in Li_2O and CaF_2 respectively

1) Ionic, ionic 2) Ionic, covalent

3) Covalent, ionic 4) Coordinate, ionic

3. Carbon has a valency of 2 in CO and 4 in CO_2 and CH_4. Its valency in acetylene (C_2H_2) is

1) 1 2) 2

3) 3 4) 4

4. Which one in the following contains ionic as well as covalent bond.

1) CH_4 2) H_2

3) KCN 4) HCl

5. The number of dative bonds in sulphuric acid molecules is

1) 0 2) 1

3) 2 4) 4

6. Which of the following molecules does not have a linear arrangement of atoms.

1) H_2S 2) C_2H_2

3) BeH_2 4) CO_2

7. Number of electrons in the valence orbit of nitrogen in an ammonia molecule is

1) 8 2) 5

3) 6 4) 7

8. The bond angle and dipole moment of water respectively are

1) 109.5º, 1.84D 2) 107.5º, 1.56D

3) 104.5º, 1.84 D 4) 102.5º, 1.56 D

9. In XeF_6, oxidation state and state of hybridisation of Xe and shape of the molecule are, respectively

1) +6, sp^3d^3, distorted octahedral

2) +4, sp^3d^2, square planar

3) +6, sp^3, pyramidal

4) +6, sp^3d^2, square pyramidal

10. In which of the following molecule/ion all the bonds are not equal

1) XeF_4 2) BF_4^-

3) C_2H_4 4) SiF_4

11. The correct order of increasing bond angles in the following species is

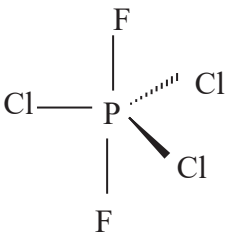
1) $ClO_2^- < Cl_2O < ClO_2$

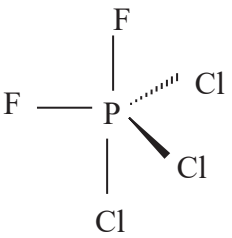
2) $Cl_2O < ClO_2 < ClO_2^-$

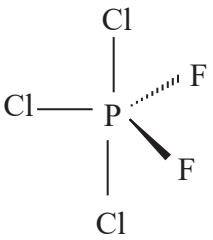
3) $ClO_2 < Cl_2O < ClO_2^-$

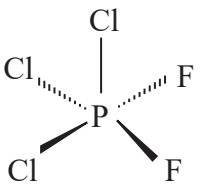
4) $Cl_2O < ClO_2^- < ClO_2$

12. The correct structure of PCl_3F_2 is

1) 

2) 

3) 

4) 

13. The state of hybridization of the central atom and the number of lone pairs over the central atom in $POCl_3$ are

1) sp, 0 2) sp^2, 0

3) sp^3, 0 4) dsp^2, 1

14. Which of the following is not tetrahedral?

1) SCl_4 2) SO_4^{2-}

3) $Ni(CO)_4$ 4) $NiCl_4^{2-}$

15. Which one of the following is a planar molecule?

1) NH_3 2) H_3O^+

3) BCl_3 4) PCl_3

16. The hybrid state of sulphur in SO_3 molecule is

1) sp^3d 2) sp^3

3) sp^3d^2 4) sp^2

17. The bond angle and % of d-character in SF_6 are

1) 120°, 20% 2) 90°, 33%

3) 109°, 25% 4) 90°, 25%

18. Two type FXF angles are present in which of the following molecules (X = S, Xe, C)

1) SF_4 2) XeF_4

3) SF_6 4) CF_4

19. The number of sp^2 hybridized carbon atoms in

$HC{\equiv}C{-}CH_2{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}CH_2{-}CH{=}CH_2$, is

1) 3 2) 5

3) 4 4) 6

20. Which of the following has $p\pi - d\pi$ bonding

1) NO_3^- 2) CO_3^{-2}

3) BO_3^{-3} 4) SO_3^{-2}

21. Main axis of diatomic molecules is z. The orbitals p_x and p_y overlap to form

1) π-molecular orbital

2) σ-molecular orbital

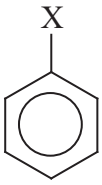
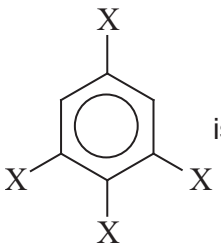
3) δ-molecular orbital

4) No bond is formed

22. Dipole moment of HCl = 1.03 D, HI = 0.38 D. Bond length of HCl = $1.3\,\mathring{A}$ and HI = $1.6\,\mathring{A}$. The ratio of fraction of electric charge, δ, existing on each atom in HCl and HI is

1) 12 : 1 2) 2.7 : 1

3) 3.3 : 1 4) 1 : 3.3

23. Dipole moment of  is 1.5 D. The dipole moment of  is

1) 1.5 D 2) 2.25 D

3) 1 D 4) 3 D

24. Arrange the following compounds in order of increasing dipole moment.

(I) Toluene

(II) m-idchlorobenzene

(III) o-dichlorobenzene

(IV) p-dichlorobenzene

1) I < IV < II < III

2) IV < I < II < III

3) IV < I < III < II

4) IV < II < I < III

25. What is the correct mode of hybridisation of the central atom in the following compounds:

XeF_2, BF_4^- and ICl_2^-

1) sp^3d^2, sp^3, sp^2

2) sp^3d, sp^3, sp^3d

3) sp^3, sp^3d, sp

4) sp^3, sp^3d, sp^3d^2

26. Florine is more electronegative than either boron or phosphrous. What conclusion can be drawn from the fact that BF_3 has no dipole moment but PF_3 does

1) BF_3 is not spherically symmetrical but PF_3 is symmetrical

2) BF_3 molecule must be linear

3) The atomic radius of P is larger than the atomic radius of B

4) The BF_3 molecule must be planar triangular

27. Amongst LiCl, RbCl, $BeCl_2$ and $MgCl_2$ the the compounds with the greatest and the least ionic character, respectively, are

1) LiCl and RbCl

2) RbCl and $BeCl_2$

3) RbCl and $MgCl_2$

4) $MgCl_2$ and $BeCl_2$

28. Which does not show resonance

1) Benzene 2) Aniline

3) Ethyl amine 4) Toluene

29. In PO_4^{3-} ion, the formal charge on each oxygen atom and P – O bond order respectively are

1) –0.75, 1.25

2) –0.75, 1.0

3) –0.75, 0.6

4) –3, 1.25

30. Which is false statement about LCAO?

1) Addition of atomic orbitals result in molecular orbitals

2) Atomic orbitals of nearly same energy combine to form molecular orbitals

3) Bonding molecular orbitals occupy higher energy than atomic orbitals

4) Each molecular orbital accommodates maximum number of two electrons

31. Which of the following molecular orbitals has two nodal planes?

1) $\sigma 2s$ 2) $\pi 2p_y$

3) $\pi^* 2p_y$ 4) $\sigma^* 2p_x$

32. The correct statement with regard to H_2^+ and H_2^- is

1) Both H_2^+ and H_2^- do not exist

2) H_2^- is more stable than H_2^+

3) H_2^+ is more stable than H_2^-

4) Both H_2^+ and H_2^- are equally stable

33. The paramagnetic behaviour of B_2 is due to the presence of

1) 2 unpaired electron in $\pi_b MO$

2) 2 unpaired electrons in $\pi^* MO$

3) 2 unpaired electrons in $\sigma^* MO$

4) 2 unpaired electrons in $\sigma_b MO$

34. Arrange the following ions in the order of decreasing X – O bond length, where X is the central atom in

1) $ClO_4^-, SO_4^{2-}, PO_4^{3-}, SiO_4^{4-}$

2) $SiO_4^{4-}, PO_4^{3-}, SO_4^{2-}, ClO_4^-$

3) $SiO_4^{4-}, PO_4^{2-}, ClO_4^-, SO_4^{2-}$

4) $SiO_4^{4-}, SO_4^{2-}, PO_4^{3-}, ClO_4^-$

35. The C – O bond length in CO, CO_2 and CO_3^{2-} follows the order

1) $CO < CO_2 < CO_3^{2-}$

2) $CO_2 < CO_3^{2-} < CO$

3) $CO > CO_2 > CO_3^{2-}$

4) $CO_3^{2-} < CO_2 < CO$

36. Which one among the following does not have the hydrogen bond

1) Phenol

2) Liquid NH_3

3) Water

4) Liquid HCl

37. Give the correct order of initials T or F for following statements. Use T if statement is true and F if it is false:

(i) The order of repulsion between different pair of electrons is lp – lp > lp – bp > bp – bp.

(ii) In general, as the number of lone pair of electrons on central atom increases, value of bond angle from normal bond angle also increase

(iii) The number of lone pair on O in H_2O is 2 while on N in NH_3 is 1

(iv) The structures of xenon fluorides and xenon oxyfluorides could not be explained on the basis of VSEPR theory

1) TTTF 2) TFTF

3) TFTT 4) TFFF

38. Match Column I with Column II and Column III and choose the correct option from the given codes.

Column I (Molecule)		Column II (No. of lone pairs and bond pairs		Column II (Shape of molecule)	
A)	NH_3	i)	1, 2	p)	Bent
B)	SO_2	ii)	1, 4	q)	Trigonal pyramidal
C)	SF_4	iii)	2, 3	r)	T-shape
D)	ClF_3	iv)	1, 3	s)	See-Saw

1) A - (iv, q); B - (ii, p); C - (i, r); D - (iii, s)

2) A - (iv, q); B - (i, p); C - (ii, s); D - (iii, r)

3) A - (i, p); B - (iii, c); C - (iv, r); D - (ii, q)

4) A - (iv, p); B - (i, r); C - (iii, q); D - (ii, s)

39. **Assertion** : All F – Si –F angles in SiF_4 are greater than 90° but less than 180°.

Reason : The lone pair - bond pair repulsion is weaker than bond pair - bond pair repulsion.

1) If Assertion and Reason both are correct and Reason is the correct explanation of Assertion

2) If Assertion and Reason both are correct but Reason is not the correct explanation of Assertion

3) Assertion is correct but Reason is incorrect

4) Assertion and Reason both are incorrect

40. Which one of the following compounds shows the presence of intramolecular hydrogen bond

1) Salicylic acid

2) Concentrated acetic acid

3) H_2O_2

4) HCN

41. Four diatomic species are listed below in different sequences. Which of these presents the correct order of their increasing bond order.

1) $C_2^{2-} < He_2^+ < NO < O_2^-$

2) $He_2^+ < O_2^- < NO < C_2^{2-}$

3) $O_2^- < NO < C_2^{2-} < He_2^+$

4) $NO < C_2^{2-} < O_2^- < He_2^+$

42. Which of the following diatomic molecular species has only π bonds according to Molecular orbital theory

1) Be_2 2) O_2

3) N_2 4) C_2

43. Which of the following set of molecules will have zero dipole moment.

1) Ammonia, beyrllium difluoride, water, 1,4-dichlorobenzene

2) Boron trifluoride, hydrogen fluoride, carbon dioxide, 1,3-dichlorobenzene

3) Nitrogen trifluoride, beryllium difluoride, water, 1,3-dichlorobenzene

4) Boron trifluoride, beryllium difluoride, carbon dioxide, 1,4-dichlorobenzene

44. Among the following which one is a wrong statement?

1) I_3^+ has bent geometry

2) PH_5 and $BiCl_5$ do not exist

3) $p\pi - d\pi$ bonds are present in SO_2

4) SeF_4 and CH_4 have same shape

45. Which of the following is most polar compound?

1) HF

2) HCl

3) HBr

4) NH_3

ANSWER KEY

1.	3	20.	3	39.	1	58.	1	77.	1
2.	2	21.	1	40.	1	59.	2	78.	2
3.	1	22.	4	41.	3	60.	1	79.	2
4.	3	23.	2	42.	4	61.	1	80.	1
5.	2	24.	1	43.	3	62.	3	81.	2
6.	1	25.	2	44.	3	63.	4	82.	4
7.	1	26.	2	45	3	64.	3	83.	1
8.	4	27.	4	46.	3	65.	1	84.	3
9.	4	28.	2	47.	1	66.	2	85.	1
10.	4	29.	4	48.	2	67.	2	86.	2
11.	2	30.	2	49.	4	68.	2	87.	1
12.	3	31.	1	50.	4	69.	4	88.	1
13.	4	32.	3	51.	3	70.	1	89.	2
14.	3	33.	3	52.	1	71.	1	90.	2
15.	2	34.	3	53.	4	72.	4	91.	4
16.	2	35.	3	54.	4	73.	3	92.	3
17.	4	36.	2	55.	3	74.	3	93.	3
18.	1	37.	3	56.	1	75.	1	94.	1
19.	4	38.	2	57.	2	76.	2	95.	1

SAMPLE QUESTIONS

1.	1	10.	3	19.	1	28.	3	37.	2
2.	1	11.	1	20.	4	29.	1	38.	2
3.	4	12.	1	21.	4	30.	3	39.	3
4.	3	13.	3	22.	3	31.	3	40.	1
5.	3	14.	1	23.	1	32.	3	41.	2
6.	1	15.	3	24.	2	33.	1	42.	4
7.	1	16.	4	25.	2	34.	2	43.	4
8.	3	17.	2	26.	4	35.	1	44.	4
9.	1	18.	1	27.	2	36.	4	45.	1

WORK BOOK

Chapter 05

REDOX REACTION

QUESTIONS

OXIDATION, REDUCTION, OXIDISING AGENT, REDUCING AGENT, OXIDATION NUMBER

1. According to modern concept, oxidation is

1) Electronation

2) De-electronation

3) Addition of oxygen

4) Addition of electronegative element

2. Which of the following is correct statement regarding competitive electron transfer reaction?

I) Placing a strip of metallic zinc in an aqueous solution of copper nitrate for about one hour, the strip becomes coated with reddish metallic copper and the blue colour of the solution disappears

II) Placing a strip of metallic copper in a $AgNO_3$ solution for one hour, solution develops blue colour due to the formation of Cu^{2+} ions

III) Placing a strip of metallic copper in a zinc sulphate solution for about one hour, black coloured CuS is formed by passing H_2S through the solution

1) I, II, III

2) I, II only

3) II, III only

4) I, III only

3. $C_2O_4^{2-} + MnO_4^- + H^+ \rightarrow Mn^{2+} + CO_2$, the reductant is

1) $C_2O_4^{2-}$ 2) H^+

3) MnO_4^- 4) Mn^{2+}

4. What will be the oxidation number of I in KI_3?

1) – 3

2) – 1

3) –1/3

4) -1/4

5. The compound formed in the brown ring test has the formula $\left[Fe(H_2O)_5NO\right]SO_4$. The oxidation state of iron in it is

1) +1 2) +2

3) +3 4) Zero

6. A, B and C are three elements forming a part of compound in oxidation states of +2, +5 and –2 respectively. The formula of the compound is

1) $A_2(BC)_2$

2) $A_2(BC_4)_3$

3) $A_3(BC_4)_2$

4) $A(BC)_2$

7. Oxidation number of Cl in HOCl is

1) –1 2) +1

3) +3 4) +5

8. Oxidation numbers of each carbon atoms in carbon suboxide (C_3O_2) is

1) -1, 0, +1 2) -2, -2, -2

3) -2, 0, -2 4) +2, 0, +2

9. The correct representation of $HAuCl_4$ using stock notation is

1) $HAu(I)Cl_4$ 2) $HAu(III)Cl_4$

3) $HAu(II)Cl_4$ 4) $HAu(IV)Cl_4$

10. The most powerful oxidizing agent in the following is

1) H_3BO_3 2) HPO_3

3) H_3PO_4 4) H_2SO_4

11. The oxidation number of Be in the mineral Beryl ($Be_3Al_2Si_6O_{18}$) is

1) +1 2) +2

3) +3 4) 0

12. **Assertion** : $HClO_4$ acts as an oxidizing agent only while $HClO_3$ acts as both oxidizing and reducing agent.

Reason : An element at its highest positive oxidation state acts as oxidizing agent only.

1) Both assertion and reason are false

2) Assertion is correct but reason is false

3) Assertion is false but reason is correct

4) Both assertion and reason are correct and reason is the correct explanation of assertion

13. The gain of electron is termed as

1) oxidation 2) reduction

3) combustion 4) neutralization

14. Oxidation number of cobalt in $K\left[Co(CO)_4\right]$ is

1) +1 2) +3

3) -1 4) -3

15. Oxidation number of carbon in CH_2Cl_2 is

1) -4 2) -4

3) 0 4) -2

16. In which of the following compounds, iron has lowest oxidation state?

1) $K_3\left[Fe(CN)_6\right]$

2) $K_4\left[Fe(CN)_6\right]$

3) $FeSO_4.(NH_4)_2SO_4.6H_2O$

4) $Fe(CO)_5$

17. The oxidation number of sulphur in $Na_2S_4O_6$ is

1) 1.5 2) 2.5

3) 3 4) 2

18. The oxidation state of osmium (Os) in OsO_4 is

1) +7 2) +6

3) +4 4) +8

19. In which of the compounds does manganese exhibit highest oxidation number?

1) MnO_2 2) Mn_3O_4

3) K_2MnO_4 4) $MnSO_4$

20. $FeS_2 + O_2 \rightarrow Fe_2O_3 + SO_2$

In the above equation the number of electrons lost by one molecule of FeS_2 is

1) 6 2) 2

3) 1 4) 11

21. The oxide, which cannot acts as a reducing agent is

1) NO_2 2) SO_2

3) CO_2 4) ClO_2

22. Which of the following involves a redox reaction?

1) Reaction of H_2SO_4 and NaOH

2) Production of ozone from oxygen in the atmosphere by lightning

3) Production of nitrogen oxides from nitrogen and oxygen in the atmosphere by lightning

4) Evaporation of water

23. The oxidation states of the most electronegative element in the products of the reaction, BaO_2 with dil. H_2SO_4 is

1) 0 and -1

2) -1 and -2

3) -2 and 0

4) +2 and +1

24. One mole of N_2H_4 loses 10 moles of electrons to form a new compound Y. Assuming that all nitrogen appear in the new compound, what is the oxidation state of nitrogen in Y? (No change in the O.S of H)

1) -1 2) -3

3) +3 4) +5

25. Oxiation states of P in $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$, respectively are

1) +3, +4, +5 2) +3, +5, +7

3) +5, +7, +1 4) +1, -5, +1

26. Which one can act as oxidising & reducing agent both?

1) HNO_2 2) H_2O_2

3) H_2SO_3 4) All

27. The oxidation number and covalence of sulphur in sulphur molecules (S_8) are:

1) 0 and 2 2) +6 and 8

3) 0 and 8 4) +6 and 2

28. In which of the following reactions, H_2O_2 acts as a reducing agent?

1) $HOCl + H_2O_2 + H^+ \rightarrow H_3O^+ + Cl^- + O_2$

2) $Mn^{2+} + H_2O_2 + OH^- \rightarrow Mn^{4+} + 2OH^-$

3) $2Fe^{2+} + H_2O_2 + OH^- \rightarrow 2Fe^{3+} + 2OH^-$

4) $PbS(s) + H_2O_2(aq) + H^+ \rightarrow PbSO_4(s) + 4H_2O(l)$

29. Of the following electronic configurations of atoms, the highest oxidation state is achieved by which one of them?

1) $(n-1)d^8ns^2$ 2) $(n-1)d^5ns^2$

3) $(n-1)d^3ns^2$ 4) $(n-1)d^5ns^1$

30. The oxidation number of the sulphur atoms in peroxomonosulphuric acid H_2SO_5 and peroxodisulphuric ($H_2S_2O_8$) respectively are:

1) +8 and +7 2) +3 and +3

3) +6 and +6 4) +4 and +6

31. Oxidation state of Pb in Pb_3O_4 is/are

1) +2 and +4 2) +2 and +3

3) +4 and +3 4) +1 and +5

32. In which of the following compounds, an element exhibits two different oxidation states?

1) NH_2OH 2) NH_4NO_3

3) N_2H_4 4) N_3H

33. The largest oxidation number exhibited by an element depends on its outer electronic configuration. Which of the following configurations, the element will exhibit largest oxidation number ?

1) $3s^1$ 2) $3s^2$

3) $3s^23p^1$ 4) $3s^23p^6$

34. **Assertion** : $HClO_4$ has more oxidising power than $HClO_3$

Reason : When the positive oxidation state of central atom increases, oxidising power increases.

1) Both assertion and reason are correct and the reason is the correct explanation of assertion.

2) Assertion is correct but the reason is wrong

3) Assertion is wrong but the reason is correct

4) Both assertion and reason are wrong

35. Oxidation number of N in HNO_4 (peroxonitric acid) is

1) –3.5 2) +7

3) +5 4) +6

36. Phosphorous has the oxidation state of +3 in

1) H_3PO_3

2) H_3PO_4

3) PH_3

4) $POCl_3$

37. The oxidation number of chromium in potassium dichromate is

1) +6 2) +2

3) –5 4) –2

38. Sodium nitroprusside is formulated as $Na_2\left[Fe(CN)_5(NO)\right]$. The oxidation state of iron is :

1) +1 2) +2

3) +3 4) 0

39. The oxidation number of sulphur in S_8, S_2F_2, H_2S respectively, are

1) 0, +1 and –2 2) +2, +1 and –2

3) 0, +1 and +2 4) –2, +1 and –2

40. In which of the following reactions, the marked element acts as the oxidizing agent?

1) $Fe^* + CuSO_4 \rightarrow FeSO_4 + Cu$

2) $H_2^* + Cl_2 \rightarrow 2HCl$

3) $C^* + H_2O \rightarrow CO + H_2$

4) $Mn^*O_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

41. **Statement I** : Both $KMnO_4$ and $K_2Cr_2O_7$ are oxidizing agents

Statement II : $KMnO_4$ is a weaker oxidizing agent than $K_2Cr_2O_7$

1) Both statement I and II are correct

2) Statement I is correct and II is incorrect

3) Statement I is incorrect and II is correct

4) Both statements I and II are incorrect

TYPES OF REDOX REACTIONS & BALANCING REDOX REACTIONS

42. Which of the following is not an example of disproportionation reaction?

1) $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$

2) $P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$

3) $2H_2O_2 \rightarrow 2H_2O + O_2$

4) $2NaOH + 2F_2 \rightarrow OF_2 + 2NaF + H_2O$

43. $10FeC_2O_4 + xKMnO_4 + 24H_2SO_4 \rightarrow$

$5Fe_2(SO_4)_3 + 20CO_2 + yMnSO_4 + 3K_2SO_4$

+ $24H_2O$, here x and y are

1) 6, 6 2) 6, 3

3) 3, 3 4) 3, 6

44. Nitric oxide acts as a reducing agent in the reaction (some reactions may be unbalanced)

1) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

2) $NO + 3I_2 + 4H_2O \rightarrow 2NO_3^- + 6I^- + 8H^+$

3) $2NO + H_2S \rightarrow N_2O + S + H_2O$

4) $2NO + H_2SO_3 \rightarrow N_2O + H_2SO_4$

45. In the reaction,

$3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow 5Br^- + BrO_3^- + 6HCO_3^-$

1) Bromine is oxidized and carbonate is reduced

2) Bromine is oxidized as well as reduced

3) Bromine is reduced and water is oxidized

4) Bromine is neither oxidized nor reduced

46. Which of the following metal/metals can displace H_2 from cold water?

I) Na

II) Ba

III) Mg

IV) Fe

1) I, II, III, IV

2) I, II, III only

3) I, II only

4) I only

47. Which of the following reaction is an example of a redox reaction?

1) $XeF_2 + PF_5 \rightarrow [XeF]^+[PF_6]^-$

2) $XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$

3) $XeF_6 + 2H_2O \rightarrow XeO_2F_2 + 4HF$

4) $XeO_4 + 3O_2F_2 \rightarrow XeF_6 + 5O_2$

48. In the reaction, $S_2^{2-} + xe^{-1} \rightarrow S^{2-}$, here x will be

1) 1 2) 2

3) 3 4) 4

49. Match List-I with List-II

List I (Reaction)	List II (Number of electrons lost or gained)
A) $Mn(OH)_2 + H_2O_2 \rightarrow MnO_2 + H_2O$	p) 8
B) $AlCl_3 + 3K \rightarrow Al + 3KCl$	q) 2
C) $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$	r) 3
D) $3H_2S + 2NO_3^- \rightarrow 3S + 2NO$	s) 6

1) A-r, B-p, C-s, D-q

2) A-q, B-r, C-p, D-s

3) A-r, B-q, C-s, D-p

4) A-s, B-p, C-r, D-q

50. $2X^- \rightarrow X_2 + 2e^-$ can be achieved only by electrolysis". This statement is most commonly applied for which of the following halogen?

1) F_2 2) Cl_2

3) Br_2 4) I_2

51. Which of the following species do not show disproportionation reaction?

1) ClO^- 2) ClO_2^-

3) ClO_3^- 4) ClO_4^-

52. The following redox reaction is balanced by which set of coefficients?

$$aZn + bNO_3^- + cH^+ \rightarrow dNH_4^+ + eH_2O + fZn^{2+}$$

	a	b	c	d	e	f
1)	1	1	10	1	3	1
2)	2	2	10	2	3	2
3)	4	2	10	1	3	4
4)	4	1	10	1	3	4

53. **Statement 1** : In the reaction

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

Zn is a reductant but itself gets oxidized.

Statement 2 : In a redox reaction, oxidant is reduced by accepting electrons and reductants oxidized by losing electrons.

1) Statement 1 and 2 are true

2) Statement 1 is true and 2 is false

3) Statement 1 is false and 2 is true

4) Statement 1 and 2 are false

54. In which of the following reactions, the underlined substance has been oxidized?

1) $\underline{Br_2} + H_2S \rightarrow 2HBr + S$

2) $\underline{2HgCl_2} + SnCl_2 \rightarrow Hg_2Cl_2 + SnCl_4$

3) $Cl_2 + \underline{2KI} \rightarrow 2KCl + I_2$

4) $2\underline{Cu^{2+}} + 4I^- \rightarrow Cu_2I_2 + I_2$

55. Which of the following elements does not show disproportionation tendency?

1) Cl 2) Br

3) F 4) I

56. The stoichiometric coefficient of MnO_4^- ions in the reaction , (alkaline medium)

$$MnO_{4(aq)}^- + Br_{(aq)}^- \rightarrow MnO_{2(s)} + BrO_{3(aq)}^-$$

1) 2 2) 1

3) 3 4) 4

57. In ionic equation,

$BiO_3^- + 6H^+ + xe^- \rightarrow Bi^{3+} + 3H_2O$ the value of x is:

1) 6 2) 2

3) 4 4) 3

58. In the reaction,

$$IO_3^- + SO_2 + 4H_2O \rightarrow I_2 + SO_4^{2-} + 8H^+$$

The coefficient of SO_2 is

1) 3 2) 4

3) 5 4) 6

59. When $Cr(s) + OH^-(aq) \rightarrow Cr(OH)_4^-(aq) + H_2(g)$ (basic solution) is balanced, the sum of the coefficients of all the reactants and the product is

1) 14 2) 15

3) 17 4) 9

60. Assertion : In the reaction,

$\frac{1}{2}O_2 + F_2 \rightarrow OF_2$, F_2 is the oxidant.

Reason : F_2 cannot show positive oxidation state.

1) Both assertion and reason are correct and the reason is the correct explanation of assertion.

2) Assertion is correct but the reason is wrong

3) Assertion is wrong but the reason is correct

4) Both assertion and reason are wrong

61. **Assertion** : Ag_2O gives Ag and O_2 on heating.

Reason : Ag^+ is more oxidising metal ion.

1) Both assertion and reason are correct and the reason is the correct explanation of assertion.

2) Assertion is correct but the reason is wrong

3) Assertion is wrong but the reason is correct

4) Both assertion and reason are wrong

62. In which of the following reactions, there is no change in valency ?

1) $4KClO_3 \rightarrow 3KClO_4 + KCl$

2) $SO_2 + 2H_2S \rightarrow 2H_2O + 3S$

3) $BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O_2$

4) $3BaO + O_2 \rightarrow 2BaO_2$

63. Which reaction is not feasible ?

1) $2KI + Br_2 \rightarrow 2KBr + I_2$

2) $2KBr + I_2 \rightarrow 2KI + Br_2$

3) $2KBr + Cl_2 \rightarrow 2KCl + Br_2$

4) $2H_2O + 2F_2 \rightarrow 4HF + O_2$

64. Which of the following is a redox reaction?

1) $NaCl + KNO_3 \rightarrow NaNO_3 + KCl$

2) $CaC_2O_4 + 2HCl \rightarrow CaCl_2 + H_2C_2O_4$

3) $Mg(OH)_2 + 2NH_4Cl \rightarrow MgCl_2 + 2NH_4OH$

4) $Zn + 2AgCN \rightarrow 2Ag + Zn(CN)_2$

65. Which of the following chemical reactions depict the oxidizing behaviour of H_2SO_4 ?

1) $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$

2) $2PCl_5 + H_2SO_4 \rightarrow 2POCl_3 + 2HCl + SO_2Cl_2$

3) $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$

4) $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$

66. Which of the following does not represent redox reaction ?

1) $Ca(OH)_2 + Cl_2 \rightarrow Ca(ClO)_2 + CaCl_2 + 2H_2O$

2) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

3) $NaIO_3 + NaHSO_3 \rightarrow NaHSO_4 + Na_2SO_4 + I_2 + H_2O$

4) $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

67. In which of the following reactions, H_2O_2 acts as a reducing agent ?

1) $2KI + H_2O_2 \rightarrow 2KOH + I_2$

2) $2FeSO_4 + H_2SO_4 + H_2O_2 \rightarrow Fe_2(SO_4)_3 + 2H_2O$

3) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

4) $Ag_2O + H_2O_2 \rightarrow 2Ag + H_2O + O_2$

68. For the reaction : $NH_3 + OCl^- \rightarrow N_2H_4 + Cl^-$

in basic medium, the coefficients of NH_3, OCl^- and N_2H_4 for the balanced equation are respectively

1) 2, 2, 2 2) 2, 2, 1

3) 2, 1, 1 4) 4, 4, 2

69. $4P + 3KOH + 3H_2O \rightarrow 3KH_2PO_2 + PH_3$

1) P is both oxidized and reduced

2) P is only reduced

3) P is only oxidized

4) P has no change in O.N

70. The coefficients of NO_3^-, IO_3^- and H_2O in the balanced equation are $I_2 + NO_3^- \rightarrow NO_2 + IO_3^- + H_2O$ (acidic medium)

1) 2, 4, 10 2) 4, 2, 10

3) 10, 4, 2 4) 10, 2, 4

REDOX TITRATIONS

71. The equivalent masses of $KMnO_4$ in acidic, neutral and strongly basic medium are respectively (as oxidizing agent)

1) M/5, M/3, M

2) M, M/3, M/5

3) M/3, M, M/5

4) M/5, M, M/3

72. In the titration, $KMnO_4$ Vs Mohr salt, the indicator used is

1) Diphenyl amine

2) Starch

3) Phenolphthalein

4) $KMnO_4$ acts as a self-indicator

73. Number of moles of $K_2Cr_2O_7$ reduced by one mole of Sn^{2+} ions is

1) 1/3 2) 3

3) 1/6 4) 6

74. The number of moles of $KMnO_4$ that will be completely reduced by one mole of ferrous oxalate in acidic medium is

1) $\frac{2}{5}$ 2) $\frac{3}{5}$

3) $\frac{4}{5}$ 4) 1

75. Which of the following is the most powerful oxidising agent?

1) F_2 2) Cl_2

3) Br_2 4) I_2

76. In acidic medium, H_2O_2 changes $Cr_2O_7^{-2}$ to CrO_5 which has two (-O-O-) bonds. Oxidation state of Cr in CrO_5 is:

1) +3 2) +6

3) -10 4) +5

77. How many moles of iodine are liberated when 1 mole of potassium dichromate reacts with potassium iodide?

1) 1 2) 2

3) 3 4) 4

78. When sulphur dioxide is passed in an acidified $K_2Cr_2O_7$ solution, the oxidation state of sulphur is changed from:

1) +4 to 0 2) +4 to +2

3) +4 to +6 4) +6 to +4

79. The reaction of aqueous $KMnO_4$ with H_2O_2 in acidic condition gives:

1) Mn^{+4} and O_2

2) Mn^{2+} and O_2

3) Mn^{2+} and O_3

4) Mn^{4+} and MnO_2

80. The number of moles of oxalic acid required by 1 mole of MnO_4^- for oxidation is (acidic medium)

1) 0.6 2) 2.5

3) 2.6 4) 5.2

81. Which substance acts as reducing agent in the following reaction ?

$$14H^+ + Cr_2O_7^{2-} + 3Ni \rightarrow 2Cr^{3+} + 7H_2O + 3Ni^{2+}$$

1) H_2O 2) Ni

3) H^+ 4) $Cr_2O_7^{2-}$

82. Which of the following involves transfer of five electrons ?

1) $MnO_4^- \rightarrow Mn^{2+}$

2) $CrO_4^{2-} \rightarrow Cr^{3+}$

3) $MnO_4^{2-} \rightarrow MnO_2$

4) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$

83. On reduction of $KMnO_4$ by oxalic acid in acidic medium, the oxidation number of Mn changes. What is the magnitude of this change ?

1) From 7 to 2

2) From 6 to 2

3) From 5 to 2

4) From 7 to 4

84. The ratio of equivalent masses of oxalic acid as an acid to that as a reductant will be

1) 1 : 1

2) 2 : 1

3) 1 : 2

4) 1 : 4

85. A 0.50 M solution of KI reacts with excess of H_2SO_4 and KIO_3 solutions according to the equation,

$$6H^+ + 5I^- + IO_3^- \rightarrow 3I_2 + 3H_2O$$

Which of the following statements is true?

1) 200 mL of the KI solution reacts with 0.10 mole of KIO_3

2) 100 mL of the KI solution reacts with 0.060M of H_2SO_4

3) 0.5 L of the KI solutions produces 0.15 mole of I_2

4) None of the above

86. 25 ml of 0.2 M H_2O_2 required 20 ml of $KMnO_4$ solution for its titration. The molarity of $KMnO_4$ solution is

1) 0.02 M

2) 0.04 M

3) 0.1 M

4) 0.3 M

87. The equivalent mass of $KMnO_4$ in the following reaction is :

$$MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

(M=Molecular mass)

1) M/2 2) M/3

3) M/4 4) M/5

88. In the following change,

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

If the atomic weight of iron is 56, then its equivalent weight will be :

1) 42 2) 21

3) 63 4) 84

89. The equivalent weight of $MnSO_4$ is half its molecular weight when it is converted in to

1) Mn_2O_3 2) MnO_4^-

3) MnO_2 4) MnO_4^{2-}

90. Equivalent mass of $K_2Cr_2O_7$, in the reaction,

$$FeSO_4 + K_2Cr_2O_7 + H_2SO_4 \rightarrow Fe_2(SO_4)_3 +$$

$$Cr_2(SO_4)_3 + K_2SO_4 + H_2O \text{ is}$$

1) M/2

2) M/3

3) M/4

4) M/6

SAMPLE QUESTIONS

1. According to classical concept, oxidation involves

1) Addition of oxygen

2) Addition of electronegative element

3) Removal of either hydrogen or some electropositive element

4) All of these

2. Oxidation number of nitrogen in $(NH_4)_2SO_4$ is

1) $-1/3$ 2) -1

3) +1 4) -3

3. Oxidation numbers of chlorine atoms in $CaOCl_2$ are

1) 0,0 2) -1, -1

3) -1,+1 4) None of these

4. The oxidation state of Fe in $K_4[Fe(CN)_6]$ is

1) +2 2) +6

3) +3 4) +4

5. In which of the following the central atom has zero oxidation state?

1) $[Ni(CO)_4]$ 2) NH_2NH_2

3) $NOClO_4$ 4) CrO_5

6. Among NH_3, HNO_3, NaN_3 and Mg_3N_2 the number of molecules having nitrogen in negative oxidation state is

1) 1 2) 2

3) 3 4) 4

7. **Statement 1** : $HClO_4$ is a stronger acid than $HClO_3$.

Statement 2 : Oxidation state of Cl in $HClO_4$ is +6 and in $HClO_3$ is +5

1) Statement 1 and 2 are true

2) Statement 1 is true and 2 is false

3) Statement 1 is false and 2 is true

4) Statement 1 and 2 are false

8. In oxygen difluoride, the oxidation number of oxygen is

1) -1 2) +1

3) +2 4) -2

9. Which of the following is a redox reaction?

1) $2CuSO_4 + 4KI \rightarrow Cu_2I_2 + 2K_2SO_4 + I_2$

2) $SO_2 + H_2O \rightarrow H_2SO_3$

3) $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$

4) $CuSO_4 + 4NH_3 \rightarrow [Cu(NH_3)_4]SO_4$

10. Oxidation number of iodine in IO_3^-, IO_4^-, KI and I_2 respectively are :

1) -1, -1, 0,+1

2) +3, +5, +7, 0

3) +5, +7, -1, 0

4) -1, -5, -1, 0

11. Which of the following have been arranged in the decreasing order of oxidation number of sulphur?

1) $Na_2S_4O_6 > H_2S_2O_7 > Na_2S_2O_3 > S_8$

2) $H_2SO_4 > SO_2 > H_2S > H_2S_2O_8$

3) $SO_2^+ > SO_4^{2-} > SO_3^{2-} > HSO_4^-$

4) $H_2SO_4 > H_2SO_3 > SCl_2 > H_2S$

12. Carbon is in lowest oxidation state:

1) CO_2 2) CF_4

3) CCl_4 4) CH_4

13. In the reaction,

$$Ag_2O + H_2O_2 \rightarrow 2Ag + H_2O + O_2$$

H_2O_2 act as:

1) Reducing agent

2) Oxidising agent

3) Both oxidising and reducing agent

4) None of these

14. In which of the following compounds, iron has an oxidation number of +3?

1) $Fe(NO_3)_2$ 2) FeC_2O_4

3) $FeCl_3$ 4) None of these

15. What is the oxidation state of P in $Ba(H_2PO_2)_2$?

1) +1 2) +2

3) +3 4) -1

16. In which of the following compounds, the oxidation number of iodine is fractional?

1) IF_7 2) HI_3

3) IF_5 4) IF_3

17. The oxidation states of S atoms in $S_4O_6^{2-}$ respectively are:

1) +6,0,0,+6 2) +3,1,+1, +3

3) +5, 0, 0, +5 4) +4, +1, +1, +4

18. Which of the following is not an example of a redox reaction ?

1) $CuO + H_2 \rightarrow Cu + H_2O$

2) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

3) $2K + F_2 \rightarrow 2KF$

4) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$

19. **Assertion** : Oxidation state of nitrogen in N_3H is +3.

Reason : Nitrogen is more electronegative than hydrogen.

1) Both assertion and reason are correct and the reason is the correct explanation of assertion.

2) Assertion is correct but the reason is wrong

3) Assertion is wrong but the reason is correct

4) Both assertion and reason are wrong

20. Among the following, identify the species with an atom in +6 oxidation state

1) MnO_4^-

2) $Cr(CN)_6^{3-}$

3) NiF_6^{2-}

4) CrO_2Cl_2

21. Which of the following examples does not represent disproportionation?

1) $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

2. $2H_2O_2 \rightarrow 2H_2O + O_2$

3) $4KClO_3 \rightarrow 3KClO_4 + KCl$

4) $3Cl_2 + 6NaOH \rightarrow 5NaCl + NaClO_3 + 3H_2O$

22. Which change represents an oxidising agent?

1) $2S_2O_3^{2-} \rightarrow S_4O_6^{2-}$

2) $Zn \rightarrow Zn^{2+}$

3) $ClO^- \rightarrow Cl^-$

4) $SO_3 \rightarrow SO_4^{2-}$

23. When $KMnO_4$ acts as an oxidising agent and ultimately forms MnO_4^{2-}, MnO_2, Mn_2O_3 and Mn^{+2}, then the number of electrons transferred in each case respectively is

1) 4, 3, 1, 5 2) 1, 5, 3, 7

3) 1, 3, 4, 5 4) 3, 5, 7, 1

24. The minimum quantity of H_2S needed to precipitate 63.5 g Cu^{2+} will be nearly

1) 63.5 g 2) 31.75 g

3) 34 g 4) 2.0 g

25. Oxidation state of Fe in Fe_3O_4 is or are

1) +3 and +4 2) +1 and +3

3) +1 and +2 4) +2 and +3

26. Which of the following substance acts only an oxidising agent

1) $KMnO_4$ 2) H_2SO_4

3) HNO_3 4) All of these

27. In acidic medium MnO_4^- oxidise I^- to

1) I_2 2) IO_3^-

3) IO_4^- 4) I_3^-

28. $KMnO_4$ reacts with oxalic acid solution,

$$2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$$

What mass of $KMnO_4$ in aqueous solution will be required to completely react with 100 ml of M/10 oxalic acid solution ?

1) 10.53 g

2) 0.632 g

3) 3.105 g

4) 3.501 g

29. Which of the following is not a redox reaction.

1) $Mg + 2HCl \rightarrow MgCl_2 + H_2$

2) $S_8 + 12OH^- \rightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$

3) $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

4) $CaCO_3 \rightarrow CaO + CO_2$

30. The indicator used in iodometric titration is

1) Phenolphthalein

2) Litmus

3) Starch

4) Potassium iodide

31. The solution in a beaker turns blue if

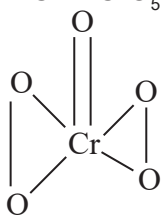
1) Cu electrode is placed in $ZnSO_4$ solution

2) Cu electrode is placed in $AgNO_3$ solution

3) Cu electrode is placed in $Al_2(SO_4)_3$ solution

4) Cu electrode is placed in $FeSO_4$ solution

32. The oxidation number of Cr in CrO_5 which has the following structure



1) +4 2) +10

3) +6 4) +3

33. Given below is a redox reaction. Which of the following types the reaction belongs to

$$CuSO_{4(aq)} + Zn_{(s)} \rightarrow Cu_{(s)} + ZnSO_{4(aq)}$$

1) Combination reaction

2) Decomposition reaction

3) Metal displacement reaction

4) Non metal displacement reaction

34. What is the change in oxidation number of carbon in the following reaction

$$CH_{4(g)} + 4Cl_{2(g)} \rightarrow CCl_{4(\ell)} + 4HCl_{(g)}$$

1) +4 to –4

2) 0 to +4

3) –4 to +4

4) 0 to –4

35. Identify the process in which change in the oxidation state is one

1) $C_2O_4^{2-} \rightarrow 2CO_2$ 2) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$

3) $CrO_4^{2-} \rightarrow Cr^{3+}$ 4) $MnO_4^- \rightarrow Mn^{2+}$

36. Oxidation number of sodium in sodium amalgam is

1) +1 2) 0

3) –1 4) +2

37. An oxidising agent is a substance which can

1) Gain electrons

2) Lose the electronegative ion

3) Undergo decrease in the oxidation number of one of its atoms

4) Undergo any one of the above changes

38. For the redox reaction,

$$Zn + NO_3^- \rightarrow Zn^{2+} + NH_4^+$$

in basic medium, coefficients of Zn, NO_3^- and OH^- in the balanced equation respectively are

1) 4, 1, 7

2) 7, 4, 1

3) 4, 1, 10

4) 1, 4, 10

39. $Cr_2O_7^{2-} \xrightarrow{H^+} Cr^{3+}$, equivalent weight of $Cr_2O_7^{2-}$ is (M is molecular weight of $Cr_2O_7^{2-}$)

1) M/6

2) M/3

3) M/4

4) M/1

40. **Statement I** : In H_2SO_5, oxidation number of 'S' is +6

Statement II : There is one peroxide linkage in H_2SO_5

1) Statement I is true, statement II is false

2) Statement I is false, statement II is true

3) Both statements I & II are false

4) Both statements I & II are true

41. In the reaction

$$As_2S_5 + xHNO_3 \rightarrow 5H_2SO_4 + yNO_2 + 2H_3AsO_4 + 12H_2O$$

The value of x and y are

1) 40, 40

2) 10, 10

3) 30, 30

4) 20, 20

42. **Assertion** : Decomposition of potassium chlorate is an example of redox reaction.

Reason : There is no change in the oxidation number potassium in decomposition of potassium chlorate.

1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true but reason is not the correct explanation of assertion

3) If assertion is true but reason is false

4) If both assertion and reason are false

43. **Assertion** : Oxygen atom in both O_2 and O_3 has an oxidation number of –2

Reason : Oxygen is assigned an oxidation number –2 in all of its compounds

1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true but reason is not the correct explanation of assertion

3) If assertion is true but reason is false

4) If both assertion and reason are false

44. The number of moles of $KMnO_4$ reduced by one mole of KI in alkaline medium is

1) 1/5

2) 2

3) 3/2

4) 4

45. In which of the following compounds hydrogen in a negative oxidation state?

1) NH_3

2) PH_3

3) H_3PO_3

4) CaH_2

ANSWER KEY

1.	2	19.	3	37.	1	55.	3	73.	1
2.	2	20.	4	38.	2	56.	1	74.	2
3.	1	21.	3	39.	1	57.	2	75.	1
4.	3	22.	3	40.	4	58.	3	76.	2
5.	1	23.	2	41.	2	59.	2	77.	3
6.	3	24.	3	42.	4	60.	1	78.	3
7.	2	25.	1	43.	1	61.	1	79.	2
8.	4	26.	4	44.	2	62.	3	80.	2
9.	2	27.	1	45.	2	63.	2	81.	2
10.	4	28.	1	46.	3	64.	4	82.	1
11.	2	29.	2	47.	4	65.	3	83.	1
12.	4	30.	3	48.	2	66.	2	84.	1
13.	2	31.	1	49.	2	67.	4	85.	3
14.	3	32.	2	50.	1	68.	3	86.	3
15.	3	33.	3	51.	4	69.	1	87.	4
16.	4	34.	1	52.	4	70.	4	88.	2
17.	2	35.	3	53.	1	71.	1	89.	3
18.	4	36.	1	54.	3	72.	4	90.	4

SAMPLE QUESTIONS

1.	1	10.	3	19.	3	28.	2	37.	4
2.	4	11.	4	20.	4	29.	4	38.	3
3.	3	12.	4	21.	1	30.	3	39.	1
4.	1	13.	1	22.	3	31.	2	40.	4
5.	1	14.	3	23.	3	32.	3	41.	1
6.	3	15.	1	24.	3	33.	3	42.	2
7.	2	16.	2	25.	4	34.	3	43.	4
8.	3	17.	3	26.	4	35.	1	44.	2
9.	1	18.	4	27.	1	36.	2	45.	4

WORK BOOK

Chapter 06

THERMODYNAMICS AND CHEMICAL ENERGETICS

QUESTIONS

BASICS OF THERMODYNAMICS

1. Classify the following as open, closed and isolated system respectively

i) Open beaker containing boiling water

ii) A chemical reaction in a closed vessel

iii) A cup of tea without lid placed on a table

iv) Hot water in perfectly insulated closed container

1) i & iii, ii, iv

2) i & ii, iii, iv

3) iii & iv; ii, i

4) ii & iv, i, iii

2. Which one of the following is a path function?

1) Temperature 2) Volume

3) Work 4) Enthalpy

3. Which of the following is an extensive property?

1) Enthalpy

2) Concentration

3) Density

4) Viscosity

4. In thermodynamics, a process is called reversible, when

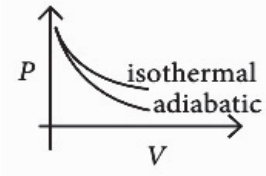
1) system and surroundings change into each other

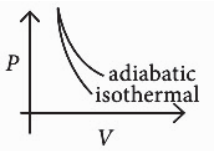
2) there is no boundary between system and surroundings

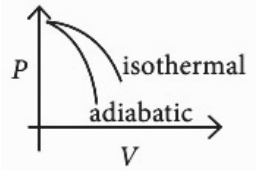
3) the system is always in equilibrium with the surroundings and the process occurs infinitesimally slowly

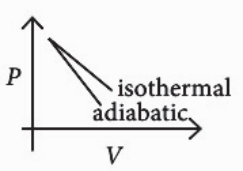
4) the system changes into surrounding spontaneously

5. The correct figure representing isothermal and adiabatic expansions of an ideal gas from a particular initial state is

1) 

2) 

3) 

4) 

6. A thermodynamic state function is a quantity

1) used to determine heat changes

2) whose value is independent of path

3) used to determine pressure volume work

4) whose value depends on temperature only

7. For the process to occur under adiabatic conditions, the correct condition is:

1) $\Delta T = 0$ 2) $\Delta p = 0$

3) q = 0 4) w = 0

8. **Assertion** : Work and heat are path functions.

Reason : Work and heat are modes of energy transfer between stystem and surroundings.

1) Both assertion and reason are true and reason is the correct explanation of assertion

2) Both assertion and reason are true but reason is not the correct explanation of assertion

3) Assertion is true, reason is false

4) Assertion is false and reason is true

REVERSIBLE AND IRREVERSIBLE WORKS

9. The work done on the system when one mole of an ideal gas is compressed isothermally to a final volume of 0.01 m^3 at constant external pressure of 5 bar is 20 kJ. What is initial volume of the gas?

1) 0.05 m^3

2) 0.025 m^3

3) 0.04 m^3

4) 0.03 m^3

10. An ideal gas expands isothermally from 10^{-3} m^3 to 10^{-2} m^3 at 300 K against a constant pressure of 10^5 Nm^{-2}. The work done will be

1) 270 kJ

2) –900 J

3) 900 kJ

4) –900 kJ

11. Calculate the work done during isothermal reversible process when 5 mol ideal gas is expanded so that its volume is doubled at 400 K?

1) –11.5 kJ 2) –344 kJ

3) 0 4) –2.8 kJ

12. 1L atm = ... J

1) 100 2) 101

3) 101.3 4) 100.3

13. Under isothermal condition, a gas at 300 K expands from 0.1 L to 0.25 L against a constant external pressure of 2 bar. The work done will be [Given that 1L bar = 100 J]

1) +30 J 2) –30 J

3) 5 kJ 4) 25 J

INTERNAL ENERGY, Ist LAW AND ENTHALPY

14. A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be

1) 1136.25 J 2) –500 J

3) –505 J 4) +515 J

15. Match the following

Column-I		Column-II	
A	Isothermal reversible process	P	$q = \Delta U$
B	Adiabatic process	Q	$W = -P\Delta V$
C	Isobaric process	R	$W = \Delta U$
D	Isochoric process	S	$W = -nRT\ln\frac{V_2}{V_1}$

1) $A \rightarrow S, B \rightarrow R, C \rightarrow Q, D \rightarrow P$

2) $A \rightarrow P, B \rightarrow Q, C \rightarrow R, D \rightarrow S$

3) $A \rightarrow S, B \rightarrow R, C \rightarrow P, D \rightarrow Q$

4) $A \rightarrow R, B \rightarrow S, C \rightarrow Q, D \rightarrow P$

16. For which of the following reactions ΔH is less than ΔU ?

1) $C_6H_{12}O_6(s)+6O_2(g)\longrightarrow 6CO_2(g)+6H_2O(\ell)$

2) $2SO_2(g)+O_2(g)\longrightarrow 2SO_3(g)$

3) $N_2O_4(g)\longrightarrow 2NO_2(g)$

4) $N_2(g)+O_2(g)\longrightarrow 2NO(g)$

17. The difference between heat of reaction at constant pressure and at constant volume for combustion of 2 moles of liquid benzene at 300 K

1) 3.74 KJ

2) –7.48 KJ

3) –3.74 KJ

4) 7.48 KJ

18. Standard enthalpy of vapourisation $\Delta_{vap}H^0$ for water at 100°C is 40.66 kJ mol^{-1}. The internal energy of vapourisation of water at 100°C (in kJ mol^{-1}) is

(Assume water vapour to behave like an ideal gas)

1) +37.56 2) –43.76

3) +43.76 4) +40.66

19. The difference between ΔH and ΔU for the combustion of toluene (C_7H_8) at 300 K is

1) –2 RT

2) –4 RT

3) +2 RT

4) +4 RT

20. One mole of methane undergoes combustion to form CO_2 and water at 25°C. Then

1) $\Delta H < \Delta U$

2) $\Delta H > \Delta U$

3) $\Delta H = \Delta U$

4) can't be predicted

21. Two moles of an ideal gas expand isothermally and reversibly from 1L to 10L at 300 K. The enthalpy change in the process is

1) 11 kJ 2) –11 kJ

3) 0 kJ 4) 4.8 kJ

22. The heat change at constant pressure for the reaction $\underset{(g)}{N_2}+\underset{(g)}{3H_2}\longrightarrow \underset{(g)}{2NH_3}$ is –92.38 kJ at 298 K. The internal energy change ΔU at 298 K is

1) –92.38 kJ 2) –87.42 kJ

3) –97.34 kJ 4) –89.9 kJ

23. ΔU^0 of combustion of methane is – X kJ mol^{-1}. The value of ΔH^0 is

1) $= \Delta U^0$ 2) $> \Delta U^0$

3) $< \Delta U^0$ 4) = 0

24. Internal energy U of a system may change when

1) Heat passes into or out of the system

2) Work is done on or by the system

3) Matter enters or leaves the system

4) All the above

25. An ideal gas is expanded isothermally at 300 K from 10 litre to 20 litre. The value of ΔU for this process is (R = 2 Cal/mol/K)

1) –414.54 Cal

2) 0

3) +414.54 Cal

4) 163.7 Cal

HEAT CAPACITY, ADIABATIC WORK AND CALORIMETRY

26. Molar heat capacity at constant pressure of aluminium is 24 JK^{-1} mol^{-1}. Quantity of heat to raise the temperature of 3g metallic aluminium from 30°C to 70°C is

1) 96 J 2) 288 J

3) 106.7 J 4) 106.7 kJ

27. The heat of combustion of ethanol determined in a bomb calorimeter is –670.48 kCal mol^{-1} at 25°C. What is ΔH at 25°C for the reaction

1) –335.24 Kcal

2) –672.95 kcal

3) –670.48 kcal

4) +670.48 kcal

28. One gram sample of NH_4NO_3 is decomposed in a bomb calorimeter. The temperature of the calorimeter increases by 6.12 K. The heat capacity of the system is 1.23 kJ/g/deg. What is the molar heat of decomposition for NH_4NO_3at constant volume?

1) -7.53 kJ/mol

2) -398.1 kJ/mol

3) -16.1 kJ/mol

4) -602 kJ/mol

29. Standard molar enthalpy of formation of CO_2 is equal to

1) Zero

2) The standard enthalpy of combustion of gaseous carbon

3) The sum of standard molar enthalpy of formation of CO and CO_2

4) The standard molar enthalpy of combustion of C (graphite)

30. From the heat of formation values, identify the product which is least stable :

1) -157.5 kcal

2) -87 kcal

3) +25 kcal

4) +94 kcal

31. 2.1g Fe combines with S evolving 3.77 kJ. The heat of formation of FeS in kJ/mol according to the equation Fe + S $\rightarrow$ FeS is (Atomic mass of Fe = 56)

1) –3.77 2) –1.79

3) –100.5 4) –5.3

ENTHALPIES OF CHEMICAL REACTIONS

32. In which of the following reactions the heat liberated is known as heat of combustion?

1) $H^+ + OH^- \longrightarrow H_2O + \text{heat}$

2) $C_{(graphite)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)} + \text{heat}$

3) $CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(\ell)} + \text{heat}$

4) $H_2SO_4 + H_2O_{(\ell)} \longrightarrow H_2SO_{4(aq)} + \text{heat}$

33. If $C_6H_6(l) + 15/2\ O_2(g) \rightarrow 3H_2O(l) + 6CO_2(g)$; $\Delta H = -3264.6 kJmol^{-1}$, the energy obtained by burning 3.9g of benzene in air is :

1) 16.32 kJ

2) 326.41 kJ

3) 32.64 kJ

4) 163.23 kJ

34. The heat of combustion of carbon to CO_2 is –393.5 kJ/mol. The heat released upon the formation of 35.2 g of CO_2 from carbon and oxygen gas is

1) 31.5 kJ

2) 315 kJ

3) 630 kJ

4) 63 kJ

35. If $\frac{1}{2}X_2O_{(s)} \longrightarrow X_{(s)} + \frac{1}{4}O_{2(g)}; \Delta H = 90\ kJ$,then heat change during reaction of metal X with one mole of O_2 to form oxide to maximum extent is

1) 360 kJ

2) -360 kJ

3) 180 kJ

4) –180 kJ

36. The enthalpy of hydrogenation of cyclohexene is –119.5 kJ mol^{-1}. If resonance energy of benzene is 150.4 kJ mol^{-1}, its enthalpy of hydrogenation would be

1) –358.5 kJ mol^{-1}

2) –508.9 kJ mol^{-1}

3)–208.1 kJ mol^{-1}

4) –269.9 kJ mol^{-1}

37. A cylinder of cooking gas is assumed to contain 14.2 kg butane (C_4H_{10}). Combustion of butane is

$$C_4H_{10(g)} + \frac{13}{2}O_{2(g)} \longrightarrow 4CO_{2(g)} + 5H_2O_{(\ell)}; \Delta H = -2660 kJ$$

If a family needs 14000 kJ of energy per day for cooking and assuming that 20% of the gas is wasted due to incomplete combustion, how long would the cylinder last?

1) 37 days 2) 18 days

3) 25 days 4) 30 days

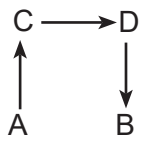
38. The heat of combustion of methane is –880 kJ mol^{-1}. If 3.2 g of methane is burnt, ... kJ of heat is evolved

1) 88 2) 264

3) 176 4) 440

HESS'S LAW, LATTICE ENTHALPY AND BOND ENERGY

39. The direct conversion of A to B is difficult, hence it is carried out by the following path



Given, $\Delta H(A \rightarrow C) = 50\ kJ$

$\Delta H(C \rightarrow D) = 30\ kJ$

$\Delta H(B \rightarrow D) = 20\ kJ$

The enthalpy change for the process $A \rightarrow B$ is

1) 100 kJ 2) –60 kJ

3) –100 kJ 4) +60 kJ

40. $\Delta H_{combustion}$ of $C_6H_6(\ell)$, $C(S)$ and $H_2(g)$ are –3000 kJ, –390 kJ and –290 kJ mol^{-1} respectively. Hence heat of formation of benzene is

1) –210 kJ mol^{-1} 2) 210 kJ mol^{-1}

3) 3680 kJ mol^{-1} 4) –3680 kJ mol^{-1}

41. The enthalpy of formation of NaCl(s) is –411.2 kJ mol^{-1}. The enthalpy of sublimation of Na(s), its ionization enthalpy in the gaseous state, the bond energy of chlorine, its electron gain enthalpy are 108.4, 495.6, 242 and –348.6 kJ mol^{-1} respectively. The energy required to break one mole of solid sodium chloride into its ions in the gaseous state is (in kJ)

1) 787.6 2) –787.6

3) 502.4 4) –502.4

42. For the reactions,

i) $H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)} + xkJ$

ii) $H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(\ell)} + ykJ$

Which one of the following statement is correct

1) x > y

2) x < y

3) x = y

4) more data required

43. Enthalpy change of solution of MCl_2 (s) in excess water is –2070 cal. Enthalpy change of hydration of MCl_2 to $MCl_2.2H_2O$ (s) is –6970 cal. What is the enthalpy change of solution of $MCl_2.2H_2O$ (s) in excess of water

1) + 4900 cal 2) –4700 cal

3) –4900 cal 4) +4700 cal

44. The enthalpies of combustion of monoclinic sulphur and rhombic sulphur are –71030 and –70960 cal respectively. The enthalpy change of the transition of monoclinic sulphur to rhombic sulphur is

1) –70 cal mol^{-1} 2) +70 cal mol^{-1}

3) 140 cal mol^{-1} 4) –140 cal mol^{-1}

45. The bond dissociation energies of X_2, Y_2 and XY are in the ratio of 1 : 0.5 : 1. ΔH for the formation of XY is –200 kJ mol^{-1}. The bond dissociation energy of X_2 will be

1) 200 kJ mol^{-1}

2) 100 kJ mol^{-1}

3) 800 kJ mol^{-1}

4) 400 kJ mol^{-1}

46. If bond enthalpies of H_2, Br_2 and HBr are 433, 192 and 364 kJ mol^{-1} respectively, heat of formation of HBr is

1) –103 kJ mol^{-1}

2) –51.5 kJ mol^{-1}

3) –159 kJ mol^{-1}

4) +103 kJ mol^{-1}

47. The bond energy of an O –H bond is 109 k cal mol^{-1}. When one mole of water is formed,

1) 218 kcal of energy is released

2) 109 kcal of energy is released

3) 218 kcal of energy is absorbed

4) 109 kcal of energy is absorbed

48. The atomisation enthalpies of CH_4 and C_2H_6 are 360 and 620 K cal mol^{-1} respectively. The bond energy of C-C bond is

1) 130 kcal mol^{-1}

2) 80 kcal mol^{-1}

3) 180 kcal mol^{-1}

4) 260 kcal mol^{-1}

49. From the following bond energies:

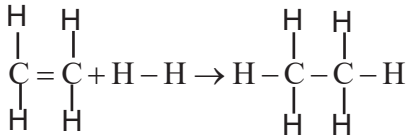
H – H bond energy : 431.37 kJ mol^{-1}

C = C bond energy : 606.10 kJ mol^{-1}

C – C bond energy : 336.49 kJ mol^{-1}

C – H bond energy : 410.50 kJ mol^{-1}

Enthalpy for the reaction,



will be

1) 553. kJ mol^{-1}

2) 1523.6 kJ mol^{-1}

3) –243.6 kJ mol^{-1}

4) –120.0 kJ mol^{-1}

50. $\Delta_f H^0$ of H_2O, CO_2 and sucrose ($C_{12}H_{22}O_{11}$) are respectively (in kJ mol^{-1}) –286, –393.5 and –2222. The enthalpy of combustion of sucrose is

1) –5466 kJmol^{-1}

2) –5646 kJmol^{-1}

3) –2823 kJmol^{-1}

4) +5466 kJmol^{-1}

51. Given that bond energies of H-H and Cl-Cl are 430 kJ mol^{-1} and 240 kJ mol^{-1} respectively and $\Delta_f H$ for HCl is -90 kJ mol^{-1}. Bond enthalpy of HCl is:

1) 245 kJ mol^{-1} 2) 290 kJ mol^{-1}

3) 380 kJ mol^{-1} 4) 425 kJ mol^{-1}

52. The enthalpy of combustion of $C_{(s)}$, $H_{2(g)}$ and $CH_{4(g)}$ are –94.2, –68.3 and –210.8 Kcal mol^{-1} respectively. Find the enthalpy of formation of CH_4 in Kcal mol^{-1}

1) –55 2) –40

3) +55 4) –20

ENTROPY & FREE ENERGY

53. For which of the following processes ΔS is negative ?

1) $H_{2(s)} \longrightarrow 2H_{(g)}$

2) $CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$

3) $NaCl_{(s)}$ dissolves in water

4) Water crystallise to ice at 0°C

54. For isothermal reversible process, ΔS_{total} will be

1) > 0 2) < 0

3) = 0 4) 1

55. $\Delta H_{vapourisation}$ of substance $X_{(\ell)}$ (molar mass 30) is 300 J/g at its boiling point 300K, then molar entropy change for the reverse condensation process is

1) 30 J/mol K

2) –300 J/mol K

3) –30 J/mol K

4) 3000 J/mol K

56. For isothermal free expansion ΔS_{sys} is

1) >0 2) <0

3) =0 4) none

57. For the process $H_2O_{(\ell)} \longrightarrow H_2O_{(g)}$

at 100°C and 1 atmosphere pressure, the correct choice is

1) $\Delta S_{system} > 0$ and $\Delta S_{surroundings} > 0$

2) $\Delta S_{system} > 0$ and $\Delta S_{surroundings} < 0$

3) $\Delta S_{system} < 0$ and $\Delta S_{surroundings} > 0$

4) $\Delta S_{system} < 0$ and $\Delta S_{surroundings} < 0$

58. In which of the following reactions, standard reaction entropy changes (ΔS^0) is positive and standard Gibb's energy change (ΔG^0) decreases sharply with increasing temperature?

1) $C_{(graphite)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}$

2) $CO_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{2(g)}$

3) $Mg_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow MgO_{(s)}$

4) $\frac{1}{2}C_{(graphite)} + \frac{1}{2}O_{2(g)} \longrightarrow \frac{1}{2}CO_{2(g)}$

59. A reaction, .A+B →C+D+q is found to have a positive entropy change. The reaction will be

1) possible at high temperature

2) possible only at low temperature

3) not possible at any temperature

4) possible at any temperature

60. The relationship between ΔG and ΔS at constant T is

1) $\Delta G = \Delta H + T\Delta S$ 2) $\Delta H = \Delta G + T\Delta S$

3) $T\Delta S = \Delta G + \Delta H$ 4) $\Delta G = -\Delta H - T\Delta S$

61. For a given reaction,

$\Delta H = 35.5 \text{ kJ mol}^{-1}$ and $\Delta S = 83.6 \text{ JK}^{-1}\text{mol}^{-1}$.

The reaction is spontaneous at (Assume that ΔH and ΔS do not vary with temperature)

1) T < 425 K 2) T > 425 K

3) All temperature 4) T > 298K

62. If for a certain reaction $\Delta_r H$ is 30 kJ mol^{-1} at 450 K, the value of $\Delta_r S$ (in JK^{-1} mol^{-1}) for which the same reaction will be spontaneous at the same temperature is

1) 70 2) –33

3) 33 4) –70

63. Entropy of X_2, Y_2 and XY_3 are 60, 40 and 50 JK^{-1} mol^{-1} respectively. For the reaction

$\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3; \Delta H = -60 \text{ kJ}$ to be at equilibrium, the temperature will be:

1) 600 K 2) 1500 K

3) 700 K 4) 725 K

64. Which of the following pairs of a chemical reaction is certain to result in a spontaneous reaction at all temperature?

1) Exothermic and increasing disorder

2) Exothermic and decreasing disorder

3) Endothermic and increasing disorder

4) Endothermic and decreasing disorder

65. The enthalpy and entropy change for the reaction

$Br_{2(\ell)} + Cl_{2(g)} \longrightarrow 2BrCl_{(g)}$ are 30 kJ mol^{-1} and 105 JK^{-1} mol^{-1} respectively. The temperature at which the reaction becomes spontaneous will be

1) 300 K 2) 280 K

3) 273 K 4) 250 K

66. Match List-I with List-II

	List-I		List-II
a	Entropy of vapourisation	i	ΔS=negative
b	ΔU in reversible adiabatic expansion of an ideal gas	ii	Decreases
c	Crystalline solid state	iii	Lowest entropy
d	A liquid freezes	iv	$\frac{\Delta H_{vap}}{T_b}$

1) $a \rightarrow iv;\ b \rightarrow ii;\ c \rightarrow iii;\ d \rightarrow i$

2) $a \rightarrow iii;\ b \rightarrow ii;\ c \rightarrow iv;\ d \rightarrow i$

3) $a \rightarrow iv;\ b \rightarrow i;\ c \rightarrow iii;\ d \rightarrow ii$

4) $a \rightarrow iv;\ b \rightarrow iii;\ c \rightarrow ii;\ d \rightarrow i$

67. In a reaction ΔH and ΔS both are more than zero. In which of the following cases, the reaction would not be spontaneous?

1) $\Delta H > T\Delta S$

2) $T\Delta S > \Delta H$

3) $\Delta H = T\Delta S$

4) $\Delta G < 0$

68. The normal boiling point of a liquid 'X' is 400 K. Which of the following statement is wrong about the process $X_{(\ell)} \rightleftharpoons X_{(g)}$?

1) At 410 K and 1 atm pressure $\Delta G = +ve$

2) At 400 K and 2 atm pressure $\Delta G = +ve$

3) At 400 K and 0.1 atm pressure $\Delta G = -ve$

4) At 400 K and 1 atm pressure $\Delta G = 0$

69. **Assertion** : Decrease in free energy causes spontaneous reaction.

Reason : Spontaneous reactions are invariably exothermic.

1) Both Assertion and Reason are correct but Reason is the correct explanation of Assertion

2) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

3) Assertion is correct but Reason is not correct

4) Both Assertion and Reason are not correct

70. Match List-I with List-II

	List-I		List-II
a	$H_2O_{(s)} \xrightarrow[1\,atm]{0°C} H_2O_{(\ell)}$	i	$\Delta G = -ve$ $\Delta S = +ve$
b	$H_2O_{(s)} \xrightarrow[1\,atm]{10°C} H_2O_{(\ell)}$	ii	$\Delta G = +ve$ $\Delta S = +ve$
c	$H_2O_{(s)} \xrightarrow[1\,atm]{-10°C} H_2O_{(\ell)}$	iii	$\Delta G = 0$ $\Delta S = +ve$
d	$H_2O_{(\ell)} \xrightarrow[1atm]{-10^0C} H_2O_{(s)}$	iv	$\Delta G = -ve$ $\Delta S = -ve$

1) a-i, b-ii, c-iii, d-iv

2) a-ii, b-i, c-iv, d-iii

3) a-iii, b-i, c-ii, d-iv

4) a-i, b-iii, c-ii, d-iv

71. Equilibrium constant of a reaction is 10, what will be the value of ΔG^0 (in kcal mol^{-1}) at 298 K?

1) 4.6

2) –1.37

3) 46

4) 4606

72. For the reaction $N_2O_{4(s)} \rightleftharpoons 2NO_{2(g)}$, the standard free energy change at 60°C [K_p = 1.33 and log 1.33 = 0.1238, log 1.5 = 0.16609, log 0.5 = –0.3010]

1) +789.3 J mol^{-1}

2) 800 J mol^{-1}

3) –800J mol^{-1}

4) –789.3 J mol^{-1}

73. In which case, change in entropy is negative?

1) $2H_{(g)} \longrightarrow H_{2(g)}$

2) Evaporation of water

3) Expansion of a gas at a constant temperature

4) Sublimation of solid to gas

74. When the egg is hard boiled, there is

1) Increase in disorder

2) Decrease in disorder

3) No change in disorder

4) ΔG is negative

75. Given $PbO_{(s)} + C_{(s)} \longrightarrow Pb_{(s)} + CO_{(g)}$; $\Delta H = 108\ kJmol^{-1}$ and $\Delta S = 190\ JK^{-1}mol^{-1}$

reduction of $PbO_{(s)}$ is spontaneous:

1) Below 296°C

2) Spontaneous at all temperatures

3) Non spontaneous at all temperatures

4) Above 296°C

76. Which expansion will produce more change in entropy during reversible and isothermal expansion?

1) 1 mol H_2 at 300 K from 2L to 20 L

2) 1 mol N_2 at 400 K from 1L to 10 L

3) 1 mol O_2 at 500 K from 3L to 30 L

4) All have same

77. For the gas phase reaction

$PCl_{5(g)} \longrightarrow PCl_{3(g)} + Cl_{2(g)}$, which of the following conditions are correct?

1) $\Delta H < 0, \Delta S < 0$ 2) $\Delta H > 0, \Delta S < 0$

3) $\Delta H = 0, \Delta S < 0$ 4) $\Delta H > 0, \Delta S > 0$

78. Standard Gibbs free energy change of a reaction is zero. The value of equilibrium constant will be

1) 10 2) 1

3) 100 4)1000

79. For a reaction, P + Q →R + S. The value of ΔH^0 is –30 k $Jmol^{-1}$ and ΔS is –100 JK^{-1} mol^{-1}. At what temperature, the reaction will be at equilibrium

1) 27°C 2) 52°C

3) 30°C 4) 45°C

80. **Statement-I** : At constant temperature and pressure chemical reactions are spontaneous in the direction of decreasing Gibb's energy

Statement-II : For every chemical reaction at equilibrium standard Gibb's energy of the reaction is zero.

1) Both Statement-I and Statement-II are true

2) Both Statement-I and Statement-II are false

3) Statement-I is true, Statement-II is false

4) Statement-I is false and Statement-II is true

81. **Statement-I** : An exothermic process which is non spontaneous at high temperature may become spontaneous at low temperature

Statement-II : Spontaneous process is an irrevessible process and may be reversed by some external agency

1) Both Statement-I and Statement-II are true

2) Both Statement-I and Statement-II are false

3) Statement-I is true, Statement-II is false

4) Statement-I is false and Statement-II is true

SAMPLE QUESTIONS

1. The correct option for free expansion of an ideal gas under adiabatic condition is

1) $q = 0,\ \Delta T = 0$ and $w = 0$

2) $q = 0,\ \Delta T < 0$ and $w > 0$

3) $q < 0,\ \Delta T = 0$ and $w = 0$

4) $q > 0,\ \Delta T > 0$ and $w > 0$

2. 64 g of oxygen (assume ideal behaviour) at 27°C undergoes reversible isothermal expansion from2.5 L to 25.L. The values of ΔU ,w and q are (in cal)

1) 0, 2764, –2764 2) 0, –2764, 2764

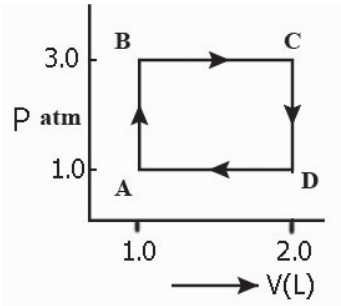
3) 2764, –2764, 0 4) –2764, 0, 2764

3. A gas expands from 300mL to 500 mL by absorbing 50J of heat against an external pressure of 0.5atm. w,q, and ΔU are respectively;

1) 40,50, -10 J 2) 50,-10,40 J

3) -10, 50, 40 J 4) -10,50,0 J

4. 1 mol of an ideal gas undergoes processes $B \rightarrow C,\ C \rightarrow D,\ D \rightarrow A$ and $A \rightarrow B$ as



Work done by the gas in complete cycle is (1 atm L = 101 J)

1) 202 J 2) 101 J

3) 303 J 4) 404 J

5. The heat liberated on complete combustion of 7.8 g benzene is 327 kJ. This heat was measured at constant volume and at 27°C. Then heat of combustion of benzene at constant pressure is (R = 8.3 J mol^{-1} K^{-1}).

1) – 1637 kJ mol^{-1}

2) –3270 kJ mol^{-1}

3) –3274 kJ mol^{-1}

4)–987.5 kJ mol^{-1}

6. The combustion of 5.0 g of coke raised the temperature of 1.0 kg of water form 10°C to 47°C. The fuel value of coke is (specific heat of water = 1 cal/g):

1) 7400 cal/g 2) 6380 kcal/g

3) 740 cal/g 4) 1680 cal/g

7. When a solid melts, there is

1) No increase in enthalpy

2) Increase in enthalpy

3) Decrease in enthalpy

4) Either increase or decrease in enthalpy

8. **Assertion** : Mode of energy transfer due to difference in pressure is work

Reason : Energy transferred due to difference in pressure depends only on initial and final pressure

1) Assertion is false but Reason is true

2) Both Assertion and Reason are true and Reason is the correct explanation of Assertion

3) Both Assertion and Reason are true and Reason is not the correct explanation of Assertion

4) Assertion is true, but Reason is false

9. For the reaction $2Cl_{(g)} \longrightarrow Cl_{2(g)}$, the correct option is

1) $\Delta_r H > 0$ and $\Delta_r S > 0$

2) $\Delta_r H > 0$ and $\Delta_r S < 0$

3) $\Delta_r H < 0$ and $\Delta_r S > 0$

4) $\Delta_r H < 0$ and $\Delta_r S < 0$

10. For irreversible expansion of an ideal gas under isothermal condition, the correct option is

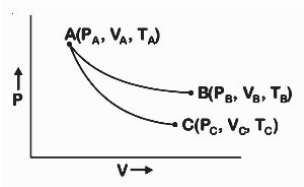
1) $\Delta U = 0,\ \Delta S_{total} = 0$

2) $\Delta U \neq 0,\ \Delta S_{total} \neq 0$

3) $\Delta U = 0,\ \Delta S_{total} \neq 0$

4) $\Delta U \neq 0,\ \Delta S_{total} = 0$

11. Reversible expansion of an ideal gas under isothermal and adiabatic conditions are as shown in the figure.



$AB \rightarrow$ Isothermal expansion

$AC \rightarrow$ Adiabatic expansion

Which of the following options is not correct?

1) $T_B > T_C$

2) $T_A = T_B$

3) $W_{isothermal} > W_{adiabatic}$

4) $T_C > T_A$

12. For the reaction, $X_2O_{4(\ell)} \rightarrow 2XO_{2(g)}$.

$\Delta U = 2.1$ kcal, $\Delta S = 20$ cal K^{-1} at 300 K.

Hence, ΔG is

1) 2.7 kcal

2) –2.7 kcal

3) 9.3 kcal

4) –9.3 kcal

13. The enthalpies of all elements in their standard states are :

1) unity

2) zero

3) < 0

4) different for each element

14. $\Delta_f H^0$ as well as $\Delta_f G^0$ is equal to zero in

1) $Br_{2(g)}$

2) $C_{(diamond)}$

3) $Cl_{2(g)}$

4) $CO_{2(g)}$

15. Consider the following spontaneous reaction

$$C_6H_{6(\ell)} + \frac{15}{2}O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(\ell)}.$$

Signs of $\Delta H, \Delta S$ and ΔG for the above reaction will be

1) +, +, –

2) –, +, +

3) –, –, –

4) +, –, +

16. The reaction $CH_{4(g)} + Cl_{2(g)} \longrightarrow CH_3Cl_{(g)} + HCl_{(g)}$ has $\Delta H = -25$ K Cal. From the following data, what is the bond energy of Cl–Cl bond

Bond	C–Cl	H–Cl	C–H	Cl–Cl	
Bond energy in kcal	84	103	x	y	x:y=9:5

1) 70 kCal

2) 80 kCal

3) 67.75 kCal

4) 57.85 kCal

17. When 0.2 g of 1-butanol was burnt in a suitable apparatus, the heat evolved was sufficient to raise the temperature of 200 g water by 5°C. The values of enthalpy of combustion and calorific value of 1-butanol are [kcal]

1) –370, –5 2) +370, 5

3) –370, 5 4) +370, –5

18. Enthalpy of vaporisation of benzene is 30.8 kJ mol^{-1} at its normal boiling point of 80°C. Time required for a 100 W electric heater to vapourise 100 g benzene at its boiling point (Given 1W = 1 Js^{-1})

1) 3.95 min

2) 5.13 min

3) 513 sec

4) 6.6 min

19. Work done by the system in a cyclic process will be

1) ΔH 2) –q

3) ΔU 4) ΔV

20. **Assertion** : Internal energy change is zero for an isothermal process occuring in an ideal gas

Reason : For an ideal gas, internal energy is a function of temperature only

1) Assertion is false but Reason is true

2) Both Assertion and Reason are true and Reason is the correct explanation of Assertion

3) Both Assertion and Reason are true and Reason is not the correct explanation of Assertion

4) Assertion is true, but Reason is false

21. In a process, 701 J of heat is absorbed by a system and 394 J of work is done by the system. What is the change in internal energy of the process?

1) 284 J 2) 394 J

3) 700 J 4) 307 J

22. In which case, a spontaneous reaction is possible at any temperature?

1) $\Delta H - ve, \Delta S + ve$ 2) $\Delta H - ve, \Delta S - ve$

3) $\Delta H + ve, \Delta S + ve$ 4) none of these

23. For two mole of an ideal gas:

1) $(C_p - C_v) = 2R$

2) $(C_p - C_v) = R/2$

3) $(C_v - C_p) = -2R$

4) $(C_p - C_v) = 0$

24. The Gibbs energy change for a reversible reaction at equilibrium is:

1) zero 2) small positive

3) small negative 4) large positive

25. Which of one of the followings has ΔS^0 positive?

1) $CaO_{(s)} + CO_{2(g)} \rightleftharpoons CaCO_{3(s)}$

2) $NaCl_{(aq)} \rightleftharpoons NaCl_{(s)}$

3) $NaNO_{3(s)} + H_2O_{(\ell)} \rightleftharpoons Na^+_{(aq)} + NO^-_{3(aq)}$

4) $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

26. A well stoppered thermoflask containing some ice cubes is an example of:

1) closed system 2) open system

3) isolated system 4) none of these

27. Internal energy and pressure of a monoatomic gas of unit volume are related as:

1) $P = \frac{2}{3}U$

2) $P = \frac{3}{2}U$

3) $P = \frac{U}{2}$

4) P = 2U

28. If an endothermic reaction is non-spontaneous at freezing point of water and becomes feasible at its boiling point, then:

1) ΔH is $-$ ve, ΔS is $+$ ve

2) ΔH and ΔS both are $+$ ve

3) ΔH and ΔS both are $-$ ve

4) ΔH is $+$ ve, ΔS is $-$ ve

29. Considering entropy (S) as a theromodynamic parameter, the criterion for the spontaneity of any process is:

1) $\Delta S_{system} + \Delta S_{surroundings}$ be $+$ ve

2) $\Delta S_{system} - \Delta S_{surroundings}$ be $+$ ve

3) ΔS_{system} be zero

4) $\Delta S_{surroundings}$ be zero

30. The entropy change for vaporisation of water to steam at 100^0C is ——— JK^{-1} mol^{-1}. Given that heat of vapourisation is 40.8 kJ mol^{-1}.

1) 109.38 2) 100.38

3) 130.38 4) 120.38

31. One mole of a gas occupying 3 dm^3 expands against constant external pressure of 1 atm to a volume of 13 dm^3. The work done is:

1) –10 atm dm^3

2) –20 atm dm^3

3) –39 atm dm^3

4) –48 atm dm^3

32. 2 mole of ideal gas at 27^0C temperature is expanded reversibly from 2 litre to 20 litre. Find entropy change: (in cal K^{-1})

(R = 2cal/mol K)

1) 92.1 2) 0

3) 4 4) 9.2

33. When 1 mole of gas is heated at constant volume, temperature is raised from 298 to 308 K. Heat supplied to the gas is 500 J. Then which statement is correct?

1) q = –w = 500 J, $\Delta U = 0$

2) $q = \Delta U = 500\,J, w = 0$

3) $q = w = 500\,J, \Delta U = 0$

4) $\Delta U = 0, q = w = -500\,J$

34. The internal energy change when a system goes from state A to B is 40 kJ/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?

1) 40 kJ

2) > 40 kJ

3) < 40 kJ

4) Zero

35. The molar heat capacity of water at constant pressure P, is 75 $JK^{-1}mol^{-1}$. When 1.0 kJ of heat is supplied to 100 g of water which is free to expand, the increase in temperature of water is:

1) 1.2 K 2) 2.4 K

3) 4.8 K 4) 6.6 K

36. At 1 atm pressure, $\Delta S = 75\,JK^{-1}mol^{-1}$; $\Delta H = 30kJ\,mol^{-1}$. The temperature of the reaction at equilibrium is:

1) 400 K 2) 330 K

3) 200 K 4) 110 K

37. Standard enthalpy and standard entropy change for the oxidation of NH_3 at 298 K are –382.64 kJ mol^{-1} and –145.6 J mol^{-1} respectively. Standard Gibbs energy change for the same reaction at 298 K is:

1) –221.1 kJ mol^{-1}

2) –339.3 kJ mol^{-1}

3) –439.3 kJ mol^{-1}

4) –523.2 kJ mol^{-1}

38. In which cases, temperature increase is noticed without providing heat to system?

I) Shaking a liquid in thermos flask

II) Adiabatic compression of gas

III) Adiabatic expansion of gas

IV) Digestion of food

1) I, II, IV 2) I, II

3) II, IV 4) I, II, III

39. The enthalpy of solution of $BaCl_{2(s)}$ and $BaCl_2.2H_2O_{(s)}$ are –20.6 and 8.8 kJ respectively. The enthalpy change for the hydration of $BaCl_2(s)$ is

1) 29.4 kJ
2) –29.4 kJ
3) –11.8 kJ
4) +11.8 kJ

40. In which process, net work done is zero?

1) Cyclic
2) Isothermal
3) Free expansion
4) Adiabatic

41. In which of the following process, there occurs a change in internal energy of system:

1) Isothermal
2) Adiabatic
3) Adiabatic free expansion
4) Cyclic

42. The enthalpy of vaporisation of a liquid is 30 kJ mol^{-1} and entropy of vaporisation is 75 J mol^{-1} K^{-1}. The boiling point of the liquid at 1 atm is:

1) 250 K
2) 400 K
3) 450 K
4) 600 K

43. For the reaction :

$H_2O_{(\ell)}(1\,bar, 373\,K) \rightarrow H_2O_{(g)}$ (1 bar, 373 K),

the correct set of thermodynamic parameters is:

1) $\Delta G = 0, \Delta S = +ve$
2) $\Delta G = 0, \Delta S = -ve$
3) $\Delta G = +ve, \Delta S = 0$
4) $\Delta G = -ve, \Delta S = +ve$

44. In the reaction : $A_{2(g)} + 3B_{2(g)} \rightarrow 2AB_{3(g)}$ the standard entropies (in JK^{-1} mol^{-1}) of $A_{2(g)}$, $B_{2(g)}$ and $AB_{3(g)}$ are respectively 190, 130 and 195 and the standard enthalpy change for the reaction is –95 kJ mol^{-1}. The temperature at which the reaction attains equilibrium is (in K)

1) 500 K
2) 400 K
3) 300 K
4) 600 K

45. ΔU is equal to:

1) Isochoric work
2) Isobaric work
3) Adiabatic work
4) Isothermal work

ANSWER KEY

1.	1	18.	1	35.	2	52.	4	68.	1
2.	3	19.	1	36.	3	53.	4	69.	3
3.	1	20.	1	37.	1	54.	3	70.	3
4.	3	21.	3	38.	3	55.	3	71.	2
5.	1	22.	2	39.	4	56.	1	72.	4
6.	2	23.	3	40.	1	57.	2	73.	1
7.	3	24.	4	41.	1	58.	1	74.	1
8.	2	25.	2	42.	2	59.	4	75.	4
9.	1	26.	3	43.	3	60.	2	76.	4
10.	2	27.	2	44.	1	61.	2	77.	4
11.	1	28.	4	45.	3	62.	1	78.	2
12.	3	29.	4	46.	2	63.	2	79.	1
13.	2	30.	4	47.	1	64.	1	80.	3
14.	3	31.	3	48.	2	65.	1	81.	1
15.	1	32.	3	49.	4	66.	1		
16.	2	33.	4	50.	2	67.	1		
17.	2	34.	2	51.	4				

SAMPLE QUESTIONS

1.	1	10.	3	19.	2	28.	2	37.	2
2.	2	11.	4	20.	2	29.	1	38.	1
3.	3	12.	2	21.	4	30.	1	39.	2
4.	1	13.	2	22.	1	31.	1	40.	3
5.	3	14.	3	23.	1	32.	4	41.	2
6.	1	15.	3	24.	1	33.	2	42.	2
7.	2	16.	4	25.	3	34.	4	43.	1
8.	4	17.	3	26.	3	35.	2	44.	1
9.	4	18.	4	27.	1	36.	1	45.	3

WORK BOOK

Chapter 07

CHEMICAL AND IONIC EQUILIBRIUM

QUESTIONS

INTRODUCTION, EQUILIBRIUM IN PHYSICAL AND CHEMICAL PROCESS ALONG WITH DYNAMIC EQUILIBRIUM AND THEIR CHARACTERISTICS

1. Which of the following does not happen at equilibrium?

1) Temperature remains constant

2) Concentration of reactant and product remain constant

3) The reaction stop to keep the concentrations constant

4) The reaction/process occurs in a closed vessel

2. Identify the incorrect statement of the following related to liquid-vapour equilibrium?

1) Vapour pressure of water increases with increase in temperature

2) Different liquids have different equilibrium vapour pressure at the same temperature

3) There is no significant difference between gas and vapour

4) If a liquid has higher vapour pressure then it has lower boiling point

3. In an experiment, if we expose three watch glasses containing separately 1ml each of acetone, ethyl alcohol and water to atmosphere and repeat the experiment with different volumes of the liquids in a warmer room. It is observed that, in all such cases the liquid eventually disappears and time taken for complete evaporation depends on

1) the nature of the liquid

2) the amount of the liquid

3) temperature

4) all of these

4. The partial pressure of ethane over a solution containing 6.56×10^{-3} g of ethane is 1 bar. If the solution contains 5×10^{-2} g of ethane, then the partial pressure of gas is

1) 6.2 bar 2) 5.6 bar

3) 7.6 bar 4) 7.3 bar

5. Identify the incorrect statement of the following

1) In solid $\rightleftharpoons$ liquid equilibrium, there is no exchange of heat with the surroundings so that the mass of two phases remains constant

2) In liquid $\rightleftharpoons$ vapour equilibrium, the vapour pressure is constant at a given temperature

3) In gas $\rightleftharpoons$ liquid equilibrium, the solubility of gas in liquid decreases with increase in temperature

4) The concentration of the solute in a saturated solution does not depend upon the temperature

6. Which one of the following statement is incorrect about chemical equilibrium?

1) chemical equilibrium is attained whether we start with reactants or products

2) chemical equilibrium is dynamic in nature

3) chemical equilibrium $CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$ is obtained when $CaCO_{3(s)}$ is heated in an open vessel

4) at equilibrium the concentration of each of the reactant and products become constant

7. A chemical system is in equilibrium, addition of a catalyst would result in

1) increase in the rate of forward reaction

2) increase in the rate of reverse reaction

3) a new reaction path

4) all are correct statements

8. A chemical reaction at equilibrium means

1) Both forward and backward reactions are stopped

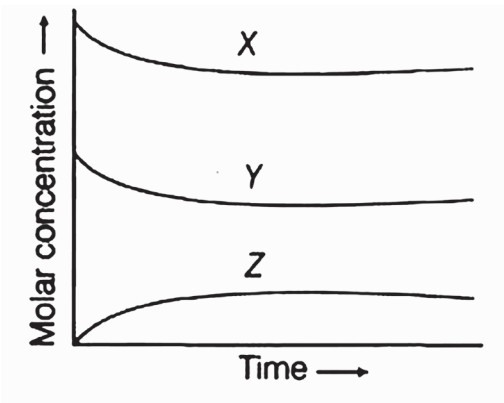
2) The masses of the reactants and products are equal

3) Concentrations of the reactants and products are equal

4) The velocity of both forward and backward reaction are equal

9. The method of preparation of ammonia can be represented graphically as

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$



In the above graph, X, Y and Z respectively are

1) N_2, H_2 and NH_3

2) NH_3, H_2 and N_2

3) H_2, N_2 and NH_3

4) N_2, NH_3 and H_2

10. In the chemical reaction

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ of equilibrium point,

1) equal volumes of N_2 and H_2 are reacting

2) equal masses of N_2 and H_2 are reacting

3) the reaction has stopped

4) the same amount of ammonia is formed is equal to the amount of NH_3 decomposed into H_2 and N_2

LAW OF MASS ACTION, LAW OF CHEMICAL EQUILIBRIUM-EQUILIBRIUM CONSTANTS (K_p and K_c)

Law of Mass Action

11. According to law of mass action, the rate of a reaction is directly proportional to

1) molarities of the reactants

2) normalities of the reactants

3) molalities of the reactants

4) mole fractions of the reactants

12. The active mass of 64 g HI in a 2L flask would be

1) 2 2) 1

3) 5 4) 0.25

13. In the case of gaseous homogeneous reaction, the active mass of the reactant is obtained by the expression

1) $\frac{PV}{RT}$ 2) $\frac{P}{RT}$

3) $\frac{RT}{P}$ 4) $\frac{n}{V}RT$

Units of K_p and K_c

14. In which of the following reactions the equilibrium constant will have no units?

1) $NO_{(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)}$

2) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

3) $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$

4) In all the above reactions

15. The unit of K_p for the following reaction

$2NH_{3(g)} \rightleftharpoons N_{2(g)} + 3H_{2(g)}$ is

1) atm
2) $(atm)^2$
3) $(atm)^{-2}$
4) $(atm)^{-1}$

K_c in terms of k_f and k_b

16. The rate of forward reaction is two times that of the reverse reaction at a given T and identical concentration. The value of K_c is

1) 0.5
2) 1.5
3) 2.5
4) 2

17. For an equilibrium reaction, the rate constants for the forward and backward reaction are 2.38×10^{-4} and 8.15×10^{-5} respectively. What will be the equilibrium constant for the reaction?

1) 92.2
2) 29.2
3) 20.2
4) 2.92

Relation between K_p and K_c

18. In which of the following reaction, $K_p > K_c$?

1) $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$
2) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$
3) $PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$
4) $2SO_{3(g)} \rightleftharpoons O_{2(g)} + 2SO_{2(g)}$

19. For the reaction $CO_{(g)} + Cl_{2(g)} \rightleftharpoons COCl_{2(g)}$

K_p/K_c equal to

1) $1/RT$
2) RT
3) $\sqrt{RT}$
4) 1

20. For the reaction, $PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$ at 250^0C the value of K_c is 26, then the value of K_p on the same temperature will be

1) 0.61 atm^{-1}
2) 0.57 atm^{-1}
3) 0.83 atm^{-1}
4) 0.46 atm^{-1}

TYPES OF CHEMICAL EQUILIBRIA AND APPLICATIONS OF EQUILIBRIUM CONSTANT

21. Two homogeneous equilibria,

$AB \rightleftharpoons A^+ + B^-$ and $AB + B^- \rightleftharpoons AB_2^-$ are

simultaneously maintained in a solution with equilibrium constants K_1 and K_2 respectively. The ratio of $[A^+]$ to $[AB_2^-]$ in the solution is

1) directly proportional to $[B^-]$
2) inversely proportional to $[B^-]$
3) directly proportional to the square of $[B^-]$
4) inversely proportional to the square of $[B^-]$

22. What is the equilibrium constant expression for the reaction

$P_{4(s)} + 5O_{2(g)} \rightleftharpoons P_4O_{10(s)}$

1) $K_c = \frac{[P_4O_{10}]}{[P_4][O_2]}$
2) $K_c = \frac{[P_4O_{10}]}{5[P_4][O_2]}$
3) $K_c = [O_2]^5$
4) $K_c = \frac{1}{[O_2]^5}$

23. In the decomposition reaction of $Fe(OH)_3$, if concentration of $[OH^-]$ in the reaction is decreased by $1/3$ times then the equilibrium concentration of Fe^{3+} will increase by

1) 8 times
2) 16 times
3) 27 times
4) 4 times

24. Which of the following is not an example of heterogeneous equilibrium?

1) $2Cu(NO_3)_{2(s)} \rightleftharpoons 2CuO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

2) $CH_3COOC_2H_{5(aq)} + H_2O_{(\ell)} \rightleftharpoons CH_3COOH_{(aq)} + C_2H_5OH_{(aq)}$

3) $Fe^{3+}_{(aq)} + 3OH^-_{(aq)} \rightleftharpoons Fe(OH)_{3(s)}$

4) $I_{2(s)} + 5F_{2(g)} \rightleftharpoons 2IF_{5(g)}$

25. Pressure of O_2 in the reaction at equilibrium $2Ag_2O_{(s)} \rightleftharpoons 4Ag_{(s)} + O_{2(g)}$ is

1) K_p 2) $\sqrt{K_p}$

3) $3\sqrt{K_p}$ 4) $2K_p$

26. Predict which of the following reaction will have appreciable concentration of reactants and products?

1) $Cl_{2(g)} \rightleftharpoons 2Cl_{(g)}$ $K_c = 5\times10^{-39}$

2) $Cl_{2(g)} + 2NO_{(g)} \rightleftharpoons 2NOCl_{(g)}$ $K_c = 3.7\times10^{8}$

3) $Cl_{2(g)} + 2NO_{2(g)} \rightleftharpoons 2NO_2Cl_{(g)}$ $K_c = 1.8$

4) Both 1 and 2

27. If K_c of the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (all gases) at 750 K is 49, then the K_c of the reaction $NH_3 \rightleftharpoons \frac{1}{2}N_2 + \frac{3}{2}H_2$ (all gases) at the same temperature is

1) $\frac{1}{49}$

2) 7

3) 49

4) $\frac{1}{7}$

28. If K_1 and K_2 are equilibrium constants of a and b respectively, the correct relation between the constants

a) $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$; K_1

b) $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$; K_2

1) $K_1^2 = \frac{1}{K_2}$

2) $K_2 = K_1^2$

3) $K_1 = \frac{1}{K_2}$

4) $K_1 = K_2$

29. At 800 K in a sealed vessel for the equilibrium, $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$

The equilibrium concentrations of $N_{2(g)}$, $O_{2(g)}$ and $NO_{(g)}$ are 0.36×10^{-3} M, 4.41×10^{-3} M and 1.4×10^{-3} M. Then the value of K_c for the reaction, $NO_{(g)} \rightleftharpoons \frac{1}{2}N_2 + \frac{1}{2}O_{2(g)}$ at 800 K is

1) 1.1

2) 0.9

3) 3×10^3

4) 9×10^{-3}

30. Which of the following oxides of nitrogem will be most stable one?

1) $2NO_{2(g)} \rightleftharpoons N_{2(g)} + 2O_{2(g)}$ $K = 6.7\times10^{16}$ mol / L

2) $2NO_{(g)} \rightleftharpoons N_{2(g)} + O_{2(g)}$ $K = 2.2\times10^{30}$

3) $2N_2O_{5(g)} \rightleftharpoons 2N_{2(g)} + 5O_{2(g)}$ $K = 1.2\times10^{24}$ mol^5L^{-5}

4) $2N_2O_{(g)} \rightleftharpoons 2N_{2(g)} + O_{2(g)}$ $K = 3.5\times10^{37}$ mol / L

CALCULATION OF K_p and K_c IN TERMS OF AMOUNT OF SUBSTANCE REACTED AS WELL AS DEGREE OF DISSOCIATION (α)

31. One of mole of a compound AB react with 1 mole of a compound CD according to the equation $AB + CD \rightleftharpoons AD + CB$, when equilibrium had been established it was found that $\frac{3}{4}$ mole each of reactant AB and CD has been converted to AD and CB. There is no change in volume the value of K_c is

1) $\frac{9}{16}$ 2) $\frac{1}{9}$

3) $\frac{16}{9}$ 4) 9

32. 3 mole of A and 1 mole of B are mixed in 1 L container. The reaction taking place is $A + B \rightleftharpoons 2C$. If 1.5 mole of C is formed at equilibrium then the value of K_c is

1) 4 2) 2.7

3) 0.5 4) 0.25

33. The equilibrium constant K_p for the reaction $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ at 1000 K is 3.5. The partial pressure of oxygen gas to give equal moles of SO_2 and SO_3 is

1) 0.29 atm 2) 3.5 atm

3) 0.53 atm 4) 1.87 atm

34. A mixture of N_2 and H_2 in the ratio of 1 : 3 reaches equilibrium with ammonia when 50% of the mixture has reacted. If total pressure is P the partial pressure of ammonia in the equilibrium mixture was

1) $P/2$ 2) $P/3$

3) $P/4$ 4) $P/6$

35. For the reaction, $C_{(s)} + CO_{2(g)} \rightarrow 2CO_{(g)}$ K_p = 63 atm at 100 K, if at equilibrium $P_{CO} = 10P_{CO_2}$ then the total pressure of the gases at equilibrium is

1) 6.3 atm 2) 6.93 atm

3) 0.63 atm 4) 0.693 atm

36. At a certain temperature, the vapour density of PCl_5 in equilibrium with PCl_3 and Cl_2 is 90. The degree of dissociation of PCl_5 is

1) 0.185 2) 0.058

3) 0.158 4) 0.258

37. For the reaction $2AB_{(g)} \rightleftharpoons A_{2(g)} + B_{2(g)}$

The degree of dissociation (α) of $AB_{(g)}$ is related to the equilibrium constant K_p by expression

1) $\frac{1+2\sqrt{K_p}}{2\sqrt{K_p}}$ 2) $\sqrt{\frac{1+2K_p}{2}}$

3) $\sqrt{\frac{2K_p}{1+2K_p}}$ 4) $\frac{2\sqrt{K_p}}{1+2\sqrt{K_p}}$

38. Two solids dissociates as follows

$A_{(s)} \rightleftharpoons B_{(g)} + C_{(g)}$; $K_{P_1} = x\ atm^2$

$D_{(s)} \rightleftharpoons C_{(g)} + E_{(g)}$; $K_{P_2} = y\ atm^2$

The total pressure in a mixture of the two solids both dissociate symultaneously is

1) $x^2 + y^2$ atm 2) $\sqrt{x+y}$ atm

3) $2\sqrt{x+y}$ atm 4) $(x + y)^2$ atm

39. 2 mole of PCl_5 were heated in a 5 L container to constant temperature. If the degree of dissociation of PCl_5 at the temperature is 0.4. The K_c of the reaction $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$ is

1) 0.27 2) 0.35

3) 0.11 4) 0.54

40. The equilibrium constants K_{p_1} and K_{p_2} for the reactions $X \rightleftharpoons 2Y$ and $Z \rightleftharpoons P + Q$ respectively are in the ratio 1 : 9. If degree of dissociation of X and Z be equal, then the ratio of total pressure at this equilibria is

1) 1 : 36 2) 1 : 1

3) 1 : 3 4) 1 : 9

RELATION BETWEEN ΔG^0 AND EQUILIBRIUM CONSTANT, REACTION QUOTIENT Q_C AND FACTORS AFFECTING EQUILIBRIA

41. The standard free energy change of a reaction is $\Delta G^0 = -115\,kJ$ at 298 K. The value of log K_p is (R = 8.314 $JK^{-1}mol^{-1}$)

1) 20.16 2) 2.303

3) 2.016 4) 13.83

42. The value of ΔG^0 for conversion of oxygen to ozone $\frac{3}{2}O_{2(g)} \rightleftharpoons O_{3(g)}$ at 298 K.

($K_p = 2.47 \times 10^{-29}$ and log 2.47 = 0.4) is

1) 163 kJ/mol

2) 2.4×10^2 kJ/mol

3) 1.63 kJ/mol

4) 2.38×10^6 kJ/mol

43. At 500 K, the K_c of the reaction, $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (all gases) is 61. A mixture of N_2, H_2 and NH_3 with molar concentrations 10^{-3} M, 3×10^{-3} M and 2×10^{-3} M respectively was prepared at 500 K which statement below is true?

1) The system is now in equilibrium

2) The forward reaction occurs

3) The backward reaction occurs

4) More data is needed to predict what happens

44. In the equilibrium, $N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$ when 5 moles of each is taken and the temperature is kept at 298 K, the total pressure was found to be 20 bar (Given $\Delta G_f^0(N_2O_4) = 100kJ, \Delta G_f^0(NO_2) = 50\,kJ$)

The reaction will be in

1) forward direction

2) reverse direction

3) equilibrium

4) cannot be predicted

45. Consider the equilibrium for which $\Delta H < 0$

$$HgO_{(s)} + 4I^-_{(aq)} + H_2O_{(\ell)} \rightleftharpoons HgI_4^{2-} + 2OH^-$$

What changes will increase the equilibrium concentration of HgI_4^{2-}

I) Increasing the mass of $HgO_{(s)}$ present

II) Increasing $[I^-]$

III) Adding 1 M HCl

1) I only

2) II only

3) II & III only

4) I, II and III

46. Which of the following reaction is favoured by increase of temperature?

1) $N_2 + 3H_2 \rightleftharpoons 2NH_3 + 22.9\,Kcal$

2) $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)} - 42.8\,Kcal$

3) $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} + 45.3\,Kcal$

4) $H_{2(g)} + Cl_{2(g)} - 44\,Kcal \rightleftharpoons 2HCl_{(g)}$

47. Which one of the following will yield great amount of products on increasing the pressure

1) $CO_{2(g)} + C_{(s)} \rightleftharpoons 2CO_{(g)}$

2) $CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$

3) $2H_{2(g)} + CO_{(g)} \rightleftharpoons CH_3OH_{(g)}$

4) $4NH_{3(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)}$

48. NO dissociated to form N_2 and O_2. To the equilibrium mixture, an inert gas is added keeping the pressure constant. Which of the following will happen?

1) Dissociation of NO will increase

2) Dissociation of NO will decrease

3) There will be no effect on equilibrium

4) Dissociation of NO may increase or decrease depending upon the amount of helium added

49. Consider the equilibrium

$$\underset{\text{(Greater volume)}}{\text{Ice}} \rightleftharpoons \underset{\text{(Less volume)}}{\text{Water}} - 2\,\text{Kcal}$$

The favourable condition for forward process are

1) low temperature, high pressure, excess of ice

2) low temperature, low pressure, excess of ice

3) high temperature, low pressure, excess of ice

4) high temperature, high pressure, excess of ice

50. Consider a hypothetic reaction of the kind

$$AB_{2(g)} + \tfrac{1}{2}B_{2(g)} \rightleftharpoons AB_{3(g)} \qquad \Delta H = -x\,kJ$$

More AB_3 coluld be produced at equilibrium by

1) using a catalyst

2) removing some of B_2

3) increasing the temperature

4) increasing the pressure

IONIC EQUILIBRIUM - DISSOCIATION OF STRONG & WEAK ELECTROLYTES & DIFFERENT CONCEPTS OF ACIDS & BASES

51. Aqueous solution of which of the following compounds is the best conductor of electric current?

1) Ammonia (NH_3)

2) Urea ($NH_2-\overset{\overset{O}{||}}{C}-NH_2$)

3) Acetic acid (CH_3COOH)

4) Hydrochloric acid (HCl)

52. Which of the following is a wek electrolyte?

1) KOH 2) $HClO_3$

3) HNO_2 4) HI

53. At infinite dilution, the percentage ionisation for both strong and weak electrolytes is

1) 1% 2) 20%

3) 50 % 4) 100 %

54. Which of the following can act both as a Bronsted acid and a Bronsted base?

1) HCl 2) H_3PO_4

3) HCO_3^- 4) O^{2-}

55. Which of the following is not a conjugate acid-base pair?

1) HPO_3^{2-}, PO_3^{3-} 2) $H_2PO_4^-, HPO_4^{2-}$

3) $H_2PO_4^-, H_3PO_4$ 4) $H_2PO_4^-, PO_3^{3-}$

56. Which of the following is strongest conjugate base?

1) ClO_4^- 2) HCO_3^-

3) F^- 4) HSO_4^-

57. The increasing order of basic strength of Cl^-, $CO_3^{2-}, CH_3COO^-, OH^-$ and F^- is

1) $OH^- < Cl^- < F^- < CH_3COO^- < CO_3^{2-}$

2) $Cl^- < F^- < CO_3^{2-} < OH^- < CH_3COO^-$

3) $Cl^- < F^- < CH_3COO^- < CO_3^{2-} < OH^-$

4) $CH_3COO^- < Cl^- < F^- < CO_3^{2-} < OH^-$

58. Which of the following molecule acts as a Lewis acid?

1) $(CH_3)_2O$ 2) $(CH_3)_3P$

3) $(CH_3)_3N$ 4) $(CH_3)_3B$

59. Which equilibrium can be described as an acid-base reaction using the Lewis acid-base definition but not using Bronsted and Lowry concept?

1) $CH_3COOH + NH_3 \rightleftharpoons CH_3 - COO^-NH_4^+$

2) $HCl + CH_3COOH \rightleftharpoons CH_3COOH_2^+ + Cl^-$

3) $Cu^{2+} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+}$

4) $CH_3COOH + H_2O \rightleftharpoons CH_3 - COO^- + H_3O^+$

60. Which of the following hehaves as both Lewis base and Bronsted base?

1) BF_3 2) Cl^-

3) H_3O^+ 4) Both 1 and 2

IONISATION OF WEAK ACID AND WEAK BASE - OSTWALD'S DILUTION LAW RELATIVE STRENGTH OF ACID & BASE, IONISATION CONSTANT OF WATER & IONIC PRODUCT OF WATER

61. A monoprotic acid in 0.1 M solution has $K_a = 1 \times 10^{-5}$, the percentage dissociation of acid is

1) 1 % 2) 99.9%

3) 0.1 % 4) 99%

62. If the degree of dissociation (α) of a certain weak monobasic acid in its 0.1 M aqueous solution at 298 K is 0.01, the α of this acid in its 0.025 M aqueous solution at 298 K is

1) 0.05 2) 0.04

3) 0.03 4) 0.02

63. At 25°C, the dissociation constant of a base, BOH is 10^{-12}. The concentration of hydroxyl ions in 0.01 M aqueous solution of the base would be

1) 1.0×10^{-6} mol/L 2) 1×10^{-7} mol/L

3) 2×10^{-6} mol/L 4) 1×10^{-5} mol/L

64. The correct expression for Ostwald's dilution law is

1) $K_a = \frac{\alpha^2}{V}$ 2) $K_a = \alpha^2 \times V$

3) $K_a = \frac{\alpha^2}{(1-\alpha)V}$ 4) $K_a = \frac{\alpha^2}{(1-\alpha)C}$

65. What is the $[H^+]$ in 0.4 M solution of HOCl, $K_a = 3.6 \times 10^{-8}$

1) 1.4×10^{-8} M 2) 1.2×10^{-4} M

3) 1.9×10^{-9} M 4) 3.7×10^{-4} M

66. If the ionisation constant of acetic acid is 1.8×10^{-5} at what concentration will it be dissociated to 2 % ?

1) 1 M 2) 0.018 M

3) 0.18 M 4) 0.045 M

67. The K_a values of formic acid and acetic acid are respectively 1.77×10^{-4} and 1.75×10^{-5}. The ratio of acid strength of 0.1 N acids is

1) 10 2) 3.18

3) 0.3 4) 5.48

68. Which of the following is the weakest?

1) $C_6H_5–NH_2$: $K_b = 3.8 \times 10^{-10}$

2) NH_4OH : $K_b = 1.6 \times 10^{-5}$

3) $C_2H_5NH_2$: $K_b = 5.6 \times 10^{-4}$

4) C_9H_7N : $K_b = 6.3 \times 10^{-10}$

69. Percentage ionisation of water at 298 K is

1) 1.8×10^{-7} 2) 0.8×10^{-9}

3) 3.6×10^{-7} 4) 3.6×10^{-9}

70. The value of ionic product of water at 393 K is

1) less than 10^{-14}

2) greater than 10^{-14}

3) equal to 10^{-14}

4) equal to 10^{-7}

pH SCALE, pOH AND THEIR APPLICATIONS

71. The number of H^+ ions present in 250 mL of a lemon juice of pH = 3 is

1) 1.5×10^{22} 2) 3×10^{21}

3) 6×10^{20} 4) 1.5×10^{20}

72. **Assertion** : pH of a neutral solution is always 7

Reason : pH of a solution does not depend upon temperature

1) Both assertion and reason are true and reason is the correct explanation of assertion

2) Both assertion and reason are true and reason is not the correct explanation of assertion

3) Assertion is true, reason is false

4) Both assertion & reason are false

73. At 100^0C, K_w of water is 55 times its value at 25^0C (log 55 = 1.74). The pH of a neutral aqueous solution at 100^0C

1) 5.13 2) 6.13

3) 7 4) 7.87

74. pH of 10^{-8} M HCl is (log 11 = 1.0413)

1) 8 2) 3

3) 2.5 4) 6.96

75. Equal volumes of three acid solutions of pH 3, 4 and 5 are mixed. What is the total $[H^+]$ concentration in the mixture?

1) 1.11×10^{-4} M 2) 3.7×10^{-4} M

3) 1.11×10^{-3} M 4) 3.7×10^{-3} M

76. For 100 times increase in concentration of H^+ ions, then the value of

1) pH increases by 2 unit

2) pH decreases by 2 unit

3) pH remains unaltered

4) pH decreases by 1 unit

77. The number of moles of Ca^{2+} required to prepare 250 ml of solution with pH = 14 (assuming complete ionisation) is

1) 0.25 2) 1

3) 0.125 4) 10

78. 0.001 mole of weak electrolyte $Zn(OH)_2$ is present in 200 mL of an aqueous solution. The pH of this solution at 298 K is (assuming infinite dilution)

1) 2 2) 4

3) 12 4) 10

79. Determine the pH of the solution that results from the addition of 20 ml of 0.01 M $Ca(OH)_2$ to 30 ml of 0.01 M HCl

1) 11.3 2) 10.53

3) 2.7 4) 8.35

80. Assuming complete dissociation, which of the following aqueous solutions will have the same pH value

i) 1 L of 0.01 M HCl

ii) 100 mL of 0.01 M H_2SO_4 is diluted to 1 L

iii) 50 mL of 0.01 M HCl is diluted to 1L

iv) mixture of 50 mL of 0.02 M H_2SO_4 and 50 mL of 0.02 M NaOH

1) i and iii

2) iii and iv

3) i and iv

4) ii and iii

RELATION BERTWEEN K_a and K_b AS WELL AS pK_a & pK_b

81. The pH of 0.5 M aqueous solution of HF ($K_a = 2 \times 10^{-4}$) is

1) 2 2) 4

3) 6 4) 10

82. pK_a values of four acids A, B, C, D are respectively 2.0, 2.5, 3.0 and 4.0. The weakest acid will be

1) A 2) B

3) C 4) D

83. The ionisation constant of HCN at 298 K is 4.8×10^{-9}. The ionisation constant of the corresponding conjugate base is

1) 2.08×10^{-6} 2) 4.8×10^{-5}

3) 2.08×10^{-5} 4) 4.8×10^{-6}

84. Given $HF + H_2O \xrightarrow{K_a} H_3O^+ + F^-$

$F^- + H_2O \xrightarrow{K_b} HF + OH^-$

Which one of the following relationship is correct

1) $K_b = K_w$ 2) $K_b = \frac{1}{K_w}$

3) $K_a \times K_b = K_w$ 4) $\frac{K_a}{K_b} = K_w$

85. Which will have the minimum value of pK_b?

1) OH^- 2) $CH_3–COO^-$

3) Cl^- 4) $HCOO^-$

86. Which of the following acids is stronger than benzoic acid (K_a of benzoic acid = 6.3×10^{-5})

1) A ($K_a = 1.62 \times 10^{-7}$) 2) B ($pK_a = 6$)

3) C ($pK_a = 4$) 4) D ($K_a = 10^{-5}$)

87. The dissociation constants of monobasic acids A, B, C and D are 6×10^{-4}, 5×10^{-5}, 3.6×10^{-6} and 7×10^{-10} respectively. The pH values of their 0.1 molar aqueous solutions are in the order

1) A < B < C < D 2) A > B > C > D

3) A = B = C = D 4) A > B < C > D

88. 1.22 g of solid benzoic acid is in equilibrium with its vapour according to the reaction

$C_6H_5COOH_{(s)} \rightleftharpoons C_6H_5COO^-_{(g)} + H^+_{(g)}$ if vapour occupies 500 ml at 0.5 atm & 273 K. Calculate the value of pK_b of 0.1 M benzoic acid is (log 671 = 2.83)

1) 2.86 2) 1.17

3) 4.5 4) 5.3

89. The pH of 0.01 M HCN solution for which is ($pK_a = 4$) is

1) 0.47 2) 1.2

3) 3 4) 4

90. For the equilibrium

$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$ $K_{a_1} = 2.5 \times 10^{-3}$

$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}$ $K_{a_2} = 8 \times 10^{-8}$

If pH of 1 M H_2CO_3 is (log 14.14 = 1.15)

1) 5.5 2) 4.85

3) 9.65 4) 6.8

POLYPROTIC ACIDS & POLYACIDIC BASES FACTORS AFFECTING ACIDIC STRENGTH

91. For every diprotic acid of the type H_2X, how would you relate the ionisation constants K_{a_1} & K_{a_2} ?

1) $K_{a_1} = K_{a_2}$

2) $K_{a_2} < K_{a_1}$

3) $K_{a_2} < K_{a_1}$

4) K_{a_1} may be greater than K_{a_2} depending on what acid H_2X

92. The correct relationship between K_{a_1}, K_{a_2} and K_{a_3} of orthophosphoric acid is

1) $K_{a_1} < K_{a_2} < K_{a_3}$ 2) $K_{a_1} > K_{a_2} < K_{a_3}$

3) $K_{a_1} > K_{a_2} > K_{a_3}$ 4) $K_{a_1} = K_{a_2} = K_{a_3}$

93. Four species are listed below

I) HCO_3^- II) H_3O^+

III) HSO_4^- IV) HSO_3F

Which one of the following is the correct sequence of their acidic strength

1) IV < II < III < I 2) II < III < I < IV

3) I < III < II < IV 4) III > I > IV > II

94. The first and second ionisation constant of H_2S are 9.1×10^{-8} and 1.2×10^{-13}. The ionisation constant for the reaction $H_2S \rightleftharpoons 2H^+ + S^{2-}$ will be

1) $(9.1 \times 10^{-8}) + (1.2 \times 10^{-13})$

2) $(9.1 \times 10^{-8}) - (1.2 \times 10^{-13})$

3) $(9.1 \times 10^{-8}) \times (1.2 \times 10^{-13})$

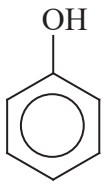
4) $(9.1 \times 10^{-8}) \div (1.2 \times 10^{-13})$

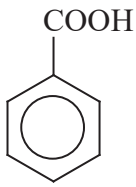
95. K_{a_1} & K_{a_2} of H_2S are 10^{-2} & 10^{-4} respectively then the pK_b of its conjugate base S^{2-} at 298 is

1) 6 2) 8

3) 10^{-8} 4) 10^{-6}

96. Which of the following acid is a polyprotic acid?

1) $HClO_4$ 2) 

3) H_2CO_3 4) 

97. In aqueous solution, the ionisation constants for carbonic acid are

$K_{a_1} = 4 \times 10^{-4}$ and $K_{a_2} = 5 \times 10^{-6}$

Select the correct statements for a saturated 0.034 M solution of carbonic acid is

1) The concentration of H^+ is double that of CO_3^{2-}

2) Concentration of H^+ & HCO_3^- are approximately equal

3) CO_3^{2-} is a weaker conjugate base than HCO_3^-

4) All statements are correct

98. Arrange the following compounds in increasing order of acidic strength

I) H_2O, II) NH_3 III) CH_4 IV) HF

1) I < II < III < IV 2) III < II < I < IV

3) II < IV < I < III 4) II < I < III < IV

99. Which of the following factor/s related to the acidic strength of monobasic acid HA is/are

1) Dissociation of acid HA

2) Large EN difference between H & A in HA

3) Bond strength of HA

4) All of these

100. Which of the following is an example of polyacidic base

1) LiOH 2) $Al(OH)_3$

3) KOH 4) NaOH

HYDROLYSIS OF SALT AND THE pH OF SALT SOLUTION

101. Aqueous solution of which of the following salt shows pH > 7

1) NaCl 2) CH_3COONa

3) NH_4Cl 4) KNO_3

102. The pH value of 0.001 M aqueous solution of NaCl is

1) 7 2) 4

3) 11 4) 5

103. Among the following, total number of compounds whose aqueous solutions turn red litmus paper to blue in KCN, NaCl, $FeCl_3$, K_2CO_3, NH_4NO_3 and LiCN

1) 6 2) 2

3) 3 4) 5

104. The equilibrium constant for the reaction

$NaOCl + H_2O \rightleftharpoons HOCl + NaOH$ in aqueous medium at 298 K is 3.6×10^{-7}. Hence the K_a of HOCl at 298 K is

1) 1.8×10^{-7} 2) 6×10^{-4}

3) 2.8×10^{-8} 4) 1.2×10^{-6}

105. 50 ml each of 0.2 M NH_4OH and 0.2 M HCl solutions are mixed. The pH of the resulting solution is (Given K_b of NH_4OH at 298 K = 10^{-5})

1) 5.5 2) 6.5

3) 5 4) 8.5

106. Match the following

Types of salt	pH of its aqueous solution
a) NH_4CN	p) pH = 7 at 298 K
b) KNO_3	q) pH = $7 - \frac{1}{2}pK_b - \frac{1}{2}\log C$
c) $(NH_4)_2SO_4$	r) pH = $7 + \frac{1}{2}pK_a + \frac{1}{2}\log C$
d) HCOONa	s) pH = $7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$

1) a-s, b-p, c-q, d-r

2) a-p, b-s, c-r, d-q

3) a-q, b-r, c-p d-s

4) a-r, b-q, c-s, d-p

107. What is the pH of the mixture obtained by mixing 50 ml of 0.05 M NH_4OH and 50 ml of 0.05 M CH_3COOH ($K_a = 1.8 \times 10^{-5}$ and $K_b = 1.8 \times 10^{-5}$)

1) 11 2) 8.5

3) 7 4) 9

108. A certain weak acid HA has a dissociation constant of 10^{-4} at 298 K. The equilibrium constant for its reaction with the strong base NaOH is

1) 10^{-10} 2) 10^{-8}

3) 10^{-9} 4) 10^{10}

109. Which of the following relations is correct for degree of hydrolysis of CH_3COONH_4?

1) $h = \sqrt{\frac{K_h}{C}}$ 2) $h = \sqrt{\frac{K_a}{K_b}}$

3) $h = \sqrt{\frac{K_w}{K_a K_b}}$ 4) $h = \sqrt{\frac{K_a K_b}{K_h}}$

110. Which of the following salt undergo anionic hydrolysis?

1) $CuSO_4$ 2) NH_4Cl

3) $FeCl_3$ 4) Na_2CO_3

BUFFER SOLUTION AND SOLUBILITY EQUILIBRIUM-SOLUBILITY PRODUCT

111. Which of the following pairs in aqueous solution cannot be a buffer?

1) $H_3PO_4 + NaH_2PO_4$

2) $NH_4OH + NH_4Cl$

3) $HNO_2 + NaNO_2$

4) $HClO_4 + NaClO_4$

112. A certain buffer solution contains equal concentration of X^- and HX. The K_b for X^- is 10^{-10}. The pH of the buffer at 298 K is

1) 4 2) 7

3) 10 4) 14

113. Which of the following buffer solution has pH value greater than 7

1) $CH_3COOH + CH_3COONa$

2) HCOOH + HCOOK

3) $NH_4OH + NH_4Cl$

4) $H_2CO_3 + NaHCO_3$

114. When a buffer solution of CH_3COOH and CH_3COONa is diluted with water

1) CH_3COO^- ion concentration increases

2) $[H^+]$ ion concentration increases

3) $[OH^-]$ ion concentration increases

4) $[H^+]$ ion concentration does not change

115. A aqueous buffer is prepared by adding 100 mL of 0.1 mol 1 L acetic acid to 50 mL of 0.2 mol 1 L of sodium acetate. If pK_a of acetic acid is 4.76, the pH of the buffer is

1) 4.26 2) 5.76

3) 3.76 4) 4.76

116. The solubility product of Hg_2I_2 is equal to

1) $\left[Hg_2^{2+}\right]\left[I^-\right]$ 2) $\left[Hg_2^{2+}\right]\left[I^-\right]^2$

3) $\left[Hg^{2+}\right]\left[I^-\right]$ 4) $\left[Hg^{2+}\right]\left[I^-\right]^2$

117. The concentration of Ag^+ ion in a saturated aqueous solution of silver oxalate ($Ag_2C_2O_4$) is 2.2×10^{-4} M at 298 K. The K_{sp} of $Ag_2C_2O_4$ at 298 K is

1) 2.4×10^{-8} M^3 2) 4.5×10^{-11} M^3

3) 5.3×10^{-12} M^3 4) 2.7×10^{-12} M^3

118. If the pH of a saturated aqueous solution of $Ba(OH)_2$ is 12, the value of its K_{sp} at 298 K is

1) 4×10^{-6} 2) 5×10^{-7}

3) 5×10^{-6} 4) 4×10^{-7}

119. If K_{sp} of Ag_2CO_3 is 8×10^{-12}, the molar solubility of Ag_2CO_3 in 0.1 M $AgNO_3$ is

1) 8×10^{-12} M 2) 8×10^{-10} M

3) 8×10^{-11} M 4) 8×10^{-13} M

120. K_{sp} of salts of types MX, MX_2 & M_3X at temperature T are 4×10^{-8}, 3.2×10^{-14} and 2.7×10^{-15} respectively. Solubilities of the salts at temperature T are in the order

1) $MX > MX_2 > M_3X$ 2) $M_3X > MX_2 > MX$

3) $MX_2 > M_3X > MX$ 4) $MX > M_3X > MX_2$

SAMPLE QUESTIONS

1. The value of K_c for the reaction, $2A_{(g)} \rightleftharpoons B_{(g)} + C_{(g)}$ at 750 K and 10 atm pressure is 2.86. The value of K_c at 750 K and 20 atm is

1) 28.6 2) 5.72

3) 2.86 4) 11.44

2. The equilibrium constant for the reversible reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ is K and for the reaction $\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightleftharpoons NH_3$, the equilibrium constant is K'. K and K' will be related as

1) K = K' 2) $K' = \sqrt{K}$

3) $K = \sqrt{K'}$ 4) K × K' = 1

3. In an exothermic reaction at equilibrium, a 10^0 rise in temperature will

1) decrease the value of equilibrium constant
2) double the value of K_c
3) not produce any change in K_c
4) produce some increase in K_c

4. For the hypothetical reaction, the equilibrium constant (K) values are given

$$A \rightleftharpoons B; K_1 = 2$$
$$B \rightleftharpoons C; K_2 = 4$$
$$C \rightleftharpoons D; K_3 = 3$$

The equilibrium constant K for the reaction $A \rightleftharpoons D$ is

1) 48 2) 6
3) 27 4) 24

5. For the reaction at 800 K

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ the ratio of K_c and K_p is (R = 0.082 L atm mol^{-1} K^{-1})

1) 2.3×10^{-4} 2) 3.2×10^{-6}
3) 2.3×10^{4} 4) 3.2×10^{6}

6. For the reaction $PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$ 280^0C the value of K_c is 26 then the value of K_p on the same temperature will be

1) 0.01 2) 0.57
3) 0.83 4) 0.46

7. For the reaction,

$Cu_{(s)} + 2Ag^+_{(aq)} \rightleftharpoons Cu^{2+}_{(aq)} + 2Ag_{(s)}$ the equilibrium constant K_c is given by

1) $\frac{[Cu^{2+}][Ag^+]^2}{[Cu][Ag^+]^2}$ 2) $\frac{[Cu^{2+}][2Ag]}{[Cu][2Ag^+]}$

3) $\frac{[Cu^{2+}]}{[Ag^+]^2}$ 4) $\frac{[Ag^+]^2}{[Cu^{2+}]}$

8. The reaction quotient (Q) for the reaction

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ is given by

$$Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

The reaction will proceed from right to left if

1) $Q = K_c$ 2) $Q < K_c$
3) $Q > K_c$ 4) $Q = 0$

9. The value of the K_c for the reaction $2A \rightleftharpoons B + C$ is 2×10^{-3}. At a given time, the decomposition of the reaction mixture is [A] = [B] = [C]. If this stage

1) the reaction is in equilibrium
2) the reaction will proceed in the forward direction
3) the reaction will proceed in the reverse direction
4) the reaction will not occur

10. 2 mole of N_2 is mixed with 6 mole of H_2 in a closed vessel of 1 L capacity. If 50% N_2 is converted into NH_3 at equilibrium, the value of K_c for the reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ is

1) 4/27 2) 27/4
3) 1/27 4) 27

11. For the reaction $AB_{(g)} \rightleftharpoons A_{(g)} + B_{(g)}$. AB is 33% dissociated at a total pressure of P. Therefore P is related to K_p by one of the following options

1) $P = K_p$ 2) $P = 3K_p$
3) $P = 4K_p$ 4) $P = 8 K_p$

12. At a particular temperature, the following equilibrium is attained when 50 % each reactant is converted into products $A_{(g)} + B_{(g)} \rightleftharpoons C_{(g)} + D_{(g)}$. If the amount of B in moles is doubled, percentage of B converted into products will be

1) 33.33% 2) 75%

3) 50% 4) 66.66%

13. The dissociation of PCl_5 takes place as $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

If the degree of dissociation is α at equilibrium pressure P, then the equilibrium constant for the reaction is

1) $K_p = \frac{\alpha^2}{1+\alpha^2 P}$ 2) $K_p = \frac{\alpha^2 P^2}{1-\alpha^2}$

3) $K_p = \frac{\alpha P^2}{1-\alpha^2}$ 4) $K_p = \frac{\alpha^2 P}{1-\alpha^2}$

14. Ammonium carbamate when heated to 200^0C gives a mixture of NH_3 and CO_2 vapours with a density of 16. What is the degree of dissociation of ammonium carbamate?

1) 3/2 2) 1/2

3) 2 4) 0.72

15. The value of ΔG^0 for the phosphorylation of glucose in glycolysis is 13.8 kJ/mol. The value of K_c at 298 K will be

1) 4.81×10^{-2} J/mol

2) 3.95×10^{-3} J/mol

3) 6.32×10^{-5} J/mol

4) 2.64×10^{-4} J/mol

16. The equilibrium constant (K) of a reaction may be written as

1) $K = e^{-\Delta G/RT}$ 2) $K = e^{-\Delta G^0/RT}$

3) $K = e^{-\Delta H/RT}$ 4) $K = e^{-\Delta H^0/RT}$

17. Consider the equilibrium reaction

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)};\ \Delta H = -98\,kJ$$

Apply Le-chatelier's principle and check which of the following is the correct effect of increase in temperature

1) concentration of N_2 decreases

2) concentration of H_2 decreases

3) concentration of NH_3 decreases

4) concentration of NH_3 increases

18. When a catalyst is added to a reversible reaction

1) it increases the speed of forward reaction only

2) it increases the speed of forward reaction more than that of backward reaction

3) it increases the value of equilibrium constant

4) equilibrium is not disturbed but attained quickly

19. According to Lechatelier's principle, maximum yield of NH_3 is obtained at

1) high temperature and low pressure

2) high pressure

3) low temperature

4) low temperature and high pressure

ASSERTION-REASON TYPE QUESTIONS

In each of the following questions, a statement of Assertion (A) is given followed by a corresponding statement of Reason (R) just below it. Of the statements, mark the correct answer as

1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true but reason is not the correct explanation of assertion

3) If assertion is true but reason is false

4) If both assertion and reason are false

20. **Assertion** : Equilibrium constant of all reactions changes with change in temperature

Reason : With increase in temperature, both forward and backward reactions are speeded up but to different extents

21. **Assertion** : The active mass of a pure solid or a pure liquid is taken as1

Reason : The active mass of pure solid or pure liquid depends upon the density and molecular mass of the substance, both of which are constant for the pure substance

22. **Assertion** : If an inert gas is added to a dissociation equilibrium keeping pressure constant, the dissociation increases

Reason : Inert gas exerts its own pressure in the vessel

23. **Assertion** : At high pressure melting of ice is favoured

Reason : Density of ice is less than that of water

24. The conjugate base of H_3O^+ is

1) OH^- 2) H^+

3) H_2O 4) H^-

25. Conjugate acid of NH_2^- is

1) NH_3 2) NH_4^+

3) N^- 4) NH_2^+

26. Which of the following is a Lewis acid?

1) Cl^- 2) $SnCl_4$

3) H_2O 4) C_2H_5OH

27. Degree of dissociation of 0.1 N CH_3COOH ($K_a = 10^{-5}$)

1) 10^{-4} 2) 10^{-5}

3) 10^{-2} 4) 10^{-3}

28. Which one of the following is the weakest base?

1) NH_4OH 2) $Ba(OH)_2$

3) $Ca(OH)_2$ 4) $Al(OH)_3$

29. Approximate relationship between dissociation constant of water (K_c) and ionic product of water (K_w) is

1) $K_w = K_c$ 2) $K_w = 55.5 \times K_c$

3) $K_w = 18 \times K_c$ 4) $14 \times K_c$

30. The ionic product of water at 310 K is 3.6×10^{-13}. The pH of neutral water at this temperature is (log 6 = 0.7782)

1) 7 2) 6.78

3) 6.22 4) 7.02

31. The ionic product of water changes when

1) an acid is added to water

2) a base is added to water

3) an acid or a base is added to water

4) temperature is changed

32. The pH of solutions A, B, C, D are respectively 9.5,2.5, 3.5, 5.5. The most acidic solution is

1) A 2) B

3) C 4) D

33. Which of the following solutions will have pH = 7 at 298 K (log 10.1 = 1.004)

1) 10^{-9} M HCl 2) 10^{-5} M NaOH

3) 10^{-9} M KOH 4) Both 1 and 3

34. A solution has pH = 5. It is diluted 100 times then it will becomes

1) neutral 2) basic

3) unaffected 4) more acidic

35. Equal volumes of two solutions of pH 4 and pH 11 are mixed. The pH of the resulting solution at 298 K will be

1) 7.5 2) 11.26

3) 13 4) 3.04

36. The number of hydroxy ions in $10cm^3$ of 0.2 M HCl solution at 298 K is ($N_A = 6 \times 10^{23}$)

1) 5×10^{-14} 2) 3×10^{8}

3) 3×10^{12} 4) 5×10^{-12}

37. Which has the highest pH?

1) CH_3COOK 2) Na_2CO_3

3) NH_4Cl 4) $NaNO_3$

38. For the salt of weak acid and strong base the hydrolysis constant is given by the expression

1) $K_h = \frac{K_w}{K_b}$ 2) $K_h = \frac{K_w}{K_a.K_b}$

3) $K_h = \frac{K_a}{K_w}$ 4) $K_h = \frac{K_w}{K_a}$

39. 1 M NaCl & 1M HCl are present in an aqueous solution. The solution is

1) not a buffer solution with pH > 7

2) a buffer solution with pH < 7

3) not a buffer solution with pH < 7

4) a buffer solution with pH > 7

40. The solubility of $PbCl_2$ is

1) $\sqrt{K_{sp}}$ 2) $(K_{sp})^{1/3}$

3) $\left(\frac{K_{sp}}{4}\right)^{1/3}$ 4) $\left(8K_{sp}\right)^{1/2}$

41. Which hydroxide will have the lowest solubility product at normal temperature (25^0C)

1) $Mg(OH)_2$ 2) $Ca(OH)_2$

3) $Ba(OH)_2$ 4) $Be(OH)_2$

42. When HCl gas is bubbled through a saturated aqueous solution of NaCl, the incorrect statement of the following are

i) K_{sp} value of saturated solution of NaCl increases but there is no change in solubility

ii) $K_{IP} < K_{SP}$

iii) Some NaCl precipitate out

iv) Degree of dissociation of NaCl increases

1) i and iii 2) i, ii and iv

3) ii, iii and iv 4) i and iv

43. $Fe_3N_{(s)} + \frac{3}{2}H_{2(g)} \rightleftharpoons 3Fe_{(s)} + NH_{3(g)}$

1) $K_c = K_p(RT)$ 2) $K_c = K_p(RT)^{1/2}$

3) $K_c = K_p(RT)^{3/2}$ 4) $K_c = K_p(RT)^{-1/2}$

44. On adding 0.1 M solution each of Ag^+, Ba^{2+}, Ca^{2+} ions in a Na_2SO_4 in a Na_2SO_4 solution, species first precipitated is (K_{sp} of $BaSO_4$ = 10^{-11}, K_{sp} of $CaSO_4$ = 10^{-6}, K_{sp} of Ag_2SO_4 = 10^{-5})

1) Ag_2SO_4 2) $BaSO_4$

3) $CaSO_4$ 4) All of these

45. At equilibrium, on adding heat, the equilibrium will shift to

1) High enthalpy side

2) low enthalpy side

3) zero enthalpy side

4) No change

ANSWER KEY

1.	3	25.	1	49.	4	73.	2	97.	2
2.	3	26.	3	50.	4	74.	4	98.	2
3.	4	27.	4	51.	4	75.	2	99.	4
4.	3	28.	1	52.	3	76.	2	100.	2
5.	4	29.	2	53.	4	77.	3	101.	2
6.	3	30.	1	54.	3	78.	3	102.	1
7.	4	31.	4	55.	4	79.	1	103.	3
8.	4	32.	1	56.	2	80.	3	104.	3
9.	3	33.	1	57.	3	81.	1	105.	3
10.	4	34.	2	58.	4	82.	4	106.	1
11.	1	35.	2	59.	3	83.	1	107.	3
12.	4	36.	3	60.	2	84.	3	108.	4
13.	2	37.	4	61.	1	85.	1	109.	3
14.	4	38.	3	62.	4	86.	3	110.	4
15.	2	39.	3	63.	2	87.	1	111.	4
16.	4	40.	1	64.	3	88.	2	112.	1
17.	4	41.	1	65.	2	89.	3	113.	3
18.	4	42.	1	66.	4	90.	2	114.	4
19.	1	43.	3	67.	2	91.	2	115.	4
20.	1	44.	2	68.	1	92.	3	116.	2
21.	4	45.	3	69.	1	93.	3	117.	3
22.	4	46.	2	70.	2	94.	3	118.	2
23.	3	47.	3	71.	4	95.	2	119.	2
24.	2	48.	3	72.	4	96.	3	120.	4

SAMPLE QUESTIONS

1.	3	10.	1	19.	4	28.	4	37.	2
2.	2	11.	4	20.	4	29.	2	38.	4
3.	1	12.	1	21.	1	30.	3	39.	3
4.	4	13.	4	22.	2	31.	4	40.	3
5.	1	14.	4	23.	1	32.	2	41.	4
6.	2	15.	2	24.	3	33.	4	42.	2
7.	3	16.	2	25.	1	34.	1	43.	2
8.	3	17.	3	26.	2	35.	2	44.	2
9.	3	18.	4	27.	3	36.	2	45.	1

WORK BOOK

Chapter 08

THE p-BLOCK ELEMENTS XI & XII

QUESTIONS

GROUP 13 ELEMENTS - BORON FAMILY

Atomic and Physical Properties

1. Gallium behaves as

1) Non metal 2) Metal

3) Metalloid 4) Transition metal

2. Which of the following is not a mineral of aluminium?

1) Bauxite 2) Cryolite

3) Feldspar 4) Kernite

3. Which of the following minerals does not contain boron?

1) Colemanite 2) Boric acid

3) Borax 4) Bauxite

4. Which one of the following is more abundant in the earth's crust?

1) B 2) Al

3) Ga 4) In

5. Which is used in high temperature thermometry?

1) B 2) Al

3) Ga 4) In

6. Which one of the following has highest ionisation enthalpy?

1) B 2) Al

3) Ga 4) In

7. Which element belongs to the family of elements, that also includes element Gallium?

1) Carbon 2) Aluminium

3) Iron 4) Arsenic

8. Which one of the following pairs of elements has nearly same (ie difference of only 2-3 kJ/mol) first ionisation enthalpies?

1) In, Tl 2) B, Al

3) Al, Ga 4) B, Tl

9. Atomic radius of boron family is in the order

1) B > Ga > Al > In > Tl

2) B < Al < Ga < In < Tl

3) B < Al < In < Ga < Tl

4) B < Ga < Al < In < Tl

10. Which one of the following has lowest boiling point?

1) B 2) Tl

3) Ga 4) Al

11. Which one of the following has lowest density?

1) B 2) Al

3) Ga 4) In

12. The highest E^0 (in V) value for $M^+ \rightarrow M$ among the group 13 elements is:

1) –0.55 2) 0.55

3) 0.34 4) 0.92

13. Which one of the following pairs of atomic numbers represents elements belongs to the same group?

1) 13 and 31 2) 11 and 20

3) 14 and 33 4) 12 and 30

14. **Assertion** : Atomic radius of Aluminium is higher than that of Gallium

Reason : The presence of additional d-electron offer poor screening effect for the outer electrons form increased nuclear charge

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

15. The electronegativity of aluminium is similar to

1) lithium 2) carbon

3) beryllium 4) boron

Chemical Properties & Group 13 Elements

16. The possible oxidation states of group 13 elements is/are

1) +3 2) +1, +3

3) +1 4) +1, +2, +3

17. Dilute sodium hydroxide does not react with which of the following?

1) Ga 2) Al

3) Ti 4) B

18. Aluminium (III) chloride forms a dimer because aluminium ————

1) Belongs to boron family

2) Has a very high ionization enthalpy

3) Can have higher co-ordination number

4) Is next to Magnesium

19. The stability of +1 oxidation state increases in the sequence ————

1) Ga < In < Al < Tl

2) Al < Ga < In < Tl

3) Tl < In < Ga < Al

4) In < Tl < Ga < Al

20. Aluminium reacts with concentrate HCl and aqueous NaOH to liberate the gases —— respectively:

1) H_2 and O_2 2) O_2 and H_2

3) H_2 and H_2 4) O_2 and O_2

21. Which of the following is acidic in nature?

1) B_2O_3 2) Al_2O_3

3) Ga_2O_3 4) Tl_2O_3

22. Which of the following oxides is strongly basic?

1) B_2O_3 2) Al_2O_3

3) Ga_2O_3 4) Tl_2O_3

23. **Assertion (A)** : $AlCl_3$ exists as a dimer through halogen bridged bonds.

Reason (R) : $AlCl_3$ gets stability by accepting electrons from the bridged halogen.

1) Both A and R are true and R is the correct explanation of A

2) Both A and R are true but R is not the correct explanation of A

3) A is true, but R is false

4) A is false, but R is true

24. Which metal is protected by a layer of its own oxide?

1) Al 2) Au

3) Fe 4) Ag

25. Aluminium metal becomes passive in

1) conc. HNO_3 2) dil. H_2SO_4

3) dil. HCl 4) conc. H_2SO_4

26. Boron can't form which one of the following anions?

1) BF_6^{3-} 2) BH_4^-

3) $B(OH)_4^-$ 4) BO_2^-

27. 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

1) $Al^{3+} + 3Cl^-$

2) $\left[Al(H_2O)_6\right]^{3+} + 3Cl^-$

3) $[Al(OH)_6]^{3+} + 3HCl$

4) $Al_2O_3 + 6HCl$

28. The correct statements among I to III regarding group 13 element oxides are:

I) Boron trioxide is acidic

II) Oxides of aluminium and gallium are amphoteric

III) Oxides of indium and thallium are basic

1) I, II and III 2) I and III only

3) I and II only 4) II and III only

29. Boron is unable to form BF_6^{3-} because of

1) High electronegativity of boron

2) High electronegativity of fluorine

3) Lack of d-orbital's in boron

4) Less difference in electronegativity between B and F

30. BF_3 is planar and electron deficient compound. Hybridization and number of electrons around the central atom, respectievely are

1) sp^2 and 8 2) sp^3 and 4

3) sp^3 and 6 4) sp^2 and 6

31. Which of the following does not exhibit inert pair effect?

1) Al 2) Tl

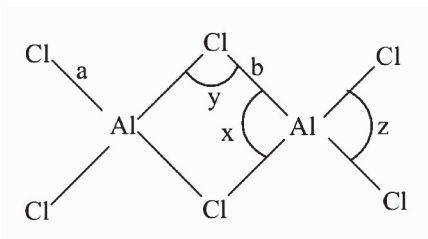
3) Pb 4) Bi

32. Electron deficient molecule is

1) CCl_4 2) PCl_5

3) BF_3 4) SF_6

33. $AlCl_3$ achieves stability by forming the dimer



The marked bond angles x, y, z and bond lengths 'a' and 'b' are correct with

	x	y	z	a	b
1)	79^0	101^0	118^0	206 pm	221 pm
2)	101^0	79^0	118^0	206 pm	221 pm
3)	118^0	101^0	79^0	221 pm	206 pm
4)	79^0	118^0	101^0	221 pm	206 pm

34. Which is false?

1) The difference in inner core of elements greatly influences physical and chemical properties of p-Block elements

2) BCl_3 is a Lewis acid

3) Hybridisation of Al in $[Al(H_2O)_6]^{3+}$ is sp^3d

4) Tl^{3+} is an oxidising agent

35. **Statement I** : Boron is unreactive with air in crystalline form

Statement II : Amorphous boron on heating in air forms B_2O_3

In light of the above statements, choose most appropriate answer from the options given below:

1) Both statement I and statement II are true

2) Both statement I and statement II are false

3) Statement I is true, but statement II is false

4) Statement I is false, but statement II is true

GROUP 14 ELEMENTS - CARBON FAMILY

Atomic and Physical Properties

36. In the ground state, carbon atom has how many unpaired electron(s)?

1) 1 2) 2

3) 3 4) 4

37. Which of the following is a metal?

1) C 2) Si

3) Ge 4) Sn

38. Which of the following statements is correct with respect to the property of elements with increase in atomic number in the carbon family?

1) Their electronegativity increases

2) Their metallic character decreases

3) Their atomic radius increases

4) Their ionisation enthalpy increases

39. Which of the following elements has the lowest melting point?

1) Sn 2) Pb

3) Si 4) Ge

40. Among the following options the element with the highest density and lowest boiling point is

1) C 2) Sn

3) Pb 4) Ge

41. The element Z = 114 has been discovered recently. It will belong to which of the following family/group and electronic configuration?

1) Carbon family, [Rn] $5f^{14}\ 6d^{10}\ 7s^2\ 7p^2$

2) Oxygen family, [Rn] $5f^{14}\ 6d^{10}\ 7s^2\ 7p^4$

3) Nitrogen family, [Rn] $5f^{14}\ 6d^{10}\ 7s^2\ 7p^6$

4) Halogen family, [Rn] $5f^{14}\ 6d^{10}\ 7s^2\ 7p^5$

42. The elements commonly used for making transistors are:

1) C and Si 2) Ga and In

3) P and As 4) Si and Ge

43. Which of the following are the ore of lead?

1) Cassiterite 2) Galena

3) Colemanite 4) Mica

44. Which is the correct order of ionisation enthalpy of group 14 elements?

1) C > Si > Ge > Sn > Pb

2) C > Si > Ge > Pb > Sn

3) C > Si > Sn > Ge > Pb

4) C > Si > Sn > Pb > Ge

45. Germanium behave as:

1) Non metal 2) Metalloid

3) Metal 4) Transition metal

Chemical Properties

46. Which of the following species do not exist?

1) $[SiF_6]^{2-}$ 2) $[SiCl_6]^{2-}$

3) $[GeCl_6]^{2-}$ 4) $[Sn(OH)_6]^{2-}$

47. What would be the product following reaction $SiCl_4 \xrightarrow{\text{excess of } H_2O}$? (Major product)

1) $SiCl_3(OH)$ 2) $Si(OH)_4$

3) $SiCl_3(OH)_2$ 4) $SiCl_4$(no reaction)

48. Among the following oxides, which one is powerful oxidant?

1) CO_2 2) SnO_2

3) SiO_2 4) PbO_2

49. The element with maximum bond energy ——

1) C 2) Pb

3) Ge 4) Si

50. Which one of the following elements reacts with steam?

1) C 2) Ge

3) Si 4) Sn

51. Which of the following is not hydrolysed easily?

1) CCl_4 2) $SiCl_4$

3) $GeCl_4$ 4) $SnCl_4$

52. More than four bonds are made by how many elements in carbon family?

1) 1 2) 2

3) 3 4) 5

53. Which of the following is incorrect statement?

1) SnF_4 is ionic in nature

2) PbF_4 is covalent in nature

3) $SiCl_4$ is easily hydrolysed

4) GeX_4 (X = F, Cl, Br, I) is more stable than GeX_2

54. **Assertion** : Pb^{4+} compounds are stronger oxidizing agents than Sn^{4+} compounds.

Reason : The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to inert pair effect.

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

55. **Assertion** : PbI_4 is a stable compound

Reason : Iodide stabilizes higher oxidation state.

1) If both assertion and reason are correct and reason is a correct explanation of the assertion

2) If both assertion and reason are correct but reason is not a correct explanation of the assertion

3) If the assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

56. **Assertion** : SiF_6^{2-} is known but $SiCl_6^{2-}$ is not

Reason : Size of fluorine is small and its lone pair of electrons interacts with d-orbitals of Si strongly.

1) If both assertion and reason are correct and reason is a correct explanation of the assertion

2) If both assertion and reason are correct but reason is not a correct explanation of the assertion

3) If the assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

57. Ge (II) compounds are powerful reducing agents whereas Pb(IV) compounds are strong oxidants. It can be due to

1) Pb is more electropositive than Ge

2) Ionization potential of lead is less than that of Ge

3) Ionic radii of Pb^{2+} and Pb^{4+} are larger than those of Ge^{2+} and Ge^{4+}

4) More pronounced inert pair effect in lead than in Ge

58. **Assertion (A)**: GeF_4 and $SiCl_4$ act as Lewis bases.

Reason (R) : Ge and Si have d-orbital's to accept electrons.

The correct answer is

1) Both A and R are correct, R is not the correct explanation of A

2) A is correct but R is not correct

3) A is not correct but R is correct

4) Both A and R are correct, R is the correct explanation of A

59. Which of the following has least tendency to undergo catenation?

1) C 2) Si

3) Ge 4) Sn

60. Which of the following dihalides will be most stable?

1) SiX_2 2) GeX_2

3) SnX_2 4) PbX_2

61. The element that shows greater ability to form $p\pi - p\pi$ multiple

1) Ge 2) Si

3) Sn 4) C

62. Which of the following oxides is amphoteric in character?

1) SnO_2 2) SiO_2

3) CO_2 4) CaO

63. Carbon and germanium belong to the 14th group. The maximum co-ordination number of carbon is less than germanium, because of ——

1) Larger size of germanium

2) Electronegativity difference

3) Availability of low-lying d-orbitals in germanium

4) Electrical conductivity

64. It is because of inability of ns^2 electrons of the valency shell to participate in bonding that

1) Sn^{2+} is oxidising while Pb^{4+} is reducing

2) Sn^{2+} and Pb^{4+} are both oxidising and reducing

3) Sn^{4+} is reducing while Pb^{4+} is oxidising

4) Sn^{2+} is reducing while Pb^{4+} is oxidising

65. Carbon and silicon belong to (IV) group. The maximum coordination number of carbon in commonly occurring compounds is 4, whereas that of silicon is 6. This is due to

1) availability of low lying d-orbital's in silicon

2) large size of silicon

3) more electropositive nature of silicon

4) both 2 and 3

GROUP 15 ELEMENTS - NITROGEN FAMILY

Atomic and Physical Properties of Group 15

66. Which statement is incorrect for nitrogen family?

1) P_4 occurs in minerals of apatite family

2) Dinitrogen is a diatomic gas with no allotropes

3) Bismuth forms only one well characterised compound in +5 oxidation state

4) Melting points of group15 elements increase regularly on moving down the group

67. Which element among the following does form triple bonds?

1) Arsenic 2) Nitrogen

3) Phosphorus 4) Antimony

68. Large difference in boiling points is observed in

1) N and P 2) P and As

3) As and Sb 4) Sb and Bi

69. N_2 does not show a strong tendency for catenation because

1) it has no 'd' orbitals in the valence shell

2) interelectronic repulsion between non bonding electrons is greater

3) N has high bond enthalpy

4) nitrogen has very high ionization enthalpy

70. The three important oxidation states of phosphorus are

1) –3, +3 and +2 2) –3, +3 and +5

3) –3, +3 and –5 4) –3, +3 and +4

71. Which is true regarding nitrogen?

1) Less electronegative

2) Has low ionisation enthalpy

3) d-orbitals are available

4) Ability to form bonds with itself

72. Which of the following configuration is characteristic of group 15 elements?

1) $(n - 1)d^{10} ns^2 np^2$

2) $(n - 1)d^{10} ns^2 np^4$

3) $ns^1 np^4$

4) $ns^2 np^3$

73. The element which occurs free in the gaseous state at room temperature is

1) Phosphorus 2) Nitrogen

3) Arsenic 4) Antimony

74. Nitrogen differs from P, As, Sb and Bi in which of the following property?

1) It forms diatomic molecules

2) It is not possible to extent its coordination number beyond 4

3) Nitrogen does not form pentahalides

4) In all the properties given above

75. **Assertion** : Catenation tendency is weaker in nitrogen

Reason : Nitrogen exists as diatomic gas

1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true but reason is not the correct explanation of assertion

3) If assertion is true but reason is false

4) If both assertion and reason are false

Chemical Properties

76. Among pnicogens, as we move down, the pentavalency becomes less pronounced due to:

1) non metallic character

2) inert pair effect

3) high electronegativity

4) large IE

77. Which of the following statement is wrong?

1) The stability of hydrides increase from NH_3 to BiH_3 in group 15

2) The decrease values of bond angles from NH_3 to SbH_3 down group 15 is due to decrease in electronegativity

3) Nitrogen can't form $p\pi - d\pi$ bond

4) Single N-N bond is weaker than the single P-P bond

78. Which is true regarding chemical properties of group 15 elements?

1) The common oxidation states are +3 and +5

2) Stability of +5 oxidation state increases down the group

3) PF_6^- is an unknown compound

4) The oxidation states of bismuth in magnesium bismuthide is –3

79. The most stable trihalide of nitrogen is:

1) NF_3 2) NCl_3

3) NBr_3 4) NI_3

80. Which of the following does not exhibit allotropy?

1) P 2) N

3) Sb 4) As

81. The boiling point of NH_3 is much higher than that of PH_3 because

1) NH_3 undergoes umbrella inversion

2) NH_3 has larger molecular weight

3) NH_3 forms inter-molecular hydrogen bonds

4) NH_3 contains ionic bonds whereas PH_3 contains covalent bonds

82. Which one of the following cannot form an amphoteric oxide?

1) Al 2) Sn

3) Sb 4) P

83. Which one of the following elements does not form the compound, M_4O_{10} (M = elements)?

1) P 2) Sb

3) As 4) Bi

84. The correct order of reducing ability of the following hydrides is

1) $BiH_3 > SbH_3 > PH_3 > NH_3$

2) $NH_3 > PH_3 > SbH_3 > BiH_3$

3) $SbH_3 > BiH_3 > PH_3 > NH_3$

4) $PH_3 > BiH_3 > SbH_3 > NH_3$

85. The following are some statements related to VA group hydrides.

I) Reducing property increases from NH_3 to BiH_3

II) Tendency to donate lone pair decreases from NH_3 to BiH_3

III) Thermal stability of hydrides decreases from NH_3 to BiH_3

IV) Bond angle of hydrides decreases from NH_3 to BiH_3

The correct statements are

1) I, II, III and IV

2) I, III and IV

3) I, II and IV

4) I and IV

86. Observe the following statements

I) The solubility of group V hydrides in water decreases from NH_3 to BiH_3

II) Phosphorus does not exhibit allotropy

III) The stability of group V hydrides decreases from NH_3 to BiH_3

The correct statement(s) are

1) 1 and 3 2) 2

3) 1 and 2 4) 1, 2 and 3

87. In the nitrogen family the H–M–H bond angle in the hydrides MH_3 gradually becomes closer to 90^0 on going from N to Sb. This shows that gradually

1) The basic strength of hydrides increases

2) Almost pure p-orbitals are used for M–H bonding

3) The bond energies of M – H bond increases

4) The bond pairs of electrons becomes nearer to the central atom

88. The element which forms oxides in all oxidation states varying from +1 to +5 is

1) N 2) P

3) As 4) Sb

89. Which is in the decreasing order of boiling points of V group hydrides?

1) $NH_3 > PH_3 > AsH_3 > SbH_3$

2) $SbH_3 > AsH_3 > PH_3 > NH_3$

3) $PH_3 > NH_3 > AsH_3 > SbH_3$

4) $SbH_3 > NH_3 > AsH_3 > PH_3$

90. Which of the following have same number of electrons in the outermost orbit?

1) Pb, Sb 2) N, O

3) As, Bi 4) P, Ca

91. Which of the following has the highest $p\pi - p\pi$ bonding tendency?

1) N 2) P

3) As 4) Sb

92. Which of the following shows nitrogen with its increasing order of oxidation number?

1) $NO < N_2O < NO_2 < NO_3^- < NH_4^+$

2) $NH_4^+ < N_2O < NO_2 < NO_3^- < NO$

3) $NH_4^+ < N_2O < NO < NO_2 < NO_3^-$

4) $NH_4^+ < NO < N_2O < NO_2 < NO_3^-$

93. Anomalous behaviour of nitrogen is due to

1) Small size and high electronegativity

2) Non-availability of d-orbitals in valency shells

3) Ease of multiple bond formation

4) All of the above

94. The oxidation number of nitrogen in calcium nitride is

1) +3 2) –3

3) +5 4) +1

95. In the following reaction

$$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$$

1) phosphorus is oxidised

2) phosphorus is oxidised and reduced

3) phosphorus is reduced

4) sodium is oxidised

96. Which of the following hydride is the most stable?

1) PH_3 2) SbH_3

3) NH_3 4) AsH_3

97. For the hydrides of nitrogen family, in going down the group:

1) stability decreases

2) reducing activity decreases

3) bond angle HEH increases

4) boiling point increases

98. The maximum covalency of nitrogen is

1) 3 2) 4

3) 5 4) 6

99. Which of the following oxide is most acidic?

1) As_2O_3 2) P_2O_5

3) Sb_2O_3 4) Bi_2O_3

100. Which of the following property is true for the given sequence?

$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$?

1) Reducing property

2) Thermal stability

3) Melting point

4) Acidic character

GROUP 16 ELEMENTS - OXYGEN FAMILY

Atomic and Physical Properties of Group 16

101. Which of the following configuration is characteristic of group 16 elements?

1) $(n - 1) d^{10} ns^2$ 2) $ns^2 np^3$

3) $ns^2 np^4$ 4) $ns^2 np^6$

102. Which one has the lowest melting point (K)?

1) O 2) S

3) Se 4) Te

103. Highest boiling point is observed for

1) S 2) Se

3) Te 4) Po

104. Which of the following is a chalcogen?

1) O 2) Sr

3) Tc 4) All

105. **Assertion** : The elements of group 16 have lower ionisation enthalpy values compared to those group 15 in the corresponding periods.

Reason : Group 15 elements have extra stable half-filled p orbitals electronic configurations

1) Both assertion and reason are correct statements and reason is the correct explanation of the assertion

2) Both assertion and reason are correct statements and reason is not the correct explanation of the assertion

3) Assertion is correct, but reason is wrong statement

4) Assertion is wrong but reason is correct statement

106. **Statement I** : Because of the compact nature of oxygen atom. It has less negative electron gain enthalpy than sulphur.

Statement II: The metallic character increases from oxygen to polonium.

In the light of the above statemenst, choose the correct answer from the option

1) Statement I is incorrect but statement II is true

2) Both statement I and statement II are true

3) Both statement I and statement II are false

4) Statement I and statement II is false

107. Which of the following is incorrect statement

1) Oxygen is the most abundant of all the elements on earth

2) Combined sulphur exists primarily as sulphates and sulphides

3) Polonium occurs in nature as a decay product of thorium and uranium minerals

4) Sulphur is the second most abundant element in the earth crust

108. The first four elements in group 16 are collectively known as

1) halogens 2) chalcogens

3) noble gases 4) carbon family

109. The correct order of electron gain enthalpy is

1) S > Se > Te > O 2) Te > Se > S > O

3) O > S > Se > Te 4) S > O > Se > Te

110. Which of the following can exhibit allotropy?

O, S, Se, Te, Po

1) All except O

2) All except Po

3) All except O and Po

4) All

Chemical Properties of Group 16

111. Which pair has compounds with the highest and lowest boiling points respectively?

1) H_2O, H_2S 2) H_2S, H_2O

3) H_2O, H_2Se 4) H_2O, H_2Te

112. Enthalpy of formation is highly positive for

1) H_2O 2) H_2S

3) H_2Se 4) H_2Te

113. Given below are two statements:

Statement I : The boiling points of the following hydrides of group 16 elements increases in the order $H_2O < H_2S < H_2Se < H_2Te$

Statement II : The boiling points of these hydrides increase with increase in molar mass

In the light of the above statements, choose the most appropriate answer from the options given below:

1) Both statement I and statement II are incorrect

2) Statement I is correct but statement II is incorrect

3) Statement I is incorrect but statement II is correct

4) Both statement I and statement II are correct

114. SF_6 is a kinetically inert substance because

1) Fluorine is highly electronegative

2) It is sterically protected

3) Greater difference in electronegativities of S and F

4) Larger size of S-atom

115. **Assertion** : Sulphur exist as S_8 but oxygen exists as O_2

Reason : Oxygen forms $p\pi - p\pi$ multiple bond due to small size and small bond length but $p\pi - p\pi$ bonding is not possible in sulphur.

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

116. An element is oxidized by fluorine and not by chlorine. Identify the element.

1) Sodium 2) Aluminium

3) Oxygen 4) Sulphur

117. Which of the following is the weakest acid in its aqueous solution?

1) H_2Te 2) H_2Se

3) H_2S 4) H_2Po

118. Which one of the VI group elements has the highest catenation power?

1) O 2) Se

3) S 4) Te

119. Which of the following behaves as both oxidising and reducing agents?

1) H_2SO_4 2) SO_2

3) H_2S 4) HNO_3

120. Which of the following is a solid at room temperature?

1) O_3 2) SO_2

3) SF_6 4) SeO_2

121. Standard enthalpy of formation is +ve for

1) H_2O 2) H_2S

3) H_2Se 4) NH_3

122. **Statement I** : SF_6 can't be hydrolysed

Statement II : Se_2Cl_2 disproportionate on heating

1) Both statement I and statement II are incorrect

2) Statement I is correct, statement II is incorrect

3) Statement I is incorrect, statement II is correct

4) Both statement-I and statement II are correct

123. Which of the following are correct regarding oxides of group 16?

1) SO_3, SeO_3 and TeO_3 are acidic in nature

2) TeO_2 is an oxidising agent

3) O_3 and SO_2 are gases while SeO_2 is a solid

4) All are correct

124. Group 16 elements combine with halogen to form large number of halides. Which is false regarding their properties?

1) SF_6 is a gas

2) TeF_4 is a solid

3) SF_4 has tetrahedral geometry

4) Stability of halides with group 16 elements decreases in the order $F^- > Cl^- > Br^- > I^-$

125. Which one of the following is non-reducing?

1) H_2S 2) H_2Te

3) H_2Se 4) H_2O

126. ———— is polyatomic molecule.

1) Calcium 2) Oxygen

3) Sulphur 4) Barium

127. Oxidation state of oxygen in F_2O is

1) +1 2) –1

3) +2 4) –2

128. Which one of the following group 16, elements does not exist in –2 oxidation state?

1) S 2) Se

3) O 4) Po

129. Which is the correct thermal stability order for H_2E (E = O, S< Se, Te and Po)?

1) $H_2Se < H_2Te < H_2Po < H_2S < H_2O$

2) $H_2S < H_2O < H_2Se < H_2Te < H_2Po$

3) $H_2O < H_2S < H_2Se < H_2Te < H_2Po$

4) $H_2Po < H_2Te < H_2Se < H_2S < H_2O$

130. H_2S is not a/an

1) reducing agent 2) acidic

3) oxidising agent 4) none of these

GROUP 17 - HALOGEN FAMILY

Atomic and Physical Properties of Group 17

131. The property of halogens which is not correctly matched is:

1) F > Cl > Br > I (Ionisation energy)

2) F > Cl > Br > I (Electron negativity)

3) I > Br > Cl > F (Density)

4) F > Cl > Br > I (electron gain enthalpy)

132. The radio active halogen is

1) Polonium 2) Chlorine

3) Radon 4) Astatine

133. Correct order of melting point of halogen family

1) $F_2 > Cl_2 > Br_2 > I_2$

2) $I_2 > Br_2 > Cl_2 > F_2$

3) $F_2 > Cl_2 > I_2 > Br_2$

4) $I_2 > Br_2 > F_2 > Cl_2$

134. Which is incorrect statement about occurrence of group 17th elements?

1) Fluorine and chlorine are resonably abundant while bromine and iodine are comparatively rare

2) The most abundant compound of chlorine is NaCl

3) Main source of fluorine is fluorspar

4) Iodine occurs free in nature

135. The general electronic configuration of halogens is

1) ns^2np^2 2) ns^2np^3

3) ns^2np^4 4) ns^2np^5

136. Consider the following statements regarding halogens

I) Due to maximum effective nuclear charge, the halogens have the smallest atomic radii in their respective periods

II) These have low ionisation enthalpy

III) Halogens have maximum negative electron hain enthalpy

IV) Fluorine is the most electronegative element in the periodic table

The correct statements are

1) I, II, III, IV 2) I, II, III

3) I, III, IV 4) II, III, IV

137. Which one of the following orders is correct for the bond dissociation enthalpy of halogens molecules?

1) $F_2 > Cl_2 > Br_2 > I_2$

2) $I_2 > Br_2 > Cl_2 > F_2$

3) $Cl_2 > Br_2 > F_2 > I_2$

4) $Br_2 > I_2 > F_2 > Cl_2$

138. The halogen-halogen bond length is shortest for:

1) Cl_2 2) F_2

3) I_2 4) Br_2

139. Ionisation enthalpy of halogens are in the order

1) F > Cl > Br > I

2) Cl > F > Br > I

3) Cl > Br > I > F

4) Cl > Br > F > I

140. Identify correct statement

1) Sea water is mainly sodium chloride solution (25% by mass)

2) Various sea weeds, contain upto 50% of iodine

3) Chile saltpetre contains upto 0.2% of sodium iodate

4) The deposits of dried up seas contains KCl. $MgCl_2.6H_2O$ along with Na_3AlF_6

Oxidation states and trends in chemical reactivity

141. Which one of the following hydrogen halides has the least bond dissociation enthalpy?

1) HF 2) HBr

3) HI 4) HCl

142. Fluorine is the best oxidising agent because it has

1) highest electron affinity

2) highest reduction potential

3) highest oxidation potential

4) lowest electron affinity

143. Which of the following does not liberate Br_2 form KBr?

1) F_2 2) Cl_2

3) I_2 4) All

144. Which of the following statement is not correct?

1) Acidic character of group 17 hydrides increases down the group

2) Oxidation states of chlorine in Cl_2O_6 is +6

3) $SbCl_3$ is more covalent than $SbCl_5$

4) Most of the reactions of fluorine are exothermic

145. Halogens react with metals to form metal halides. Order of ionic character of monovalent metal halides is

1) MF > MCl > MBr > MI

2) MCl > MBr > MI > MF

3) MI > MBr > MCl > MF

4) MI > MBr > MF > MCl

146. Among the following, non-existing species is

1) ClF

2) BrF

3) IF_2

4) IF_7

147. Which is incorrectly matched?

1) Liquid halogens-Br_2

2) Most electronegative element - F_2

3) The most reactive halogen - F_2

4) The strongest oxidising agent - I_2

148. Which of the following halogen acid is a liquid?

1) HI

2) HF

3) HCl

4) HBr

149. Which of the following are correct regarding halogens?

A) Fluorine forms only one oxoacid

B) O_2F_2 oxidises plutonium to PuF_6

C) Chlorine oxides are highly reactive oxidising agents and tends to explode

D) Bromine oxides are least stable and exist only at low temperature

E) I_2O_5 is used in the estimation of carbon monoxide

F) In the interhalogen compound XX_n^1, the maximum value of n is 8

1) All the above 2) A, B, C, D and E

3) B, C and F 4) A, B, C and F

150. Which of the following statements about the halogens is correct?

1) They are all diatomic and forms univalent ions

2) They are all diatomic and forms divalent ions

3) They are all capable of exhibiting several oxidation states

4) They can mutually displace each other from the solution of their compound with metals

151. The element which can displace three other halogens from their compounds is

1) Cl 2) Br

3) I 4) F

152. Which one of the following reactions does not occur?

1) $F_2 + 2Cl^- \rightarrow 2F + Cl_2$

2) $Cl_2 + 2F^- \rightarrow 2Cl + F_2$

3) $Br_2 + 2I^- \rightarrow 2Br + I_2$

4) $Cl_2 + 2\,Br^- \rightarrow 2Cl + Br_2$

153. **Assertion** : Halogens do not occur in free state

Reason : Halogens are highly reactive

1) If both assertion and reason are true and the reason is a correct explanation of the assertion

2) If both assertion and reason are true but reason is not a correct explanation of the assertion

3) If assertion is true but the reason is false

4) If both assertion and reason are false

154. When Br_2 is treated with aqueous solutions of NaF, NaCl and NaI separately

1) F_2,Cl_2 and I_2 are liberated

2) Only F_2 and Cl_2 are liberated

3) Only I_2 is liberated

4) Only Cl_2 is liberated

155. Strongest reducing agent is:

1) F^-

2) Cl^-

3) Br^-

4) I^-

156. The correct order of the thermal stability of hydrogen halides (H-X) is

1) HI > HCl < HF > HBr

2) HCl < HF > HBr < HI

3) HF > HCl > HBr > HI

4) HI < HBr > HCl < HF

157. Which of the following statement is not true?

1) Halogens act as strong oxidizing agents

2) Fluorine can displace oxygen from water molecule

3) Iodine has good solubility in water

4) Solubility of iodine in water much increases by adding KI due to formation of I_3^- ions

158. The element with atomic number 117 if discovered would be placed in

1) noble gas family

2) alkali family

3) alkaline earth family

4) halogen family

159. Which is the weakest acid out of HF HCl, HBr and HI?

1) HF 2) HBr

3) HCl 4) HI

GROUP 18 ELEMENTS - NOBLE GASES

Atomic and Physical Properties of Group 18 Elements

160. The rare gas which is more abundant in atmosphere is

1) Ne 2) Rn

3) Xe 4) Ar

161. Which one of the following is not a monoatomic element?

1) Copper 2) Helium

3) Iodine 4) Barium

162. **Assertion (A)** : The boiling points of noble gases increases from He to Xe.

Reason (R) : The interatomic van der Waals attractive forces increases from He to Xe

The correct answer is

1) Both A and R are true, and R is the correct

2) Both A and R are false, and R is not the correct explanation of A

3) A is true but R is not true

4) A is not true but R is true

163. Which of the following noble gases has the highest van der Waal's forces of attraction?

1) Ar 2) Ne

3) Xe 4) He

164. **Assertion** : Inert gases are monoatomic

Reason : Inert gases have stable configuration

1) If both assertion and reason are correct and the reason is a correct explanation of the assertion

2) If both assertion and reason are correct and the reason is not a correct explanation of the assertion

3) If the assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

165. Which one of the following represents noble gas configuration?

1) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 5s^2\ 5p^6\ 5d^6\ 6s^2$

2) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 5s^2\ 5p^6\ 5d^1\ 6s^2$

3) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 5s^2\ 5p^6$

4) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4f^{14}\ 5s^2\ 5p^6\ 5d^1$

166. Ionisation potential for a noble gas is:

1) maximum in a period

2) minimum in a period

3) either minimum or maximum

4) constant

167. The gas most difficult to liquefy is:

1) He 2) Ne

3) Xe 4) Ar

168. The noble gas that does not occur in the atmosphere is

1) Ra 2) Kr

3) He 4) Ne

169. The lightest gas is

1) N_2 2) Ar

3) Rn 4) He

Chemical Properties

170. Which noble gas least tendency to form compounds?

1) Ar 2) Kr

3) He 4) Xe

171. Identify the element having zero valency

1) Sulphur 2) Phosphorous

3) Lead 4) Radon

172. What is the atomic number (z) of the noble gas that reacts with fluorine?

1) 54 2) 10

3) 18 4) 2

173. Who discovered the first noble gas compound?

1) Neils Bohr 2) Neil Bartlett

3) Neil Armsstrong 4) William

174. Which of the following noble gases is most reactive?

1) He 2) Ne

3) Ar 4) Xe

175. Which noble gas has the highest first ionizatin energy?

1) helium 2) xenon

3) radon 4) neon

176. Which of the following noble gases has the highest positive electron gain enthalpy value?

1) Helium

2) Krypton

3) Argon

4) Neon

177. Noble gases are named because of their inertness towards reactivity. Identify an incorrect statement about them.

1) Noble gases have large positive value of electron gain enthalpy

2) Noble gases are sparingly soluble in water

3) Noble gases have very high melting and boiling point

4) Noble gases have weak dispersion force

178. Which type of bond is present in Xe molecule?

1) Covalent

2) Ion-dipole

3) van der Waals

4) Dipole-dipole

179. The only confirmed compound of Radon is

1) Rn_2O

2) Rn_2F

3) RnF

4) RnF_2

SAMPLE QUESTIONS

1. Which element of group 13 forms the most stable +1 oxidation state?

1) B 2) Al

3) Ga 4) Tl

2. Which of the following elements forms only covalent bonds with others?

1) B 2) Al

3) Ga 4) In

3. Amongst the following, which metal exist in liquid state during summer?

1) B 2) Al

3) Ga 4) In

4. Which member of group 13 does not generally exhibit the group valency in its compounds?

1) Al 2) Ga

3) In 4) Tl

5. Which of the following oxide is amphoteric in nature?

1) B_2O_3

2) Al_2O_3

3) In_2O_3

4) Tl_2O_3

6. Which of the following statement is false?

1) BCl_3 and $AlCl_3$ are both Lewis acids

2) Boron trioxide shows the acidic character

3) Aluminium is a good reducing agent

4) Boron can able to form BF_6^{3-} ion

7. Boric acid is

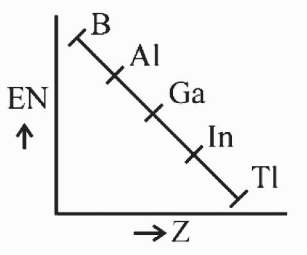
1) $Na_2B_4O_7.10H_2O$

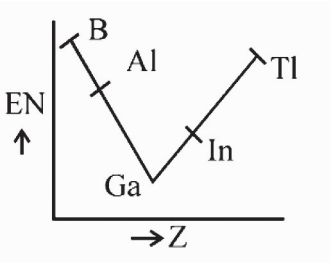
2) $Na_2B_4O_7.4H_2O$

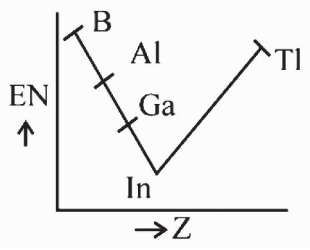
3) $B(OH)_3$

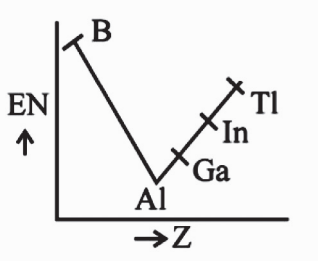
4) B_2O_3

8. Which one of the following correctly represents the variation of electronegativity (EN) with atomic number (Z) of group 13 elements?

1) 

2) 

3) 

4) 

9. Which of the following is a non-metal?

1) C 2) Ge

3) Sn 4) Fl

10. Most thermally stable tetrahalide is

1) CCl_4 2) $SiCl_4$

3) $GeCl_4$ 4) $PbCl_4$

11. The catenation tendency of C, Si and Ge is in the order Ge < Si < C. The bond energies (in kJ mol^{-1}) of C – C, Si – Si and Ge – Ge bonds are respectively

1) 348, 297, 260

2) 297, 348, 260

3) 348, 260, 297

4) 260, 297, 348

12. Which is incorrect with group 14 elements?

1) Covalent radii increases from carbon to silicon and thereafter a small increase

2) After the first member, EN values remain nearly the same

3) The first IE values have a regular decreases downwards except lead

4) Density of Pb is less than that of C

13. The reducing power of divalent species increases in the order

1) Ge < Sn < Pb

2) Sn < Ge < Pb

3) Pb < Sn < Ge

4) None of these

14. Which of the following species doesn't exist?

1) SiF_6^{2-}

2) $SiCl_6^{2-}$

3) $GeCl_6^{2-}$

4) $\left[Sn(OH)_6\right]^{2-}$

15. The hybridisation of Pb in PbI_4 is

1) sp^2 2) sp^3

3) sp^3d 4) none

16. Which one of the following is effected by water?

1) C 2) Ge

3) Pb 4) None

17. Tin monoxide is

1) Distinctly acidic 2) Neutral

3) Basic 4) Amphoteric

18. What is the number of valence electrons in nitrogen

1) 7 2) 3

3) 5 4) 8

19. What are the similarities between nitrogen and phosphorus?

1) Forms diatomic molecules

2) Not possible to extent its coordination number beyond 4

3) Forms pentahalides

4) Forms acidic oxide

20. The p-block element that forms basic oxide is

1) N 2) P

3) As 4) Bi

21. Nitrogen is relatively inactive element because

1) its atoms has a stable completely filled electronic configuration

2) it has low atomic radius

3) its electronegatively is fairly high

4) dissociation energy of its molecule is fairly high

22. **Assertion** : Catenation tendency is weaker in nitrogen

Reason : Nitrogen exists as diatomic gas

1) If both assertion and reason are true and the reason is a correct explanation of the assertion

2) If both assertion and reason are true but reason is not a correct explanation of the assertion

3) If assertion is true but the reason is false

4) If both assertion and reason are false

23. The hydrides of group 15 elements act as

1) Lewis acids 2) Lewis bases

3) Both 4) None of these

24. The stable oxidation state of Bi is:

1) –1 2) +3

3) +5 4) +2

25. Which species has the electron configuration of $[Xe]4f^{14}\ 5d^{10}\ 6s^2\ 6p^3$

1) Mc 2) Bi

3) Sb 4) As

26. Match column I with column II

Column I		Column II	
A)	Gypsum	P)	$CuFeS_2$
B)	Epsom salt	Q)	$BaSO_4$
C)	Baryte	R)	$MgSO_4.7H_2O$
D)	Copper pyrites	S)	$CaSO_4.2H_2O$

1) A-P, B-Q, C-R, D-S

2) A-S, B-R, C-Q, D-P

3) A-Q, B-P, C-S, D-R

4) A-S, B-P, C-Q, D-R

27. Group 16 elements combine with halogen to form large number of halides. Which is false regarding their properties?

1) SF_6 is inert towards hydrolysis

2) SF_4 is a gas

3) Hybridisation of S in SCl_2 is sp^2

4) Stability of halides with group 16 elements decreases in the order $F^- > Cl^- > Br^- > I^-$

28. Which of the following is wrong regarding chalcogens?

1) General electronic configuration is ns^2np^3

2) Ionisation enthalpy decreases down the group

3) Electron gain enthalpy of first element is least negative

4) All exhibit allotropy

29. Which one of the following statement is false?

1) Oxygen has less negative electron gain enthalpy than sulphur

2) Oxygen has less electronegativity than fluorine

3) Melting point of oxygen is less than that of sulphur (monoclinic)

4) Oxygen is a non metal while sulphur is a metal

30. If X is a member of chalcogen family, the highest of X^{-2} is exhibited by:

1) Oxygen

2) Sulphur

3) Selenium

4) Tellurium

31. **Assertion** : SF_4 does not have a tetrahedral structure

Reason : S in SF_4 has two lone pairs

1) If both assertion and reason are true and the reason is a correct explanation of the assertion

2) If both assertion and reason are true but reason is not a correct explanation of the assertion

3) If assertion is true but the reason is false

4) If both assertion and reason are false

32. Identify incorrect statement

1) H_2S is more acidic than H_2O

2) SF_6 exist but OF_6 does not

3) Te has larger boiling point than Po

4) Sulphur has larger ionisation enthalpy than oxygen

33. **Statement I** : TeO_2 acts as an oxidising agent as well as reducing agent

Statement II : SO_2 acts as an oxidising agent as well as reducing agent

1) Both statement I and statement II are true

2) Both statement I and statement II are false

3) Statement I is true, but statement II is false

4) Statement I is false, but statement II is true

34. Which of the following hydrides of the oxygen family shows the lowest boiling point?

1) H_2O 2) H_2S

3) H_2Se 4) H_2Te

35. The colour of Br_2 is

1) yellow 2) greenish yellow

3) red 4) violet

36. Which bond has the leastest polarity?

1) H – F 2) H – Cl

3) H – Br 4) H – I

37. The halogen having the highest covalent radius is

1) F 2) I

3) Cl 4) Br

38. The strongest oxidising agent among the following is

1) Oxygen 2) Fluorine

3) Chlorine 4) Bromine

39. The hydrides of the first elements in groups 15-17 namely NH_3 H_2O and HF respectively show abnormally high values for melting and boiling points. This is due to

1) small size of N, O and F

2) the ability to form extensive intermolecular H-bonding

3) the ability to form extensive intramolecular H-bonding

4) effective van der Waal's interaction

40. pK_a value is least for

1) HF 2) HCl

3) HBr 4) HI

41. Match List-I with List-II

List-I (Halogen)		List-II (Bond dissociation enthalpy)	
A)	F_2	p)	158.8 kJ mol^{-1}
B)	Cl_2	q)	242.6 kJ mol^{-1}
C)	Br_2	r)	192.8 kJ mol^{-1}
D)	I_2	s)	151.1 kJ mol^{-1}

1) A-p, B-q, C-r, D-s

2) A-q, B-r, C-p, D-s

3) A-p, B-r, C-q D-s

4) A-q, B-s, C-s, D-p

42. Which of the following statements is incorrect regarding nobel gases?

1) The most abundant inert gas is argon

2) Electrongain enthalpy of Kr and Xe are same

3) High ionisation enthalpy due to stable electronic configuration

4) No true compounds of Ar, Ne or He are yet known

43. Which of the following noble gas compound does not exist/not identified?

1) XeF_4

2) RnF_2

3) HeF_2

4) KrF_2

44. The electron gain enthalpy of neon is

1) –116 kJ/mol

2) –96 kJ/mol

3) +96 kJ/mol

4) +116 kJ/mol

45. **Assertion** : He has the highest ionisation enthalpy in the periodic table

Reason : He has a very small atomic size and a stable electronic configuration

1) If both assertion and reason are true and the reason is a correct explanation of the assertion

2) If both assertion and reason are true but reason is not a correct explanation of the assertion

3) If assertion is true but the reason is false

4) If assertion is false but the reason is true

ANSWER KEY

1.	2	37.	4	73.	2	109.	1	145.	1
2.	4	38.	3	74.	4	110.	4	146.	3
3.	4	39.	1	75.	2	111.	1	147.	4
4.	2	40.	3	76.	2	112.	4	148.	2
5.	3	41.	1	77.	1	113.	1	149.	2
6.	1	42.	4	78.	4	114.	2	150.	1
7.	2	43.	2	79.	1	115.	1	151.	4
8.	3	44.	2	80.	2	116.	3	152.	2
9.	4	45.	2	81.	3	117.	3	153.	1
10.	2	46.	2	82.	4	118.	3	154.	3
11.	1	47.	2	83.	4	119.	2	155.	4
12.	2	48.	4	84.	1	120.	4	156.	3
13.	1	49.	1	85.	1	121.	3	157.	3
14.	1	50.	4	86.	1	122.	4	158.	4
15.	3	51.	1	87.	2	123.	4	159.	1
16.	2	52.	4	88.	1	124.	3	160.	4
17.	4	53.	2	89.	4	125.	4	161.	3
18.	3	54.	3	90.	3	126.	3	162.	1
19.	2	55.	4	91.	1	127.	3	163.	3
20.	3	56.	1	92.	3	128.	4	164.	1
21.	1	57.	4	93.	4	129.	4	165.	3
22.	4	58.	3	94.	3	130.	3	166.	1
23.	1	59.	4	95.	2	131.	4	167.	1
24.	1	60.	4	96.	3	132.	4	168.	1
25.	1	61.	4	97.	1	133.	2	169.	4
26.	1	62.	1	98.	2	134.	4	170.	3
27.	2	63.	3	99.	2	135.	4	171.	4
28.	1	64.	4	100.	2	136.	3	172.	1
29.	3	65.	1	101.	3	137.	3	173.	2
30.	4	66.	4	102.	1	138.	2	174.	4
31.	1	67.	2	103.	3	139.	1	175.	1
32.	3	68.	3	104.	1	140.	3	176.	4
33.	1	69.	2	105.	1	141.	3	177.	3
34.	3	70.	2	106.	2	142.	2	178.	3
35.	1	71.	4	107.	4	143.	3	179.	4
36.	2	72.	4	108.	2	144.	3		

ANSWER KEY

SAMPLE QUESTIONS

1.	4	12.	4	23.	2	34.	2
2.	1	13.	3	24.	2	35.	3
3.	3	14.	2	25.	2	36.	4
4.	4	15.	4	26.	2	37.	2
5.	2	16.	4	27.	3	38.	2
6.	4	17.	4	28.	1	39.	2
7.	3	18.	3	29.	4	40.	4
8.	4	19.	4	30.	1	41.	1
9.	1	20.	4	31.	3	42.	2
10.	1	21.	4	32.	4	43.	3
11.	1	22.	2	33.	4	44.	4
						45.	1

WORK BOOK

Chapter 09

ORGANIC CHEMISTRY; SOME BASIC PRINCIPLES & TECHNIQUES - PART-I (NOMENCLATURE)

QUESTIONS

INTRODUCTION

1. Saturated hydrocarbons are otherwise referred as

1) Alkane 2) Alkene

3) Alkyne 4) Alkenynes

2. Which of the following compounds contain one sp hybridised carbon atom?

1) $(CH_3)_2CO$

2) C_6H_6

3) $CH_2 = C = O$

4) $CH_3 – CH = CH_2$

3. Thiophene is

1) Heterocyclic but not aromatic

2) Homocyclic but not aromatic

3) Heterocyclic and aromatic

4) Homocyclic and aromatic

4. The no.of 2° carbon atoms in the following $(CH_3)_2CHCH_2CH(CH_3)_2$ is

1) 1 2) 2

3) 3 4) 4

5. Which of the following is incorrect about homologous series

1) They have a difference of $–CH_2$ group between any two successive members

2) They can be represented by a general formula

3) They are all unbranched compounds

4) They contain the same functional group

6. Which of the following is the first member of ester homologous series

1) Ethylethanoate

2) Methylethanoate

3) Methylmethanoate

4) Ethylmethanoate

7. In IUPAC system 1° prefix is used to specify

1) Presence of functional group

2) Presence of side chain

3) Presence of multiple bond

4) Whether the compound is cyclic or acyclic

8. Which one of the following is the heterocyclic compound

1) Phenol 2) Aniline

3) Toluene 4) Furan

9. The suffix for alcohol, aldehyde and ketone according to IUPAC system are respectively

1) –al, –ald, ket

2) –ol, -al, ket

3) –ol, –al, –one

4) –one, –al, –ol

10. Match the column I with column II

Column I		Column II	
1)	1^0 suffix	a)	–ol
2)	2^0 suffix	b)	cyclo
3)	1^0 prefix	c)	nitro
4)	2^0 prefix	d)	ene

1) 1-d, 2-a, 3-b, 4-c 2) 1-b, 2-c, 3-d, 4-a

3) 1-d, 2-b, 3-a, 4-c 4) 1-a, 2-b, 3-c, 4-a

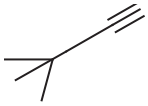
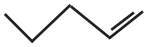
11. The hybridisation of 3rd carbon of the compound $CH_3 - CH = C = CH - CH_3$ is

1) sp^3 2) sp

3) sp^2 4) sp^3d

12. Which one is the correct bond line structure of the following compound $(CH_3)_2CHC \equiv CH$?

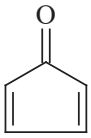
1) 2)

3)  4) 

13. Which of the following is alicyclic, heterocyclic compound?

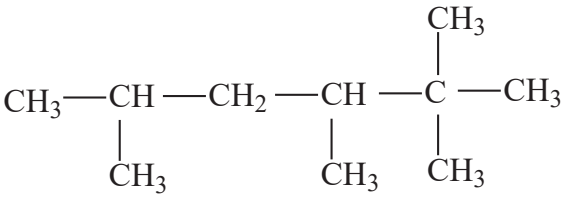
1)

2)

3) 

4)

14. How many primary, secondary, tertiary and quaternary carbon atoms are present in the following compound



1) One primary, two secondary and two tertiary

2) Five primary, one secondary, one tertiary and one quaternary

3) Six primary, one secondary, two tertiary and one quaternary

4) Six primary, four secondary

SATURATED HYDROCARBONS

15. Identify the false statement

1) IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-$ 1-Methyl ethyl

2) Isobutyl is also accepted as IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-$

3) IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2-$ is 2-Methylbutyl

4) Isopentyl is also accepted as IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2-$

16. IUPAC name of the compound

$CH_3CH_2\underset{\underset{CH_2CH_3}{|}}{CH}-CH(CH_3)CH_2CH_3$ is

1) 4-Methyl-3-ethylhexane

2) 3-Ethyl-4-methylhexane

3) 1,1-Diethyl-2-methylbutane

4) 3-Methyl-4,4-diethylbutane

17. The compound with an isogroup is

1) 2,2,3,3-Tetramethylpentane

2) 2,2-Dimethylpentane

3) 2,2,3-Trimethylpentane

4) 2-Methylbutane

18. IUPAC name of neohexane

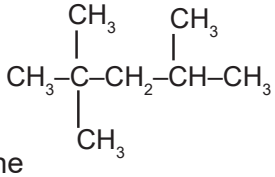
1) 2-Methylbutane

2) 2,2-Dimethylbutane

3) 2-Methylpropane

4) 2,2,3-Trimethylpropane

19. IUPAC name of isooctane is



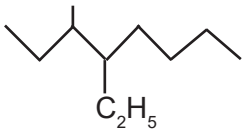
1) 2,4,4-Trimethylpentane

2) 2,2,4-Trimethylpentane

3) Neooctane

4) Isopropyl neobutylmethane

20. Name of the compound given below is



1) 3-Methyl-4-ethyloctane

2) 2,3-Diethylheptane

3) 5-Ethyl-6-methyloctane

4) 4-Ethyl-3-methyloctane

21. Which of the following is an alkylidene group?

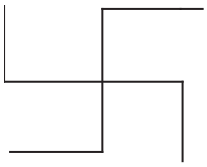
1) $CH_3 - CH_2 -$

2) $CH_3 - CH$

3) $CH_3 - C$

4) $CH_3 -$

22. The IUPAC name ofg the given structure is



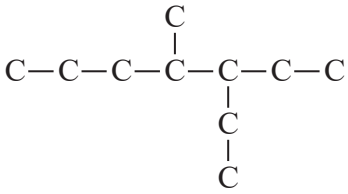
1) 3,3-Dimethylpentane

2) 3,3-Diethylpentane

3) 3-Ethyl-3-methylpentane

4) 3-Ethyl-3-ethylpentane

23. The name of the saturated hydrocarbons with the following skeleton



1) 4-Methyl-5-ethylheptane

2) 3-Ethyl-4-methylheptane

3) 3-Isopentylheptane

4) Isodecane

24. Which of the following IUPAC name is correct?

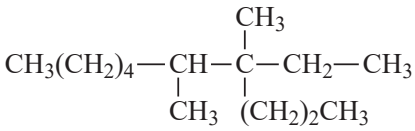
1) 2-Methyl-3-ethylpentane

2) 2-Ethyl-3-methylpentane

3) 3-Ethyl-2-methylpentane

4) 3-Methyl-2-ethylpentane

25. IUPAC name of



is

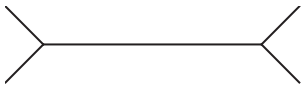
1) 3,4-Dimethyl-3-n-propylnonane

2) 4-Ethyl-4,5-dimethyldecane

3) 6,7-Dimethyl-7-n-propylnonane

4) 6,7-Dimethyl-7-diethyldecane

26. IUPAC name of the given structure is



1) 2,2-Dimethylbutane

2) Isohexane

3) 2,3-Dimethylbutane

4) Diisohexane

27. The IUPAC name of $(CH_3)_2CHCH_3$ is:

1) Isopropylmethane

2) 2-Methylpropane

3) Trimethylmethane

4) Dimethylethane

28. The IUPAC name of isooctane is

1) 2,2-Dimethylpentane

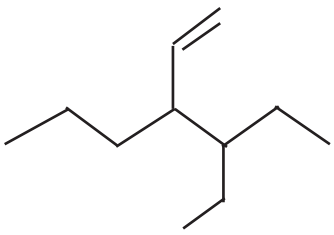
2) 2,3-Dimethylpentane

3) 2,3,3-Trimethylpentane

4) 2,2,4-Trimethylpentane

UNSATURATED HYDROCARBONS

29. The correct IUPAC name of the compound



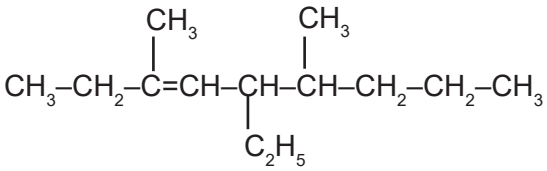
1) 3-Ethyl-4-ethenylheptane

2) 3-Ethyl-4-propylhex-5-ene

3) 3-(1-Ethyl propyl)hex-1-ene

4) 4-Ethyl-3-propylhex-1-ene

30. The correct IUPAC name of the compound



1) 5-Ethyl-3,6-dimethylnon-3-ene

2) 5-Ethyl-4,7-dimethylnon-3-ene

3) 4-Methyl-5,7-dimethyloct-2-ene

4) 2,4-Dimethyl-5-methyloct-2-ene

31. The correct IUPAC name of 2-Ethylpent-3-yne

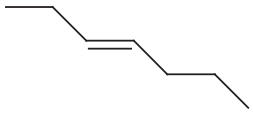
1) 3-Methylhex-4-yne

2) 4-Ethylpent-3-yne

3) 4-Methylhex-2-yne

4) 2-Ethylpent-4-yne

32. IUPAC name of



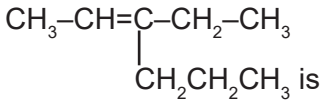
1) Hept-3-ene

2) Hept-4-ene

3) Hex-2-ene

4) Hex-3-ene

33. The IUPAC name of the compound



is

1) 3-Ethylhex-2-ene

2) 3-Propyl-hex-2-ene

3) 3-Propylhex-3-ene

4) 4-Ethylhex-4-ene

34. The IUPAC name of $(CH_3)_3C–CH = CH_2$ is

1) 2,3-Dimethylbut-3-ene

2) 2,3-Dimethylpent-4-ene

3) 3,3-Dimethylbut-1-ene

4) 2,3-Dimethylpent-1-ene

35. **Assertion (A** : The correct IUPAC name of the compound $CH_2=CH-CH_2-C\equiv CH$ is pent-1-en-3-yne

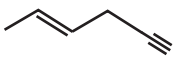
Reason (R) : When both double and triple bond are at same position, double bond get the preference

1) Assertion and Reason are correct Reason is not correct explanation of Assertion

2) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

3) Assertion wrong Reason correct

4) Assertion and Reason are incorrect

36. IUPAC name of 

1) hex-2-en-5-yne

2) hexa-2-en-5-yne

3) hex-4-en-1-yne

4) hex-1-yne-4-ene

37. Give the IUPAC name of tetra methyl ethylene

1) 2,3-Dimethyl but-2-ene

2) 1,1,2,2-Tetramethyl ethene

3) 2,3-Dimethyl butane

4) 1,1,2,2-Tetramethyl ethane

38. The IUPAC name of

$$(CH_3)_2CH-CH=CH-CH=CH-\underset{\underset{C_2H_5}{|}}{CH}-CH_3$$

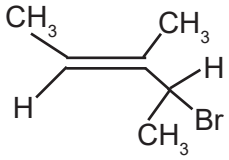
1) 2,7-Dimethylnona-3,5-diene

2) 2,7-Dimethyl-2-ethylheptadiene

3) 2-Methyl-7-ethylocta-3,5-diene

4) 1,1-Dimethyl-6-ethylhepta-2,4-diene

39. What is the IUPAC name of the following compound?



1) 3-Bromo-1,2-dimethylbut-1-ene

2) 4-Bromo-3-methylpent-2-ene

3) 2-Bromo-3-methyl pent-3-ene

4) 3-Bromo-3-methyl-1, 2 dimethyl prop-1-ene

40. The IUPAC name of the compound

$$CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{CH_2}{\|}}{C}-CH_2-CH_3$$

1) 2-Ethyl-3-methylbut-1-ene

2) 2-Isopropyl but-1-ene

3) 2-Methyl-3-ethylbut-3-ene

4) 2(1-Methyl ethyl)but-1-ene

41. The IUPAC name of

$$CH_3-CH=\underset{\underset{CH_2CH_2CH_3}{|}}{C}-CH_2CH_3$$ is

1) 3-Propylhex-2-ene

2) 3-Propylhex-3-ene

3) 4-Ethylhex-4-ene

4) 3-Ethylhex-2-ene

42. The correct IUPAC name of the compound,

$$\begin{array}{l} \qquad\qquad\qquad\qquad\quad CH_3 \\ \qquad\qquad\qquad\qquad\quad | \\ CH_3CH_2-\underset{\underset{|}{}}{C}=CH-CH-CH_2-CH_3 \\ CH_3CH_2-CH-CH_2-CH_2-CH_2-CH_3 \end{array}$$

1) 5,6-Diethyl-3-methyl-dec-4-ene

2) 5,6-Diethyl-8-methyl-dec-6-ene

3) 6-Butyl-5-ethyl-3-methyl-oct-4-ene

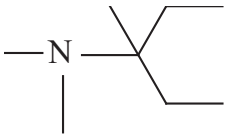
4) 2,4,5-Triethyl-3-nonane

ORGANIC COMPOUNDS CONTAINING FUNCTIONAL GROUP

43. IUPAC name of $CH_3-O-CH_2CH_3$ is

1) Ethoxymethane
2) Methoxyethane
3) Methylethylether
4) Ethylmethylether

44. The IUPAC name of the following compound



1) N,N-Dimethyl-3-methylpentanamine
2) N,N,3-Trimethylpentan-3-amine
3) 3-Methyl-N,N,3-Trimethylpentanamine
4) Both 1 and 2

45. The IUPAC name of Cl_3CCH_2CHO is

1) Chloral
2) 3,3,3-Trichloropropanal
3) 1,1,1-Trichloropropanal
4) 2,2,2-Trichloro propanal

46. The structure of 4-Methyl pent-2-en-1-ol is

1) $(CH_3)_2C = CHCH_2CH_2OH$
2) $(CH_3)_2CHCH = CHCH_2OH$
3) $CH_3\ CH_2\ CH = CH\ CH_2OH$
4) $CH_3CH\ (OH)\ CH = C(CH_3)_2$

47. The compound $(RCO)_2O$ belongs to the class

1) Alkanoid
2) Acid anhydrides
3) Esters
4) Alkendiones

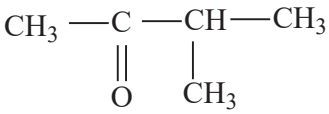
48. The formula of propane nitrile is

1) CH_3CN
2) CH_3CH_2CN
3) $CH_3CH_2CH_2CN$
4) CH_3CH_2NC

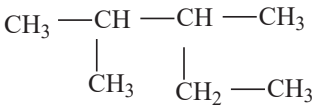
49. The common name of propanone is

1) Acetone
2) Dimethyl ketone
3) Ethyl methyl ketone
4) Both 1 and 2

50. The incorrect IUPAC name is

1) 

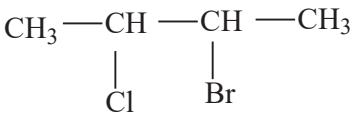
2-Methylbutan-3-one

2) 

2, 3-Dimethylpentane

3) $CH_3 - C\equiv C - CH(CH_3)_2$

4-Methylpent-2-yne

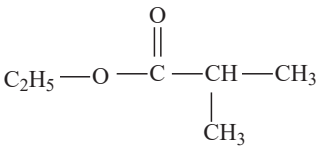
4) 

2-Bromo-3-chlorobutane

51. The IUPAC name of $CH_2 = CH - CN$ is

1) Ethane nitrile
2) Vinyl cyanide
3) Cyano ether
4) Prop-2-enenitrile

52. The IUPAC name of



is

1) Ethoxymethanone

2) Ethyl-2-methylpropanoate

3) Ethoxypropanone

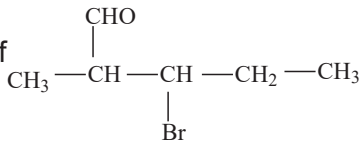
4) 2-Methylethoxypropanone

53. Ethanoyl chloride is the IUPAC name of

1) CH_3CH_2Cl 2) CH_3COCl

3) CCl_3CHO 4) $CH_2ClCOOH$

54. The IUPAC name of



is

1) 2-Methyl-3-bromohexanal

2) 3-Bromo-2-methylbutanal

3) 3-Bromo-3-formylpentane

4) 3-Bromo-2-methylpentanal

55.

List-I (Functional group)		List-II (Suffix name)	
A)	$-CONH_2$	P)	Carbonitrile
B)	–CN	Q)	Carboxamide
C)	–CHO	R)	Carboxylic acid
D)	–COOH	S)	Carbaldehyde

1) A-P; B-Q; C-R; D-S

2) A-Q; B-P; C-R; D-S

3) A-Q; B-P; C-S; D-R

4) A-S; B-P; C-Q; D-R

56. The correct IUPAC name of the compound CH_3NHCHO

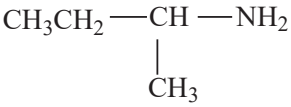
1) Methylaminoformyl

2) Methylaminomethanal

3) N-Methylformaldehyde

4) N-Methylmethanamide

57. IUPAC name of



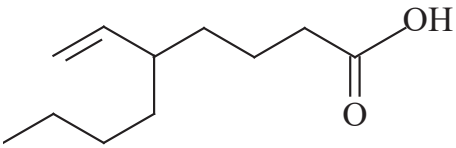
1) N-Methylbutanamine

2) 2-Methylpropanamine

3) Butan-2-amine

4) Butanamine

58. IUPAC name of the compound



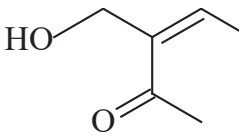
1) 5-Isobutylhept-6-enoic acid

2) 5-sec Butylhept-6-enoic acid

3) 5-tert Butylhept-6-enoic acid

4) 5-Butylhept-6-enoic acid

59. The IUPAC name of



1) 3-Acetyl-2-butene-4-ol

2) 3-Ethylidene-4-hydroxy-2-butanone

3) 3-(Hydroxymethyl)pent-3-en-2-one

4) 2-Acetyl-2-butene-1-ol

60. Which group is always taken as substituent in IUPAC nomenclature

1) $-NH_2$

2) $-NO_2$

3) $>C=O$

4) $-\overset{O}{\overset{\|}{C}}-H$

61. The IUPAC name of the compound

$$\begin{array}{c} CH_2-COOH \\ | \\ HOOC-C-OH \\ | \\ CH_2-COOH \end{array}$$ is

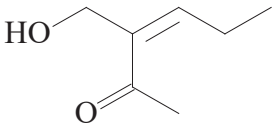
1) Citric acid

2) 1, 2, 3-tricarboxypropan-2-ol

3) 2-Hydroxypropane-1,2,3-tricarboxylic acid

4) 3-Hydroxy-3-carboxypentane-1,5-dioic acid

62. Number of carbon atoms in the parent chain of



is

1) 4 2) 5

3) 6 4) 7

63. IUPAC name of lactic acid $CH_3CH(OH)COOH$

1) 1-Hydroxypropanoic acid

2) 2-Carboxyethanol

3) 2-Hydroxypropanoic acid

4) 1-Hydroxyethanoic acid

64. IUPAC name of $(CCl_3)_2CHCl$ is

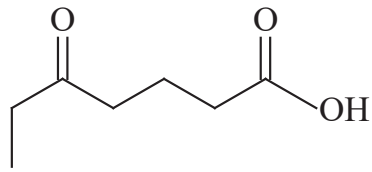
1) 1, 1, 1, 2, 3, 3, 3-hepta chloro propane

2) Tri chloromethyl ethane

3) Bis(trichloro methyl)chloromethane

4) 1, 1, 1, 2, 3, 3, 3-hepta chloro-2-(trichloromethyl propane)

65. IUPAC name of the compound



1) 5-oxo hexanoic acid

2) 3-oxohexanoic acid

3) 3,5-dioxohexanol

4) 5-oxoheptanoic acid

66. IUPAC name of the compound

$$CH_3-\overset{CH_3}{\overset{|}{C}}=CH-COOH$$ is

1) 2-Methylbut-2-enoic acid

2) 3-Methylbut-3-enoic acid

3) 3-Methylbut-2-enoic acid

4) 2-Methylbut-3-enoic acid

67. The IUPAC name of $CH_3-CH=CH-COOC_2H_5$ is

1) Ethylbut-1-enoate

2) Ethylbut-2-enoate

3) Ethylprop-2-enoate

4) Hex-2-enoate

68. The IUPAC name of $CH_3CH(OH)CH_2CH_2COOH$ is

1) 4-Hydroxy pentanoic acid

2) 1-carboxybutan-3-ol

3) 1-carboxybutan-4-ol

4) 4-carboxybutan-2-ol

69. The IUPAC name of the compound is

$$\begin{array}{ccc} CH_2 & -CH & -CH_2 \\ | & | & | \\ CN & CN & CN \end{array}$$

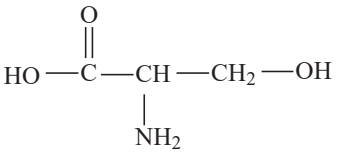
1) 1, 2, 3-Tricyanopropane

2) Propane tricarbylamine

3) Propane-1,2,3-tricarbonitrile

4) 2-cyano pentane-1,5-dinitrile

70. The IUPAC name of the following compound is



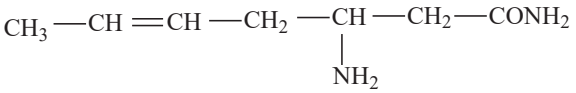
1) 3-Amino-2-hydroxypropanoic acid

2) 2-Aminopropan-3-ol-1-oic acid

3) 2-Amino-3-hydroxy propanoic acid

4) Amino hydroxy propanoic acid

71. The IUPAC name of the following is

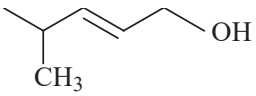


1) 3-Aminohept-5-enamide

2) 5-Amino hex-2-ene carbamide

3) 3-Amino-1-heptanamide

4) 4-Amino hept-4-enamide

72. IUPAC name of  is

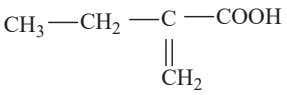
1) 5-Methylhexanol

2) 2-Methylhexenol

3) 2-Methyl hex-3-enol

4) 4-Methylpent-2-en-1-ol

73. The correct IUPAC name of



is

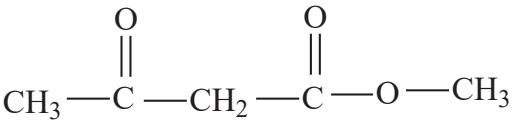
1) 2-Methylbutanoic acid

2) 2-Ethylprop-2-enoic acid

3) 2-Carboxy butene

4) None of the above

74. IUPAC name of the compound



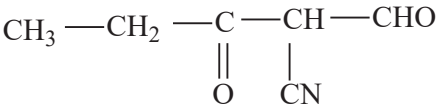
1) Methoxybutan-2,4-dione

2) Methyl-3-oxobutanoate

3) 3-oxomethylbutanoate

4) 2-oxomethylbutanoate

75. The correct IUPAC name of the compound



is

1) 2-Cyano-3-oxopentanal

2) 2-Formyl-3-oxopentanenitrile

3) 2-Cyanopentane-1,3-dione

4) 1,3-Dioxo-2-cyanopentane

76. **Assertion (A)**: Acetic acid is the IUPAC name of CH_3COOH

Reason (R) : Alkanoic acid is the IUPAC name of carboxylic acid

1) Assertion and Reason are correct Reason is not correct explanation of Assertion

2) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

3) Assertion wrong Reason correct

4) Assertion and Reason are incorrect

77. **Assertion (A)**: The IUPAC name of the compound $NCCH_2CH_2COOH$ is 3-cyanopropanoic acid

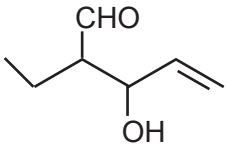
Reason (R) : –COOH is considered as substituent group while –CN is considered as principal functional group

1) Assertion and Reason are correct Reason is not correct explanation of Assertion

2) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

3) Assertion correct Reason wrong

4) Assertion and Reason are incorrect

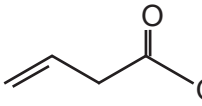
78. The IUPAC name of 

1) 3-Hydroxy-2-methylpent-4-en-1-al

2) 2-Ethyl-3-hydroxypent-4-en-1-al

3) 2-Methyl-3-hydroxybutanal

4) 3-Hydroxy-2-ethylpent-4-en-1-al

79. The IUPAC name of 

is

1) But-3-enoic acid 2) But-1-enoic acid

3) Pent-4-enoic acid 4) Prop-2-enoic acid

80. IUPAC name of $H_3C–\underset{\underset{OH}{|}}{CH}–CH_2–\underset{\underset{COOH}{|}}{CH}–CH_3$

1) 4-Hydroxy-1-methylpentanoic acid

2) 4-Hydroxy-2-methylpentanoic acid

3) 2-Hydroxy-4-methylpentanoic acid

4) 2-Hydroxy-2-methylpentanoic acid

81. IUPAC name of $CH_3–\underset{\underset{CH_3–CH–CH_3}{|}}{N}–CH_2–CH_3$

1) N-Ethyl-N-methylpropan-2-amine

2) Ethylmethylpropylamine

3) N-Propyl-N-ethylmethanamine

4) N-Methyl-N-ethylpropanamine

82. The IUPAC name of

$CH_3–\overset{\overset{O}{||}}{C}–CH_2–CH_2–\overset{\overset{O}{||}}{C}–OH$ is

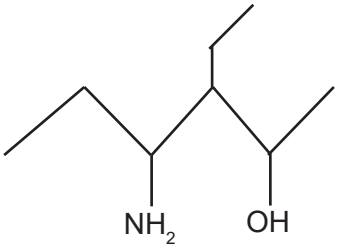
1) 1-Hydroxypentane-1,4 dione

2) 1,4 -Dioxopentanol

3) 1-Carboxybutan-3-one

4) 4-Oxopentanoic acid

83. IUPAC name of given compound is:



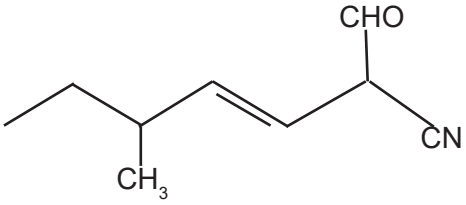
1) 3-Ethyl-4-amino-hexan-2-ol

2) 3-Amino-4-ethylhexan-5-ol

3) 2-Hydroxy-4-amino-hexan

4) 4-Amino-3-ethylhexan-2-ol

84. Give IUPAC name of :



1) 2-Cyano-5-methylhept-3-enal

2) 2-Formyl-5-methylhept-3-enenitrile

3) 2-Oxo-5-methylhept-3-ene-1-nitrile

4) 1-Cyano-1-formyl-4-methylhex-2-ene

85. The IUPAC name of $CH_3–CH_2–COO–COCH_3$ is

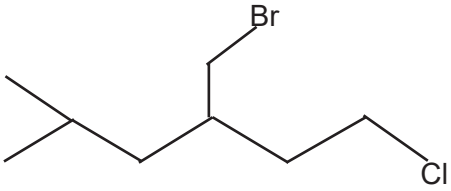
1) Acetyl propanoate

2) Ethoxy propanoxy ether

3) Ethanoic propanoic anhydride

4) Ethyl propanoate

86. IUPAC name of



is

1) 1,1-Dimethyl-3-(bromoethyl)-5-chloropentane

2) 3-(Bromomethyl)-1-chloro-5-methylhexane

3) 1-(Bromomethyl)-2-(chloroethyl)-4-methylpentane

4) 4-(Bromomethyl)-1-chloro-6-methylheptane

87. One among the following is the correct IUPAC name of the compound $CH_3 - CH_2 - O - CHO$. Identify

1) Ethoxy methanal

2) Ethoxy formaldehyde

3) Ethyloxo formaldehyde

4) Ethyl methanoate

88. **Statement I** : The IUPAC name of citric acid is 2-Hydroxy propane-1, 2,3-tricarboxylic acid.

Statement II : When 3 or more like carbon containing functional groups are directly attached to a carbon chain, the parent chain does not include the carbon atoms of the functional group.

1) **Statement I** is correct but **statement II** is incorrect.

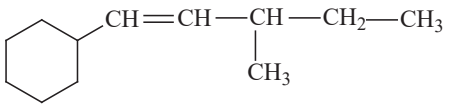
2) **Statement I** is incorrect but **statement II** is correct.

3) Both **statement I** and **statement II** are correct.

4) Both **statement I** and **statement II** are incorrect.

ALICYCLIC COMPOUNDS

89. The IUPAC name of



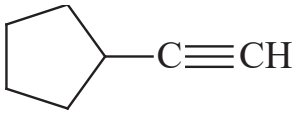
1) 1-Cyclohexyl-3-methyl pent-1-ene

2) 3-Methyl-5-cyclohexylpent-1-ene

3) 1-Cyclohexyl-3-ethyl but-1-ene

4) 1-Cyclohexyl-3,4-dimethyl but-1-ene

90. The correct IUPAC name of the compound

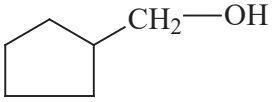


1) Ethynyl cycloheptane

2) Acetylene cyclopentane

3) Cyclopentyl ethyne

4) Cyclopentyl acetylene

91. IUPAC name of 

1) Hydroxy methyl pentane

2) Cyclopentyl methanol

3) 1-Hydroxy-1-cyclopentyl methane

4) Cyclopentane methanol

92. Give the IUPAC names of tert-Butyl cyclopentane

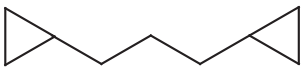
1) (1, 1-Dimethyl ethyl) cyclopentane

2) 3-Methyl-3-cyclopentyl propane

3) 2-Cyclopentyl-3-methyl propane

4) Methyl propyl cyclopentane

93. IUPAC name of the compound is



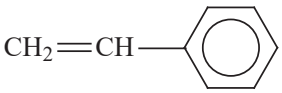
1) 1,3-Dicyclopropyl propane

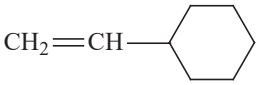
2) Propyl dicyclopropane

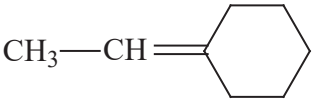
3) Nonane

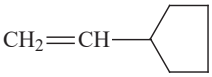
4) 1, 4-Dicyclopropyl butane

94. Ethylidene cyclohexane is

1) 

2) 

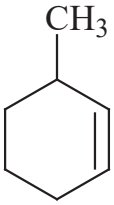
3) 

4) 

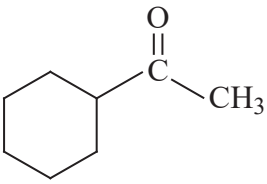
95. IUPAC name of

is

1) N-Cyclohexylbenzamide
2) N-Phenyl-N-cyclohexylmethanamide
3) N-Phenylcyclohexanecarboxamide
4) N-Cyclohexyl phenylamide

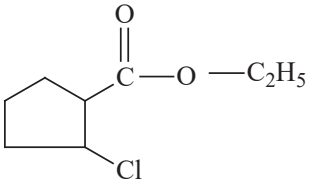
96. IUPAC name of  is

1) 3-Methylhexene
2) 3-Methylcyclohexene
3) 6-Methylcyclohexene
4) 1-Methylcyclohex-2-ene

97. The IUPAC name of  is

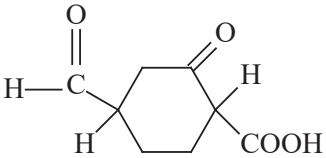
1) Acetylcyclohexadiene
2) Cyclohexylethanone
3) 6-Cyclohexa-1,3-dienylethanone
4) None of these

98. The correct IUPAC name of



1) Ethyl-2-chlorocyclopentane carboxylate
2) 2-chloroethylcyclopentane carboxylate
3) 1-chloro-2-ethoxycarbonyl cyclopentane
4) 2-chlorocyclopentanoate

99. The IUPAC name of the following polyfunctional compound is

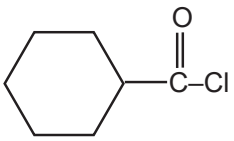


1) 2, 4-Dioxocyclohexanoic acid
2) 2,4-Dioxo cycloheptanoic acid
3) 4-Formyl-2-oxocyclohexane-1-carboxylic acid
4) 2,4-Dioxocyclohexane-1-carboxylic acid

100 **Statement I** : is called cyclohexanecarbonitrile.

Statement II : It is an aromatic compound.

1) Both statement I and statement II are correct
2) Both statement I and statement II are incorrect
3) Statement I is correct but statement II is incorrect
4) Statement I is incorrect but statement II is correct

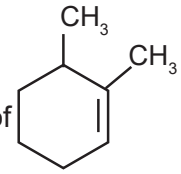
101. IUPAC name 

1) Cyclohexanoylchloride

2) Cyclohexanecarbonylchloride

3) Chlorocyclohexanone

4) None of these

102. The IUPAC name of 

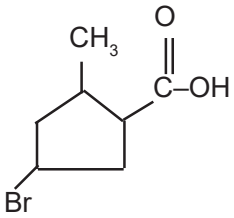
1) 1,6-Dimethylcyclohexene

2) 1,2-Dimethylcyclohex-2-ene

3) 2,3-Dimethylcyclohexene

4) 1,2-Dimethylcyclohex-6-ene

103. The IUPAC name of the following compound



is

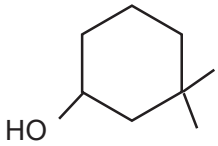
1) 3-Bromo-5-methylcyclopentanecarboxylic acid

2) 3-Bromo-5-methylcyclopentanoic acid

3) 5-Bromo-3-methylcyclopentanoic acid

4) 4-Bromo-2-methylcyclopentanecarboxylic acid

104. The IUPAC name of the compound is



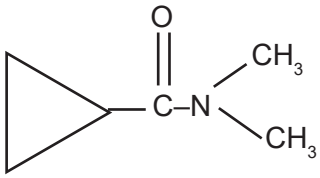
1) 3,3-Dimethycyclohexan-1-ol

2) 1,1-Dimethyl-3-hydroxycyclohexane

3) 3,3-Dimethyl-1-hydroxycyclohexane

4) 1,1-Dimethyl-3-cyclohexanol

105. IUPAC name of the following compound

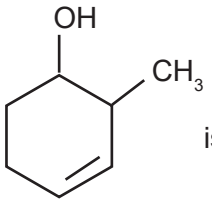


1) N,N-Dimethylcyclopropanecarboxamide

2) N-Methylcyclopropanamide

3) Cyclopropionamide

4) None of the above

106. IUPAC name of  is

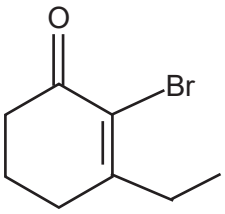
1) 4-Hydroxy-3-methylcyclohexene

2) 2-Methylcyclohex-3-en-1-ol

3) 3-Hydroxy-2-methylcyclohexene

4) 1-Hydroxy-3-methylcyclohexene

107. The IUPAC name of the following compound is



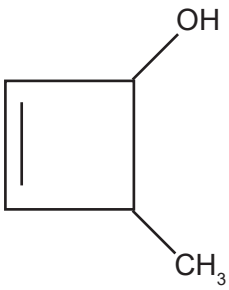
1) 1-Bromo-2-ethylcyclohex-1-en-6-one

2) 1-Bromo-6-ethylcyclohex-1-en-2-one

3) 2-Bromo-3-ethylcyclohex-2-en-1-one

4) 2-Bromo-1-ethylcyclohex-1-en-3-one

108. What is the IUPAC name of the following compound ?



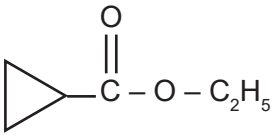
1) 3-Methylcyclobut-1-en-2-ol

2) 4-Methylcyclobut-2-en-1-ol

3) 4-Methylcyclobut-1-en-3-ol

4) 2-Methylcyclobut-3-en-1-ol

109. IUPAC name of the compound is

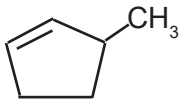


1) Ethylcyclopropanoate

2) Cyclopropylethanoate

3) Cyclopropylpropanoate

4) Ethylcyclopropanecarboxylate

110. **Assertion** :  is 3-Methyl cyclopentene

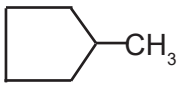
Reason : In numbering double bonded carbon atom get preference than alkyl group in cycloalkene

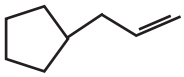
1) If both assertion and reason are true, and reason is the correct explanation of assertion

2) If both assertion and reason are true but reason is not the correct explanation of the assertion

3) If assertion is true but reason is false

4) If the assertion and reason both are true

111. **Statement I** : The correct IUPAC name for the compound  is Methyl cyclopentane.

Statement II : The IUPAC name of the compound  is 3-cyclopentylprop-1-ene

1) Both **statement I** and **statement II** are correct.

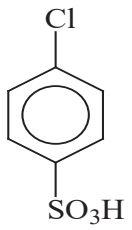
2) Both **statement I** and **statement II** are incorrect.

3) **Statement I** is correct but **statement II** is incorrect.

4) **Statement I** is incorrect but **statement II** is correct.

AROMATIC COMPOUNDS

112. IUPAC name of



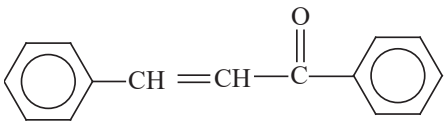
1) 4-Chlorobenzoic acid

2) 4-Chloro benzene sulphonic acid

3) Chloro sulphonic acid

4) Phenyl chlorosulphonic acid

113. IUPAC name of



is

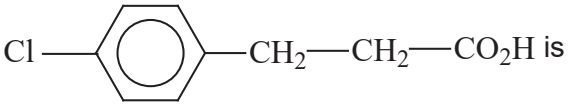
1) 1, 3-Diphenyl prop-2-en-1-one

2) Diphenyl propione

3) Phenyl propiophenone

4) 1, 3-Diphenyl prop-1-en-3-one

114. IUPAC name of



is

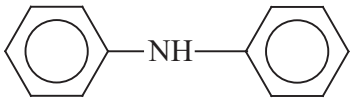
1) 3-(4-Chlorophenyl) propanoic acid

2) 4-(3-Chlorophenyl) propanoic acid

3) 1-Chloro-4-ethyl benzoic acid

4) Chloro ethyl phenyl carboxylic acid

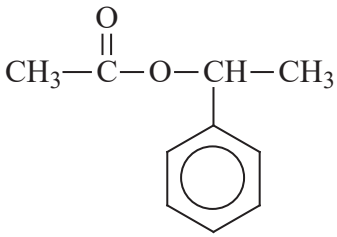
115. IUPAC name of



1) Biphenyl aniline 2) N-phenyl aniline

3) Diphenylamine 4) Both 2 and 3

116. The IUPAC name of



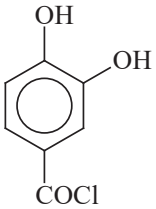
1) (1-Phenylethyl) ethanoate

2) 1-Acetoxyethylbenzene

3) 1-Methyl benzylacetate

4) 1-Phenyl-1-acetyloxyethane

117. IUPAC name of



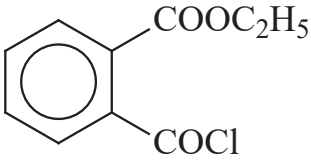
1) 1,2-Dihydroxybenzoyl chloride

2) 3,4-Dihydroxybenzoylchloride

3) 4,5-Dihydroxybenzoyl chloride

4) 1-Chlorocarbonyl benzene-3,4-diol

118. The IUPAC name of



is

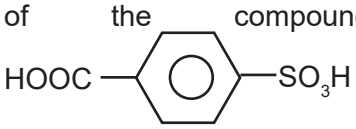
1) 2-Chlorocarbonyl ethyl benzoate

2) 2-Carboxy ethyl benzoylchloride

3) Ethyl-2-(chlorocarbonyl) benzoate

4) Ethyl-1-(chlorocarbonyl) benzoate

119. Assertion (A): The IUPAC name of the compound



is 4-Carboxybenzenesulphonic acid.

Reason (R) : While determining the priority of functional groups –COOH is preferred over $–SO_3H$ group

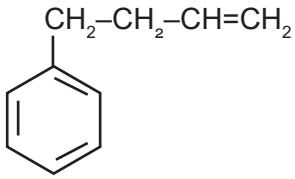
1) Assertion and Reason are correct Reason is not correct explanation of Assertion

2) Both Assertion and Reason are correct, Reason is the correct explanation of Assertion

3) Assertion wrong Reason correct

4) Assertion and Reason are incorrect

120. IUPAC name of



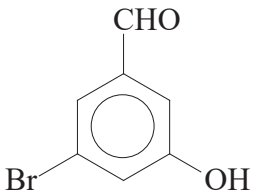
1) 2-Phenylbutene

2) Methylpropenylbenzene

3) 4-Phenylbut-1-ene

4) 2-Phenylbut-3-ene

121. The IUPAC name of



is

1) 3-Hydroxy-5-bromobenzaldehyde

2) 3-Bromo-5-hydroxybenzaldehyde

3) 5-Bromo-3-hydroxybenzaldehyde

4) 5-Bromo-3-formylphenol

122. IUPAC name of m-cresol is

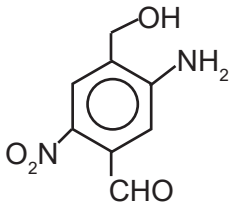
1) Benzene-1,3-diol

2) 3-Chlorophenol

3) 3-Methylphenol

4) 3-Methoxyphenol

123. The IUPAC name of the following compounds



is

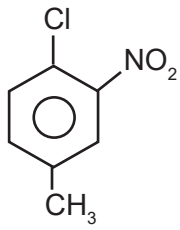
1) 2-Nitro-4-(hydroxymethyl)-5-aminobenzaldehyde

2) 3-Amino-4-(hydroxymethyl)-1-5-nitrobenzaldehyde

3) 5-Amino-4-(hydroxymethyl)-2-nitrobenzaldehyde

4) 4-Amino-2-formyl-5-(hydroxymethyl)-nitrobenzene

124. The IUPAC name for



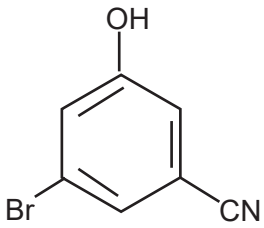
1) 1-Chloro-2-nitro-4 methylbenzene

2) 1-Chloro-4-methyl-2-nitrobenzene

3) 2-Chloro-1-nitro-5-methyl benzene

4) m-Nitro-p-chlorotoluene

125. Consider the following compound



What is the acceptable IUPAC name of the above compound ?

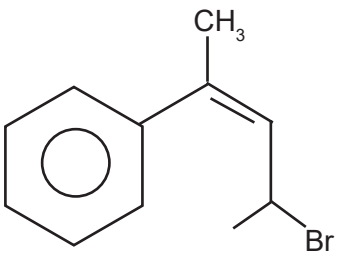
1) 3-Bromo-5-cyanophenol

2) 5-Bromo-3-cyanophenol

3) 3-Bromo-5-hydroxybenzonitrile

4) 5-Bromo-3-hydroxybenzonitrile

126. IUPAC name of the following is



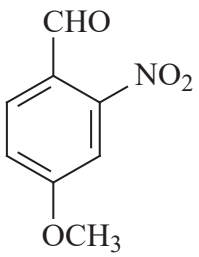
1) 4-Bromo-2-phenylpent-2-ene

2) 2-Bromo-4-phenylpent-2-ene

3) 4-Bromo-2-phenylpent-4-ene

4) 2-Bromo-4-phenylpent-3-one

127. The correct IUPAC name of the compound



1) 2-Formyl-5-methoxynitrobenzene

2) 4-Formyl-3-nitroanisole

3) 4-Methoxy-2-nitrobenzaldehyde

4) 4-Methoxy-6-nitrobenzaldehyde

SAMPLE QUESTIONS

1. Which of the following is the correct IUPAC name for $(CH_3)_2C = CH - CH_2OH$?

1) 3-Methylbut-2-en-1-ol

2) 2-Methylbut-3-en-1-ol

3) 2-Methylbut-2-en-1-ol

4) 3-Methylpent-3-en-1-ol

2. Identify the correct IUPAC name for $CH_3–CH_2–CH(CH_3)–COOH$

1) 2-Methylbutanoic acid

2) 3-Methylbutanoic acid

3) 2-Methylpentanoic acid

4) 3-Methylpentanoic acid

3. What is the correct IUPAC name of the following compound?

$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{C}=CHCH_2CH(CH_3)_2$$

1) 2,5-Dimethylpent-2-ene

2) 3,5-Dimethylpent-2-ene

3) 2,5-Dimethylhexa-3-ene

4) 2,5-Dimethylhex-2-ene

4. Identify the correct IUPAC name for this compound

$$CH_3C \equiv CCH_2CH_3$$

1) Pent-2-yne

2) Pent-3-yne

3) 1-Methylbut-1-yne

4) Pent-2-ene

5. What is the IUPAC name of the following compound?

$CH_3CHClCH_2CHO$

1) 3-Chlorobutanal

2) 2-Chlorobutanal

3) 3-Chloro-1-oxobutane

4) 3-Chloro-3-methylpropanal

6. The IUPAC name of the compound $CH_3C(CN) = CH_2$ is

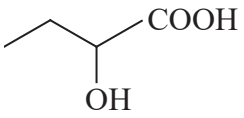
1) 2-Cyanoprop-1-ene

2) 3-Cyanoprop-2-ene

3) Prop-2-enenitrile

4) 2-Methylprop-2-enenitrile

7. What is the correct IUPAC name of the following compound



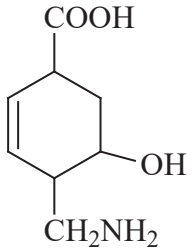
1) 3-Hydroxybutanoic acid

2) 2-Hydroxybutanoic acid

3) 1-Carboxypropan-1-ol

4) 2-Hydroxybutanecarboxylic acid

8. The correct IUPAC name of following compound is



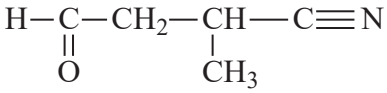
1) 4-Aminomethyl-3-hydroxycyclohex-5-ene-1-carboxylic acid

2) 2-Aminomethyl-5-carboxycyclohex-3-en-1-ol

3) 4-Aminomethyl-5-hydroxycyclohex-2-ene-1-carboxylic acid

4) 3-Hydroxy-4-aminomethylcyclohex-5-en-1-oic acid

9. IUPAC name of given compound is:



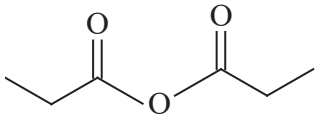
1) 3-Carbonitrile-3-methylbutanal

2) 3-Keto-2-methylpropanenitrile

3) 3-Cycanobutanal

4) 2-Methyl-4-oxobutanenitrile

10.



The IUPAC name of the compound is:

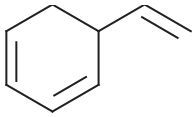
1) Propanoic anhydride

2) Dipropanoic anhydride

3) Ethoxypropanoic acid

4) 1-Oxopropylpropanoate

11. The correct IUPAC name of the compound



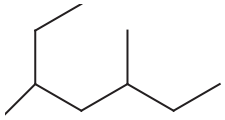
1) 1-Ethenylcyclohexa-2,4-diene

2) 5-Ethenylcyclohexa-1,3-diene

3) 6-Ethenylcyclohexa-1,3-diene

4) Cyclohexa-2,4-dienylethene

12. The correct IUPAC name of the alkane



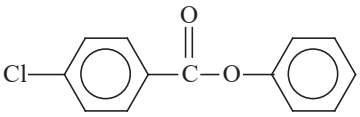
is:

1) 2-Ethyl-4-methylhexane

2) 5-Ethyl-3-methylhexane

3) 3,5-Dimethylhepatne

4) 3,5-Dimethylhexane

13. IUPAC name of 

is:

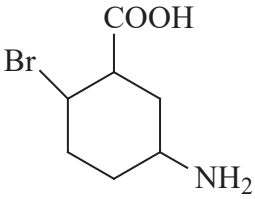
1) 4-Chlorophenylbenzoate

2) Phenyl-4-chlorobenzoate

3) Benzyl-4-chlorobenzenecarboxylate

4) 4-Chlorodiphenylcarboxylate

14. The correct IUPAC name of compound is:



1) 3-Amino-6-bromocyclohexane-1-carboxylic acid

2) 2-Bromo-5-aminocyclohexane-1-carboxylic acid

3) 5-Amino-2-bromocyclohexane-1-carboxylic acid

4) 4-Bromo-5-carboxycyclohexanamine

15. The compound which represents an unsaturated hydrocarbon is:

1) $CH_3 - C \equiv N$

2) $CH_3 - CH = CH_2$

3) $CH_3 - CH = O$

4) all of these

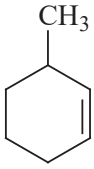
16. The compound 2-chloro-3-methyl-1-butanol has the following formula

1) $CH_3CH(CH_3)CHClCH_2OH$

2) $CH_3CHOHCH(CH_3)CH_2Cl$

3) $CH_2ClC(CH_3)_2CH_2OH$

4) $CH_3CHClCH(CH_3)CH_2OH$

17. The IUPAC name of 

is:

1) 3-Methylcyclohexene

2) 1-Methylcyclohex-2-ene

3) 6-Methylcyclohexene

4) 1-Methylcyclohex-5-ene

18. The correct IUPAC name for $H_2C = CH - C \equiv CH$ is:

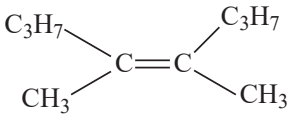
1) But-3-en-1-yne

2) But-1-en-3-yne

3) But-1-yn-3-ene

4) But-3-yn-1-ene

19. The IUPAC name of the compound



is

1) 4,5-Dimethyloct-4-ene

2) 2,3-Dipropylbut-2-ene

3) 4-Methyl-5-propylhex-4-ene

4) none of the above

20. Among the following, the one having longest chain is:

1) Neopentane

2) Isopentane

3) 2-Methylpentane

4) 2,2-Dimethylbutane

21. The IUPAC name of compound having formula $(CH_3)_3C - CH = CH_2$ is:

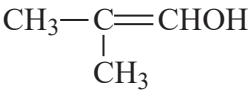
1) 3,3-Trimethyl-1-propene

2) 1,1,1-Trimethyl-3-propene

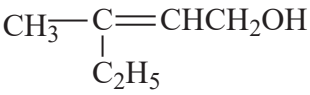
3) 3,3-Dimethyl-1-butene

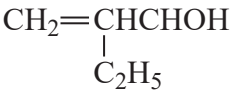
4) 1,1-Dimethyl-3-butene

22. The structural formula for 2-Ethylprop-2-en-1-ol is:

1) 

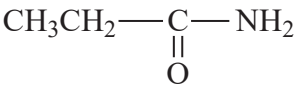
2) $C_2H_5CH = CHCH_2OH$

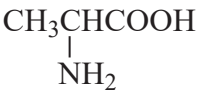
3) 

4) 

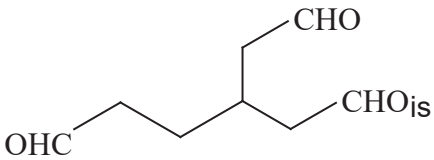
23. Which of the following compound contains amide functional group?

1) $CH_3CH_2NHCH_3$

2) 

3) 

24. The correct IUPAC name for



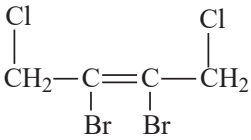
is

1) 3-(Formylmethyl)hexane-1,6-dial

2) 2-(Formylmethyl)butane-1,4-dial

3) 2-(Formylmethyl)butane-1,4-dicarbaldehyde

4) None of the three

25. The name of  according to IUPAC nomenclature system is

1) dichlorodibromobutene

2) dichlorodibromobutane

3) 1, 4-dichloro-2,3-dibromobut-2-ene

4) 2,3-dibromo-1,4-dichlorobut-2-ene

26. The correct IUPAC name among the following is

$CH \equiv C - CH_2 - CH_2 - OH$

1) Prop-3-yn-1-ol 2) But-4-ol-4-yne

3) But-3-ol-2-yne 4) But-3-yn-1-ol

27. The IUPAC name of

$CH_3 - CH = CH - C \equiv CH$ is:

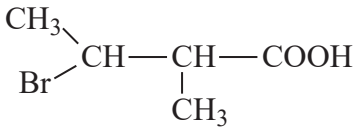
1) Pent-3-en-1-yne

2) Pent-2-en-4-yne

3) Pent-1-yn-3-ene

4) Pent-4-yn-2-ene

28. What is the IUPAC name of the compound

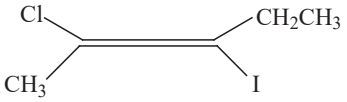


1) 2-Bromo-3-methylbutanoic acid

2) 2-Methyl-3-bromobutanoic acid

3) 3-Bromo-2-methylbutanoic acid

4) 3-Bromo-2,3-dimethylpropanoic acid

29. 

The IUPAC name of the above mentioned compound is:

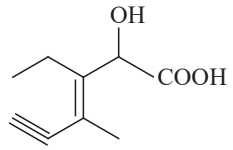
1) 3-Iodo-2-chloropent-2-ene

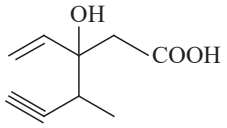
2) 4-Chloro-3-iodopent-3-ene

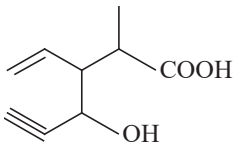
3) 2-Chloro-3-iodopent-2-ene

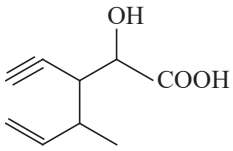
4) None of these

30. Which structure corresponds to the IUPAC name 3-Ethyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid?

1) 

2) 

3) 

4) 

31. The IUPAC name of the compound

$$CH_3-CH_2-\underset{}{\overset{CH_3}{\overset{|}{C}}}H-CONH_2$$

1) 2-Ethylbutanamide

2) 2-Methylbutanamide

3) 1-Amino-2-methylpropane

4) None

32. IUPAC name of

$$CH_3-CH_2-\underset{C_2H_5}{\underset{|}{C}}H-\underset{OH}{\underset{|}{C}}H-CH_2Cl$$

1) 1-Chloro-4-methyl-hexanal

2) 1-Chloro-3-ethyl-2-pentanol

3) 1-Chloro-4-methyl-2-hexanol

4) 1-Chloro-2-hydroxy-4-methylhexane

33. IUPAC name of $CH_3CH_2CH{=}\underset{CH_3}{\underset{|}{C}}-CH_2OH$

1) 2-Methylpentylalcohol

2) 4-Methyl-3-pentene-1-ol

3) 2-Methylpent-2-en-1-ol

4) 4-Methylpentyl alcohol

34. IUPAC name of

$$OHC-CH{=}CH-\underset{CH_2CH_2CH_2CH_3}{\underset{|}{CH}}-CH{=}CH_2 \text{ is}$$

1) 4-Butyl-2,5-hexadien-1-al

2) 5-Vinyloct-3-en-1-al

3) 5-Vinyloct-5-en-8-al

4) 3-Butyl-1,4-hexadiene-6-al

35. The IUPAC name of the compound

$$CH_2{=}\underset{CH_3}{\underset{|}{C}}-CH_2-C{\equiv}CH \text{ is}$$

1) 2-Methylpent-1-en-4-yne

2) 4-Methylpent-4-en-1-yne

3) 2-Methylpent-2-en-4-yne

4) 4-Methylpent-3-en-1-yne

36. The number of 4^0 carbon atoms in 2,2,4,4-tetramethylpentane is

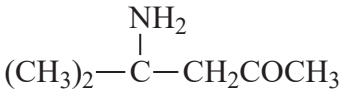
1) 1

2) 2

3) 3

4) 4

37. The given compound in IUPAC may be called



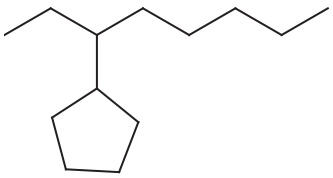
1) Diacetone

2) Acetone amine

3) Diacetone amine

4) 4-Amino-4-methylpentan-2-one

38. The IUPAC name of the given compound



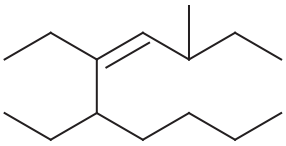
1) Octylcyclopentane

2) 3-Cyclopentyloctane

3) Cyclopentaneoctanes

4) 6-Cyclopentyloctane

39. IUPAC name of the given compound



1) 5,6-Diethyl-3-methyldec-4-ene

2) 7-Methylheptene

3) 3,3-Diethyl-5-ethyl-4-decene

4) None of these

40. Match the following

List I	List II
A) Dimethyl acetylene	i) Propanone
B) Methyl acetic acid	ii) Trichloromethane
C) Chloroform	iii) Propanoic acid
D) Acetone	iv) But-2-yne

The correct matching is

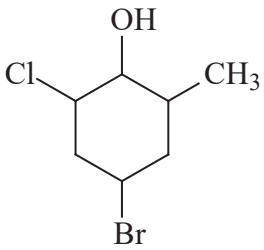
1) A-iv, B-iii, C-ii, D-i

2) A-i, B-ii, C-iii, D-iv

3) A-iii, B-iv, C-i, D-ii

4) A-ii, B-i, C-iv, D-iii

41. IUPAC name of the given compound is



1) 4-Bromo-2-chloro-6-methylcyclohexanol

2) 5-Bromo-3-chloro-1-methylcyclohexanol

3) 1-Bromo-5-chloro-3-methyl-3-cyclohexanol

4) 5-Bromo-1-chloro-3-methyl-3-cyclohexanol

42. Match the following

List I	List II
A) Benzene	i) Aromatic (bicyclic)
B) Naphthalene	ii) Aromatic (monocyclic)
C) Anthracene	iii) Alicyclic
D) Pyridine	iv) Heterocyclic
E) Cycloalkane	v) Aromatic tricyclic

1) A-i, B-ii, C-iii, D-v, E-iv

2) A-ii, B-i, C-v, D-iv, E-iii

3) A-iii, B-v, C-ii, D-i, E-v

4) A-v, B-iv, C-i, D-iii, E-ii

43. The decreasing order of the priority of functional groups is

1) –COOH > –COCl > –CN > –CHO

2) –COOH > –CHO > –COCl > –CN

3) –COOH > –CHO > –CN > –COCl

4) –COOH > –CN > –CHO > –COCl

44. Which of the following contains only 1^0 and 3^0 carbon atoms?

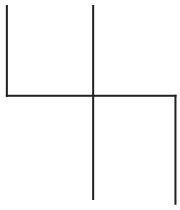
1) n-Butane

2) Isobutane

3) Isopentane

4) Neopentane

45. The IUPAC name ofg the given structure is



1) 3,3-Dimethylpentane

2) 3,3-Diethylpentane

3) 3-Ethyl-3-methylpentane

4) 3-Ethyl-3-ethylpentane

ANSWER KEY

1.	1	27.	2	53.	2	79.	1	105.	1
2.	3	28.	4	54.	4	80.	2	106.	2
3.	3	29.	4	55.	3	81.	1	107.	3
4.	1	30.	1	56.	4	82.	4	108.	2
5.	3	31.	3	57.	3	83.	4	109.	4
6.	3	32.	1	58.	4	84.	2	110.	1
7.	4	33.	1	59.	3	85.	3	111.	1
8.	4	34.	3	60.	2	86.	2	112.	2
9.	3	35.	2	61.	3	87.	4	113.	1
10.	1	36.	3	62.	3	88.	3	114.	1
11.	2	37.	1	63.	3	89.	1	115.	2
12.	1	38.	1	64.	1	90.	3	116.	1
13.	1	39.	2	65.	4	91.	2	117.	2
14.	3	40.	1	66.	3	92.	1	118.	3
15.	3	41.	4	67.	2	93.	1	119.	3
16.	2	42.	1	68.	1	94.	3	120.	3
17.	4	43.	2	69.	3	95.	3	121.	2
18.	2	44.	2	70.	3	96.	2	122.	3
19.	2	45.	2	71.	1	97.	2	123.	3
20.	4	46.	2	72.	4	98.	1	124.	2
21.	2	47.	2	73.	2	99.	3	125.	3
22.	2	48.	2	74.	2	100.	3	126.	1
23.	2	49.	4	75.	2	101.	2	127.	3
24.	3	50.	1	76.	3	102.	1		
25.	2	51.	4	77.	3	103.	4		
26.	3	52.	2	78.	2	104.	1		

SAMPLE QUESTIONS

1.	1	10.	1	19.	1	28.	4	37.	4
2.	1	11.	2	20.	3	29.	3	38.	2
3.	4	12.	3	21.	3	30.	1	39.	1
4.	1	13.	2	22.	4	31.	2	40.	1
5.	1	14.	3	23.	2	32.	2	41.	1
6.	4	15.	2	24.	1	33.	3	42.	2
7.	2	16.	1	25.	4	34.	1	43.	1
8.	3	17.	1	26.	4	35.	1	44.	2
9.	4	18.	2	27.	1	36.	2	45.	1

WORK BOOK

Chapter 10

ORGANIC CHEMISTRY; SOME BASIC PRINCIPLES & TECHNIQUES - PART-II (REACTION MECHANISM)

QUESTIONS

INTRODUCTION AND ISOMERISM

1. Compounds having same formula but different arrangement of atoms in their molecules are called:

1) allotropes 2) isotopes

3) isomers 4) polymers

2. Isomers have essentially identical:

1) structural formula

2) chemical properties

3) molecular formula

4) physical properties

3. Number of acyclic structural isomers respresented by molecular formula $C_4H_{10}O$ is:

1) 7 2) 6

3) 4 4) 5

4. The compound $C_4H_{10}O$ can show:

1) metamerism

2) position isomerism

3) functional isomerism

4) all of the three

5. The molecular formula of a saturated compound is $C_2H_4Cl_2$. This formula permits the existence of two:

1) Functional isomers

2) Position isomers

3) Metamers

4) Tautomers

6. The compound which is not isomeric with diethylether is:

1) Methyl n-propylether

2) 1-butanol

3) 2-methylpropan-2-ol

4) butanone

7. Which type of isomerism is shown by diethylether and methylpropylether?

1) Chain 2) Functional

3) Metamerism 4) Position

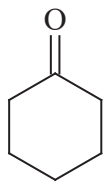
8. Aldehydes and ketones are:

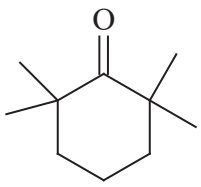
1) homologues 2) functional isomers

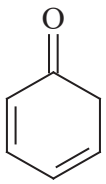
3) allotropes 4) polymers

9. In which of the following compounds maximum enolisation takes place

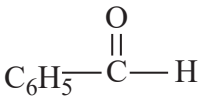
1) $CH_3-\overset{\overset{O}{||}}{C}-CH_3$

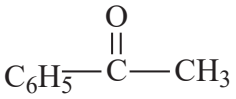
2) 

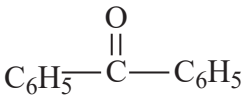
3) 

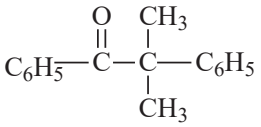
4) 

10. Keto-enol tautomerism observed in:

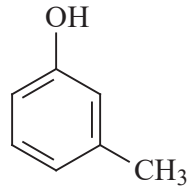
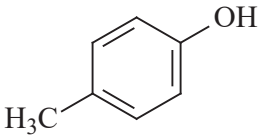
1) 

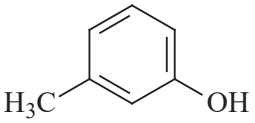
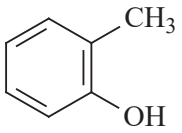
2) 

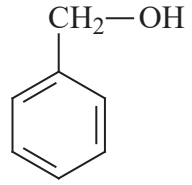
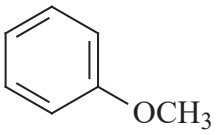
3) 

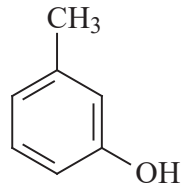
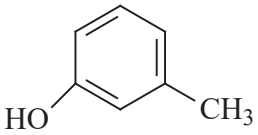
4) 

11. Which of the following pairs of compounds are not isomers

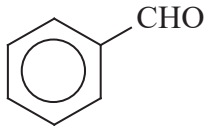
1)  and 

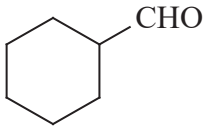
2)  and 

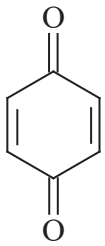
3)  and 

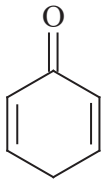
4)  and 

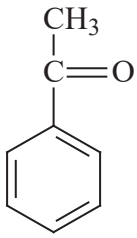
12. Tautomerisation is not observed in

i) 

ii) 

iii) 

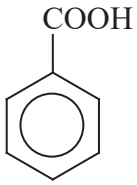
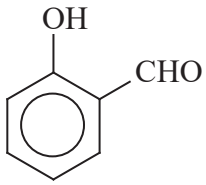
iv) 

v) 

1) i & iii
2) i, iii, iv & v
3) iv & v
4) iii, iv & v

13. Number of primary amines of the formula $C_4H_{11}N$ is:

1) 1
2) 2
3) 3
4) 4

14.  and  are:

1) position isomers
2) chain isomers
3) functional isomers
4) stereoisomers

15. Number of structural isomers for C_6H_{14} is:

1) 3
2) 4
3) 5
4) 6

Types of bond fission in a covalent bond & Types of attacking reagents

16. Which among the following statement is incorrect in case of Heterolytic cleavage

1) The shared pair of electrons remains with one of the fragments

2) After heterolysis one atom has a sextet of electronic structure and positive charge

3) Heterolytic cleavage of bromomethane will give CH_3^+ and Br^-

4) Heterolytic cleavage of bromo methane will give CH_3^- and Br^+

17. Which among the following statement is incorrect

1) The organic reactions which proceed through heterolytic bond cleavage are called polar reactions

2) In homolysis one of the electrons of the shared pair in a covalent bond goes with each of the bonded atoms

3) In homolytic cleavage the movement of a single electron take place instead of an electron pair

4) In homolysis electron movement is shown by curved double headed arrow

18. Homolytic fission of covalent bonds is favoured by:

1) High temperature

2) UV radiations

3) Non-polar solvents

4) All

19. The correct representation of heterolytic fission of $CH_3 - X$ is:

1) $CH_3 - X \rightarrow \overset{\oplus}{C}H_3 + \overset{\ominus}{X}$

2) $CH_3 - X \rightarrow \overset{\ominus}{C}H_3 + \overset{\oplus}{X}$

3) $CH_3 - X \rightarrow \overset{\oplus}{C}H_3 + \overset{\ominus}{X}$

4) $CH_3 - X \longrightarrow \dot{C}H_3 + \dot{X}$

20. Which of the following is strongest nucleophile

1) $CH_3\bar{O}$ 2) $:\bar{O}H$

3) $C_6H_5\bar{O}$ 4) $CH_3CO\bar{O}$

21. Which of the following represents a set of nucleophiles?

1) BF_3, H_2O, $\bar{N}H_2$

2) $AlCl_3$, BF_3, NH_3

3) $\bar{C}N, R\bar{C}H_2, ROH$

4) All of these

22. Which of the following species does not acts as a nucleophile?

1) ROH 2) ROR

3) H_2O 4) $AlCl_3$

23. Which of the following is an electrophile?

1) Lewis acid

2) Lewis base

3) Negatively charged species

4) All positively charged species

24. Which of the following pairs represent electrophiles?

1) $AlCl_3$, H_2O 2) SO_3, $\overset{+}{N}O_2$

3) BF_3, H_2O 4) NH_3, SO_3

25. Which out of A, B, C and D is/are not correctly categorised.

	Nucleophile	Electrophile
A)	HS^-	Cl^+
B)	BF_3	$(CH_3)_3N$
C)	H_2N^-	$\overset{+}{N}O_2$
D)	$R_3C–X$ (X = Halogen)	$C_2H_5O^-$

1) B, C and D 2) C and D

3) C only 4) B and D

26. Which of the following groups contain only electrophiles?

1) $C_2H_5^-, \dot{C}_2H_5, C_2H_5^+$

2) BF_3, NH_3, H_2O

3) $NO_2^+, CH_3^+, R_3\ddot{N}$

4) $AlCl_3$, SO_3, NO_2^+

Electron displacement effects in covalent bonds

27. Inductive effect refers to :

1) electron displacement along a σ bond

2) complete transfer of one of the shared pair of electrons to one of the atoms joined by a double bond

3) complete transfer of electrons in a π bond

4) All of the above

28. +I effect is shown by:

1) $– NO_2$ 2) – Cl

3) – Br 4) $– CH_3$

29. Maximum – I effect is exerted by the group

1) C_6H_5 – 2) $– OCH_3$

3) – Cl 4) $– NO_2$

30. Zero inductive effect is exerted by:

1) $C_6H_5–$ 2) H

3) $CH_3–$ 4) –Cl

31. Which of the following is the correct order of –I effect

1) –F > –Cl > –Br > –I

2) $-\overset{\oplus}{N}R_3 > -C\equiv C-H > – CH = CH_2$

3) $–F > –OH > –NH_2$

4) All are correct

32. Which of the following exhibit electromeric effect

1) Alkanes

2) Aldehydes

3) Alkyl halides

4) Alkyl amines

33. Shifting of electron of a multiple bond under the influence of a reagent is called:

1) I-effect 2) M-effect

3) E-effect 4) Hyperconjugation

34. The temporary effect in which there is complete transfer of a shared pair of pi-electrons to one of the atoms joined by a multiple bond in presence of an attacking reagent is called

1) Inductive effect

2) Electromeric effect

3) Resonance effect

4) Hyperconjugation effect

35. Resonance of $–NH_2$ group is possible in:

1) p-Toluidine 2) Ethylamine

3) 1-Aminobutane 4) Benzylamine

36. Addition of H^+ to alkenes is an example of:

1) +I effect 2) –I effect

3) +E effect 4) –E effect

37. The correct decreasing order for acid strength is

1) $NO_2CH_2COOH > NCCH_2COOH > FCH_2COOH > ClCH_2COOH$

2) $FCH_2COOH > NCCH_2COOH > NO_2CHCOOH > ClCH_2COOH$

3) $NO_2CH_2COOH > FCH_2COOH > CNCH_2COOH > ClCH_2COOH$

4) $CNCH_2COOH > O_2NCH_2COOH > FCH_2COOH > ClCH_2COOH$

38. Among the following which oneis most basic?

1) NH_3 2) CH_3NH_2

3) $CH_3-\underset{\underset{O}{||}}{C}-NH_2$ 4) $C_6H_5NH_2$

39. Which of the following molecules has inductive, mesomeriic and Baker Nathan effect?

1) C_2H_5Cl

2) $CH_3 - CH = NH_2$

3) $CH_2 = CH - CH = CH_2$

4) $CH_3-CH=CH-\underset{\underset{O}{||}}{C}-CH_3$

40. $:\bar{C}H_2-\underset{\underset{O:}{||}}{C}-CH_3$ and $H_2C=\underset{\underset{:O:^-}{|}}{C}-CH_3$ are:

1) resonating structure

2) tautomers

3) geometrical isomers

4) optical isomers

41. The arragement of $(CH_3)_3C–$, $(CH_3)_2CH–$, $CH_3CH_2–$ when attached a benzene or an unsaturated group in increasing order of (+I) inductive effect is:

1) $(CH_3)_3C– < (CH_3)_2CH– < CH_3CH_2–$

2) $CH_3CH_2– < (CH_3)_2CH– < (CH_3)_3C–$

3) $(CH_3)_2CH– < (CH_3)_3C– < CH_3CH_2–$

4) $(CH_3)_3C– < CH_3CH_2– < (CH_3)_2CH–$

42. The resonance structures have

i) Same position of nuclei

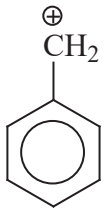
ii) Same number of unpaired electrons

iii) Same number of covalent bonds

1) Both I & II 2) Both II & III

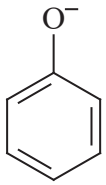
3) Both I & III 4) All of these

43. Resonance is not observed in

1) 

2) $CH_2=CH-\overset{\oplus}{C}H_2$

3) $CH_2=CH-\overset{\oplus}{N}H_3$

4) 

REACTION INTERMEDIATE

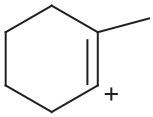
44. Match the column

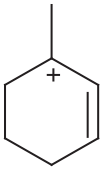
Column - I		Column-II	
A)	Free radical	I)	Trigonal planar
B)	Carbocation	II)	Pyramidal
C)	Carbanion	III)	Linear

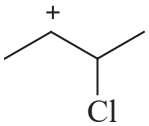
1) A-I, B-I, C-II 2) A-III, B-I, C-I

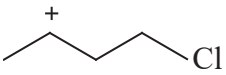
3) A-III, B-II, C-I 4) A-II, B-III,C-III

45. In which of the following most stable carbocation is

1) 

2) 

3) 

4) 

46. The least stable radical among the following is

1) $CH_3-\dot{C}H_2$

2) $CH_3-\dot{C}H-CH_3$

3) $CH_3-\underset{\underset{CH_3}{|}}{\dot{C}}-CH_3$

4) $\dot{C}H_3$

47. Which of the following statements is wrong?

1) A tertiary free radical is more stable than a secondary free radical

2) A secondary free radical is more stable than a primary free radical

3) A tertiary carbocation is more stable than a secondary carbocation

4) A primary carbocation is more stable than a secondary carbocation

48. Most stable carbocation is:

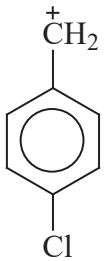
1) $CH_3-\overset{+}{C}H_2$

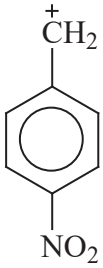
2) $\overset{+}{C}H_2CHCl_2$

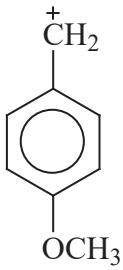
3) $\overset{+}{C}H_2CH_2Cl$

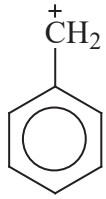
4) $\overset{+}{C}H_2-CH_2NO_2$

49. Most stable carbocation is:

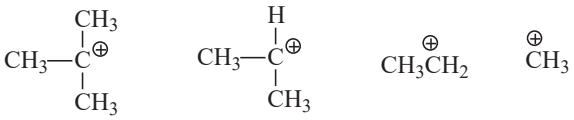
1) 

2) 

3) 

4) 

50. Choose the correct order of stability of carbocation.



I II III IV

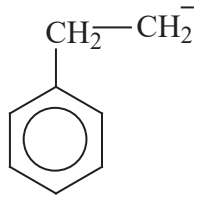
1) I < II < III < IV

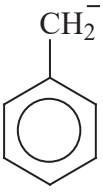
2) IV < III < II < I

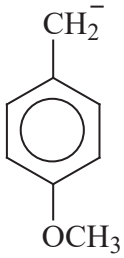
3) III < IV < II < I

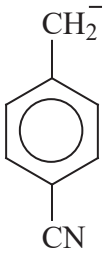
4) IV < I < II < III

51. The most stable carbanion among the following is

1) 

2) 

3) 

4) 

52. Arrange the carbanions,

$(CH_3)_3\overline{C}, (CH_3)_3\overline{C}H, C_6H_5\overline{C}H_2$ in order of their decreasing stability:

1) $C_6H_5\overline{C}H_2 > (CH_3)_3\overline{C} > (CH_3)_2\overline{C}H$

2) $(CH_3)_2\overline{C}H > C_6H_5\overline{C}H_2 > (CH_3)_3\overline{C}$

3) $C_6H_5\overline{C}H_2 > (CH_3)_2\overline{C}H > (CH_3)_3\overline{C}$

4) $(CH_3)_3\overline{C} > (CH_3)_2\overline{C}H > C_6H_5\overline{C}H_2$

53. The most stable carbanion among the following is:

1) $C_6H_5—CH_2—\overset{\ominus}{C}H_2$

2) $C_6H_5—\overset{\ominus}{C}H_2$

3) $CH_3—O—C_6H_4—\overset{\ominus}{C}H_2$

4) $O_2N—C_6H_4—\overset{\ominus}{C}H_2$

54. Arrange the carboanions,

$(CH_3)_3\overline{C}, \overline{C}Cl_3, (CH_3)_2\overline{C}H, C_6H_5\overline{C}H_2$ in order of their decreasing stability:

1) $C_6H_5\overline{C}H_2 > \overline{C}Cl_3 > (CH_3)_3\overline{C} > (CH_3)_2\overline{C}H$

2) $(CH_3)_2\overline{C}H > \overline{C}Cl_3 > C_6H_5\overline{C}H_2 > (CH_3)_3\overline{C}$

3) $\overline{C}Cl_3 > C_6H_5\overline{C}H_2 > (CH_3)_2\overline{C}H > (CH_3)_3\overline{C}$

4) $(CH_3)_3\overline{C} > (CH_3)_2\overline{C}H > C_6H_5\overline{C}H_2 > \overline{C}Cl_3$

55. Which of the following carbocations will be more stable?

1) Ph_3C^+ 2) $CH_3-\overset{+}{C}H_2$

3) $(CH_3)_2\overset{+}{C}H$ 4) $CH_2=CH-\overset{+}{C}H_2$

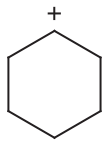
56. Arrange the following free radicals in order of decreasing stability:

Methyl (I), Vinyl (II), Allyl (III), Benzyl (IV)

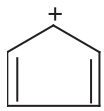
1) I > II > III > IV 2) III > II > I > IV

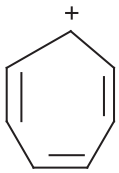
3) II > I > IV > III 4) IV > III > I > II

57. The stability of the following carbocations decreases in the order

a) 

b)

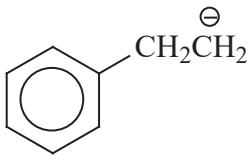
c) 

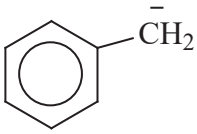
d) 

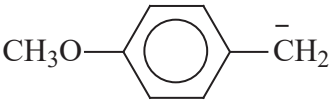
1) d > a > b > c 2) d > b > c > a

3) d > c > b > a 4) d > b > a > c

58. The most stable carbanion is

1) 

2) 

3) 

4)

Types of Organic Reaction

59. The reaction,

$$(CH_3)_3C-Br \xrightarrow{H_2O} (CH_3)_3C-OH \text{ is}$$

1) elimination reaction

2) substitution reaction

3) free radical reaction

4) addition reaction

60. Alkenes readily undergo:

1) substitution reactions

2) addition reactions

3) elimination reactions

4) rearrangement reactions

61. The following reaction is:

$$C_2H_5Br + KOH \rightarrow C_2H_5OH + KBr \ :$$

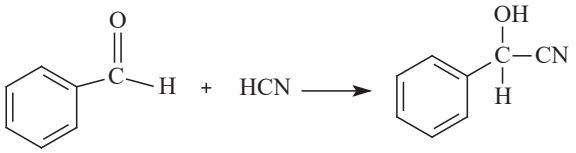
1) electrophilic substitution

2) elimination

3) nucleophilic substitution

4) addition

62. The following reaction is an example of:



1) nucleophilic substitution

2) electrophilic substitution

3) electrophilic addition

4) nucleophilic addition

63. The reaction between ethylene and bromine is an example of:

1) eletrophilic addition

2) electrophilic substitution

3) nucleophilic addition

4) nucleophilic substitution

64. In the nitration of benzene with a mixture of conc.HNO_3 and conc.H_2SO_4, the active species involved is:

1) nitric ions 2) nitrate ion

3) nitronium ion 4) nitrogen dioxide

65. Nitration of benzene is:

1) nucleophilic substitution

2) nucleophilic addition

3) electrophilic substitution

4) free radical substitution

66. Addition of HI on the double bond of propene yields isopropyl iodide and not n-propyl iodide as the major product. This is because the addition proceeds through:

1) a more stable carbonium ion

2) a more stable carbanion ion

3) a more stable free radical

4) none of the above is a correct statement

67. Which of the following alkyl halides is hydrolysed by S_N1 mechanism?

1) CH_3Cl 2) CH_3CH_2Cl

3) $CH_3CH_2CH_2Cl$ 4) $(CH_3)_3CCl$

68. Which one of the following statements is wrong about S_N2 reaction?

1) The rate of reaction is independent of the concentration of nucelophile

2) Nucleophile attacks the carbon from the side opposite to where the leaving group is attached

3) Only in one step the bond formation and bond breaking takes place

4) The rate of reaction $\propto$ [substrate] [nucleophile]

69. Markownikoff's rule is applicable to which of the following reactions?

1) C_2H_4 + HBr 2) C_3H_6 + Cl_2

3) C_3H_6 + HBr 4) C_3H_6 + Br_2

70. The addition of HBr to propylene takes place opposite to Markownikoff's rule in presence of:

1) sunlight 2) peroxide

3) platinum catalyst 4) none of these

71. Anti-Markovnikoff's addition is not observed in:

1) propene 2) 1-butene

3) 2-pentene 4) 2-butene

72. S_N1 mechanism for the hydrolysis of an alkyl halide involves the formation of:

1) free radical 2) carbocation

3) carbanion 4) no intermediate

73. $CH_3Br + OH \rightarrow CH_3OH + Br$ proceeds by S_N2 mechanism. The rate depends on the concentration of

1) CH_3Br, $\bar{O}H$ 2) CH_3Br only

3) $\bar{O}H$ only 4) CH_3Br, CH_3OH

74. Alkene + HX → Products is a/an

1) Electrophilic addition reaction

2) Nucleophilic addition reaction

3) Free radical addition reaction

4) Free radical substitution reaction

75. Dehydration of alcohols in acidic medium involve

1) Free radical intermediate

2) Carbocation intermediate

3) Carbanion intermediate

4) Carbene intermediate

SAMPLE QUESTIONS

1. Total number of structural isomers possible for C_3H_6 are:

1) 2 2) 1

3) 4 4) 3

2. An aromatic compound of formula C_7H_7Cl has —— structural isomers

1) 5 2) 2

3) 4 4) 3

3. CH_3CH_2OH and CH_3OCH_3 are the example of

1) chain isomerism

2) functional isomerism

3) position isomerism

4) metamerism

4. Which organic structure among the following is not an isomer of the compound

$CH_3–CO–CH_2CH_2CH_2CH_3$?

1) $CH_3CH_2OCH = CHCH_2CH_3$

2) $CH_3CH = CHCH_2CH_2CHO$

3) $(CH_3)_2CH – CO – CH_2CH_3$

4) $CH_3CH_2COCH_2CH_2CH_3$

5. Which are isomers?

1) ethyl alcohol and dimethyl ether

2) acetone and acetaldehyde

3) propionic acid and propanone

4) methyl alcohol and dimethylether

6. Methoxyethane and propanol are the examples of isomerism of the type

1) structural 2) position

3) functional 4) tautomerism

7. Isomers of propionic acid are

1) $HCOOC_2H_5$ and CH_3COOCH_3

2) $HCOOC_2H_5$ and C_3H_7COOH

3) CH_3COOCH_3 and C_3H_7OH

4) C_3H_7OH and CH_3COCH_3

8. $C_6H_5C \equiv N$ and $C_6H_5N \overset{\rightarrow}{=} C$ are which type of isomers?

1) position 2) functional

3) tautomerism 4) linkage

9. In which of the following, functional group isomerism is not possible?

1) Alcohols 2) Aldehydes

3) Alkyl halides 4) Cyanides

10. The compounds $CH_3CH = CHCH_3$ and $CH_3CH_2CHH = CH_2$

1) are tautomers

2) are position isomers

3) contain same number of sp^3–sp^3, sp^3–sp^2 and sp^2–sp^2 carbon-carbon bonds

4) exist together in dynamic equilibrium

11. Heterolytic fission of a covalent bond in organic molecules gives

1) free radicals

2) cations and anions

3) only cations

4) only anions

12. Which of the following statements is not correct?

1) Carbocation posses sextet of electrons

2) The order of carbocation stability is:

$$\overset{+}{C}H_3 > (CH_3)_2\overset{+}{C}H > (CH_3)_3\overset{+}{C}$$

3) Carbocations have trigonal planar shape

4) Carbocations are formed by heterolytic cleavage

13. Heterolytic fission of C–Br bond results in the formation of

1) free radical 2) carbanion

3) carbocation 4) both 2 and 3

14. Which of the following carbocations is least stable?

1) tert. Alkyl 2) sec.Alkyl

3) pri-Alkyl 4) Methyl

15. Which of the following ions is most stable?

1) $CH_3-\overset{+}{\underset{\underset{CH_3}{|}}{C}}-CH_3$

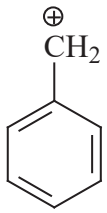
2) $CH_3CH_2\overset{+}{C}H_2$

3) $CH_3\overset{+}{C}HCH_2CH_3$

4) CH_3^+

16. The order of stability of the following carbocations:

$$\underset{I}{CH_2=CH-\overset{\oplus}{C}H_2}; \underset{II}{CH_3-CH_2-\overset{\oplus}{C}H_2};$$



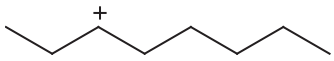
is:

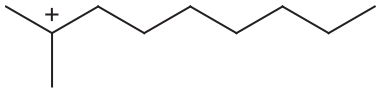
III

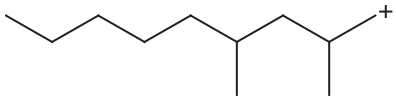
1) III > II > I 2) II > III > I

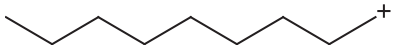
3) I > II > III 4) III > I > II

17. Select the most stable carbocation amongst the following

1) 

2) 

3) 

4) 

18. What is the correct order of decreasing stability of the following cations

I) $CH_3-\overset{\oplus}{C}H-CH_3$

II) $CH_3-\overset{\oplus}{C}H-OCH_3$

III) $CH_3-\overset{\oplus}{C}H-CH_2-OCH_3$

1) II > I > III 2) II > III > I

3) III > I > II 4) I > II > III

19. The most stable carbonium ion among the following is

1) $C_6H_5\overset{+}{C}HC_6H_5$ 2) $C_6H_5\overset{+}{C}H_2$

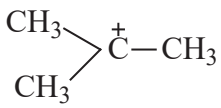
3) $CH_3\overset{+}{C}H_2$ 4) $C_6H_5CH_2\overset{+}{C}H_2$

20. The organic reaction which proceed through heterolytic bond cleavage are called ———

1) ionic 2) polar

3) nonpolar 4) both 1 and 2

21. Among the following, the true property about


is

1) it is non-planar around C^+

2) its C^+ is sp^2-hybridized

3) an electrophile can attack on its C^+

4) it does not undergo hydrolysis

22. Which of the following is strongest nucleophile

1) Br^- 2) $:OH^-$

3) $:CN^-$ 4) $C_2H_5\bar{O}:$

23. Which of the following represents a set of nucleophiles?

1) BF_3, H_2O, NH_2^- 2) $AlCl_3$, BF_3, NH_3

3) CN^-, RCH_2^-, ROH 4) All of these

24. Which of the following species does not acts as a nucleophile?

1) ROH 2) ROR

3) H_2O 4) BF_3

25. Which of the following is an electrophile?

1) $AlCl_3$

2) ROH

3) H_2O

4) NH_3

26. Which of the following pairs represent electrophiles?

1) NH_3, H_2O 2) $\overset{+}{R}, R-\overset{+}{C}O$

3) BF_3, $\bar{C}N$ 4) NH_3, SO_3

27. Point out the incorrect statement about resonance?

1) Resonance structures should have equal energy

2) In resonating structures, the constituent atoms must be in the same position

3) In resonating structures, there should not be same number of electron pairs

4) Resonating structures should differ only in the location of electrons around the constituent atoms

28. In which of the following, resonance will be possible?

1) $CH_3-CH_2-CH_2-CHO$

2) $CH_2=CH-CH=O$

3) CH_3COCH_3

4) $CH_2=CH-CH_2-CH=CH_2$

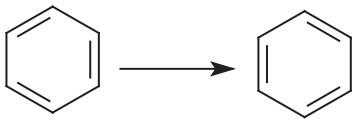
29. Which of the following statements regarding the resonance energy of benzene is correct?

1) Resonance energy is the energy required to break the C – H bond in benzene

2) Resonance energy required to break the C – C bond in benzene

3) Resonance energy is a measure of stability of benzene

4) Resonance energy is the energy required to convert



30. Which of the following is not correctly matched?

Group showing +R effect	Hroup showing –R effect
a) –NHCOR	–COOH
b) $>C=O$	–OH
c) –OR	–CHO
d) –OCOR	$-NO_2$

31. The polarity is produced in the molecule by the interaction of two π-bonds or between a π-bond and lone pair of electrons present on an adjacent atom.

The above statement is true for which of the following?

1) Inductive effect

2) Electromeric effect

3) Resonance effect

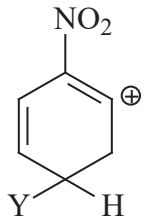
4) Hyperconjugation

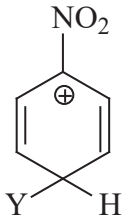
32. Which of the following carboxylate ions is most stable?

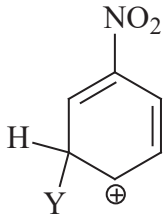
1) $CH_3 - COO^-$ 2) $ClCH_2 - COO^-$

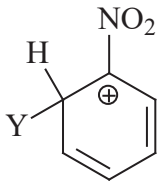
3) $FCH_2 - COO^-$ 4) $F_2CH - COO^-$

33. Which of the following carbocations is expected to be most stable?

1) 

2) 

3) 

4) 

34. Which of the following cations would have the greatest stability?

1) $CH_3 - S - CH_2^+$ 2) $(CH_3)_2NCH_2^+$

3) $CH_3 - O - CH_2^+$ 4) $F - CH_2^+$

35. Which of the following carbocations are more stabilised by hyperconjugation?

1) tert-Butyl 2) neopentyl

3) isopropyl 4) ethyl

36. In which of the following species hyperconjugation is possible:

1) $CH_3 - \overline{C}H_2$

2) $C_6H_5 - CH_3$

3) $CH_2 = CH_2$

4) $CH_3-C(CH_3)_2-CH=CH_2$

37. Alkyl groups are ortho para directing because of

1) Inductive effect

2) Electromeric effect

3) Resonance

4) Hyperconjugation

38. Which one of the following statements is wrong about S_N2 reaction?

1) The rate of reaction is independent of the concentration of nucleophile

2) Nucleophile attacks the carbon from the side opposite to where the leaving group is attached

3) Only in one step the bond formation and bond breaking takes place

4) The rate of reaction $\propto$ [substrate] [nucleophile]

39. Markownikoff's rule is applicable to which of the following reactions?

1) C_2H_4 + HBr

2) C_3H_6 + Cl_2

3) But-1-ene + HBr

4) C_3H_6 + Br_2

40. The addition of HBr in presence of peroxide to propylene takes place opposite to Markownikoff's rule the reaction follows:

1) Free radical addition

2) Nucleophilic addition

3) Free radical substitution

4) Elimination

41. Anti-Markownikoff's addition is not observed in:

1) Propene

2) 1-Butene

3) 2-Pentene

4) 2,2-Dimethylbut-2-ene

42. Ammonia is iso-structural with:

1) carbanion 2) free radical

3) carbocation 4) carbene

43. Which of the following statements is correct?

1) Allyl carbocation $\left(H_2C=CH-\overset{+}{C}H_2\right)$ is more stable than propyl carbocation

2) Propyl carbocation is more stable than allyl carbocation

3) Both are equally stable

4) None of the above

44. In a reaction of C_6H_5Y, the major product (> 60%) is m-isomer, so the group Y is

1) –COOH

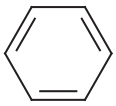
2) $–NH_2$

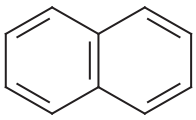
3) –OH

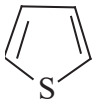
4) –Cl

45. Which of the following chemical system is non aromatic?

1)

2) 

3) 

4) 

ANSWER KEY

1.	3	20.	2	39.	4	58.	4
2.	3	21.	3	40.	1	59.	2
3.	1	22.	4	41.	2	60.	2
4.	4	23.	1	42.	1	61.	3
5.	2	24.	2	43.	3	62.	4
6.	4	25.	4	44.	1	63.	1
7.	3	26.	4	45.	2	64.	3
8.	2	27.	1	46.	4	65.	3
9.	4	28.	4	47.	4	66.	1
10.	2	29.	4	48.	1	67.	4
11.	4	30.	2	49.	3	68.	1
12.	1	31.	4	50.	2	69.	3
13.	4	32.	2	51.	4	70.	2
14.	3	33.	3	52.	3	71.	4
15.	3	34.	2	53.	4	72.	2
16.	4	35.	1	54.	3	73.	1
17.	4	36.	3	55.	1	74.	1
18.	4	37.	1	56.	4	75.	2
19.	3	38.	2	57.	4		

SAMPLE QUESTIONS

1.	1	10.	2	19.	1	28.	2	37.	4
2.	3	11.	2	20.	2	29.	3	38.	1
3.	2	12.	2	21.	4	30.	2	39.	3
4.	2	13.	3	22.	4	31.	3	40.	2
5.	1	14.	4	23.	3	32.	4	41.	2
6.	3	15.	1	24.	4	33.	3	42.	1
7.	1	16.	4	25.	1	34.	2	43.	1
8.	2	17.	2	26.	2	35.	2	44.	1
9.	3	18.	1	27.	1	36.	2	45.	1

WORK BOOK

Chapter 11

ORGANIC CHEMISTRY; SOME BASIC PRINCIPLES & TECHNIQUES - PART-III (PURIFICATION & CHARACTERISATION OF ORGANIC COMPOUNDS)

QUESTIONS

Techniques of purification of organic compounds

1. A mixture of naphthalene and sodium chloride can be separated into pure compounds by

1) Crystallisation

2) Sublimation

3) Distillation

4) Vacuum distillation

2. Anthraquinone is a highly volatile solid. It can be purified from non volatile impurities by

1) Crystallisation

2) Fractional crystallisation

3) Distillation

4) Sublimation

3. A mixture contains 71% calcium sulphate and 29% of camphor. A suitable method of separation of the components of the mixture?

1) Sublimation

2) Distillation

3) Fractional distillation

4) Distillation under reduced pressure

4. Benzoic acid is soluble in hot water but sparingly soluble in cold water. An impure sample of benzoic acid can be purified by

1) Distillation

2) Steam distillation

3) Crystallisation

4) Solvent extraction

5. In the recrystallisation of solid organic compounds, the coloured impurities are removed by boiling the solution of the compound with

1) Activated charcoal

2) Oxalic acid

3) Magnesium sulphate

4) Calcium chloride

6. By mistake, an alcohol (boiling point 97°C) was mixed with hydrocarbon (boiling point 68°C). Method used to separate the two compounds

1) Steam distillation

2) Simple distillation

3) Fractional distillation

4) Differential distillation

7. **Assertion:** Simple distillation can help in separating a mixture of propan-1-ol (b.p. 97°C) and propanone (b.p. 56°C)

Reason : Liquids with a difference of more than 20°C in their boiling points can be separated by simple distillation.

1) Both A and R are correct and R is the correct explanation of A

2) Both A and R are correct and R is not the correct explanation of A

3) Both A and R are not correct

4) A is not correct but R is correct

8. From a mixture of two miscible volatile liquids the components can be separated in pure form by fractional distillation only when

1) they have a large difference in their boiling points

2) they have nearly the same boiling points

3) they form an azeotropic mixture

4) they donot form an azeotropic mixture

9. Refining of petroleum involves the process of

1) Simple distillation

2) Steam distillation

3) Distillation under reduced pressure

4) Fractional distillation

10. In steam distillation, the steam volatile compound and water distils together at

1) the normal boiling point at water

2) the normal boiling point of the compound

3) a temperature below the normal boiling point of the compound

4) a temperature below the normal boiling point of both compound and water

11. The most commonly used method for isolating essential oils from plant sources

1) Steam distillation

2) Simple distillation

3) Fractional distillation

4) Vaccuum distillation

12. Steam distillation is applied to those organic compounds which are

1) Steam volatile and soluble in water

2) Steam volatile and insoluble in water

3) non-steam volatile but soluble in water

4) neither steam volatile nor soluble in water

13. A compound 'X' has boiling point of 475 K but is starts decomposing at 400K. Which type of distillation process is suitable for its purification?

1) Simple distillation

2) Fractional distillation

3) Distillation under reduced pressure

4) Steam distillation

14. The distillation technique most suited for separating glycerol from spent-lye in the soap industry is

1) Distillation under reduced pressure

2) Simple distillation

3) Fractional distillation

4) Steam distillation

15. An organic substance from the aqueous solution can be separated by

1) Distillation

2) Steam distillation

3) Solvent extraction

4) Fractional distillation

16. The separation of a mixture of organic compound into individual components by column chromatography is based on the difference in their

1) Solubilities 2) Adsorption

2) Melting points 4) Partition coefficients

17. The most commonly used adsorbent in column chromatography is

1) Sand 2) Calcium carbonate

3) Charcoal 4) Silica gel

18. Given below are two statements: One is labelled in Assertion (A) and the other is labelled as Reason (R).

Assertion(A): Thin layer chromatography is an adsorption chromatography.

Reason (R): Thin layer of silica gel is spread over a glass plate of suitable size in thin layer chromatography . Which act as an adsorbent.

In the light of the above statements, choose the correct answer from the options given below.

1) Both A and R are correct and R is the correct explanation of A

2) Both A and R are correct and R is not the correct explanation of A

3) Both A and R are not correct

4) A is not correct but R is correct

19. Which of the following statements is correct for paper chromatography?

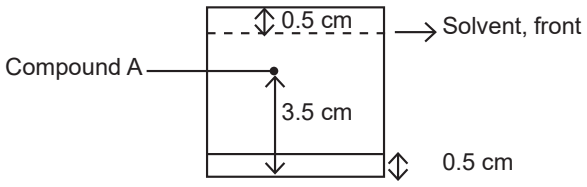
1) Paper sheet forms the stationary phase

2) Water present in the pores of the paper forms the stationary phase

3) Paper and water present in its pores together from the stationary phase

4) Water present in the mobile phase gets and adsorbed by the paper which then forms the stationary phase

20. Following chromatogram was developed by adsorption of compound 'A' on a 6 cm TLC glass plate. Retardation factor of the compound A is



1) 0.4 2) 0.5

3) 0.6 4) 0.7

Qualitative Analysis of Elements

21. The hydrocarbon on heating with cupric oxide gives CO_2 and a compound 'A'. The compound 'A' on reaction with anhydrous $CuSO_4$ gives ..... colour

1) White 2) Blue

3) Green 4) Orange

22. Lassaigne's test is used for the detection of

1) N, S and halogens

2) C, H and P

3) C, H and O

4) C, S and P

In each of the following questions, a statement of Assertion (A) is given followed by a corresponding statement of Reason (R) just below it. Of the statements, mark the correct answer as

1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true and reason is not the correct explanation of assertion

3) If assertion is true and reason is false

4) If both assertion and reason are false

23. **Assertion :** In Lassaigne's test, the organic compound is fused with sodium metal

Reason: The organic compound is fused with sodium to convert covalent compounds into ionic compounds.

24. When a nitrogeneous organic compound is fused with metallic sodium, its nitrogen is converted to

1) Sodium thiocyanate

2) Sodium nitrate

3) Sodium amide

4) Sodium cyanide

25. In Lassaigne's test for nitrogen, prussian blue colour develops due to the formation of

1) $Na\overset{III}{Fe}\left[\overset{II}{Fe}(CN)_6\right]$

2) $Na\overset{II}{Fe}\left[\overset{III}{Fe}(CN)_6\right]$

3) $Fe_4\left[Fe(CN)_6\right]_3$

4) $Na_2\overset{II}{Fe}\left[\overset{II}{Fe}(CN)_6\right]$

26. The sodium fusion extract of an organic compound on acidification with acetic acid followed by addition of lead acetate solution produced a black precipitate. So the compound contains

1) Nitrogen 2) Phosphorus

3) Sulphur 4) Bromine

27. The violet colour that develops on addition of sodium nitroprusside solution to sodium fusion extract of a sulphur containing organic compound is due to formation of

1) $Na_4\left[Fe(CN)_5NOS\right]$

2) $Na_2\left[Fe(CN)_5NO\right]$

3) $Na_3[Fe(SCN)_6]$

4) $Na_4[Fe(CN)_5S]$

28. Which of the nitrogen-containing organic compound doesnot respond positively to Lassaigne's test for nitrogen?

1) NH_2NH_2

2) $C_6H_5NH_2$

3) NH_2CONH_2

4) NH_2CH_2COOH

29. Which of the following sodium compound is formed when an organic compound containing both nitrogen and sulphur is fused with sodium?

1) Sulphite and cyanide

2) Thiocyanate

3) Cyanide and sulphide

4) Nitrate and sulphide

30. The sodium fusion extract of an organic compound on acidification with dilute HCl and subsequent treatment with $FeCl_3$ develops a blood-red colour. The organic compound contains

1) Bromine

2) Nitrogen

3) Sulphur

4) Both nitrogen and sulphur

31. The formula of sodium nitroprusside is

1) $Na_4[Fe(CN)_6]$

2) $Na_3[Fe(CN)_5NO]$

3) $Na_2[Fe(CN)_5NO]$

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

32. The sodium fusion extract of an organic compound is boiled with nitric acid and then treatment with silver nitrate solution. A white precipitate is formed which dissolves in ammonia solution. The organic compound contains

1) Sulphur

2) Chlorine

3) Phosphorus

4) Nitrogen

33. The Lassaigne's extract is boiled with conc. HNO_3 while testing for halogen, by doing so it

1) increases the concentration of NO_3^- ions

2) Decomposes Na_2S and NaCN, if formed

3) helps in the precipitation of AgCl

4) Increases the solubility product of AgCl

34. Lassaigne's test (with silver nitrate) is commonly used to detect halogens such as chlorine, bromine and iodine but not useful for fluorine because the product AgF formed is

1) Volatile

2) Explosive

3) a liquid

4) soluble in water

35. An organic compound is fused with sodium peroxide and the fused mass is extracted with water. The extract is heated with nitric acid and ammonium molybdate. A yellow precipitate is obtained. So the compound contains

1) Sulphur 2) Chlorine

3) Nitrogen 4) Phosphorus

Quantitative Analysis of elements

36. Carbon and hydrogen in an organic compound are estimated by

1) Dumas method

2) Carius method

3) Liebig's method

4) Kjeldahl's method

37. An organic compound contains 69% carbon and 4.8% hydrogen, the remainder being oxygen. The mass of CO_2 and H_2O produced when 0.2 g of this compound is subjected to complete combustion

1) 0.605 g, 0.0468 g

2) 0.605 g, 0.0648 g

3) 0.506 g, 0.0864 g

4) 0.560 g, 0.0864 g

38. Nitrogen present in an organic compound is estimated by

1) Liebig's combustion method

2) Aluise's method

3) Dumas method

4) Carius method

39. In Dumas method of estimation of nitrogen, the gas collected in the nitrometer is

1) N_2 2) NH_3

3) NO_2 4) N_2O

40. In Dumas method, nitrogen gas produced from the compound is collected in a nitrometer completely filled with

1) water

2) $CuSO_4$ solution

3) dilute HCl solution

4) Concentrated KOH solution

41. In the estimation of nitrogen by Dumas method, 0.112 g of an organic compound gave 22.4 mL of nitrogen gas at STP. The percentage of nitrogen in the compound is

1) 20.2 2) 47.5

3) 25.0 4) 15.5

42. In Duma's method of estimation of nitrogen, 0.1840g of an organic compound gave 30 mL of nitrogen collected as 287 K and 758 mm Hg pressure. The percentage composition of nitrogen in the compound is ..... (Aqueous tension and 287 K = 14 mm of Hg)

1) 19 2) 27

3) 11 4) 43

43. In Kjeldahl's method, nitrogen present in a compound is estimated by converting it finally into

1) NH_3 2) $(NH_4)_2SO_4$

3) N_2 4) $NH_2 – NH_2$

44. Kjeldahl's method of estimation of nitrogen is not applicable to

1) Amides 2)Amines

3) Diazocompounds 4) Amino acids

45. In Kjeldahl's method an organic compound is digested with concentrated sulphuric acid to convert its nitrogen on to

1) NH_3 2) $(NH_4)_2SO_4$

3) $(NH_4)_2SO_3$ 4) N_2

46. 0.24 g of a nitrogeneous compound was analysed by Kjeldahl's method. The liberated ammonia was absorbed in 25 mL of 0.5 N H_2SO_4. The excess acid required 38.5 mL of 0.2 N NaOH for complete neutralization. The percentage of nitrogen in the compound is

1) 16.7 2) 30.5

3) 28.0 4) 20.2

47. Kjeldahl's method was used for the estimation of nitrogen in an organic compound. The ammonia evolved from 0.55 g of the compound neutralised 12.5 mL of 1M H_2SO_4 solution. The percentage of nitrogen in the compound is

1) 64 2) 84

3) 46 4) 74

48. Chlorine present in organic compounds are estimated by

1) Carius method 2) Duman method

3) Liebig's method 4) Kjeldahl's method

49. In the Carius method, halgoens present in organic compounds are estimated in the form of

1) Barium halide 2) Silver halide

3) Hydrogen halide 4) Gaseous halogen

50. 0.25 g of an organic compound containing chlorine gave 0.40g of silver chloride in carius estimation. The percentage of chlorine present in the compound is

1) 20 2) 30

3) 40 4) 50

51. 0.400 g of an organic compound (X) gave 0.376 g of AgBr in Carius method for estimation of bromine % of bromine in the compound (X) is

1) 20 2) 30

3) 40 4) 50

52. 0.156 g of an organic compound on heating with excess of fuming nitric acid and silver nitrate produced 0.235g of silver iodide. The percentage of iodine in the compound

1) 61.41 2) 71.41

3) 81.41 4) 91.41

53. 0.32 g of an organic compound containing sulphur was heated with fuming nitric acid to convert sulphur into sulphuric acid. The latter was then precipitated as $BaSO_4$ by adding excess of $BaCl_2$ solution. 0.233 g of $BaSO_4$ was obtained, the percentage of sulphur in the compound is approximately

1) 15 2) 10

3) 30.5 4) 20.6

54. 0.262 g of an organic compound containing phosphorus gave 0.111 g of magnesium pyrophosphate. What is the percenrage of phosphorus in the compound?

1) 11.8 2) 18.1

3) 23.6 4) 35.4

55. Complete combustion of 1.80g of an oxygen containing compound ($C_xH_yO_z$) gave 2.64 g of CO_2 and 1.08 g of H_2O. The percentage of oxygen in the organic compound is

1) 51.63 2) 63.53

3) 53.33 4) 50.33

SAMPLE QUESTIONS

1. Which of the following mixtures can be separated into pure components by sublimation?

1) Naphthalene and camphor

2) Camphor and anthracene

3) Naphthalene and ammonium chloride

4) Camphor and sodium chloride

2. Suggest the method to purify iodine containing traces of common salt

1) Vacuum distillation

2) Distillation

3) Fractional distillation

4) Distillation under reduced pressure

3. The separation of the components from a mixture of two organic solids by crystallisation is based on the difference in their

1) Adsorptivities 2) Solubilities

3) Densities 4) Melting point

4. How will you separate a solution (miscible) of benzene and $CHCl_3$?

1) Sublimation 2) Filtration

3) Distillation 4) Crystallisation

5. From a mixture of methanol (b.p. 65°C) and acetone (b.p. 56°C) the components can be separated by

1) simple distillation

2) distillation under reduced pressure

3) steam distillation

4) fractional distillation

6. Which of the following pairs of compounds cannot be separated from their mixture by steam distillation?

1) o- and p-nitrophenol

2) o- and p-hydroyxbenzaldehyde

3) o- and p-bromoanilines

4) Aniline and nitrobenzene

7. For the separation of two immiscible liquids which method is used?

1) chromatography

2) Differential extraction

3) Steam distillation

4) Sublimation

8. In column chromatography

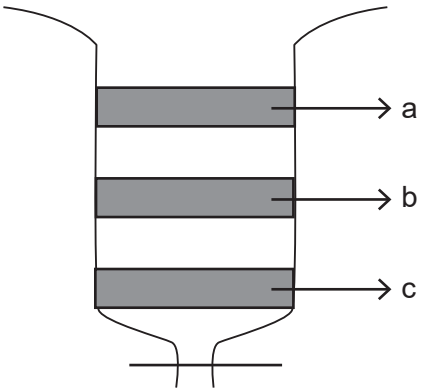
1) Mobile phase is a liquid and stationary phase is a solid

2) Mobile phase is solid and stationary phase is a liquid

3) both phase are liquids

4) both phases are solids

9. From the figure of column chromatography given below. Identify incorrect statements



A) Compound c is more polar than 'a' and 'b'

B) Compound 'a'is least polar

C) Compound 'b' comes out of the solution before 'a' and after 'c'

D) Compound 'a' spends more time in the column

Choose the correct answer from the options given below

1) A, B and D only

2) B and D only

3) B, C and D only

4) A, B and C only

10. Which one of the following techniques is not used to spot components of a mixture separated on thin layer chromatographic plate?

1) I_2 (solid)

2) U.V. light

3) Visualisation agent as a component of mobile phase

4) Spraying of an appropriate reagent

11. Which of the following compounds will develop a red colour in Lassaigne's test for nitrogen if excess of sodium is not used in the fusion of the compound?

1) $NH_2-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2$ 2) $NH_2-\overset{\overset{\displaystyle S}{\|}}{C}-NH_2$

3) $C_6H_5CH_2NH_2$ 4) $C_6H_5CONH_2$

12. For the detection of phosphorus, the organic compound after fusion with Na_2O_2 is extracted with water, boiled with HNO_3 and then ammonium molybdate added to it. A yellow precipitate obtained which is due to the formation of

1) Ammonium phosphate

2) Ammonium phosphomolybdate

3) Ferric phosphate

4) Disodium ammonium phosphate

13. 0.5 g of an organic compound (X) with 60% carbon will produce how many grams of CO_2 on complete combustion

1) 1.1 2) 1.2

3) 3.3 4) 9.4

14. 0.2 g of an organic compound on complete combustion produce 0.18g of water. Then the percentage of hydrogen in it

1) 5 2) 10

3) 15 4) 20

15. A sample of 0.125 g of an organic compound when analysed by Dumas method yields 22.78 mL of nitrogen gas collected over KOH solution at 280 K and 759 mm Hg. The percentage of nitrogen in the organic compound. (Vapour pressure of water at 280 K is 14.2 mm Hg)

1) 13 2) 22

2) 46 4) 35

16. In Dumas method of estimation of nitrogen 0.35 g of an organic compound gave 55 mL of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound would be (Aqueous tension at 300 K = 15 mm)

1) 14.45 2) 15.45

3) 16.42 4) 17.45

17. 0.8g of an organic compound was analysed by Kjeldahl's method for estimation of nitrogen. If the percentage of nitrogen in the compound was found to be 42% then ..... mL of 1M H_2SO_4 would have been neutralised by the ammonia evolved during the analysis

1) 13 2) 12

3) 15 4) 17

18. For the estimation of nitrogen, 1.4 g of organic compound was digested by Kjeldahl's method and the evolved ammonia was absorbed in 60 mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required 20 mL of $\frac{M}{10}$ sodium hydroxide for complete neutralisation. The percentage of nitrogen in the compound is

1) 3% 2) 5%

3) 6% 4) 10%

19. **Assertion** : During digestion with conc. H_2SO_4, the nitrogen of the organic compound is converted into $(NH_4)_2SO_4$

Reason : $(NH_4)_2SO_4$ on heating with a concentrated solution of NaOH liberates NH_3

1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true and reason is not the correct explanation of assertion

3) If assertion is true but reason is false

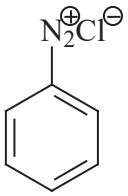
4) If both assertion and reason are false

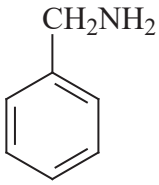
20. The ammonia evolved from the treatment of 0.3g of an organic compound for the estimation of nitrogen was passed in 100 mL of 0.1 M sulphuric acid. The excess of acid required 20mL of 0.5 M sodium hydroxide solution for complete neutralization. The organic compound is

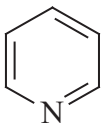
1) Urea 2) Thiourea

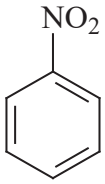
3) Acetamide 4) Benzamide

21. Nitrogen can be estimated by Kjeldahl's method for which of the following compounds?

1) 

2) 

3) 

4) 

22. 0.59 g acetamide was Kjeldahlised and the NH_3 evolved was passed through 50 mL 0.5 N H_2SO_4. How many mL of 1M NaOH would be required to neutralise the residual acid?

1) 35 mL 2) 15 mL

3) 50 mL 4) 40 mL

23. In the estimation of nitrogen by Kjeldahl's method, 2.8 g of an organic compound required 20 mili mole of H_2SO_4 for the complete neutralisation of NH_3 gas evolved. The percentage of nitrogen in the sample is

1) 20% 2) 10%

3) 40% 4) 30%

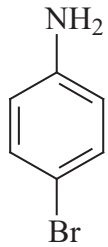
24. 0.38g of an organic chloro compound gave 0.57 g of silver chloride in Carius estimation. The percentage of chlorine in the organic compound is

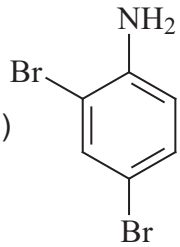
1) 38.5% 2) 37.10%

3) 35.75% 4) 36.25%

25. In Carius method of estimation of halogen, 0.172 g of an organic compound showed presence of 0.08g of bromine. Which of these is the correct structure of the compound?

1) CH_3–Br 2) CH_3CH_2Br

3) 

4) 

26. 0.5g of an organic compound on heated with excess of fuming nitric acid and silver nitrate gave 0.5875 g of silver iodide. The percentage of iodine in the compound

1) 30.16 2) 63.5

3) 43.21 4) 55.85

27. In the Carius method of estimation of sulphur, an organic compound is heated with fuming nitric acid to convert sulphur present in the compound into

1) $(NH_4)_2SO_4$ 2) H_2S

3) SO_2 4) H_2SO_4

28. Phosphorus present in an organic compound is generally estimated in the form of

1) Magnesium pyrophosphate

2) Ammonium phosphomolybdate

3) Either of the above

4) None of the above

29. How much sulphur is present in an organic compound if 0.53g of the compound gave 1.158 g of $BaSO_4$ on Carius method

1) 15% 2) 20%

3) 25% 4) 30%

30. An organic compound weighing 0.31g gave 0.444 g of magnesium pyrophosphate in the estimation of phosphorus by Carius method. The % of P in the compound is

1) 20 2) 14

3) 30 4) 40

31. 0.46 g of an organic compound containing carbon, hydrogen and oxygen was heated strongly in a stream of N_2 gas. The gaseous mixture thus obtained was passed first over heated coke at 1373 K and then through warm solution of iodine pentoxide when 1.27g of I_2 was liberated. The percentage of oxygen present in the organic compound is

1) 87.34 2) 86.96

3) 97.38 4) 38.47

32. **Statement-I :** A mixture of chloroform and aniline can be separated by simple distillation.

Statement-II : When separating aniline from a mixture of aniline and water by steam distillation aniline boils below its boiling point

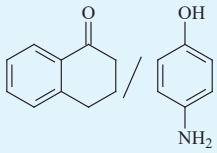
1) Statement-I is false but statement-II is true

2) Both statement-I and statement-II are false

3) Statement-I is true but statement-II is false

4) Both statement-I and statement-II are true

33. Match items of column-I and column-II

Column-I (Mixture of compounds)		Column-II (Separation techniques)	
A	H_2O/CH_2Cl_2	I	Crystallization
B		II	Differential extraction
C	Separtion of crude oil into different fractions of petroleum industry	III	Column chro-matography
D	$C_6H_{12}O_6/NaCl$	IV	Fractional distillation

Choose match is

1) A→iii; B→iv; C→ii; D→i

2) A→i; B→iii; C→ii; D→iv

3) A→ii; B→iv; C→i; D→iii

4) A→ii; B→iii; C→iv; D→i

34. Using column chromatography, mixture of two compounds 'A' and 'B' was separated. 'A' eluted first, this indicates 'B' has

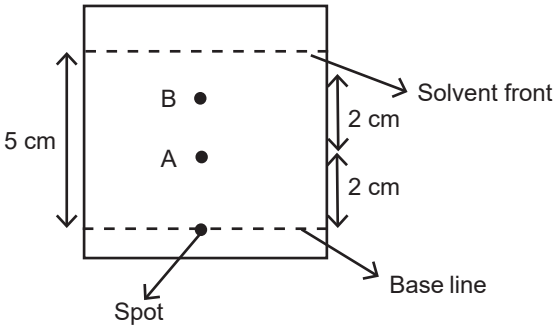
1) low R_f, weaker adsorption

2) high R_f, stronger adsorption

3) high R_f, weaker adsorption

4) low R_f, stronger adsorption

35. Using the provided information in the following paper chromatography



Paper chromatography for compounds A and B the calculated R_f value of B is

1) 0.6 2) 0.7

3) 0.8 4) 0.1

36. Which of the following is a 'FALSE' statement?

1) Carius tube is used in the estimation of sulphur in organic compound

2) Carius method is used for the estimation of nitrogen in an organic compound

3) Phosphoric acid produced on oxidation of phosphorus present in an organic compound is precipitated as $Mg_2P_2O_7$ by adding in magnesia mixture

4) Kjeldahl's method is used for the estimation of nitrogen in an organic compound

37. Match the organic compound in column-I with the Lassaigne's test results in column-II appropriately

Column-I		Column-II	
A	Aniline	I	Red colur with $FeCl_3$
B	Benzene sulphonic acid	II	Violet colour with sodium nitroprusside
C	Thiourea	III	Blue colour with hot and acidic solution of $FeSO_4$

1) A→ii; B→i; C→iii 2) A→iii; B→ii; C→i

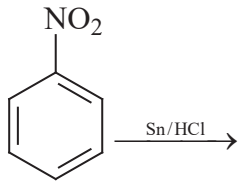
3) A→ii; B→iii; C→i 4) A→iii; B→i; C→ii

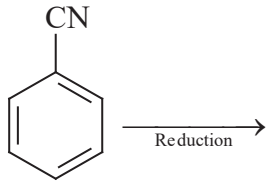
38. Compounds that will give positive Lassaigne's test for both nitrogen and halogen is

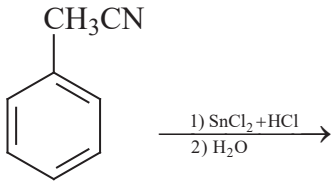
1) NH_2OH, HCl 2) $CH_3NH_2.HCl$

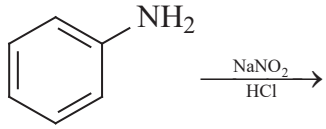
3) NH_4Cl 4) $N_2H_4.HCl$

39. The Kjeldahl method of nitrogen estimation fails for which of the following reaction products

a) 

b) 

c) 

d) 

1) b and c 2) a, c and d

3) c an d 4) a and d

40. The number of moles of CuO that will be utilized in Dumas method for estimating nitrogen in a sample of 57.5 g of N, N-Dimethylaminopentane is .....

1) 9.75 2) 11.25

3) 12.25 4) 15.56

41. The percentage of nitrogen in an organic compound was found to be 43%. The ammonia evolved from Kjeldahlization of 0.8g of this compound was absorbed in 20 m L of 1M H_2SO_4. The concentration of H_2SO_4 in the resultant solution would be (Assuming no volume change on dissolution of NH_3)

1) 0.8 M
2) 0.4 M
3) 0.6 M
4) 0.2 M

42. In Carius tube, an organic compound 'X' is treated with sodium peroxide to form a mineral acid 'Y'. The solution of $BaCl_2$ is added to 'Y' to form a precipitate 'Z'. Z is used for the quantitative estimation of an extra element. 'X' could be

1) Methionine
2) Chloroxylenol
3) Cytosine
4) Nucleotide

43. The catalyst used in Kjeldahl's method for estimation of nitrogen is

1) Copper
2) Magnesium
3) Mercury
4) Sodium

44. Which of the following statements is/are correct

i) When a Lassaignes solution is heated with dil. HNO_3, cooled and $AgNO_3$ solution is added, a yellow precipitate, partially soluble in NH_3 or NH_4OH, indicates the presence of iodine in organic compound

ii) When $(CH_3COO)_2Pb$ solution is added to the acidified Lassaigne's extract of an organic compound, a black precipitate of PbS is formed

iii) An organic compound containing N, on heating with conc.H_2SO_4 gives $(NH_4)_2SO_4$ which liberates NH_3 on treatment with excess of NaOH

iv) Nitroprusside ion is $[Fe(CN)_5NOS]^{2-}$

1) 1, 2 only
2) 2, 3 only
3) 3, 4 only
4) 1, 4 only

45. The approximate range of sample quantity for CHN elemental analyser is

1) 1-2 mg
2) 1-3 mg
3) 5.7 mg
4) 10-15 mg

ANSWER KEY

1.	2	15.	3	29.	2	43.	1
2.	4	16.	2	30.	4	44.	3
3.	1	17.	4	31.	3	45.	2
4.	3	18.	1	32.	2	46.	3
5.	1	19.	2	33.	2	47.	1
6.	2	20.	3	34.	4	48.	1
7.	1	21.	2	35.	4	49.	2
8.	4	22.	1	36.	3	50.	3
9.	4	23.	1	37.	3	51.	3
10.	4	24.	4	38.	3	52.	3
11.	1	25.	3	39.	1	53.	2
12.	2	26.	3	40.	4	54.	1
13.	3	27.	1	41.	3	55.	3
14.	1	28.	1	42.	1		

SAMPLE QUESTIONS

1.	4	10.	3	19.	2	28.	3	37.	2
2.	2	11.	2	20.	1	29.	4	38.	2
3.	2	12.	2	21.	2	30.	4	39.	3
4.	3	13.	1	22.	2	31.	2	40.	2
5.	4	14.	2	23.	1	32.	4	41.	2
6.	4	15.	2	24.	2	33.	4	42.	1
7.	2	16.	3	25.	3	34.	4	43.	3
8.	1	17.	2	26.	2	35.	3	44.	2
9.	3	18.	4	27.	4	36.	2	45.	2

WORK BOOK

Chapter 12

HYDROCARBON

QUESTIONS

ALKANES

1. The major constituent of natural gas is

1) methane 2) propane

3) butane 4) hexane

2. Which one of the following gives only one monochloro derivative?

1) neo-Pentane 2) n-Hexane

3) 2-Methylpentane 4) 3-Methylpentane

3. Wurtz reaction may be used to unite

1) two alkyl halides

2) two aryl halides

3) alkyl and aryl halides

4) two benzene units

4. Which of the following compounds will react with Na to form 4,5-diethyloctane?

1) $CH_3CH_2CH_2CH_2Br$

2) $CH_3CH_2CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2CH_2Br$

3) $CH_3CH_2CH_2CH_2-\underset{\underset{Br}{|}}{CH}-CH_3$

4) $CH_3CH_2CH_2-\underset{\underset{Br}{|}}{CH}-CH_2CH_3$

5. An alkyl halide X reacts with sodium to form 3,8-dimethyldecane. What is X?

1) $CH_3CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2CH_2Cl$

2) $CH_3CH_2CH_2CH_2Cl$

3) $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{H}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2-CH_2-CH_2-CH_2Cl$

4) $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2CH_2Cl$

6. A mixture of 1-iodoethane and 1-iodopropane is treated with sodium metal and dry ether to carry out Wurtz reaction. Which of the following hydrocarbons will be formed?

1) Propane + Hexane

2) Ethane + Propane

3) Butane + Propane

4) Butane + Pentane + Hexane

7. Which alkane is produced when sodium salt of butanoic acid is heated with soda lime?

1) CH_3CH_3 2) $CH_3CH_2CH_2CH_3$

3) CH_4 4) $CH_3CH_2CH_3$

8. Which of the following statements is true?

1) Soda lime is a mixture of sodium hydroxide and potassium hydroxide

2) Methane can be prepared by Wurtz reaction

3) In alkanes all carbon atoms are sp^3 hybridised

4) neo-Pentane yields three different monochloro derivatives

9. Match the column I with column II and mark the appropriate choice.

Column I		Column II	
A)	n-Butane → 2-Methylpropane	i)	Free radical substitution
B)	$CH_4 + Cl_2 \xrightarrow{h\upsilon} CH_3Cl$	ii)	Wurtz reaction
C)	RCOONa + soda lime → RH	iii)	Isomerisation
D)	$RX + Na \xrightarrow{ether} R-R$	iv)	Decarboxylationj

1) A-iii, B-i, C-iv, D-ii 2) A-ii, B-iv, C-i, D-iii

3) A-i, B-ii, C-iv, D-iii 4) A-iv, B-i, C-iii, D-ii

10. How many structural isomers are possible for the C_5H_{12}?

1) 2 2) 3

3) 4 4) 5

11. In the free radical chlorination of methane, the chain initiating step involves the formation of

1) chlorine free radical

2) hydrogen chloride

3) methyl radical

4) chloromethyl radical

12. n-Hexane isomerises in presence of an anhydrous aluminium chloride and hydrogen chloride gas to give

1) 2-Methyl pentane

2) 3-Methyl pentane

3) Both 1 and 2

4) Neither 1 nor 2

13. Spatial arrangements of atoms which can be converted into one another by rotation around a C – C single bond are called

1) Stereoisomers 2) Tautomers

3) Optical isomers 4) Conformers

14. Which one of the following gives only one monochloro derivative ?

1) n-hexane

2) 2-methylpentane

3) 2,3-dimethylpentane

4) neo-pentane

15. Ethene when treated with Br_2 in the presence of CCl_4 which compound is formed

1) 1,2-dibromoethane

2) 1-bromo-2-chloroethane

3) Both 1 and 2

4) 1, 1, 1-tribromoethane

16. Among the following reactions, the reaction that "does not" given alkane product is

1) $CH_3C \equiv CCH_3 \xrightarrow{Pt, H_2}$

2) $CH_3CH_2CH_2CH_2CO_2Na \xrightarrow{Electrolysis}$

3) $CH_3CH_2Br \xrightarrow{Na,\ dry\ ether}$

4) $CH_3CH_2CH_2CH_2F \xrightarrow{Zn, H^{\oplus}}$

17. **Assertion (A)**: Sodium acetate on Kolbe's electrolysis gives ethane.

Reason (R) : Methyl free radical is formed at cathode

1) Both A and R are true and R is a correct explanation for A

2) Both A and R are true but R is not a correct explanation for A

3) A is true, R is false

4) A is false, R is true

18. The chlorination of ethane is an example of

1) Nucleophilic substitution

2) Electrophilic substitution

3) Free radical substitution

4) Rearrangement

19. Methane can be converted to ethane by the reaction,

1) Chlorination followed by the reaction with alcoholic KOH

2) Chlorination followed by the reaction with aqueous KOH

3) Chlorination followed by Wurtz reaction

4) Chlorination followed by decarboxylation

20. **Assertion** : CH_4 does not react with Cl_2 in dark.

Reason : Chlorination of CH_4 takes place in sunlight.

1) If both assertion and reason are correct and the reason is a correct explanation of the assertion

2) If both assertion and reason are correct but reason is not a correct explanation of the assertion

3) If the assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

21. What is Z in the following reaction ?

$$CH_3-CH_2-CO_2^-Na^{\oplus} \xrightarrow{NaOH/CaO} Z$$

1) propane 2) n-butane

3) ethane 4) ethyne

22. Which of the following reactions is used to prepare isobutane ?

1) Wurtz reaction of C_2H_5Br

2) Hydrolysis of n-butylmagnesium iodide

3) Reduction of propanol with red phosphorus and HI

4) Decarboxylation of 3-methylbutanoic acid

23. The product/s of following reaction is (are)

$$C_2H_5Br + 2Na + CH_3Br \xrightarrow{\text{dry ether}} ?$$

1) ethane

2) propane

3) butane

4) ethane, propane and butane

24. Arrange the following in decreasing order of their boiling points

I) n-Butane

II) 2-methylbutane

III) n-pentane

IV) 2, 2-dimethylpropane

1) I > II > III > IV

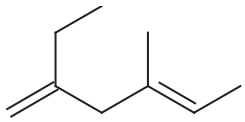
2) II > III > IV > I

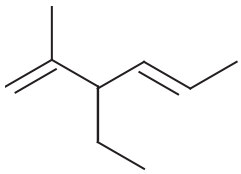
3) IV > III > II > I

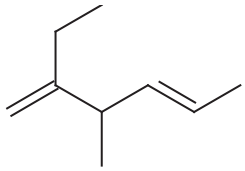
4) III > II > IV > I

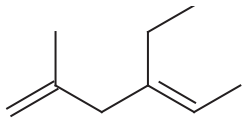
ALKENES

25. The correct structure of 2-Ethyl-3-methylhexa-1,4-diene.

1) 

2) 

3) 

4) 

26. Which alkene gives only acetone on ozonolysis?

1) Isobutylene

2) 2,3-Dimethyl-1-butene

3) 2,3-Dimethyl-2-butene

4) 2,2-Dimethyl-1-butane

27. Arrange the following alkanols a, b and c in order of their reactivity towards acid catalyzed dehydration.

1) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-\underset{\underset{OH}{|}}{CH_2}$

2) $CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2-CH_3$

3) $CH_3-\overset{\overset{CH_3}{|}}{CH}-\overset{\overset{OH}{|}}{CH}-CH_3$

4)

28. When 3,3-dimethylbutan-2-ol is heated with H_2SO_4, the major product obtained is

1) 2,3-dimethylbut-2-ene

2) 3,3-dimethylbut-1-ene

3) 2,3-dimethylbut-1-ene

4) 2,3-dimethylbutane

29. An organic compound E (C_5H_8) on hydrogenation gives compound F(C_5H_{12}). Compound E on ozonolysis gives formaldehyde and 2-ketopropanal. What is F?

1) $CH_2=CH-\underset{\underset{CH_2}{||}}{C}-CH_3$

2) $CH_3CH_2CH_2CH_2CH_3$

3) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_3$

4) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH=CH_2$

30. Reactivity of alkenes towards HX increases in the order

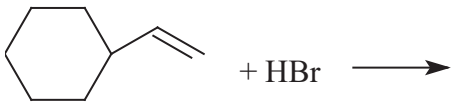
1) 2-methylpropene > propene > ethene

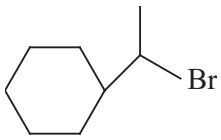
2) 2-methylpropene > ethene > propene

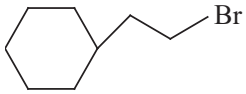
3) Ethene > propene > isobutylene

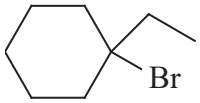
4) Propene > ethene > isobutylene

31. In the reaction, possible products are



1) 

2) 

3) 

4) All of these

32. Consider the following reactions,

$$C_2H_2 \xrightarrow[500^0 C]{\text{red hot iron tube}} A$$

$$A \xrightarrow[70^0 C]{\text{conc.}HNO_3, \text{conc.}H_2SO_4} B$$

$$B \xrightarrow{LiAlH_4} C_6H_5-N=N-C_6H_5$$

A and B are

1) A = C_2H_4, B = C_6H_6

2) A = C_2H_6, B = $C_6H_5NH_2$

3) A = C_2H_4, B = $C_6H_5NH_2$

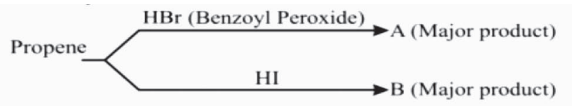
4) A = C_6H_6, B = $C_6H_5NO_2$

33. Idnetify the substrate in this reaction:

$$? \xrightarrow[443K]{H_2SO_4} H_2C = CH_2$$

1) Isopropyl alcohol 2) Methyl alcohol
3) Ethyl alcohol 4) n-Propyl alcohol

34. Identify A and B in the reaction



1) A : $CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$,

B : $CH_3-CH_2-CH_2-I$

2) A : $CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$,

B : $CH_3-\underset{\underset{I}{|}}{CH}-CH_3$

3) A : $CH_3-CH_2-CH_2-Br$

B : $CH_3-CH_2-CH_2-I$

4) A : $CH_3-CH_2-CH_2-Br$

B : $CH_3-\underset{\underset{I}{|}}{CH}-CH_3$

35. Consider the following statements :

Statement I : 1-Butene reacts with HBr to give 1-bromobutane.

Statement II : Reactive intermediate of the above reaction is carbocation.

Which one of the following is correct in respect of the above statements ?

1) Both statement I and statement II are correct and statement Ii is the correct explanation of statement I

2) Both statement I and statement II are correct but statement II is not correct explanation of statement I

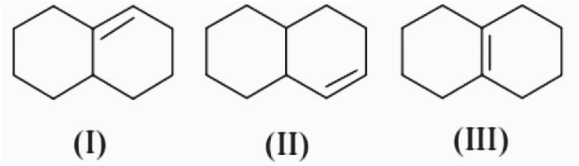
3) Statement I is correct but statement II is incorrect

4) Statement I is incorrect but statement II is correct

36. Bayer's reagent reacts with which of the following compounds to give glycol ?

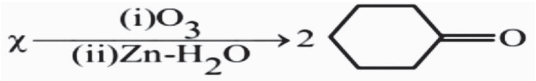
1) Methane 2) Ethane
3) Ethylene 4) Acetylene

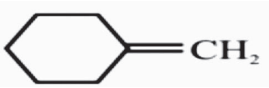
37. The stability order of the given alkeness is

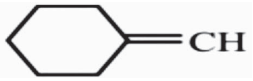


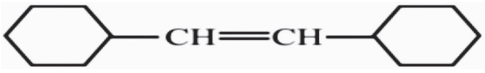
1) I > II > III 2) I > III > II
3) III > II > I 4) III > I > II

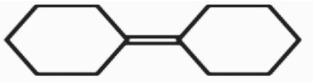
38. Identify 'X' in the following reaction.



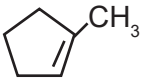
1) 

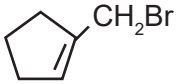
2) 

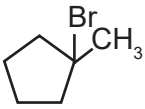
3) 

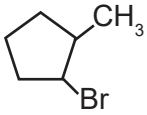
4) 

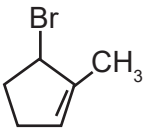
39. What is the major product obtained from the addition of HBr to the following compound?

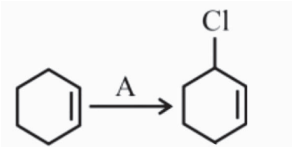


1) 

2) 

3) 

4) 

40. 

Identify the reagent(s) 'A' and condition(s) for the reaction

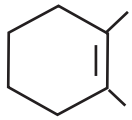
1) A = Cl_2; dark, Anhydrous $AlCl_3$

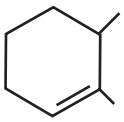
2) A = HCl; $ZnCl_2$

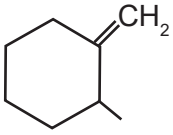
3) A = Cl_2; UV light

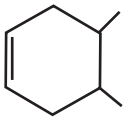
4) A = HCl; Anhydrous $AlCl_3$

41. The order of stability among the following alkenes is :

i) 

ii) 

iii) 

iv) 

1) i > iv > ii > iii 2) ii > i > iii > iv

3) i > ii > iv > iii 4) iii > iv > ii > i

42. Identify the main product in the reaction

$$(CH_3)_3COH \xrightarrow[358K]{20\%\ H_3PO_4}$$

1) $(CH_3)_2C = CH_2$

2) $(CH_3)_2CHOH$

3) $CH_3CH = CHCH_3$

4) $CH_3CH_2CH = CH_2$

43. The compound which on ozonolysis produces a mixture of propanone and ethanal is

1) 2-methylbut-1-ene

2) 2-pentene

3) 2-pentyne

4) 2-methylbut-2-ene

44. One mole of a symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44 u. The alkene is

1) Ethene 2) Propene

3) 1-butene 4) 2-butene

45. Ethylene may be obtained by dehydration of which of the following with concentrated H_2SO_4 at 160 - 170°C

1) C_2H_5OH 2) CH_3OH

3) $CH_3CH_2CH_2OH$ 4) $(CH_3)_2CHCH_2OH$

46. A reagent used to test for unsaturation in alkenes is

1) Ammoniacal $AgNO_3$

2) conc. H_2SO_4

3) Solution of Br_2 in CCl_4

4) Ammoniacal Cu_2Cl_2

47. **Assertion** : Propene reacts with HI in presence of peroxide to give 1-iodopropane

Reason : 1^0 free radical is more stable than 2^0 free radical

1) if both assertion and reason are correct and reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

48. **Assertion** : Addition of HBr on 2-butene give two isomeric products.

Reason : Addition of HBr on 2-butene follows Markovnikov rule

1) if both assertion and reason are correct and reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If the assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

ALKYNES

49. The IUPAC name of $HC\equiv C-\underset{\underset{CH_3}{|}}{C}=CH-CH_3$ is

1) 3-Methyl-2-penten-4-yne
2) 3-Methyl-3-penten-1-yne
3) 3-Methyl-4-pentyn-1-ene
4) 3-Methylpentenyne

50. IUPAC name of $CH_3-CH=C=CH-C\equiv CH$ is

1) 2-Hexen-4-yne
2) Hexa-2,3-dien-1-yne
3) Hexa-3,4-dien-1-yne
4) None of these

51. For preparing acetylene in Kolbe's electrolysis, we take

1) $CH_3-\underset{\underset{CHCOOK}{||}}{C}-COOK$

2) $\underset{\underset{CHCOOK}{||}}{CHCOOK}$

3) $CH_3-CH_2-\underset{\underset{CHCOOK}{||}}{C}COOK$

4) $\begin{array}{l} CH_3-C-COOK \\ \quad\;\; || \\ CH_3-C-COOK \end{array}$

52. In the reaction,

$CH_3CH_2CCl_2CH_3 \xrightarrow[\Delta]{X} CH_3C\equiv CCH_3$ the reagent X is

1) KOH/C_2H_5OH 2) Zn
3) KOH/H_2O 4) Na

53. Propyne is formed by heating 1,2-dibromopropane with

1) C_2H_5ONa
2) Alc. KOH and sodamide
3) Aqueous alkali
4) Soda lime

54. Which IUPAC name is correct?

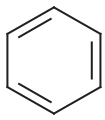
1) $CH_3-\underset{\underset{C_2H_5}{|}}{C}=\underset{\underset{C_2H_5}{|}}{C}-CH_3 \longrightarrow$ 2,3-Diethylbutene

2) $HC\equiv C-\underset{\underset{HC-CH_2}{|}}{CH}-CH_2-CH_2-CH_3 \longrightarrow$ 3-Ethynlpenta-1,4-diene

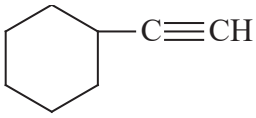
3) $HC\equiv C-CH=CH_2 \rightarrow$ But – 1 – en – 3 – yne

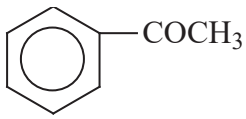
4) $CH_3-CH=CH-C\equiv CH \rightarrow$ Pent – 1 – yne – 3 – ene

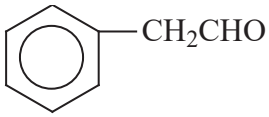
55. Which of the following catalyst is used for the following conversion?

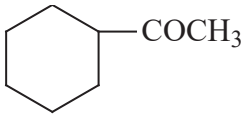
$3CH\equiv CH \xrightarrow{873K}$ 

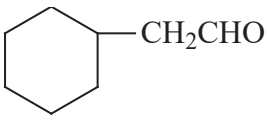
1) Platinized asbestos 2) Red hot iron tube
3) Platinized nickel 4) Iron-molybdenum

56. Hydration of  in presence of $H_2SO_4/HgSO_4$ gives

1) 

2) 

3) 

4) 

57. The catalyst required for the reaction

$$HC \equiv CH + dil.H_2SO_4 \xrightarrow{Catalyst} CH_3CHO \text{ is}$$

1) $HgSO_4$ 2) Pd

3) Pt 4) $AlCl_3$

58. Which one of these will react with sodium metal?

1) Ethyne 2) Ethene

3) Ethane 4) Ether

59. Hydration of propyne gives

1) 1-Propanol 2) 2-Propanol

3) Propanal 4) Propanone

60. Heating a mixture of sodium benzoate and soda lime gives

1) Methane

2) Phenol

3) Calcium benzoate

4) Benzene

61. To distinguish between propene and propyne, the reagent would be

1) Bromine

2) Alkaline $KMnO_4$

3) Ammoniacal silver nitrate

4) Ozone

62. When treated with ammoniacal cuprous chloride, which one among the following forms red precipitate?

1) C_2H_6 2) C_2H_4

3) C_2H_2 4) C_6H_6

63. A metallic carbide on treatment with water gives a colourless gas which burns readily in air and the gas released gives a precipitate with ammoniacal silver nitrate solution, Gas evolved is

1) Methane 2) Ethane

3) Acetylene 4) Ethylene

64. Acetylenic hydrogens are acidic because

1) Sigma electron density of C–H bond in acetylene is nearer to carbon, which has 50% s-character

2) Acetylene has only one hydrogen on each carbon

3) Acetylene contains least number of hydrogens among the possible hydrocarbons having two carbons

4) Acetylene belongs to the class of alkynes with molecular formula C_nH_{2n-2}

65. The gaseous substance which decolourises bromine but does not give a precipitate with ammoniacal silver nitrate is :

1) C_2H_6 2) C_2H_4

3) C_2H_2 4) CH_4

66. Consider the following reactions,

$$C_2H_2 \xrightarrow[500^0 C]{\text{red hot iron tube}} A$$

$$A \xrightarrow[70^0 C]{conc.HNO_3, conc.H_2SO_4} B$$

A and B are

1) A = C_2H_4, B = C_6H_6

2) A = C_2H_6, B = $C_6H_5NH_2$

3) A = C_2H_4, B = $C_6H_5NH_2$

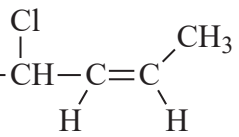
4) A = C_6H_6, B = $C_6H_5NO_2$

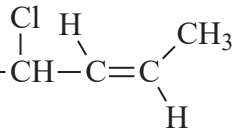
67. In the reaction,

$$Ph-CH_2-C\equiv C-CH_3 \xrightarrow{\text{Birch reduction}}$$

$$A \xrightarrow{Cl_2/h\nu} B,$$

B is

1) 

2) 

3) Ph – CH_2 – CH(Cl) – CH = CH – CH_3

4) None of these

68. $CH_3-C\equiv C-CH_3$ → (Lindlar's catalyst) → A; (Na in Liq. NH_3) → B

In the above reaction A and B are respectively

1) cis and trans but-2-ene

2) trans and cis but-2-ene

3) Both cis but-2-ene

4) Both trans but-2-ene

69. When 1-butyne undergoes addition with the help of $HgSO_4 + H_2SO_4$, the product (s) formed is/are

1) $CH_3CH_2COOH + HCOOH$

2) $CH_3CH_2COCH_3$

3) $CH_3CH_2CH_2COOH$

4) $CH_3CH_2CH_2CHO$

70. **Assertion** : Acetylene is acidic in nature.

Reason : In acetylene carbon is sp^2 hybridised

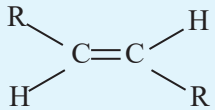
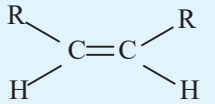
1) Assertion is not correct but Reason is correct

2) Both assertion and reason are correct and reason is the correct explanation of assertion

3) Both assertion and reason are correct but reason is not the correct explanation of assertion

4) Assertion is correct, but reason is not correct

71. Match the following.

Column-I (Alkyne + Reagent)		Column-II (Final product)	
A)	$R-C\equiv C-R + Pd\|C\|H_2 \rightarrow$	1)	
B)	$R-C\equiv C-R + Na$ $Liq.NH_3 \rightarrow$	2)	RCH_2-CH_2-R
C)	$RC\equiv CR + Pd$ $\|H_2 \rightarrow$	3)	
D)	$R-C\equiv C-R \xrightarrow[H_2O_2/OH]{BH_3,THF}$	4)	$RCH_2-\overset{\overset{O}{\|}}{C}-CH_3$

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

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

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

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

72. Propyne and propene can be distinguished by

1) conc. H_2SO_4

2) Br_2 in CCl_4

3) dil. $KMnO_4$

4) $AgNO_3$ in NH_3

73. Identify the incorrect statement/statements

i) Alkynes are more reactive than alkenes towards electrophilic addition reaction

ii) Alkynes are less reactive than alkenes towards electrophilic addition reaction

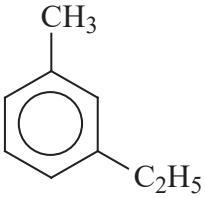
iii) Alkynes decolourises Br_2 water

iv) Addition of HBr to alkynes in presence of peroxide proceeds via markownikoff rule

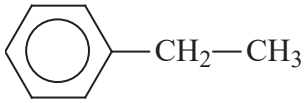
1) i and ii 2) ii and iii

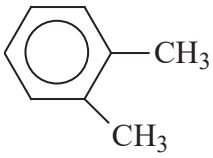
3) i and iv 4) ii and iv

AROMATIC HYDROCARBON

74. IUPAC name of  is

1) 3-Methyl-1-ethylbenzene
2) 1-Ethyl-3-methylbenzene
3) 2-Ethyl-1-methylbenzene
4) 1-Ethyl-2-methylbenzene

75. The compounds,  are

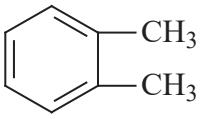
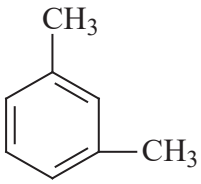
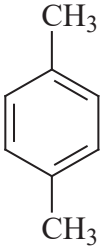


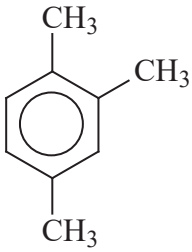
1) Chain isomers
2) Metamers
3) Position isomers
4) Tautomers

76. Nitrobenzene can be prepared from benzene by using a mixture of conc.HNO_3 and conc. H_2SO_4. In the nitrating mixture, HNO_3 acts as

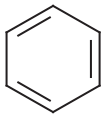
1) Base
2) Acid
3) Reducing agent
4) Catalyst

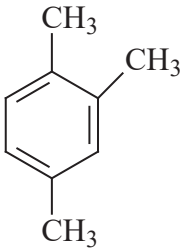
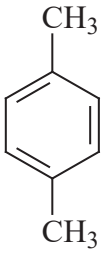
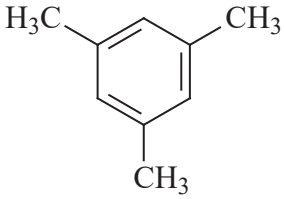
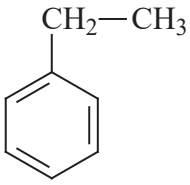
77. Ring nitration of dimethyl benzene results in the formation of only one nitro dimethyl benzene. The dimethylbenzene is

1) 
2) 
3) 
4) None of these

78. IUPAC name of  is

1) 1,2,4-trimethylbenzene
2) 1,34-trimethylbenzene
3) 1,2,5-trimethylbenzene
4) Xylene

79.  $\xrightarrow[AlCl_3]{CH_3-Cl(excess)}$ A. A is a trisubstituted benzene. The structure of 'A' is

1) 
2) 
3) 
4) 

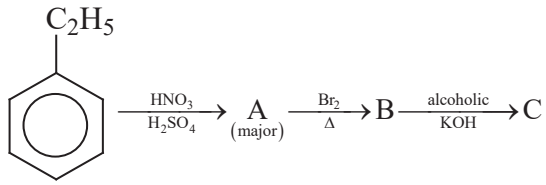
80. Benzene with n-propyl chloride in the presence of anhydrous $AlCl_3$ to give predominantly

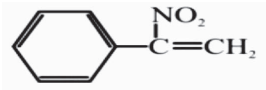
1) Isopropylbenzene
2) n-propylbenzene
3) Propiophenone
4) 1-chloro-3-propylbenzene

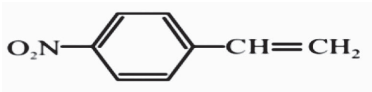
81. Function of $AlCl_3$ in Friedel-Craft's reaction is to

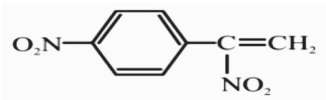
1) produce nucleophile
2) to absorb HCl
3) produce electrophile
4) to absorb water

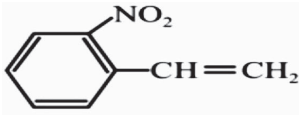
82. In the given reaction sequence, the major product 'C' is :



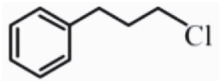
1) 

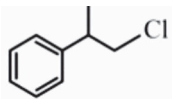
2) 

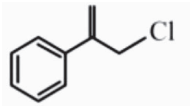
3) 

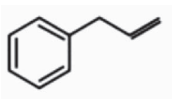
4) 

83. What is the major product [Y] of the reaction

1) 

2) 

3) 

4) 

84. When chlorine is passed through boiling toluene we get

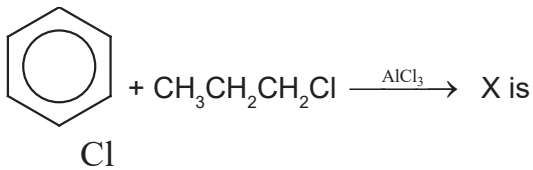
1) o-chlorotoluene
2) p-chlorotoluene
3) mixture of o and p-chlorotoluene
4) benzyl chloride

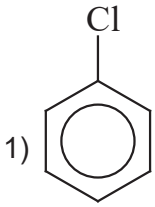
85. Match the columns

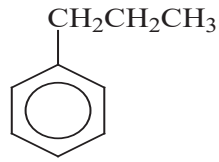
Column-I		Column-II	
A)	Aromatic	p)	Planar
B)	Antiaromatic	q)	Non-planar
C)	Huckel rule	r)	$4n\pi$ localised electrons
D)	Cyclo-octatetraene	s)	$(4n+2)\pi$ delocalised electrons

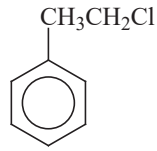
1) A-(p,s), B-(p,r), C-(p,s), D-(q,r)
2) A-(p,r), B-(p,s), C-(s), D-(q,r)
3) A-(p,s), B-(s), C-(p,r), D-(q,r)
4) A-(q,r), B-(p,r), C-(s), D-(p,s)

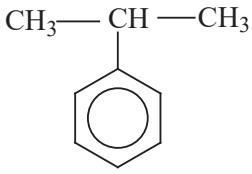
86. Predict structure of X in the following reaction



1) 

2) 

3) 

4) 

87. Name the products of the following reactions.

I) C_6H_6 reacts with methyl chloride in presence of $AlCl_3$

II) C_6H_6 reacts with acetyl chloride in presence of $AlCl_3$

III) C_6H_6 reacts with fuming nitric acid in presence of conc.H_2SO_4

IV) C_6H_6 is catalytically hydrogenated

	I	II	III	IV
1)	Chloro-meth-ane	Toluene	Nitro-ben-zene	n-Hex-ane
2)	Methyl ben-zene	Chloro-benzene	Phenyl nitrite	Trimeth-yl ben-zene
3)	Benzyl chlo-ride	Trimethyl benzene	Trinitro toluene	Toluene
4)	Tolu-ene	Aceto phenone	Nitro ben-zene	Cyclo-hexane

88. The carbon-carbon bond length in benzene molecule is

1) 1.54 A^0

2) 1.39 A^0

3) 1.33 A^0

4) 1.20 A^0

89. The function of anhydrous aluminium chloride in the Friedel-Crafts reaction is

1) to absorb water

2) to absorb hydrochloric acid

3) to produce an electrophile

4) to produce nucleophile

90. The reaction

$$C_6H_5Br + 2Na + C_2H_5Br \rightarrow C_6H_5C_2H_5 + 2NaBr$$

is known as

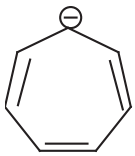
1) Friedel-Crafts reaction

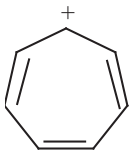
2) Wurtz reaction

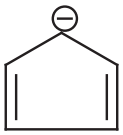
3) Sandmeyer's reaction

4) Wurtz-Fittig reaction

91. Which of the following is aromatic?

a) 

b) 

c) 

d)

1) b and c

2) b and d

3) a and d

4) a and c

92. The correct order of reactivity towards electrophilic substitution is

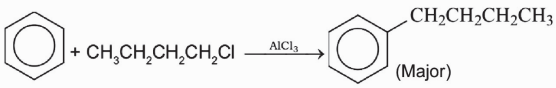
1) Benzene > phenol > benzoic acid > chlorobenzene

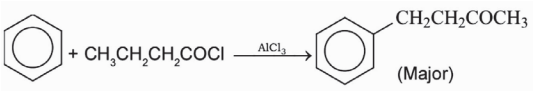
2) Phenol > benzene > chlorobenzene > benzoic acid

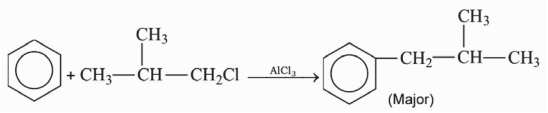
3) Chlorobenzene > benzoic acid > phenol > benzene

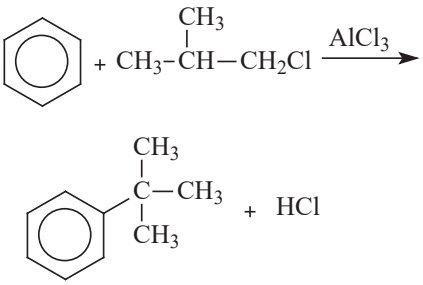
4) Benzoic acid > chlorobenzene > benzene > phenol

93. Identify the correct reaction

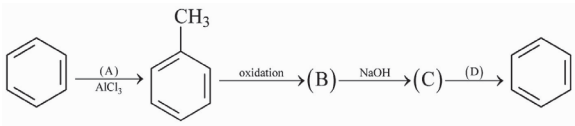
1) 

2) 

3) 

4) 

94. Complete the reaction with suitable reagents and compounds



1) (A) - CH_4, (B) - C_6H_5CHO, (C) - C_6H_5COONa, (D) - CH_4

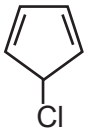
2) (A) - CH_3Cl, (B) - C_6H_5COOH, (C) - C_6H_5COONa, (D) - alc.KOH

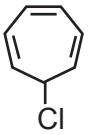
3) (A) - CH_3Cl, (B) - C_6H_5COOH, (C) - C_6H_5COONa, (D) - NaOH + CaO

4) (A) - CH_3COCl, (B) - C_6H_5CHO, (C) - C_6H_5COONa, (D) - $AlCl_3$

95. Which of the following gives precipitate of AgCl with $AgNO_3$?

1)

2) 

3) 

4) 1 and 3

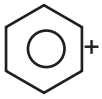
96. Identify the wrong statement

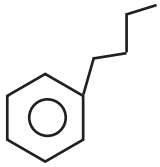
1) Benzene easily undergoes nucleophilic addition reaction

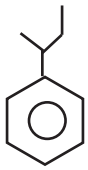
2) Benzene react with alkyl chloride in presence of $AlCl_3$ gives toluene

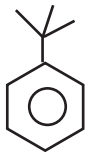
3) Benzene on ozonolysis give glyoxal

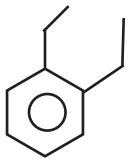
4) Ethylbenzene on oxidation with hot $KMnO_4/OH^-$ followed by acidification gives benzoic acid

97.  + Butylchloride + $AlCl_3 \rightarrow$ P. The product 'P' is

1) 

2) 

3) 

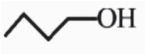
4) 

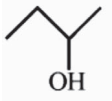
SAMPLE QUESTIONS

1. Which of the following compounds will be formed as a major product on treatment of 2-bromobutane with ethanolic KOH ?

1)

2)

3) 

4) 

2. When sodium propionate undergoes Kolbe's electrolysis gives

1) Propyl amine
2) Butane
3) Acetone
4) Acetaldehyde

3. Match the columns

Column-I		Column-II	
A)	$CH_4 + O_2 \xrightarrow{Cu/523K/100atm}$	p)	HCHO
B)	$CH_4 + O_2 \xrightarrow[\Delta]{Mo_2O_3}$	q)	$(CH_3)_3COH$
C)	$C_2H_6 + O_2 \xrightarrow[\Delta]{(CH_3COO)_2Mo}$	r)	CH_3OH
D)	$(CH_3)_3CH \xrightarrow[\text{oxidation}]{KMnO_4}$	s)	CH_3COOH

1) A-s, B-p, C-r, D-s

2) A-q, B-p, C-s, D-r

3) A-r, B-p, C-s, D-q

4) A-p, B-q, C-r, D-s

4. Match the following ?

Reaction		Nature of Reaction	
a)	$RBr \xrightarrow{Na}$	i)	Partial reduction
b)	$RCOO^-Na^+ \xrightarrow[CaO,\Delta]{NaOH}$	ii)	Electrophilic addition
c)	$R-C\equiv C-R' \xrightarrow[\text{Catalyst}(H_2)]{\text{Lindlar's}}$	iii)	Wurtz reaction
d)	$H_2C=CH_2 \xrightarrow{Br_2/CCl_4}$	iv)	Decarboxylation
		v)	Decarboxylative dimerization

1) a-iii, b-v, c-i, d-ii

2) a-iii, b-iv, c-i, d-ii

3) a-ii, b-iii, c-i, d-ii

4) a-v, b-i, c-iii, d-ii

5. Which of the following statement(s) is/are correct ?

i) Alkanes can have infinite number of conformations by rotation around C–C single bonds.

ii) Rotation around C–C single bond is completely free.

iii) Rotation is hindered by a small energy barrier of 1-20 kJ mol^{-1} due to torsional strain

1) i and ii 2) i and iii

3) ii and iii 4) only iii

6. **Assertion** : CH_4 does not react with Cl_2 in dark

Reason : Chlorination of CH_4 takes place in sunlight

1) Assertion is correct, reason is correct; reason is a correct explanation for assertion

2) Assertion is correct, reason is correct; reason is not a correct explanation for assertion

3) Assertion is correct, reason is incorrect

4) Assertion is incorrect, reason is correct

7. Dry distillation of sodium propanoate with sodalime gives

1) Propane 2) Propene

3) Ethane 4) Ethene

8. The decreasing order of boiling points is

1) n-pentane > iso-pentane > neo-pentane

2) iso-pentane > n-pentane > neo-pentane

3) neo-pentane > iso-pentane > n-pentane

4) n-pentane > neo-pentane > iso-pentane

9. The most volatile compound is

1) 2, 2-dimethyl propane

2) 2-metyl butane

3) isobutane

4) n-pentane

10. Arrange the following in decreasing order of their boiling points

I) n-Butane

II) 2-methylbutane

III) n-pentane

IV) 2, 2-dimethylpropane

1) I > II > III > IV 2) II > III > IV > I

3) IV > III > II > I 4) III > II > IV > I

11. The reaction conditions leading to the best yields of C_2H_5Cl are

1) $C_2H_6(\text{excess}) + Cl_2 \xrightarrow{\text{uv light}}$

2) $C_2H_6 + Cl_2 \xrightarrow[\text{room temperature}]{\text{dark}}$

3) $C_2H_6 + Cl_2(\text{excess}) \xrightarrow{\text{uv light}}$

4) $C_2H_6 + Cl_2 \xrightarrow{FeCl_3}$

12. When isobutane undergo oxidation with $KMnO_4$, the resultant product is .....

1) Isobutyl alcohol

2) Tertbutyl alcohol

3) Neopentyl alcohol

4) No reaction

13. Which of the following products is formed when n-heptane is passed over ($Al_2O_3 + Cr_2O_3$) catalyst at 773 K?

1) Benzene

2) Toluene

3) Polyheptane

4) Cycloheptane

14. A reaction between methyl magnesium bromide and ethyl alcohol gives

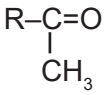
1) Methane 2) Ethane

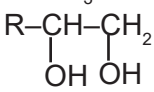
3) Propane 4) Butane

15. The alkene R – CH = CH_2 reacts readily with B_2H_6 and formed the product B which on oxidation with alkaline hydrogen peroxide produces

1) R – CH_2 – CHO

2) R – CH_2 – CH_2 – OH

3) 

4) 

16. 3-Phenylpropene on reaction with HBr gives (as a major product) :

1) $C_6H_5CH(Br)CH_2CH_3$

2) $C_6H_5CH(Br)CH_2CH_2OCH_3$

3) $C_6H_5CH_2CH_2CH_2Br$

4) $C_6H_5CH(Br)CH = CH_2$

17. Geometrical isomerism is exhibited by (i) 1-pentene (ii) 2-pentene (iii) 2-chloro-2-pentene (iv) 3-methyl-2-pentene

1) i and ii

2) ii and iii

3) iii and iv

4) ii, iii and iv

18. In the following reactions; A and B respectively are

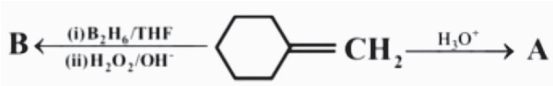
$$A \xrightarrow{HBr} C_2H_5Br \xrightarrow{B} A$$

1) C_2H_4, alc.KOH/Δ

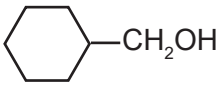
2) C_2H_5Cl; aq. KOH/Δ

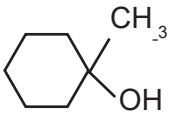
3) CH_3OH; aq. KOH/Δ

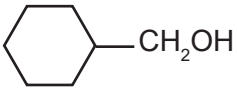
4) C_2H_2; PBr_3

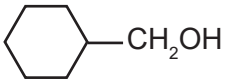
19. 

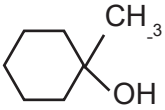
A and B respectively are

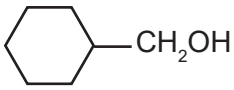
1) Both 

2) Both 

3) 

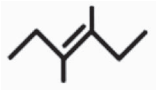
, 

4) 

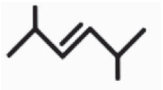
, 

20. Which of the following alkenes will give propanone and propanal on reductive ozonolysis

1)

2) 

3)

4) 

21. Which of the following reactions is the example of electrophilic substitution ?

1) $CH_2 = CH_2 + HCl \rightarrow CH_3CH_2Cl$

2) $CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} CH_2(Br) - CH_2(Br)$

3) $CH_2 = CH_2 + H_2 \xrightarrow{Ni} CH_3 - CH_3$

4) $C_6H_6 + CH_3Cl \xrightarrow{AlCl_3} C_6H_5CH_3 + HCl$

22. Peroxide effect is observed with the addition of HBr but not with the addition of HI to unsymmetrical alkene because

1) H–I bond is stronger than H–Br and is not cleaved by the free radical

2) H–I bond is weaker than H–Br bond so that iodine free radicals combine to form iodine molecules

3) Bond strength of HI and HBr are same but free radicals are formed in HBr

4) All of these

23. Which of the following statements are correct?

i) The general formula of alkenes is C_nH_{2n}.

ii) Alkenes are also known as paraffins

iii) Bond length of C – C double bond in alkene is shorter than C – C single bond in alkane

iv) C–C double bond in alkene consists of two sigma bonds

v) Alkenes are easily attacked by electrophilic reagent

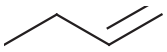
1) i and iv
2) i, iii and v
3) i and iii
4) i, ii, iv and v

24. Match the columns

	Column-I		Column-II
A)	$CH \equiv CH + H_2 \rightarrow CH_2 = CH_2$	p)	Zn
B)	$CH_3CH_2Br \rightarrow CH_2 = CH_2$	q)	Conc. H_2SO_4
C)	$CH_2BrCH_2Br \rightarrow CH_2 = CH_2$	r)	$Pd/BaSO_4$
D)	$CH_3CH_2OH \rightarrow CH_2 = CH_2$	s)	Alc.KOH

1) A-r, B-s, C-p, D-q
2) A-s, B-r, C-q, D-p
3) A-q, B-p, C-s, D-r
4) A-r, B-s, C-q, D-p

25. Which of the following is formed as the major product when Butan-1-ol is heated with conc. H_2SO_4?

1) 

2)

3)

4)

26. Ethylene reacts with bromine in CCl_4 gives

1) $Br - CH_2 - CH_3$

2) $CH_3 - CBr_3$

3) $Br–CH_2–CH_2Br$

4) $CHBr_3$

27. Identify the product C in the following series of reaction

$$CH_2 = CH_2 \xrightarrow{H_2O^+} A \xrightarrow[\Delta]{H_2SO_4} B \xrightarrow{Br_2} C \xrightarrow[2.NaNH_2]{1.alc.KOH} D$$

1) Ethene 2) Ethyne

3) Ethane 4) Vinyl alcohol

28. The intermediate during the addition of HCl to propene in the presence of peroxide is

1) $CH_3\overset{+}{C}HCH_2Cl$

2) $CH_3\dot{C}HCH_2Cl$

3) $CH_3\overset{+}{C}HCH_3$

4) $CH_3CH_2\overset{+}{C}H_2$

29. The addition of HCl to 1-phenylpropene gives

1) $C_6H_5CHClCH_2CH_3$

2) $C_6H_5CH_2CHClCH_3$

3) $C_6H_5CH_2CH_2CH_2Cl$

4) $C_6H_5CH(CH_3)CH_2Cl$

30. The product obtained in the reaction $CF_3 - CH = CH_2 + HCl \longrightarrow$ is

1) $CF_3CH_2 – CH_2Cl$

2) $CF_3CHClCH_3$

3) $CF_3CHCl–CH_2Cl$

4) None of these

31. The alkene that exhibits geometrical isomerism is

1) 2-methyl propene

2) 2-butene

3) 2-methyl-2-butene

4) propene

32. Choose the correct reagents used in the conversion

$$CH_2 = CH_2 \xrightarrow{(p)} \underset{Br}{CH_2} - \underset{Br}{CH_2} \xrightarrow{(q)} CH_2 = CHBr$$

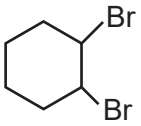
$\xrightarrow{(r)}$ $CH \equiv CH \xrightarrow{(s)}$

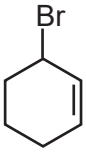
	p	q	r	s
1)	Br_2/CCl_4	alc.KOH	NaOH	Al_2O_3
2)	HBr	alc.KOH	CaC_2	$KMnO_4$
3)	HBr	alc.KOH	$NaNH_2$	red hot, iron tube
4)	Br_2/CCl_4	alc.KOH	$NaNH_2$	red hot, iron tube

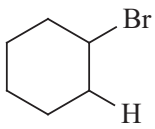
33. $CCl_3-CH=CH_2 \xrightarrow{HOCl} P$. Major product 'P' is

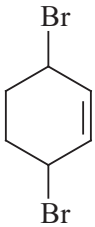
1) $CCl_3-\underset{\underset{OH}{|}}{CH}-CH_2Cl$
2) $CCl_3-\underset{\underset{Cl}{|}}{CH}-CH_2OH$
3) $CCl_3-\underset{\underset{Cl}{|}}{CH}-\underset{\underset{Cl}{|}}{CH_2}$
4) $CCl_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{OH}{|}}{CH_2}$

34. $\xrightarrow{Br_2/CCl_4} P$. The product 'P' is

1) 

2) 

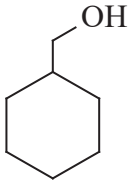
3) 

4) 

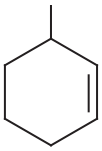
35. $CH_3-CH=CH_2 \xrightarrow[273K]{dil.KMnO_4} A$.

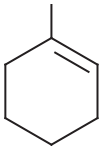
Product A is

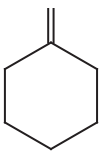
1) Acetic acid
2) Propane-1,2-diol
3) Propan-2-one
4) CO_2

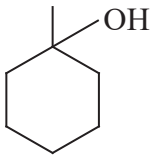
36. 

$\xrightarrow[\Delta]{H^+} P$; Major product P is

1) 

2) 

3) 

4) 

37. Tert.butylchloride can be converted to isobutene by

1) alc.KOH
2) Na/ether
3) $LiAlH_4$
4) All

38. $CH_3-CH_2-CH=CH_2 \xrightarrow[h\nu]{NBS} A \xrightarrow[\Delta]{alc.KOH} B$.

The product B is

1) $CH_2 = CH - CH = CH_2$
2) $CH_2 = C = CH - CH_3$
3) $CH_3-\underset{\underset{Br}{|}}{CH}-CH=CH_2$
4) $CH_3-CH=CH-CH_2-Br$

39. $CH \equiv CH + 2Cl_2 \xrightarrow{CCl_4}$ Product A is

1) $\underset{\underset{Cl}{|}}{\overset{\overset{Cl}{|}}{CH}}-\underset{\underset{Cl}{|}}{\overset{\overset{Cl}{|}}{CH}}$
2) CH_3-CHCl_2
3) $\underset{\underset{Cl}{|}}{CH_2}-\underset{\underset{Cl}{|}}{CH_2}$
4) $CH_2=CCl_2$

40. Match the following reactants in column I with the corresponding reaction products in column II and choose the correct option from the codes given below.

	Column-I		Column-II
A)	Benzene + Cl_2 $\xrightarrow{AlCl_3}$	p)	Benzoic acid
B)	Benzene + CH_3Cl $\xrightarrow{AlCl_3}$	q)	Methyl phenyl ketone
C)	Benzene + CH_3COCl $\xrightarrow{AlCl_3}$	r)	Toluene
D)	Toluene $\xrightarrow{KMnO_4/NaOH}$	s)	Chlorobenzene

1) A-s, B-r, C-q, D-p
2) A-s, B-r, C-p, D-q
3) A-r, B-s, C-p, F-q
4) A-r, B-s, C-q, D-p

41. 3-Phenylpropene on reaction with HBr gives (as a major product):

1) $C_6H_5CH(Br)CH_2CH_3$

2) $C_6H_5CH(Br)CH_2CH_2OCH_3$

3) $C_6H_5CH_2CH_2CH_2Br$

4) $C_6H_5CH(Br)CH = CH_2$

42. For $CH_3-CH_2-Cl \xrightarrow[KOH]{alc.} C_2H_4 + KCl + H_2O.$

It is example of

1) α - elimination

2) γ -elimination

3) β -elimination

4) Both 1 & 3

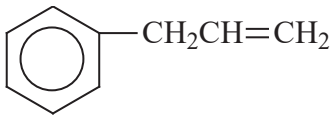
43. Propene on hydroboration and oxidation produces

1) $CH_3CH_2CH_2OH$

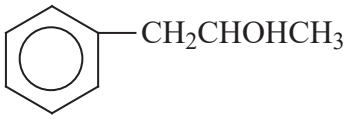
2) $CH_3CHOHCH_3$

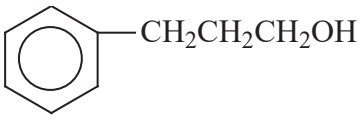
3) $CH_3CHOHCH_2OH$

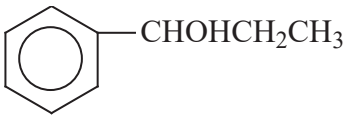
4) CH_3CH_2CHO

44. 

On mercuration and demercuration produces

1) 

2) 

3) 

4) None of these

45. The major product obtained on treatment of $CH_3CH_2CH(F)CH_3$ with CH_3O^-/CH_3OH is:

1) $CH_3CH_2CH(OCH_3)CH_3$

2) $CH_3CH = CHCH_3$

3) $CH_3CH_2CH = CH_2$

4) $C_6H_5CH(Br)CH = CH_2$

ANSWER KEY

1.	1	21.	3	41.	3	61.	3	81.	3
2.	1	22.	4	42.	1	62.	3	82.	2
3.	1	23.	4	43.	4	63.	3	83.	4
4.	4	24.	4	44.	4	64.	1	84.	4
5.	1	25.	3	45.	1	65.	2	85.	1
6.	4	26.	3	46.	3	66.	4	86.	4
7.	4	27.	3	47.	4	67.	2	87.	4
8.	3	28.	1	48.	3	68.	1	88.	2
9.	1	29.	3	49.	2	69.	2	89.	3
10.	2	30.	1	50.	3	70.	4	90.	4
11.	1	31.	4	51.	2	71.	4	91.	1
12.	3	32.	4	52.	1	72.	4	92.	2
13.	4	33.	3	53.	2	73.	3	93.	4
14.	4	34.	4	54.	3	74.	2	94.	3
15.	1	35.	4	55.	2	75.	1	95.	4
16.	4	36.	3	56.	3	76.	1	96.	1
17.	3	37.	4	57.	1	77.	3	97.	2
18.	3	38.	4	58.	1	78.	1		
19.	3	39.	2	59.	4	79.	1		
20.	2	40.	3	60.	4	80.	1		

SAMPLE QUESTIONS

1.	2	10.	4	19.	4	28.	3	37.	4
2.	2	11.	1	20.	3	29.	1	38.	1
3.	3	12.	2	21.	4	30.	1	39.	1
4.	2	13.	2	22.	2	31.	2	40.	1
5.	2	14.	1	23.	2	32.	4	41.	1
6.	2	15.	2	24.	1	33.	2	42.	3
7.	3	16.	1	25.	3	34.	1	43.	1
8.	1	17.	4	26.	3	35.	2	44.	1
9.	3	18.	1	27.	2	36.	2	45.	3

WORK BOOK

Chapter 13

SOLUTIONS

QUESTIONS

DIFFERENT SOLUTIONS AND THEIR CONCENTRATIONS

1. If two bottles A and B contain 1 M and 1 m aqueous solution of sulphuric acid respectively,

1) A is more concentrated than B

2) B is more concentrated than A

3) Concentration of A is equal to concentration of B

4) It is not possible to compare the concentration

2. Identify the phase of solute and solvent for a solution of amalgam of mercury with sodium

Solute	Solvent
1) Solid	liquid
2) Solid	solid
3) Liquid	solid
4) Solid	gas

3. What is the percentage of solute in the resultant solution, if it is obtained by mixing 300 g of 30% and 200 g 20% solution by weight?

1) 50 % 2) 26 %

3) 62% 4) 32%

4. The amount of water required to make 10% ethanol in water solution using 10 ml of pure ethanol is

1) 90 ml 2) 50 ml

3) 30 ml 4) 60 ml

5. If we have 10 molal urea solution, calculate mole fraction of urea in this solution and also calculate w/w % of urea (MW = 60)

1) 20% 2) 30%

3) 37.5 % 4) 28 %

6. Calculate molarity of $CaCO_3$(aq) solution which has concentration of $CaCO_3$ = 200 ppm

1) 2×10^{-3} 2) 8×10^{-3}

3) 10×10^{-3} 4) 5×10^{-3}

7. The normality of 1.5 M H_3PO_4 is ———

1) 7 2) 8

3) 4.5 4) 10.5

8. How much volume of 10 M HCl should be diluted with water to prepare 2 L of 5 M HCl?

1) 1 L 2) 2 L

3) 3 L 4) 1.5 L

9. Find the percentage by weight of aspirin in the solution prepraed by dissolving 3.65 g of aspirin in 25.08 g of water

1) 13.8 % 2) 12.7%

3) 30 % 4) 28.3%

10. A solution was prepared by adding 125 cm^3 of isopropyl alcohol to water until the volume of the solution was 175 cm^3. Find the volume percentage of isopropyl alcohol in the solution

1) 71.4 % 2) 80%

3) 23.7% 4) 88%

11. If the density of some lake water is 1.25 g m L^{-1} and contains 92 g Na^+ ions per kg of water, what will be the molality of Na^+ ions in the lake?

1) 2 m 2) 4 m

3) 8 m 4) 6 m

12. 1000 g aqueous solution of $CaCO_3$ contains 10 g of calcium carbonate, concentration of the solution is :

1) 10 ppm 2) 100 ppm

3) 1000 ppm 4) 10,000 ppm

13. The mole fraction of oxygen in a mixture of 7 g of nitrogen and 8g of oxygen is :

1) $\frac{8}{15}$ 2) 0.5

3) 0.25 4) 1.0

14. The molarity of 98% H_2SO_4 (d = 1.8 g mL^{-1}) by wt. is

1) 6M 2) 18M

3) 10M 4) 4M

15. A 500 g tooth paste sample has 0.02 g fluoride concentration. What is the concentration of fluorine in terms of ppm level :

1) 250 2) 40

3) 400 4) 1000

16. A certain sample of well water contains 0.1% Ca^{2+} (w/w). The concentration of Ca^{2+} in the water, expressed as ppm is

1) 10^{-1} 2) 10

3) 100 4) 1000

17. Dissolving 120g of urea (mol.wt.=60) in 1000g of water gave a solution of density 1.15 g/mL. The molarity of the solution is

1) 1.78 M 2) 2 M

3) 2.05 M 4) 2.22 M

18. Mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride

1) 0.35 2) 0.458

3) 0.7 4) 0.831

19. 250 ml of 6 M HCl and 650 ml of 3 M HCl were mixed together. What volume of water is to be added so that the molarity of the final solution is 3M?

1) 300 ml 2) 1150 ml

3) 250 ml 4) 135 ml

20. How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3? The concentrated acid is 70% HNO_3

1) 90.0 g conc. HNO_3 solution

2) 70.0 g conc. HNO_3 solution

3) 54.0 g conc. NHO_3 solution

4) 45 g conc. HNO_3 solution

RAOULT'S LAW (IDEAI & NON IDEAL SOLUTIONS)

21. The value of Henry's law constant for helium (He), hydrogen (H_2) and oxygen (O_2) are respectively 144.97 K bar, 69.16 K bar and 34.86 K bar at 293 K. The correct order of their solubility is

1) $O_2 < He < H_2$ 2) $He < O_2 < H_2$

3) $He < H_2\ O_2$ 4) $H_2 < He < O_2$

22. Calculate the concentration of nitrogen present in the water. Assuming that, the temperature is 25^0C, total pressure is 1 atm and mole fraction of nitrogen is 0.78.

[K_H for nitrogen = 8.42×10^{-4} M/mm Hg]

1) 4.99 M 2) 4.99×10^{-2} M

3) 4.99×10^{-4} M 4) None of these

23. The solubility of N_2 in water at 300 K and 500 torr partial pressure is 0.01 g L^{-1}. The solubility in (g L^{-1}) at 750 torr partial pressure is

1) 0.02 2) 0.015

3) 0.0075 4) 0.005

24. Anoxia is a condition, generally seen in climbers because of

1) high concentration of oxygen at high attitudes

2) high concentration of air at high attitudes

3) high partial pressure of oxygenn at high attitudes

4) low partial pressure of oxygen at high attitudes

25. What is the composition of gases in the tanks used by the scuba divers?

1) 11.7 % helium, 32.1 % nitrogen, 56.2% oxygen

2) 11.7 % helium, 56.2% nitrogen, 32.1% oxygen

3) 56.2% helium, 11.7% nitrogen 32.1% oxygen

4) 56.2% helium, 32.1% nitrogen 11.7% oxygen

26. When a binary solution of two volatile liquids are taken in a closed vessel, then

1) Both the components would evaporate and an equilibrium would be established between vapour phase and liquid phase

2) Both components would evaporate but equilibrium would not be established between vapour phase and liquid phase

3) None of components would evaporate and no equilibrium would be established between vapour phase and liquid phase

4) None of the above

27. Raoult's law becomes a special case of Henry's law, when

1) $K_H = P_i^0$ 2) $K_H > P_i^0$

3) $K_H < P_i^0$ 4) $K_H \geq P_i^0$

28. At 300 K two pure liquids A and B have vapour pressure 150 mm Hg and 100 mm Hg, respectively. In an equimolar liquid mixture of A and B, the mole fraction of B in vapour phase is

1) 0.6 2) 0.5

3) 0.8 4) 0.4

29. Solution of bromoethane and chloroethane

1) obeys Raoult's law over the entire range of concentration

2) is a non-ideal solution

3) has $\Delta V_{mix} \neq 0$

4) all of the above

30. The solution which shows large positive deviation from Raoult's law form

1) maximum boiling azeotrope at a specific composition

2) maximum freezing azeotrope at a specific composition

3) minimum boiling azeotrope at a specific composition

4) minimum freezing azeotrope at specific composition

31. A non-ideal solution was prepared by mixing 30 ml chloroform and 50 ml acetone. The volume of mixture will be

1) > 80 ml 2) < 80 ml

3) = 80 ml 4) none of these

32. $CO_{(g)}$ is dissolved in H_2O at 30^0C and 0.020 atm. Henry's law constant for this system is 6.20×10^4 atm. Thus, mole fraction of CO (g) is

1) 1.72×10^{-7} 2) 3.22×10^{-7}

3) 0.99 4) 0.01

33. The boiling points of C_6H_6, CH_3OH, $C_6H_5NH_2$ and $C_6H_5NO_2$ are 80^0C, 65^0C, 184^0C and 212^0C respectively. Which of the following will have highest vapour pressure at room temperature?

1) C_6H_6 2) CH_3OH

3) $C_6H_5NH_2$ 4) $C_6H_5NO_2$

34. The partial pressure of O_2 in air is 0.21 atm at sea level. The aquatic life requires a concentration of O_2 atleast 4.16 mg/litre. What is the solubility of O_2. ($K_H = 1.3 \times 10^{-3}$ $molL^{-1}atm$)

1) 8.6 mg/L 2) 7.8 mg/L

3) 9.3 mg/L 4) 6.8 mg/L

35. A solution containing components A and B follows Raoult's law when

1) A–B attraction force is greater than A–A and B–B

2) A-B attraction force is less than A–A and B–B

3) A–B attraction force remains same as A–A and B–B

4) Volume of solution is different from sum of volume of solute and solvent

36. P_A and P_B are the vapour pressure of pure liquid components, A and B, respectively of an ideal binary solution. If X_A represents the mole fraction of component A, the total pressure of the solution will be

1) $P_A + X_A(P_B–P_A)$ 2) $P_A + X_A(P_A–P_B)$

3) $P_B + X_A(P_B–P_A)$ 4) $P_B + X_A(P_A–P_B)$

37. Henry's law constant for dissolution of CH_4 in benzene at 298 K is 2×10^5 mm of Hg. Then mole fraction of CH_4 in benzene at 298 K under 760 mm of Hg is :

1) 1.2×10^{-5} 2) 3.8×10^{-3}

3) 4×10^{-7} 4) 1×10^{-2}

38. Which of the following gas does not obey Henry's law ?

1) NH_3 2) H_2

3) O_2 4) He

39. Low concentration of oxygen in the blood and tissues of people living at high altitude is due to

1) low temperature

2) low atmospheric pressure

3) high atmospheric pressure

4) both low temperature and high atmospheric pressure

40. Value of Henry's constant K_H

1) increases with increase in temperature

2) decreases with increase in temperature

3) remains constant

4) first increases, then decreases

41. Henry's law constant for CO_2 in water is 1.67×10^8 Pa at 298 K. Calculate the quantity of CO_2 in 1L of soda water when packed under 2.5 atm CO_2 pressure at 298 K.

1) 3.65 g L^{-1} 2) 7.85 g L^{-1}

3) 1.23 g L^{-1} 4) 6.49 g L^{-1}

42. At 88^0C benzene has a vapour pressure of 900 torr and toluene has a vapour pressure of 360 torr. What is the mole fraction of benzene in the mixture with toluene that will be boil at 88^0C at 1 atm pressure (benzene-toluene form an ideal solution).

1) 0.35 2) 0.82

3) 0.56 4) 0.74

43. Which condition is not satisfied by an ideal solution

1) ΔH mixing = 0

2) ΔV mixing = 0

3) ΔS mixing = 0

4) Obeyance of raoult's law

44. At 80^0C, the vapour pressure of pure liquid 'A' is 520 mm Hg and that of pure liquid 'B' is 1000 mm Hg. If a solution of 'A' and 'B' boils at 80^0C and 1 atm pressure, the amount of 'A' in the mixture is (1 atm = 760 mm Hg).

1) 52 mol percent 2) 34 mol percent

3) 48 mol percent 4) 50 mol percent

45. An azeotropic mixture of two liquids has b.p. lower than either of them when it :

1) shows a (+ve) deviation from Raoult's law

2) shows no deviation from Raoult's law

3) shows (+ve) deviation from Henry's law

4) shows (–ve) deviation from Henry's law

46. The vapour pressure of a solution having solid as solute and liquid as solvent is :

1) Directly proportional to mole fraction of the solvent

2) Inversely proportional to mole fraction of the solvent

3) Directly proportional to mole fraction of the solute

4) Independent of to mole fraction of the solute

47. The vapour pressure of water is 12.3 KPa at 300K. Calculate the vapour pressure of 1 molal solution of a solute in it.

1) 12.08 KPa 2) 8.2 KPa

3) 15.5 KPa 4) 6.3 KPa

48. Which one of the following statement is incorrect

1) Different gases have different K_H values at the same temperature

2) K_H is a function of nature of gas

3) Value of K_H decreases with increase in temperature

4) Aquatic species are more comfortable in cold water rather than in warm water

49. Slope of the graph between vapour pressure of solution (P) and molefraction of solute (X_B) is

1) P_A^0

2) P_B^0

3) $P_A^0 - P_B^0$

4) $P_B^0 - P_A^0$

50. Which one of the following statement is in correct

1) Components of azeotropes cannot be separated by fractional distillation

2) The solution show +ve deviation from Raoults law form minimum boiling azeotropes

3) The solution show –ve deviation from raoults law form minimum boiling azeotropes

4) Azeotropes are formed by non-ideal solution

51. The mole fraction of helium in a saturated solution at 0°C is 1.2×10^{-6}. Find the pressure of helium above the solution. Henry's law constant is 6.8×10^{-6} atm^{-1}

1) 1.176 atm

2) 0.716 atm

3) 0.176 atm

4) 0.567 atm

52. If the solubility of H_2S in water at NTP is 0.195m, the Henry's law constant of H_2S is

1) 202 atm 2) 286 atm

3) 318 atm 4) 346 atm

53. Which will form maximum boiling azeotrope?

1) $C_6H_6 + C_6H_5CH_3$ solution

2) $HNO_3 + H_2O$ solution

3) $C_2H_5OH + H_2O$ solution

4) n- hexane and n - heptane

54. Vapour pressure of solution containing 3 and 1 mol respectively of x and y is 550 mm. At the same temperature another solution (containing 4 and 1 mol x and y respecrively), the vapour pressure becomes 560 mm. At this temperature calculate vapour pressure of x and y in pure form

1) 600, 400 2) 700, 100

3) 300, 400 4) 500, 200

COLLIGATIVE PROPERTIES

55. 10 g of a solute is dissolved in 80 g of acetone, vapour pressure of the solution = 271 mm of Hg. If the vapour pressure of pure acetone is 283 mm Hg. Calculate molar mass of solute?

(concentration > 5%)

1) 163 g/mol 2) 180 g/mol

3) 173 g/mol 4) 200 g/mol

56. Mixture of volatile compounds A and B has total vapour pressure (in torr) $P = 254 - 119\chi_A$, where χ_A is mole fraction of A in mixture. Hence P_A^0 and P_B^0 are (in torr)

1) 254, 119 2) 119, 254

3) 135, 254 4) 119, 373

57. The vapour pressure of benzene at 90^0C is 1020 torr. A solution of 5g of a solute in 58.5 g benzene has vapour pressure 990 torr. The molecular weight of the solute is

1) 220 2) 320

3) 240 4) 290

58. The amount of ice that will separate on cooling a solution containing 50 g of ethylene glycol in 200 g water to -9.3^0C is

(K_f = 1.86 K m^{-1})

1) 38.71 g 2) 38.71 mg

3) 42 g 4) 42 mg

59. Calculate K_b of water if L_{vap} = 540 cal/g, $\Delta T_b = 100^0C$?

1) 0.82 2) 0.73

3) 0.52 4) 0.89

60. Molal depression constant for water is 1.86^0C. The freezing point of a 0.05 molal solution of a non electrolyte in water is:

1) -93^0C 2) -0.093^0C

3) -0.93^0C 4) 0.0093^0C

61. How much C_2H_5OH should be added to 1 litre H_2O, so that it will not freeze at -20^0C?

($K_f = 1.86^0C/m$)

1) 380.2 g 2)170.3g

3) 400g 4) 494.6 g

62. Calculate osmotic pressure of 0.1 M urea aqueous solution at 300 K

1) 3.20 atm 2) 1.78atm

3) 1.46 atm 4)2.46atm

63. If 6 g of urea,18g glucose & 34.2 g sucrose are dissolved to make 500ml of a solution at 300 K. Calculate osmotic pressure?

1) 80.3 atm 2) 1.76 atm

3) 14.76atm 4) 1.83 atm

64. If 200 ml of 0.1 M urea solution is mixed with 300ml of 0.2 M glucose solution at 300 K,calculate osmotic pressure?

1) 3.94 atm 2) 4.34 atm

3) 7.20 atm 4) 1.34atm

65. Osmotic pressure method is used to determine molar mass of protein,macromolecules like polymers,biomolecules etc, because

1) osmotic pressure is measured at room temperature

2) osmotic pressure depends upon molality

3) these are not stable at high temperature and have poor solubility

4) Both 1 and 3

66. Reverse osmosis is a process

1) in which applied pressure to the solution side is larger than the osmotic pressure

2) in which solvent moves from solution of higher concentration to solution of lower concentration

3) which is used for desalination of sea water

4) all of the above

67. Which of the following material is used for making semipermeable membrane for carrying reverse osmosis for desalination of water?

1) Potassium nitrate

2) Cellulose acetate

3) Cell membrane

4) Parchment membrane

68. Solutions A,B,C and D are respectively 0.1 M glucose,0.05 M NaCl, 0.05 M $BaCl_2$ and 0.1M $AlCl_3$. Which one of the following pairs is isotonic?

1) A & B 2) B & C

3) A & D 4) A & C

69. Colligative properties of solutions are those which depend upon

1) the nature of the solvent

2) the nature of the solute

3) the number of solute particles

4) All of these

70. A plant cell shrinks when it is kept in

1) Hypotonic solution

2) A hypertonic solution

3) A solution isotonic with cell sap

4) Water

71. A semipermeable membrane used in the measurement of osmotic pressure of a solution allows the passage of

1) Solute molecules through it

2) solvent molecules through it

3) both solvent and solute molecules

4) either solvent or solute

72. In the case of osmosis, solvent molecules move from solution of

1) Lower concentration to higher concentration

2) Higher concentration to lower concentration

3) Lower vapour pressure to higher vapour pressure

4) None of these

73. 1.00 g of a non-electrolyte solute (molar mass 250g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant, K_f of benzene is 5.12 K kg mol^{-1}, the freezing point of benzene will be lowered by

1) 0.3 K 2) 0.5 K

3) 0.4 K 4) 0.2

74. A solution of 1.25 g of a non-electrolyte in 20g of water freezes at 271.94 K. If K_f = 1.86 K molality^{-1} then the molecular wt. of the solute is : (Freezing point of pure water is 273.15 K)

1) 207.8 g mol^{-1}

2) 179.79 g mol^{-1}

3) 209.6 g mol^{-1}

4) 96.01 g mol^{-1}

75. A 0.2 molal aqueous solution of a weak acid (HX) is 20% ionized. The freezing point of this solution is (Given K_f = 1.86^{0}C kg mol^{-1} for water)

1) –0.45^{0}C

2) –0.90^{0}C

3) –0.21^{0}C

4) –0.43^{0}C

76. The rise in the boiling point of a solution containing 1.8g of glucose in 100 g of solvent is 0.1^{0}C. The molal elevation constant of the liquid is

1) 0.01 K/m 2) 0.1 K/m

3) 1 K/m 4) 10 K/m

77. How many grams of sucrose (Mol. wt = 342) should be dissolved in 100 g water inorder to produce a solution with 105^{0}C difference between the freezing point and boiling point?

(K_b for water = 0.51 and K_f for water is 1.86 K kg mol^{-1}).

1) 63 g 2) 72 g

3) 95 g 4) 57 g

78. **Statement I** : The lowering of vapour pressure of a solution causes a lowering of the freezing point.

Statement II : A solution will freeze when its vapour pressure equals the vapour pressure of the pure solid solvent.

1) Statement I and II are correct

2) Statement I is correct and statement II is incorrect

3) Statement I is incorrect and statement II is correct

4) Statement I and II are incorrect

79. The amount of solute (mol. mass = 60) that must be added to 180 g of water so that the vapour pressure of water is lowered by 10% is

1) 30 g 2) 66 g

3) 120 g 4) 12 g

80. Equal volumes of ethylene glycol (mol. mass = 62) and water are mixed. K_f of water = 1.86 K kg mol^{-1}. The density of ethylene glycol is 1.11g/ml and that of water is 1g/ml.The depression of freezing point produced is

1) 0.0033 2) 0.0333

3) 0.333 4) 33.3

81. A 0.1 molal aquous solution of a weak acid is 30% ionised. If K_f for water is 1.86^{o}C/m, the freezing point of solution will be

1) –1.8^{o}C 2) –0.18^{o}C

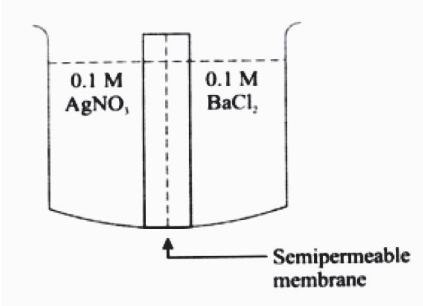
3) –0.54^{o}C 4) –0.24^{o}C

82. A solution containing 62g ethylene glycol in 250g water is cooled to -10°C. If K_f for water is 1.86 K kgmol^{-1}, the amount of water (in g) separated as ice is:

1) 32 2) 48

3) 16 4) 64

83. Study the following figure and pickout the correct option (s)



1) A white precipitate of AgCl is formed on $AgNO_3$ side

2) A white precipitate of AgCl is formed on $BaCl_2$ side

3) No precipitate is formed on either side

4) Precipitate is formed on either side

84. xg of a non-electrolytic compound (molar mass = 200 g) are dissolved in 1L of 0.05 M NaCl aqueous solution. The osmotic pressure of this solution is found to be 4.92 atm at 27°C. Assume complete dissociation of NaCl and ideal behaviour of this solution. Then the value of x is

1) 10 2) 20

3) 30 4) 45

85. Solute A is a ternary electrolyte and solute B is non-electrolyte. If 0.1 M solution of solute B produces an osmotic pressure of 2P, then 0.05 M solution of A at the same temperature will produce an osmotic pressure equal to

1) P 2)1.5 P

3) 2P 4) 3P

Van't Hoff Factor

86. The van't Hoff factor (i) for a compound which undergoes dissociation in one solvent and association in other solvent respectively

1) greater than one and greater than one

2) less than one and greater than one

3) less than one and less than one

4) greater than one and less than one

87. Compound A undergoes tetramerisation in the given solvent. The van't Hoff factor is

1) 2 2) 0.5

3) 0.25 4) 0.125

88. Arrange the following aqueous solutions in the order of their increasing boiling points

I) 10^{-2} M NaCl

II) 10^{-3} M $MgCl_2$

III) 10^{-4} M urea

IV) 10^{-4} M Na

1) I < II < IV < III

2) III < IV < II < I

3) II < I < III < IV

4) IV < III < I= II

89. The degree of dissociation (α) ; If a weak electrolyte; A_xB_y is related to Van't Hoff factor (i) is given by the expression

1) $\alpha = \frac{i-1}{(x+y-1)}$ 2) $\alpha = \frac{i-1}{x+y+1}$

3) $\alpha = \frac{x+y-1}{i-1}$ 4) $\alpha = \frac{x+y+1}{i-1}$

90. The van't Hoff factor of $BaCl_2$ at 0.01 M concentration is 1.98.The percentage of dissociation of $BaCl_2$ at this concentration is

1) 49 2) 69

3) 89 4) 98

91. Which of the following has least freezing point?

1) 1% sucrose 2) 1% NaCl

3)1% $CaCl_2$ 4) 1% glucose

92. The freezing point depression constant for water is -1.86^0C $molal^{-1}$.If 5g Na_2SO_4 is dissolved in 45 g of H_2O,the freezing point is changed by -3.82^0C. Calculate the Van't Hoff factor for Na_2SO_4.

1) 0.381 2) 2.05

3) 2.63 4) 3.11

93. Which of the following aqueous solutions should have the highest boiling point?

1) 1 M NaOH 2) 1 M Na_2SO_4

3) 1 M NH_4NO_3 4) 1 M KNO_3

94. In comparison to a 0.01 M solution of glucose,the depression in freezing point of a 0.01 M $MgCl_2$ solution is

1) the same 2) about twice

3) about three times 4) about six times

95. The values of van't Hoff factors for KCl,NaCl and K_2SO_4 respectively are

1) 2, 2 and 2 2) 2, 2 and 3

3) 1,1 and 2 4) 1,1 and 1

96. Which one of the following solution has highest boiling point.

1) 1 M glucose 2) 1 M KCl

3) 1 M K_2SO_4 4) 1 M Na_3PO_4

97. Which of the following is correct

1) $i = \dfrac{\text{Abnormal molar mass}}{\text{Normal molar mass}}$

2) $i = \dfrac{\text{Observed colligative property}}{\text{Calculated colligative property}}$

3) $i = \dfrac{\text{Total number of moles of particle after dissociation}}{\text{Total number of moles of particles before dissociation}}$

4) Both 2 and 3

98. A salt MX_2 ionises as : $MX_2 \rightleftharpoons M^{2+} + 2X^-$.

It was observed that a given solution of the salt and the same freezing point as a solution of sucrose of twice the molality. The apparent degree of ionisation of the salt is

1) 0.25 2) 0.50

3) 0.33 4) 0.67

SAMPLE QUESTIONS

1. 0.01 mole of a non-electrolyte is dissolved in 10 g of water. The molality of the solution is

1) 0.1 m 2) 0.5 m

3) 1.0 m 4) 0.18 m

2. Mole fraction of solute in benzene is 0.2, then the molality of the solution is

1) 3.2 2) 2

3) 4 4) 3.4

3. 8g NaOH is dissolved in one litre of solution, its molarity is :

1) 0.8 M 2) 0.4 M

3) 0.2 M 4) 0.1 M

4. For the reaction A + 2B → AB_2. The volume of 0.1M A is required to react with 40 ml 0.2M B solution is

1) 160 ml 2) 80 ml

3) 40 ml 4) 20 ml

5. 1 mol of heptane (V.P = 92 mm of Hg) was mixed with 4 mol of octane (V.P = 31 mm of Hg). The vapour pressure of resulting ideal solution is :

1) 46.2 mm of Hg

2) 40.0 mm of Hg

3) 43.2 mm og Hg

4) 38.4 mm of Hg

6. If P_A^0 and P_B^0 are 108 and 36 torr respectively.

What will be the mole fraction of A is vapour phase if B has mole fraction in solution 0.5.

1) 0.25 2) 0.75

3) 0.60 4) 0.35

7. Among the following, that does not form an ideal solution is :

1) C_6H_6 and $C_6H_5CH_3$

2) C_2H_5Cl and C_6H_5OH

3) C_6H_5Cl and C_6H_5Br

4) C_2H_5Br and C_2H_5I

8. When equimolar aqueous solutions of glucose, sodium chloride and barium nitrate are compared the vapour pressure of the solutions will be in the following order :

1) Glucose > NaCl > $Ba(NO_3)_2$

2) Glucose = NaCl = $Ba(NO_3)_2$

3) $Ba(NO_3)_2$ > NaCl > Glucose

4) NaCl > $Ba(NO_3)_2$ > Glucose

9. Methanol and C_2H_5OH form an ideal solution. Solution is prepared by mixing 32 g of CH_3OH and 23g of C_2H_5OH at 300K. At 300K $P^0_{methanol} = 90\,mm\ of\ Hg$ and $P^0_{ethanol} = 51\,mm\ of\ Hg.$

Calculate the VP of solution.

1) 52 mm of Hg 2) 28 mm of Hg

3) 77 mm of Hg 4) 87 mm of Hg

10. Which one of the following statement is incorrect ?

1) Greater the lowering of vapour pressure, greater is the boiling point of the solution

2) Greater the lowering of vapour pressure, lower is the freezing point of the solution

3) At the freezing point, the solute and the solvent have same vapour pressure

4) The units of molal depression constant are Km^{-1}

11. A solution which has lower osmotic pressure compared to that of the other solution is known as

1) Hypotonic

2) Hypertonic

3) Isotonic

4) None of the above

12. Which of the following colligative properties can provide molar mass of proteins (or polymers or colloids) with greater precision ?

1) Relative lowering of vapour pressure

2) Elevation of boiling point

3) Depression in freezing point

4) Osmotic pressure

13. The vapour pressure of pure A is 10 torr and at the same temperature when 1 g of B is dissolved in 20 gm of A, its vapour pressure is reduced to 9.0 torr. If the molecular mass of A is 200 amu, then the molecular mass of B is:

1) 100 amu 2) 90 amu

3) 75 amu 4) 120 amu

14. Which solution will have least vapour pressure:

1) 0.1 M $BaCl_2$ 2) 0.1 M urea

3) 0.1 M Na_2SO_4 4) 0.1 M Na_3PO_4

15. The molal elevation constant of water is 0.52K molality^{-1}. The boiling point of 1.0 molal aqueous KCl solution (assuming complete dissociation of KCl), should be :

1) 100.52^{0}C 2) 101.04^{0}C

3) 99.48^{0}C 4) 98.96^{0}C

16. An aqueous solution freezes at – 0.186^{0}C

(K_f= 1.86 K kg mol^{-1}; K_b = 0.512 K kg mol^{-1}).

What is the elevation in boiling point ?

1) 0.186 2) 0.512

3) $\frac{0.512}{1.86}$ 4) 0.0512

17. If 0.44 gm of substance dissolved in 22.2 gm of benzene lowers the freezing point of benzene by 0.567^{0}C, then the molecular mass of substance is, the molal depression constant = 5.12^{0}C mol^{-1}

1) 128.4 2) 156.6

3) 178.9 4) 232.4

18. K_2HgI_4 is 40% ionised in aqueous solution. The value of its van't Hoff factor (i) is

1) 1.6 2) 1.8

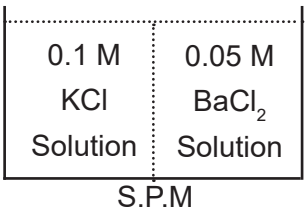
3) 2.0 4) 2.2

19. Osmotic pressure of a solution is 0.0821 atm at a temperature of 300 K. The concentration in mole/lit will be

1) 0.33 2) 0.066

3) 0.3 × 10^{-2} 4) 3

20. Consider this figure and select the correct statement :



1) $BaCl_2$ flows towards the KCl solution

2) KCl flows towards the $BaCl_2$ solution

3) there will be no movement of any solute

4) first KCl flows towards $BaCl_2$ then reverse process takes place

21. Solutions A, B, C and D are respectively 0.1M glucose, 0.05 M NaCl, 0.05 M $BaCl_2$ and 0.1 M $AlCl_3$. Which one of the following pairs is isotonic ?

1) A and B 2) B and C

3) A and D 4) A and C

22. The osmotic pressure of a solution containing 4.0 g solute (molar mass 246) per litre at 27^{0}C is (R= 0.082 L atm K^{-1} mol^{-1}).

1) 0.1 atm 2) 0.3 atm

3) 0.4 atm 4) 0.9 atm

23. Which one of the following solution has highest boiling point.

1) 1 M glucose 2) 1 M KCl

3) 1 M K_2SO_4 4) 1 M Na_3PO_4

24. 15 g of an unknown molecular substance was dissolved in 450 g of water. The resulting solution freezes at –0.34^{0}C. What is the molar mass of the substance ? (K_f for water = 1.86 K kg mol^{-1}).

1) 182.35 g mol^{-1}

2) 110.5 g mol^{-1}

3) 108 g mol^{-1}

4) 143 g mol^{-1}

25. 2g of benzoic acid dissolved in 25 g of benzene shows a depression in freezing point equal to 1.62K. Molal depression constant K_f of benzene is 4.9 K kg mol^{-1}. What is the percentage association of the acid if it forms a dimer in the solution

1) 80 % 2) 65 %

3) 99.2 % 4) 75 %

26. KI and sucrose solution with 0.1 M concentration have osmotic pressure of 0.465 atm and 0.245 atm respectively. Find the degree of dissociation of KI

1) 68.5 % 2) 53.9%

3) 77.9 % 4) 89.8 %

27. Calculate the boiling point of a solution prepared by adding 15 g of NaCl to 250 g of water (K_b for water = 0.512 K kg mol^{-1})

1) 103.5^{0}C 2) 101.05^{0}C

3) 104.3^{0}C 4) 105.01^{0}C

28. Example of a gaseous solution is

1) oxygen dissolved in water

2) solution of hydrogen in Pd

3) chloroform mixed with N_2 gas

4) copper dissolved in gold

29. Example of a solid solution is :

1) Camphor in Nitrogen gas

2) Ethanol dissolved in water

3) Oxygen dissolved in water

4) Solution of hydrogen in palladium

30. The mole fraction of water in 20% aqueous solution of H_2O_2 is :

1) 77/68

2) 68/77

3) 20/80

4) 80/20

31. The density of 1.40 molal solution of acetic acid is 1.084g/ml. The molarity of solution will be

1) 1.30 M

2) 1.40 M

3) 1.50 M

4) 1.60 M

32. If 100cm^3 of 0.3M NaCl and 150cm^3 of 0.1M $CaCl_2$ solutions are mixed, the molarity of Cl^- in the mixture is:

1) 0.24 2) 0.18

3) 0.5 4) 0.6

33. A solution has a 1:4 mole ratio of pentane to hexane. The vapour pressure of the pure hydrocarbons at 30°C are 440 mm Hg for pentane & 120 mm Hg for hexane. The mole fraction of pentane in the vapour phase at 30°C is

1) 0.2 2) 0.478

3) 0.549 4) 0.786

34. The vapour pressure of two pure liquids A & B at t°C are 75 & 21mm Hg respectively. The two when mixed form an ideal solution. What is the mole ratio in which the two be mixed to get a solution whose vapour pressure at t°C is 39mm Hg ?

1) 2:3 2) 5:3

3) 1 : 2 4) 3:5

35. 6.0 g of urea (molecular weight = 60) was dissolved in 9.9 moles of water. If the vapour pressure of pure water is P°, the vapour pressure of solution is

1) 0.10 P° 2) 1.10 P°

3) 0.90 P° 4) 0.99 P°

36. In a 0.2 molal aqueous solution of a weak acid HX the degree of ionization is 0.3. Taking k_f for water as 1.85, the freezing point of the solution will be nearest to

1) –0.240°C 2) +0.480°C

3) –0.480°C 4) –0.360°C

37. An aqueous solution of 1% (w/v) urea (Mol. mass = 60g/mol) in isotonic with 5% (w/v) aqueous solution of a certain non volatile normal solute, both the solution being at the same temperature. The molecular mass of this non.volatile solute is

1) 300 2) 350

3) 200 4) 250

38. Which of the following aqueous solutions at the same temperature are not isotonic with one another?

1) 0.15 M urea

2) 0.05 M $CaCl_2$

3) 0.1M $MgSO_4$

4) 0.15 M glucose

39. Osmotic pressure of 40% urea solution is 1.64 atm and that of 3.42% cane sugar solution is 2.46 atm. When equal volumes of the above two solutions are mixed, osmotic pressure of the resulting solution is

1) 1.64 atm

2) 2.46atm

3) 4.10 atm

4) 2.05atm

40. 75.2g C_6H_5OH is dissolved in 1kg of solvent of K_f =14 $Kkgmol^{-1}$. If the depression in freezing point is 7K then find the percentage of dimerization of phenol

1) 7.5 2) 55

3) 75 4) 85

41. A 0.025M solution of monobasic acid had a freezing point of -0.06°C. Calculate Ka for acid (K_f =1.86 K kg mol^{-1}). Assume M=m

1) 4×10^{-3}

2) 3×10^{-4}

3) 2×10^{-3}

4) 3×10^{-3}

42. Human red blood cells(RBC) is isotonic with

1) 0.91% solution of NaCl

2) 0.8% solution of NaCl

3) 1% solution of NaCl

4) Any percentage solution of NaCl

43. Which of the following represents correctly, the changes in thermodynamic properties during the formation of 1 mol of an ideal binary solution

1) $\Delta H_{mix} = -ve,\ \Delta G_{mix} = +ve,\ T\Delta S_{mix} = 0$

2) $\Delta H_{mix} = 0,\ \Delta G_{mix} = +ve,\ T\Delta S_{mix} = -ve$

3) $\Delta H_{mix} = 0,\ \Delta G_{mix} = -ve,\ T\Delta S_{mix} = +ve$

4) $\Delta H_{mix} = -ve, \Delta G_{mix} = 0, T\Delta S_{mix} = +ve$

44. The freezing point of a 0.08 molal aqueous solution of $NaHSO_4$ is –0.372°C. If K_f for water is 1.86 K kg mol^{-1}, the dissociation constant for the reaction $HSO_4^- \rightleftharpoons H^+ + SO_4^{2-}$ is

1) 0.02

2) 0.04

3) 0.06

4) 0.08

45. An example of a solution having liquid in gas is

1) $CHCl_3$ droplets in N_2 gas

2) Dry air

3) Au–Hg

4) $C_2H_5OH + H_2O$

ANSWER KEY

1.	1	21.	3	41.	1	61.	4	81.	4
2.	3	22.	3	42.	4	62.	4	82.	4
3.	2	23.	2	43.	3	63.	3	83.	3
4.	1	24.	4	44.	4	64.	1	84.	2
5.	3	25.	2	45.	1	65.	4	85.	4
6.	1	26.	1	46.	1	66.	4	86.	4
7.	3	27.	1	47.	1	67.	2	87.	3
8.	1	28.	4	48.	3	68.	1	88.	2
9.	2	29.	1	49.	4	69.	3	89.	1
10.	1	30.	3	50.	3	70.	2	90.	1
11.	2	31.	2	51.	3	71.	2	91.	3
12.	4	32.	2	52.	2	72.	1	92.	3
13.	2	33.	2	53.	2	73.	3	93.	2
14.	2	34.	1	54.	1	74.	4	94.	3
15.	2	35.	3	55.	1	75.	1	95.	2
16.	4	36.	4	56.	3	76.	3	96.	4
17.	3	37.	2	57.	1	77.	2	97.	4
18.	2	38.	1	58.	1	78.	1	98.	2
19.	3	39.	2	59.	3	79.	2		
20.	4	40.	1	60.	2	80.	4		

SAMPLE QUESTIONS

1.	3	10.	3	19.	3	28.	3	37.	1
2.	1	11.	1	20.	3	29.	4	38.	3
3.	3	12.	4	21.	1	30.	2	39.	4
4.	3	13.	2	22.	3	31.	2	40.	3
5.	3	14.	4	23.	4	32.	1	41.	4
6.	2	15.	2	24.	1	33.	2	42.	1
7.	2	16.	4	25.	3	34.	3	43.	3
8.	1	17.	3	26.	4	35.	4	44.	2
9.	3	18.	2	27.	2	36.	3	45.	1

WORK BOOK

Chapter 14

ELECTROCHEMISTRY

QUESTIONS

GALVANIC CELL AND NERNST EQUATION

1. An electrode consisting of Zn rod immersed in 1M solution of $ZnSO_4$ is combined with SHE and the emf of the cell comes out to be 0.76 V. The cell may be represented as

1) Pt, H_2(1 bar)|H^+(1M)||Zn^{2+}(1M)|Zn

2) Zn|Zn^{2+} (1M)||H^+ (1M)|H_2(1 bar), Pt

3) Pt, H_2(1 bar)|H^+ (1M)||Zn^{2+}(2M)|Zn

4) Zn|Zn^{2+}(1M)||H^+ (1M)|H_2(2 bar), Pt

2. Which of the following statement is true for Daniell cell

1) Cation move towards Zn electrode

2) Cation move towards Cu electrode

3) Current flows from Zn electrode to Cu electrode

4) Electron flows from Cu electrode to Zn electrode

3. The cell reaction is spontaneous or feasible when the emf of the cell is

1) Negative

2) Positive

3) Zero

4) Either +ve or -ve

4. EMF of the cell at 25°C is Mg|Mg^{2+} (0.01 M)||Ag^+ (1×10^{-4} M)|Ag

$$E^0_{Ag^+|Ag} = 0.8 \text{ V}$$

$$E^0_{Mg^{2+}|Mg} = -2.36 \text{ V}$$

1) 3.17 V 2) 1.28 V

3) 4.2 V 4) 2.987 V

5. Zn can not displace following ions from their aqueous solution

1) Ag^+ 2) Cu^{2+}

3) Fe^{2+} 4) Na^+

6. If a spoon of copper metal is placed in a solution of ferrous sulphate

1) Cu will precipitate out

2) Iron will precipitate

3) Cu and Fe will precipitate

4) No reaction will take place

7. The standard electrode potential value of the elements A, B and C are 0.68, –2.50 and 0.50 V respectively. The order of their reducing power is

1) A > B > C

2) A > C > B

3) C > B > A

4) B > C > A

8. The oxidation potential of Zn, Cu, Ag, H_2 and Ni are 0.76 V, –0.34 V, –0.80 V, 0 V, 0.25 V respectively. Whic of the following reaction will provide maximum voltage?

1) $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$

2) $Zn + 2Ag^{+} \rightarrow 2Ag + Zn^{2+}$

3) $H_2 + Cu^{2+} \rightarrow 2H^{+} + Cu$

4) $H_2 + Ni^{2+} \rightarrow 2H^{+} + Ni$

9. The standard reduction potential at 25°C of Li^{+}/Li, Ba^{2+}/Ba, Na^{+}/Na and Mg^{2+}/Mg are –3.05 V, –2.73 V, –2.71 V and –2.37 V respectively. Which one of the following is the strongest oxidising agent?

1) Na^{+} 2) Li^{+}

3) Ba^{2+} 4) Mg^{2+}

10. The standard electrode potential of Zn, Ag and Cu are –0.76 V, 0.80 V and 0.34 V respectively, then:

1) Ag can oxidise Zn and Cu

2) Ag can reduce Zn^{2+} and Cu^{2+}

3) Zn can reduce Ag^{+} and Cu^{2+}

4) Cu can oxidise Zn and Ag

11. A standard electrode potentials of four elements are

A = –0.250 V,

B = –0.140 V

C = –0.126 V,

D = –0.402 V

The element that displaces A from its compounds aqueous solution is

1) B 2) C

3) D 4) None of the above

12. The following four colourless salt solutions are placed in separate test tubes and a strip of Cu is placed in each solution which finally turns blue:-

1) $Zn(NO_3)_2$ 2) $Mg(NO_3)_2$

3) KNO_3 4) $AgNO_3$

13. $E^0 (Ni^{2+}/Ni) = -0.25$ V

$E^0 (Au^{3+}/Au) = 1.50$ V

The emf of the voltaic cell

Ni/Ni^{2+} (1.0 M)||Au^{3+}(1.0 M)|Au is

1) 1.25 V 2) –1.75 V

3) 1.75 V 4) 4.0 V

14. The emf of the cell

Tl(s) | Tl^{+} (0.0001 M)||Cu^{2+}(0.01 M)|Cu(s) is 0.83 V. The emf of this cell will be increased by

1) Increasing the concentration of Cu^{+2} ions

2) Decreasing the concentration of Tl^{+}

3) Increasing the concentration of both Cu^{2+} and Tl^{+}

4) 1 and 2 both

15. The potential of hydrogen electrode $\left(P_{H_2} = 1 \text{ atm}; \left[H^{+}\right] = 0.1 \text{ M}\right)$ at 25°C will be

1) 0.00 V 2) –0.059 V

3) 0.118 V 4) 0.059 V

16. The potential of hydrogen electrode at pH = 4 is

1) 0.591 V 2) 0.2364 V

3) 0.123 V 4) 0.188 V

17. Which of the following represents the potential of silver wire dipped into 0.01 M $AgNO_3$ solution at 25°C?

1) $E^0 - 0.0591$

2) $E^0 + 0.0591$

3) $E^0 - 2 \times 0.0591$

4) $E^0 + 2 \times 0.0591$

18. Which is not true for a standard hydrogen electrode?

1) The hydrogen ion concentration is 1M

2) Temperature is 25°C

3) Pressure of hydrogen is 1 bar

4) It contains a metallic conductor which does not adsorb hydrogen

19. E^0 for the half cell

$Zn^{2+}|Zn$ is –0.76 V. E.m.f. of the cell

$Zn|Zn^{2+}$ (1M) || $2H^+$ (1M)$|H_2$ (1 atm) is

1) –0.76 V

2) +0.76 V

3) –0.38 V

4) +0.38 V

20. Which of the following statements is correct:-

1) Oxidation occur at anode in both galvanic and electrolytic cell

2) Reduction occurs at anode in both galvanic and electrolytic cell

3) Reduction occur at anode in electrolytic cell whereas oxidation occur at cathode in galvanic cell

4) Oxidation occur at anode in electrolytic cell where as reduction occur at anode in a galvanic cell

21. The metal displace hydrogen from dil HCl

1) Ag

2) Pt

3) Cu

4) Zn

22. If a spoon of Iron metal is placed in a solution of copper sulphate

1) Cu will precipitate out

2) Iron will precipitate

3) Cu and Fe will precipitate

4) No reaction will take place

23. The standard electrode potential value of the elements A, B and C are –1.53, –3.05 and 0.25 V respectively. The order of their oxidising power is

1) A > B > C

2) A > C > B

3) C > A > B

4) B > C > A

24. The measured emf of the cell

$Pt_{(s)}, H_{2(g)}(1\ atm) | H^+_{(aq)}(1M) || Au^{3+}_{(aq)}(1M) | Au_{(s)}$ is

+1.4 V. The standard reduction potential of Au is

1) 0.34 V

2) +1.4 V

3) –1.4 V

4) 2.8 V

25. **Assertion (A)** : For three half-cell reactions involving different number of electrons. $E_3 = E_1 + E_2$

Reason (R) : $\Delta G_3 = \Delta G_1 + \Delta G_2$

1) If A and R both are correct and R is the correct explanation of A

2) If A and R both are correct and R is not the correct explanation of A

3) A is true but R is false

4) A is false but R is true

26. A standard hydrogen electrode has zero electrode potential because

1) hydrogen is easiest to oxidise

2) this electrode potential is assumed to be zero

3) hydrogen atom has only one electron

4) hydrogen is the lighest element

27. Match the following:-

Column-I		Column-II	
A)	A gas contact with an inert electrode	p)	Electrode potential
B)	the potential difference in volts between the two electrodes	q)	O_2 liberated at anode and the pH of the solution will not change
C)	Li metal has the lowest standard electrode potential	r)	$H_{2(g)}$/Pt
D)	Electrolysis of aq. Na_2SO_4 using Pt electrodes	s)	Strongest reducing agent

1) A→s; B→r; C→q; D→p

2) A→r; B→p; C→s; D→q

3) A→p; B→q; C→r; D→s

4) A→q; B→s; C→q; D→r

28. Which is not true for standard electrode potentials?

1) E^0 for oxidation is the negative of E^0 for reduction

2) Cell constituents are in their standard states

3) The potential for the standard hydrogen electrode is chosen to be +1.00 V

4) The half reactions are written as reduction reactions

29. Which of the following staetment is incorrect?

1) Li has lowest electrode potential indicating that Li^+ ion is the weakest oxidisng agent

2) Lithium metal is the most powerful reducing agent

3) Electrochemical cells are extensively used for determining pH of solution, solubility and equilibrium constant

4) If standard electrode potential of an electrode is greater than zero, then its reduced form is less stable compared to hydrogen gas.

30. **Statement-I** : The standard electrode potential of fluorine is the highest in electrochemical series

Statement-II : F_2 has maximum tendency to get reduced to fluoride ion (F^-)

1) Statement-I and II are correct

2) Statement-I is correct but I is incorrect

3) Statement-I is incorrect but I is correct

4) Statement-I and II are incorrect

31. **Statement-I** : F_2 gas is the strongest oxidising agent.

Statement-II : Fluoride ion (F^-) is the weakest reducing agent.

1) Statement-I and II are correct

2) Statement-I is correct but I is incorrect

3) Statement-I is incorrect but I is correct

4) Statement-I and II are incorrect

32. **Assertion (A):** Platinum and gold are used as inert electrodes.

Reason (R) : They do not participate in the reaction but provide their surface for oxidation and reduction reaction and for conduction of electrons.

1) A and R are correct and R is the correct explanation of A

2) A and R are correct but R is not the correct explanation of A

3) A is correct but R is incorrect

4) A is incorrect but R is correct

33. Which of the following statement is incorrect about Daniell cell?

1) In Daniell cell oxidation half reaction occurs on the zinc electrode

2) In Daniell cell reduction half reaction occurs on the zinc electrode

3) In Galvanic cell electrons flows from negative electrode to positive electrode

4) The direction of current flow is form cathode to anode

34. Which of the following equation correct

1) $E_{cell} = E_{cathode}(red.pot) - E_{anode}(ox.pot)$

2) $E_{cell} = E_{anode}(red.pot) - E_{cathode}(red.pot)$

3) $E_{cell} = E_{cathode}(red.pot) + E_{anode}(red.pot)$

4) $E_{cell} = E_{anode}(ox.pot) - E_{cathode}(ox.pot)$

35. Functions of salt bridge are

1) By completing electrical circuit, it allow the flow of current

2) It helps to maintain electrical neutrality of the solutions in the two half cells

3) It prevents the intermixing of solutions and ions in the half cells

4) All of these

36. Arrange the following metals Cu, Al, Zn, Fe, Mg in the order in which they displace each other from the solution of their salt

1) Zn, Al, Mg, Cu, Fe

2) Cu, Al, Zn, Mg, Fe

3) Mg, Al, Zn, Fe, Cu

4) Fe, Cu, Al, Mg, Zn

37. $Fe^{2+}_{(aq)} + Ag^{+}_{(aq)} \longrightarrow Fe^{3+}_{(aq)} + Ag_{(s)}$. Calculate the $\Delta_r G^0$ of the reaction

$\left(E^0_{Fe^{3+}/Fe^{2+}} = 0.77\ V,\ E^0_{Ag^+/Ag} = 0.8\ V\right)$

1) – 5.732 kJ

2) 28.95 kJ

3) – 3.92 kJ

4) – 2.895 kJ

38. Which of the following statement is incorrect?

1) Electrical work done in one second is equal to electrical potential multiplied by total change passed

2) Reversible work done by the Galvanic cell is equal to decrease in Gibbs free energy

3) Gibbs free energy of the reaction, $\Delta_r G = -nFE_{cell}$

4) E_{cell} is an extensive property

39. Electrode potential of hydrogen electrode in negative in

1) $\underset{1\,M}{H^+_{(aq)}} \,|\, \underset{1\,atm}{H_2}$

2) $\underset{2\,M}{H^+_{(aq)}} \,|\, \underset{1\,atm}{H_2}$

3) $\underset{0.1\,M}{H^+_{(aq)}} \,|\, \underset{1\,atm}{H_2}$

4) $\underset{2\,M}{H^+_{(aq)}} \,|\, \underset{2\,atm}{H_2}$

40. Consider the following electrodes

A) $\underset{10^{-4}\,M}{Cu^{2+}_{(aq)}} \,|\, Cu_{(s)}$

B) $\underset{10^{-1}\,M}{Cu^{2+}_{(aq)}} \,|\, Cu_{(s)}$

C) $\underset{10^{-2}\,M}{Cu^{2+}_{(aq)}} \,|\, Cu_{(s)}$

If the standard reduction potential of Cu is 0.34 V, reduction potential in volts of the above follows the order

1) A > C > B 2) B > C > A

3) A > B > C 4) C > B > A

41. Given E^0 of $Pb^{2+}_{(aq)} \,|\, Pb_{(s)}$ and $Ce^{4+}_{(aq)} \,|\, Ce^{2+}_{(aq)}$ are –0.12 V and +0.4 V respectively, which among the following statements are true?

1) Galvanic cell between two is $Pb_{(s)} \,|\, Pb^{2+}_{(aq)} \,||\, Ce^{4+}_{(aq)} \,|\, Ce^{2+}_{(aq)}, Pt$

2) Spontaneous cell reaction is $Pb_{(s)} + Ce^{4+}_{(aq)} \rightarrow Pb^{2+}_{(aq)} + Ce^{2+}_{(aq)}$

3) Cell voltage is 0.52 V

4) All are correct

42. The value of equilibrium constant for feasible cell reaction is

1) <1 2) equal to 1

3) >1 4) zero

43. $Fe(s)|Fe^{2+}$ (0.001 M)$||H^+$ (1M)$|H_{2(g)}$ (1 bar)| Pt(s), the emf of the cell is

$E^0_{Fe^{2+}/Fe} = -0.44\ V$

1) 0.875 V 2) 0.5285 V

3) 1.2 V 4) 0.231 V

CONDUCTANCE OF ELECTROLYTIC SOLUTION

44. **Assertion (A)** : The correct order of molar conductance at infinite dilution is KCl > NaCl > LiCl.

Reason (R) : KCl is stronger electrolyte than NaCl which is stronger than LiCl.

1) If A and R both are correct and R is the correct explanation of A

2) If A and R both are correct and R is not the correct explanation of A

3) A is true but R is false

4) A is false but R is true

45. **Assertion (A)** : For a weak electrolyte, the plot of molar conductivity (Λ_m) against $\sqrt{C}$ (C is concentration in mol lit^{-1}) is nearly linear.

Reason (R) : The molar conductivity at infinite dilution (Λm) for an electrolyte can be considered equal to the sum of the limiting molar conductivities of the individual ions.

1) If A and R both are correct and R is the correct explanation of A

2) If A and R both are correct and R is not the correct explanation of A

3) A is true but R is false

4) A is false but R is true

46. Match the following

Column-I		Column-II	
A)	Anode	p)	E^0 cathode $-E^0$ anode
B)	Conductance	q)	mass of product deposited by 1 coulomb of electricity
C)	Electrochemical equivalent	r)	$(\text{resistance})^{-1}$
D)	E^0 cell	s)	where oxidation take place
		t)	molecular weight of ion

1) A→s; B→r; C→q; D→p

2) A→p; B→q; C→s; D→r

3) A→t; B→q; C→r; D→s

4) A→q; B→r; C→s; D→t

47. Which of the following statements is correct?

1) Specific conductance increases with dilution

2) Molar conductance decreases with dilution

3) The conductance of all electrolytes increase with temperature

4) Molar conductance becomes minimum at infinite dilution

48. The electronic conductance depends on

1) Nature and structure of the metal

2) The number of valence electrons per atom

3) Pressure

4) Both 1 and 2

49. The specific conductance of 0.1 M KCl solution at 23°C is 0.015 ohm^{-1} cm^{-1}. The resistance of the cell containing the solution at the same temperature was found to be 60 ohm. The cell constant will be

1) 0.15 cm^{-1}

2) 1.9 cm^{-1}

3) 0.9 cm^{-1}

4) 2.0 cm^{-1}

50. If the molar conductance of value of Mg^{2+} and Br^- at infinite dilution are respectively 106 and 78.1 Scm^2 mol^{-1}, then that $MgBr_2$ is (In S cm^2 mol^{-1})

1) 262.2 Scm^2 mol^{-1}

2) 436.5 Scm^2 mol^{-1}

3) 128 Scm^2 mol^{-1}

4) 308.2 Scm^2 mol^{-1}

51. Molten sodium chloride conduts electricity due to the presence of

1) free electrons

2) free ions

3) free molecule

4) free atoms of Na and Cl

52. Which of the following NaCl solution has the lowest value of molar conductance?

1) 0.1 M 2) 0.05 M

3) 0.5 M 4) 0.001 M

53. Which of the following solution of KCl will have the highest specific conductance?

1) 0.001 M 2) 0.05 M

3) 0.1 M 4) 0.02 M

54. The value of molar conductivity of HCl is greater than that of KCl at a particular temperature because

1) Molar mass of HCl is less than that of KCl

2) HCl is strongly acidic

3) Ionisation of HCl is larger than that of NaCl

4) Ionic mobility of H^+ ions is more than that of K^+

55. The resistance of 0.02 M solution of an electrolyte was found to be 200 ohm at 298 K using a conductivity cell of cell constant 0.40 cm^{-1}. The molar conductivity of the solution is

1) 125 $Scm^2\ mol^{-1}$

2) 50 $Scm^2\ mol^{-1}$

3) 60 $Scm^2\ mol^{-1}$

4) 100 $Scm^2\ mol^{-1}$

56. Which one of the following is correct?

1) Specific conductance increases on dilution

2) Specific condutance decreases on dilution

3) Molar conductivity decreases on dilution

4) Molarity of the solution increases on dilution

57. The molar conductivity at infinite dilution of $AgNO_3$, AgCl and NaCl are 116.5, 121.6 and 110.3 $Scm^2\ mol^{-1}$ respectively. The molar conductivity of $NaNO_3$ at infinite dilution is

1) 110.5 S $cm^2\ mol^{-1}$

2) 105.2 S $cm^2\ mol^{-1}$

3) 98.2 $Scm^2\ mol^{-1}$

4) 130 $Scm^2\ mol^{-1}$

58. For HCl solution at 35°C, molar conductivity at infinite dilution is 425 $ohm^{-1}\ cm^2\ mol^{-1}$. The specific condutance of solution of HCl is 3.825 $ohm^{-1}cm^{-1}$. If the degree of dissociation is 90%. The molarity of the solution is

1) 10 M

2) 0.9 M

3) 1.2 M

4) 5 M

59. The molar conductivity of 0.01 M CH_3COOH at 25°C is 90 and at infinite dilution it is 450. The dissociation constant of CH_3COOH is

1) 1×10^{-4}

2) 2×10^{-3}

3) 3×10^{-5}

4) 4×10^{-4}

60. Which one of the following statement is correct?

1) Molar conductivity of a solution at a given concentration is the conductance of volume V of solution containing one mole of electrolyte kept between two electrodes of area of cross section A and distance of unit length

2) Molar conductivity increases with decrease in concentration

3) Λ_m of strong electrolyte can be presented by equation $\Lambda_m = \Lambda_m^0 - A\sqrt{c}$

4) All of these

61. Which of the following is/are correct?

1) $\Lambda^0_{m(KCl)} - \Lambda^0_{m(NaCl)} = \Lambda^0_{m(KBr)} - \Lambda^0_{m(NaBr)}$

2) $\Lambda^0_{m(Kl)} - \Lambda^0_{m(NaI)} = \Lambda^0_{m(KBr)} - \Lambda^0_{m(NaBr)}$

3) $\Lambda^0_{m(NaBr)} - \Lambda^0_{m(NaCl)} = \Lambda^0_{m(KBr)} - \Lambda^0_{m(KCl)}$

4) All of these

62. The relationship between $\lambda_m = \lambda_m^0 - A\sqrt{C}$ will not hold good for the electrolyte

1) HCl 2) KCl

3) $BaCl_2$ 4) HCN

63. Molar conductance of KCl increases slowly on dilution because of

1) Increase in degree of ionisation

2) Increase in total number of current carrying species

3) Weakening of inter ionic attraction and increase in ionic conductance

4) Increase in hydration of ions

64. Which of the following compounds has highest molar conductivity as molarity → 0

1) HCl 2) KCl

3) NaCl 4) LiCl

65. The molar conductance of $\frac{M}{10}$ solution of weak monobasic acid is 8 ohm^{-1} cm^2 mol^{-1} and at infinite dilution is 400 ohm^{-1} cm^2 mol^{-1}. What is the pH of solution

1) 4 2) 2.7

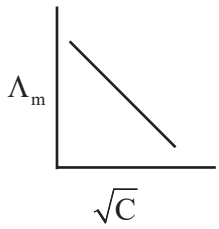
3) 3.7 4) 4.5

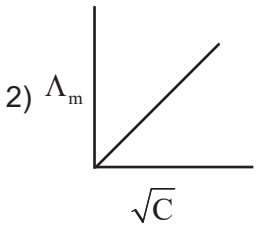
66. Same quantity of current is passed through molten $AlCl_3$ and NaCl. If 4.6 g sodium is formed, amount of Al formed is

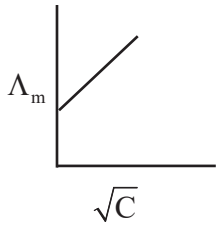
1) 4.3 g 2) 1.8 g

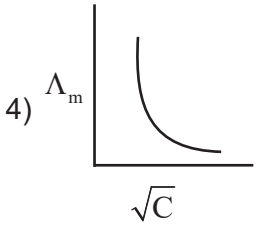
3) 3.8 g 4) 2.4 g

67. Which of the following curve gives the variation of Λ_m with $\sqrt{C}$ for CH_3COOH?

1) 

2) 

3) 

4) 

ELECTROLYTIC CELL

68. **Assertion (A)** : 1 faraday of electricity is passed through acidified H_2O, volume of O_2 liberated at STP will be 5.6 L.

Reason (R) : Equivalent weight of oxygen is 16

1) If A and R both are correct and R is the correct explanation of A

2) If A and R both are correct and R is not the correct explanation of A

3) A is true but R is false

4) A is false but R is true

69. **Assertion (A)** : 1 faraday of electricity deposits 1g equivalent of Ag or Cu or Al

Reason (R) : 1 mol electrons are required to reduce 1 mol of Ag^+ or Cu^{2+} or Al^{3+} ion.

1) If A and R both are correct and R is the correct explanation of A

2) If A and R both are correct and R is not the correct explanation of A

3) A is true but R is false

4) A is false but R is true

70. By passage of 1F of electricity

1) 9g of Al is deposited

2) 5.6 L of O_2 gas evolved at anode

3) 0.5 mol of Cu is deposited

4) All of these

71. Electrolysis of water gives 11.2 L of hydrogen at STP at the cathode. The oxygen evolved at the anode under similar conditions is

1) 5.6 L 2) 8g

3) 0.25 mol 4) All of these

72. One Faraday of electricity will liberate one mole of the metal from the solution of

1) Auric chloride

2) Silver nitrate

3) Calcium chloride

4) Copper sulphate

73. When 96500 C of electricity are passed through barium chloride solution, the amount of barium deposited will be (Ba - 137.3)

1) 137.3 g 2) 274.6 g

3) 34.32 g 4) 68.65 g

74. A current of 9.65 A flowing for 10 minute deposits 3.0 g of a metal. The equivalent weight of the metal is

1) 10 2) 30

3) 50 4) 96.5

75. Match the items of column-I and column-II

Column-I		Column-II	
i)	Lechlanche cell	a)	Cell reaction $2H_2 + O_2 \rightarrow 2H_2O$
ii)	Ni-Cd cell	b)	does not involve any ion in solution and is used in hearing aids
iii)	Fuel cell	c)	rechargeable
iv)	Mercury cell	d)	reaction at anode, $Zn \rightarrow Zn^{2+} + 2e^-$

1) i → d; ii →b; iii →c; iv →d

2) i → d; ii →c; iii →a; iv →b

3) i → a; ii →b; iii →c; iv →d

4) i → d; ii →c; iii →b; iv →a

76. What will be the weight of deposited silver on passing 965 coulombs of electricity in solution of $AgNO_3$?

1) 1.08 g

2) 2.16 g

3) 0.54 g

4) 0.27 g

77. In the electrolysis of fused NaCl, 4.6 g of Na is produced at cathode. Volume of Cl_2 gas at STP liberated at anode is

1) 22.4 L 2) 5.6 L

3) 2.24 L 4) 11.2 L

78. 6 Faraday of electricity is passed through three electrolytic cell connected in series containing Na^+, Zn^{2+} and Au^{3+} respectively. The mole ratio in which the three metal ions are discharged at the electrode is

1) 1 : 2 : 3 2) 6 : 3 : 2

3) 2 : 3 : 5 4) 3 : 4 : 2

79. How much electricity in terms of faraday is required to produce 40g of Al from molten Al_2O_3

1) 3F 2) 2F

3) 6F 4) 4.44 F

80. In the electrolysis of which solution, OH^- ions are discharged?

1) Aq. NaCl

2) Aq. $CuSO_4$

3) Aq. KCl

4) Molten NaCl

81. What is the product formed at anode and cathode by the electrolysis of dil.H_2SO_4 using Pt electrode

1) H_2 and O_2

2) SO_2 and H_2

3) O_2 and H_2

4) $S_2O_6^{2=}$ and H_2

82. What is the product formed at the anode by the electrolysis of concentrated H_2SO_4 using Pt electrode

1) H_2

2) O_2

3) $S_2O_8^{2-}$

4) SO_2

83. If a current of 0.5 ampere flows through a metallic wire for 2 hours then how many electrons would flow through the wire?

1) 1.03×10^{21}

2) 2.247×10^{22}

3) 4.48×10^{23}

4) 6.02×10^{23}

84. Consider the reaction:

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$. What is the quantity of electricity in coulomb needed to reduce 10^{-3} mole of $Cr_2O_7^{2-}$?

1) 579 C 2) 675 C

3) 96500 C 4) 3350 C

85. How much electricity is required in Faraday for the oxidation of 51g of H_2O_2

1) 1F

2) 2F

3) 4F

4) 3F

86. A solution $Ni(NO_3)_2$ is electrolysed between platinum electrode using a current of 5 amperes, 1.83 g of nickel is formed. Time taken for electrolysis is (Ni-58.7)

1) 20 min

2) 40 min

3) 10 min

4) 35 min

87. An aqueous solution of $AgNO_3$ is electrolysed with Ag electrode. Which of the following is true

1) Anode : $Ag \rightarrow Ag^+ + e^-$

2) Cathode : $Ag^+ + e^- \rightarrow Ag$

3) Anode : $2H_2O \rightarrow O_2 + 4H^+ + e^-$

4) Both 1 and 2

88. During the electrolysis of the aqueous solution of copper sulphate using Cu electrode the reaction taking place at the anode is

1) $Cu^{2+} + 2e^- \rightarrow Cu$

2) $Cu \rightarrow Cu^{2+} + 2e^-$

3) $2H_2O \rightarrow O_2 + 4H^+ + 4e$

4) $H_2O + e^- \rightarrow OH^- + \frac{1}{2}H_2$

89. Which of the following aqueous solution of salt on electrolysis changes the pH

1) Aq. $NaNO_3$ 2) Aq. $CuCl_2$

3) Aq. NaOH 4) Aq. Na_2SO_4

90. Which of the following metal cannot be obtained by the electrolysis of aqueous solution of metal salt

1) Ag 2) Cu

3) Au 4) Ca

COMMERCIAL CELLS AND CORROSION

91. **Assertion (A)** : The voltage of mercury cell remains constant during its life.

Reason (R) : Net cell reaction of mercury cell does not involve any ion.

1) If A and R both are correct and R is the correct explanation of A

2) If A and R both are correct and R is not the correct explanation of A

3) A is true but R is false

4) A is false but R is true

92. Lead storage battery contains

1) Electrolyte as 38% H_2SO_4

2) Pb plates coated with PbO_2 act as cathode

3) Pb rod as anode

4) All of these

93. During the charging of lead storage battery

1) PbO_2 dissolved

2) Pb dissolves

3) H_2SO_4 is regenerated

4) H_2SO_4 is consumed

94. Which of the following statement is incorrect?

1) In leclanche cell, the space between electrode is filled by moist paste of NH_4Cl and $ZnCl_2$

2) In the reaction at the anode, manganese is reduced from +4 oxidation state to +3 state

3) The cell potential of Leclanche cell is nearly 1.5 V

4) In Leclanche cell, the NH_3 produced in the reaction forms complex with Zn^{2+} to give $[Zn(NH_3)_4]^{2+}$

95. Which of the following statement is incorrect about Leclanche cell

1) Anode : $Zn(s) \rightarrow Zn^{2+} + 2e^-$

2) Cathode : $MnO_2 + NH_4^+ + e^- \rightarrow MnO(OH) + NH_3$

3) Cathode : MnO_2

4) Anode : Zinc

96. Which of the following statement is/are correct?

i) Mercury cell suitable for low current devices like hearing aids and watches

ii) Mercury cell consist of Zn-Hg amalgam as anode

iii) Anode : $Zn(Hg) + 2OH^- \rightarrow ZnO(s)+H_2)+2e^-$

iv) Cathod : $HgO + H_2O + 2e^- \rightarrow Hg(l() + 2OH^-$

1) i, ii and iii

2) i, ii, iii and iv

3) i and ii

4) ii, iii and iv

97. **Statement-I** : A 38% solution of H_2SO_4 is used as an electrolyte in lead storage battery.

Statement-II : The cell reaction when battery is in use are

$$\text{Anode}: Pb_{(s)} + SO_{4(aq)}^{2-} \rightarrow PbSO_{4(s)} + 2e^-$$

$$\text{Cathode}: PbO_{2(s)} + SO_4^{2-} + 4H^+ \rightarrow PbSO_4 + 2H_2O$$

1) Statement-I and II are correct

2) Statement-I is correct but II is incorrect

3) Statement-I is incorrect but II is correct

4) Statement-I and II are incorrect

98. **Assertion** : The cell potential of mercury cell is approximately 1.35 V and remains constant during its life.

Reason : The overall reaction (Zn(Hg) + HgO(s) → ZnO(g) + Hg(l) does not involve any ios in solution, whose concenration can change during its life time.

1) A and R are correct and R is the the correct explanation of A

2) A and R are correct but R is not the correct explanation of A

3) A is correct but R is incorrect

4) A is incorrect but R is correct

99. Which of the following statements is/are incorrect about fuel cell?

1) It is a galvanic cell that convert energy of combustion of fuel directly into electrical energy

2) H_2–O_2 fuel cell was used in the Appolo space programme for providing electrical power

3) The cell runs continuously as long as the reactant are supplied

4) The electrode reaction are

$$\text{Anode}: O_{2(g)} + 2H_2O_{(\ell)} + 4e^- \rightarrow 4OH^-(aq)$$

$$\text{Cathode}: 2H_{2(g)} + 4OH^-_{(aq)} \rightarrow 4H_2O_{(l)} + 4e^-$$

100. Which of the following statements is/are correct about fuel cells

1) Highly efficient (about 70% efficient)

2) Concentrated aqueous KOH/NaOH is used as electrolyte

3) Catalyst like Pt or Pd metals are incorporated into the electrode for increasing the rate of electrode reaction

4) All are correct

SAMPLE QUESTIONS

1. How many coulombs of electricity are required for complete oxidation of 90g of H_2O?

1) 32250 c 2) 96500 c

3) 4000 c 4) 965000 c

2. Calculate the standard EMF of a cell which involves the following cell reaction

$Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$

$\left(E^0_{Zn^{2+}|Zn} = -0.76\,V,\ E^0_{Ag^+|Ag} = +0.80\,V\right)$

1) 1.1 V 2) 2.3 V

3) 0.78 V 4) 1.56 V

3. The electrode potential of a copper wire dipped in 0.1 M $CuSO_4$ solution at 25°C is $\left(E^0_{Cu^{2+}|Cu} = +0.34\ V\right)$

1) 0.31045 V 2) 1.325 V

3) 0.625 V 4) 2.41 V

4. At what pH of HCl solution will hydrogen gas electrode show electrode potential of –0.118 V? H_2 gas is bubbled at 298 K and 1 atm pressure

1) 5 2) 2

3) 4 4) 3

5. Resistance of 0.2 M solution of an electrolyte is 50 ohm. The specific conductance of the solution is 1.3 Sm^{-1}. If resistance of the 0.4 M solution of the same electrolyte is 260 ohm, its molar conductivity is

1) 6250 $Sm^2\ mol^{-1}$

2) $6.25 \times 10^{-4}\ Sm^2\ mol^{-1}$

3) $3.125 \times 10^{-3}\ Sm^2\ mol^{-1}$

4) $1.25 \times 10^{-2}\ Sm^2\ mol^{-1}$

6. The cell constant of a conductivity cell

1) Changes with change of electrolye

2) Changes with change of concentration of electrolyte

3) Changes with temperature of electrolyte

4) Remains constant for cell

7. While charging the lead storage battery

1) $PbSO_4$ anode is reduced to Pb

2) $PbSO_4$ cathode is reduced to Pb

3) $PbSO_4$ cathode is oxidised to Pb

4) $PbSO_4$ anode is oxidised to PbO_2

8. The quantity of charge required to obtain one mole of aluminium from Al_2O_3 is

1) 1F 2) 6F

3) 3F 4) 2F

9. An electrochemical cell can behave like and electrolytic cell when

1) $E_{cell} = 0$

2) $E_{cell} > E_{ext}$

3) $E_{ext} > E_{cell}$

4) $E_{cell} = E_{ext}$

10. For the given cell, $Mg|Mg^{2+}||Cu^{2+}|Cu$

1) Mg is cathode

2) Cu is cathode

3) The cell reaction is $Mg+Cu^{2+} \rightarrow Mg^{2+} + Cu$

4) Both 2 and 3

11. $\Lambda^0_{m(H_2O)}$ is equal to

1) $\Lambda^0_{m(HCl)} + \Lambda^0_{m(NaOH)} - \Lambda^0_{m(NaCl)}$

2) $\Lambda^0_{m(NH_4OH)} + \Lambda^0_{m(HCl)} - \Lambda^0_{m(NH_4Cl)}$

3) $\Lambda^0_{m(HNO_3)} + \Lambda^0_{m(NaNO_3)} - \Lambda^0_{m(NaOH)}$

4) Both 1 and 2

12. Which has maximum potential for the half cell reaction $H^+ + e^- \rightarrow \frac{1}{2}H_2$

1) 1M HCl

2) 1M NaOH

3) Pure water

4) A solution with pH=4

13. The reaction taking place in the cell

$Pt|H_{2(g)}|HCl(1M)|AgCl|Ag$ is

1) $AgCl + \frac{1}{2}H_2 \rightarrow Ag + H^+ + Cl^-$

2) $Ag + H^+ + Cl^- \rightarrow AgCl + \frac{1}{2}H_2$

3) $2Ag^+ + H_2 \rightarrow 2Ag + 2H^+$

4) $2Ag + 2H^+ \rightarrow Ag^+ + H_2$

14. Calculate the reduction potential of a half cell consisting of platinum electrode immersed in 2M Fe^{2+} and 0.02 M Fe^{3+}

Given $E^0_{Fe^{2+}/Fe^{3+}} = 0.771$ V

1) 0.653 V 2) 0.889 V

3) 0.438 V 4) 2.771 V

15. The standard emf of a galvanic cell involving 2 moles of electron in the redox reaction is 0.59 V. The equilibrium constant for the redox reaction of the cell is

1) 10^{20} 2) 10^{-10}

3) 10^2 4) 10^{10}

16. For the half cell reaction,

$$2H_2O + 2e^- \rightarrow H_2 + 2OH^-;\ E^0 = -0.8277\ V$$

at 298 K. Autoprotolysis constant of water calculated from this value will be

1) 1×10^{-10} 2) 1×10^{-12}

3) 1×10^{-13} 4) 1×10^{-14}

17. Which of the following are correct?

1) Electrolysis of dilute NaOH solution gives H_2 at cathode and O_2 at the anode

2) Electrolsis of aqueous KF solution gives fluorine at the anode

3) Electrolysis of dilute H_2SO_4 gives O_2 at node

4) All of these

18. Which of the following relationship is/are correct?

1) pH of solution in hydrogen electrode = $+0.0591 \log \frac{1}{[H^+]}$

2) $E^0_{cell} = \frac{0.0591}{n} \log K_c$

3) Cell constant = $\frac{\text{Conductivity}}{\text{Conductance}}$

4) All of these

19. The electrode potential of hydrogen electrode will be maximum if the solution used is

1) 0.1 M HCl 2) 0.1 M H_2SO_4

3) 0.1 M CH_3COOH 4) 0.1 M NaOH

20. For a cell reaciton $Mg|Mg^{2+}(xM)||\ F_2|F^-(yM)$, Pt. The emf will be maximum of x and y respectively are

1) 1M, 1M 2) 1M, 0.01 M

3) 0.01 M, 0.01 M 4) 0.01 M, 1M

21. Unit for a cell constant (G^*) is

1) cm 2) cm^2

3) m^2 4) m^{-1}

22. If the salt bridge is removed from two half cells, of a Galvanic cell, the voltage

1) drop to zero

2) does not change

3) increases gradually

4) cannot be predicted

23. If the molar conductance value of Ca^{2+} and Cl^- at infinite dilution are respectively 118.88×10^{-4} m^2 Ohm^{-1} mol^{-1} and 77.33×10^{-4} m^2 ohm^{-1} mol^{-1}, then that of $CaCl_2$ is (in m^2 ohm^{-1} mol^{-1})

1) 118.88×10^{-4} 2) 154.66×10^{-4}

3) 273.54×10^{-4} 4) 196.21×10^{-4}

24. Three litre of 0.5 M $K_2Cr_2O_7$ solution have to be completely reduced in the acidic medium. The number of faradays of electricity required will be

1) 9F 2) 18 F

3) 3F 4) 12 F

25. 0.25 mole of propane is subjected to combustion. If this reaction is used for making fuel cell, the number of moles of electron involved in each half cell for this amount of propane will be

1) 3 2) 5

3) 2 4) 10

26. In Mg-Al cell, the number of electrons involved in the cell reaction is

1) 15 2) 12

3) 6 4) 10

27. **Statement-I :** Electrolysis of an aqueous solution of KI gives I_2 at the anode but that of KF gives O_2 at the anode and not F_2.

Statement-II : F_2 is more reactive than I_2

1) Both statement-I and II are true

2) Statement-I is true but statement-II is false

3) Statement-I is false but statement-II is false

4) Both statement-I and II are false

28. **Statement-I :** Specific conductivity of an electrolytic solution decreases with dilution where as molar conductivity increases with dilution.

Statement-II : Specific conductivity is the conductance of 1 moles of electrolyte

1) Both statement-I and II are true

2) Statement-I is true but statement-II is false

3) Statement-I is false but statement-II is false

4) Both statement-I and II are false

29. E_1, E_2 and E_3 are the emf values of the three galvanic cell respectively?

i) $Zn|Zn^{2+}(1M)||Cu^{2+}$ (0.1 M)|Cu

ii) $Zn|Zn^{2+}$ (1M)$||Cu^{2+}$ (1M)|Cu

iii) $Zn|Zn^{2+}$ (0.1 M)$||Cu^{2+}$ (1M)|Cu

Which of the following is true?

1) $E_2 > E_3 > E_1$ 2) $E_3 > E_2 > E_1$

3) $E_1 > E_2 > E_3$ 4) $E_1 > E_3 > E_2$

30. The molar conductance at infinite dilution of HCl and NaCl are 426.15 and 126.15 ohm^{-1} cm^2 mol^{-1} respectively. It can be said that the mobility of

1) Cl^- ion is much more than that of H^+ ions

2) Na^+ ion is much more than that of H^+ ions

3) H^+ ion is much more than that of Na^+ ions

4) H^+ is same as that of Na^+ ions

31. What current is to be passed for 0.25 s for deposition of a certain weight of metal which is equal to its electrochemical equivalents?

1) 4A 2) 100 A

3) 8A 4) 2A

32. A curret of 2A passes for 5 hours through a molten metal salt deposits 22.2 g of metal (At. wt. = 177). The oxidation state of metal is

1) +1 2) +2

3) +3 4) +4

33. A certain current liberates 0.504g of hydrogen in 2 hours. How may grams of oxygen can be liberated by the same current in the same time?

1) 2 g 2) 0.4 g

3) 4g 4) 8g

34. **Assertion (A):** Copper liberates H_2 from a dilute solution of HCl

Reason (R) : Hydrogen is below copper in the electrochemical series.

1) Both A and R are correct and R is the correct explanation of A

2) Both A and R are correct and R is the incorrect explanation of A

3) A is correct but R is incorrect

4) Both A and R are false

35. **Assertion (A):** For the Daniell cell, $Zn|Zn^{2+}||Cu^{2+}|Cu$ with E_{cell} = 1.1 V, the application of opposite potential greater than 1.1 V results into flow of electron from cathode to anode.

Reason (R) : Zn is deposited at zinc electrode and Cu is dissolved at copper electrode.

1) Both A and R are correct and R is the correct explanation of A

2) Both A and R are correct and R is the incorrect explanation of A

3) A is correct but R is incorrect

4) Both A and R are false

36. The conductivity of centimolar solution of KCl at 25°C is 0.0630 ohm^{-1} cm^{-1} and the resistance of the cell containing the solution at 25°C is 30 ohm. The value of cell constant is

1) 3.26 cm^{-1} 2) 1.34 cm^{-1}

3) 3.82 cm^{-1} 4) 1.89 cm^{-1}

37. Following limiting molar conductivities are given as

$$\lambda^0_{m(H_2SO_4)} = x\,Scm^2mol^{-1}$$
$$\lambda^0_{m(K_2SO_4)} = y\,Scm^2mol^{-1}$$
$$\lambda^0_{m(CH_3COOK)} = z\,Scm^2mol^{-1}$$
$$\lambda^0_{m(\text{in } Scm^2mol^{-1})} \text{ for } CH_3COOH \text{ will be}$$

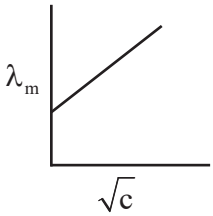
1) x – y + 2z

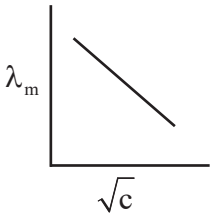
2) x + y –z

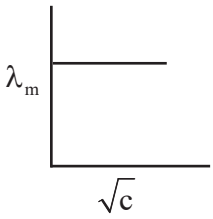
3) x– y + z

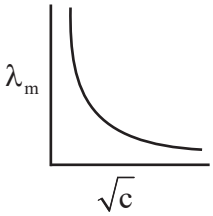
4) $\frac{x-y}{2}+z$

38. For aqueous solution of $CaCl_2$ electrolyte graph between molar conductivity (λ_m) vs $\sqrt{C}$ is

1) 

2) 

3) 

4) 

39. The passage of electricity through certain electrolyte results in the liberation of H_2 gas at the cathode. The electrolyte could be

1) $CuSO_4$ (aq)

2) $AuCl_3$(aq)

3) $AgNO_3$(aq)

4) KNO_3(aq)

40. Which is/are true for standard electrode potentials?

1) E^0 for oxidation is the negative of E^0 for reduction

2) Cell constituents are in their standard state

3) The half cell reaction are written as reduction

4) All are correct

41. The half cell reaction for the corrosion

$$2H^+ + \tfrac{1}{2}O_2 + 2e^- \longrightarrow H_2O,\ E^0 = 1.23\ V$$

$$Fe^{2+} + 2e^- \longrightarrow E_{(s)};\ E^0 = -0.44\ V$$

Find the ΔG^0 (in kJ) for the overall reaction

1) –76 2) –322

3) –161 4) –152

42. When a current of 1.5 ampere is passed through acidulated water for two hours, then the volume of hydrogen (H_2) at NTP produced will be

1) 1.5 L 2) 0.5 L

3) 1.25 L 4) 2.5 L

43. If Zn^{2+}|Zn electrode is diluted 1000 times, then the change in emf is

1) increases by 59 mV

2) decreases by 88.65 mV

3) increases by 886.5 mV

4) decreases by 44.3 mV

44. One faraday of electricity is passed separately through one litre of one molar aqueous solution of $AuCl_3$ and $SnCl_4$. The number of moles of Au and Sn deposited at cathode are respectively

1) 3 and 2 2) 4 and 3

3) 3 and 4 4) 2 and 1

45. The equation representing the process by which standard reduction potential of zinc can be defined in

1) $Zn^{2+}_{(s)} + 2e^- \longrightarrow Zn(s)$

2) $Zn_{(g)} \longrightarrow Zn^{2+}_{(g)} + 2e^-$

3) $Zn^{2+}_{(g)} + 2e^- \longrightarrow Zn_{(s)}$

4) $Zn^{2+}_{(aq)} + 2e^- \longrightarrow Zn(s)$

ANSWER KEY

1.	2	21.	4	41.	4	61.	4	81.	3
2.	2	22.	1	42.	3	62.	4	82.	3
3.	2	23.	3	43.	2	63.	3	83.	2
4.	4	24.	2	44.	3	64.	1	84.	1
5.	4	25.	4	45.	4	65.	2	85.	4
6.	4	26.	2	46.	1	66.	2	86.	1
7.	4	27.	2	47.	3	67.	4	87.	4
8.	2	28.	3	48.	4	68.	3	88.	2
9.	4	29.	4	49.	3	69.	3	89.	2
10.	3	30.	1	50.	1	70.	4	90.	4
11.	3	31.	1	51.	2	71.	4	91.	1
12.	4	32.	1	52.	3	72.	2	92.	4
13.	3	33.	2	53.	3	73.	4	93.	3
14.	4	34.	4	54.	4	74.	3	94.	2
15.	2	35.	4	55.	4	75.	2	95.	3
16.	2	36.	3	56.	2	76.	1	96.	2
17.	3	37.	4	57.	1	77.	3	97.	1
18.	4	38.	4	58.	1	78.	2	98.	1
19.	2	39.	3	59.	4	79.	4	99.	4
20.	1	40.	2	60.	4	80.	2	100.	4

SAMPLE QUESTIONS

1.	4	10.	4	19.	2	28.	2	37.	4
2.	4	11.	4	20.	3	29.	2	38.	2
3.	1	12.	1	21.	4	30.	3	39.	4
4.	2	13.	1	22.	1	31.	1	40.	4
5.	2	14.	1	23.	3	32.	3	41.	2
6.	4	15.	1	24.	1	33.	3	42.	3
7.	1	16.	4	25.	2	34.	4	43.	2
8.	3	17.	3	26.	3	35.	2	44.	2
9.	3	18.	4	27.	1	36.	4	45.	4

WORK BOOK

Chapter 15

CHEMICAL KINETICS

QUESTIONS

RATE OF A CHEMICAL REACTION

1. Which of the following expression is correct for the rate of reaction given below?

$$5Br^- + BrO_3^- + 6H^+ \longrightarrow 3Br_2 + 3H_2O$$

1) $\frac{\Delta[Br^-]}{\Delta t} = \frac{5\Delta[H^+]}{\Delta t}$

2) $\frac{\Delta[Br^-]}{\Delta t} = \frac{6}{5}\frac{\Delta[H^+]}{\Delta t}$

3) $\frac{\Delta[Br^-]}{\Delta t} = \frac{5}{6}\frac{\Delta[H^+]}{\Delta t}$

4) $\frac{\Delta[Br^-]}{\Delta t} = 6\frac{\Delta[H^+]}{\Delta t}$

2. In the following reaction rate of formation of NO is 3×10^{-2} gs^{-1}

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

1) Rate of disappearance of NH_3 is 1.7×10^{-2} gs^{-1}

2) Rate of disappearance of O_2 is 3×10^{-2} gs^{-1}

3) Rate of formation of H_2O is 4.5×10^{-3} gs^{-1}

4) Option 1 and 3 are correct

3. In a reaction 2A→Product concentration of A decreases from 0.5 mol L^{-1} to 1.4 mol L^{-1} in 10 min. Thus average rate is

1) 1×10^{-3}

2) 1×10^{-2}

3) 4×10^{-3}

4) 5×10^{-3}

4. During the decomposition of H_2O_2 to give oxygen, 48 g O_2 is formed per minute at a certain point of time. The rate of formation of water at this point is

1) 0.75 mol min^{-1}

2) 1.5 mol min^{-1}

3) 2.25 mol min^{-1}

4) 3 mol min^{-1}

5. Which of the following will react at the highest rate?

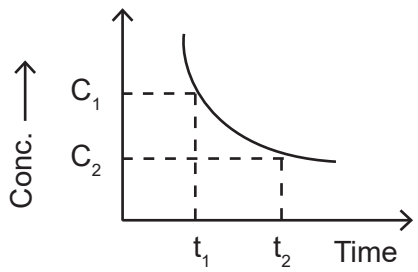
1) 1 mol of A and 1 mol of B in 1L vessel

2) 2 mol of A and 2 mol of B in a 2L vessel

3) 3 mol of A and 3 mol of B in a 3L vessel

4) All would react at the same rate

6. The graph plotted between concentration versus time



1) It gives rate of disapperance of reactant

2) Rate = $-\frac{d[C_2 - C_1]}{t_2 - t_1}$

3) Both 1 and 2

4) It predicts the order of reaction

7. The minus sign in rate = $\frac{-d[A]}{dt}$ indicates the ..... in concentration of the ..... with time. The rate of a reaction is always ..... quantity. The rate of reaction increases with ..... in concentration of reactants. The blanks in questions corresponds to

1) decrease, products, positivie, increase

2) increase, reactants, negative, decrease

3) decrease, reactants, positive, increase

4) increase, products, positive, increase

8. For the gaseous phase reaction

$$CH_3CHO \rightarrow CH_4 + CO$$

$$\frac{-d[CH_3CHO]}{dt} = 1\times10^{-5}[CH_3CHO]^x$$

when $[CH_3CHO]$ = 0.1 M;

$\log\left[\frac{-d[CH_3CHO]}{dt}\right] = -6.5$. Thus x is

1) 1.5 2) –1.5

3) –1 4) +1

9. Which of the following statement is incorrect?

1) Unit of rate of disappearance is Ms^{-1}

2) Unit of rate of reaction is Ms^{-1}

3) Unit of rate constant K depends upon order

4) Unit of K for first order reaction is Ms^{-1}

10. For the reaction $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$, the initial concentration of I^- was 0.20 mol L^{-1} and the concentration after 20min was 0.18 mol. L^{-1}. Then the rate of formation of I_2 in mol. L^{-1} min^{-1} would be

1) 1×10^{-3} 2) 5×10^{-4}

3) 1×10^{-4} 4) 2×10^{-3}

11. Factors affecting rate are

1) concentration 2) surface area

3) temperature 4) all these

12. For the reaction A + 3B →Products. Rate = $\frac{-d[A]}{dt} = K[A]^2[B]$, the expression for the rate of reaction in terms of change in the concentration of B, $\frac{-d[B]}{dt}$ will be

1) $K[A]^2[B]$ 2) $K[A^2]$ [3B]

3) $3K[A]^2$ [B] 4) $\frac{1}{3}K[A]^2[B]$

13. 2A →B + C, it would be a zero order of reaction when

1) The rate of reaction is proportional to square of concentration of A

2) The rate of reaction remains same at any concentration of A

3) The rate remains unchanged at any concentration of B and C

4) The rate of reaction doubles if concentration of B is increased to double

14. For the reaction,

$2NO_{(g)} + 2H_{2(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$, the rate of expression can be written in the following ways

$$\frac{d[N_2]}{dt} = K_1[NO][H_2]; \frac{d[H_2O]}{dt} = K[NO][H_2]$$

$$\frac{-d[NO]}{dt} = K_1'[NO][H_2] \frac{-d[H_2]}{dt} = K_1''[NO][H_2]$$

The relationship between K, K_1, K_1' and K_1'' is

1) $K = K_1 = K_1' = K_1''$

2) $K = 2K_1 = K_1' = K_1''$

3) $K = 2K_1' = K_1 = K_1''$

4) $K = K_1 = K_1' = 2K_1''$

15. For a reaction A + B→Products, the rate of reaction was doubled when concentration of A was doubled, the rate was doubled when concentration of A and B were doubled the order of reaction with respect to A and B are

1) 1, 1 2) 2, 0

3) 1, 0 4) 0, 1

ORDER AND MOLECULARITY

16. Identify the incorrect statement from the following

1) Molecularity of a third order elementary reaction is three

2) Molecularity is applicable only for elementary reactions

3) Order of a reaction cannot be a fraction

4) Reactions with molecularity greater than three are very rare and slow to proceed

17. A reaction involves two reactants. The rate of reaction is directly proportional to the concentration of one of them and inversely proportional to the concentraiton of the other. The overall order of the reaction will be

1) One 2) Two

3) Zero 4) None of these

18. **Assertion** : The rate of a reaction always depends upon the concentration of the reactants only.

Reason : The order of a reaction cannot be negative with respect to a substance present in the reaction.

1) Both assertion and reason are true and reason is the correct explanation of assertion

2) Both assertion and reason are true and reason is not the correct explanation of assertion

3) Assertion is true but reason is false

4) Both assertion and reason are false

19. The rate constant of a reaction is 2.1×10^{-2} mol^{-2} $litre^2$ min^{-1}. The order of reaction is

1) zero 2) 1

3) 2 4) 3

20. An elementary reaction between A and B is second order reaction which of the following rate equation must be correct?

1) $r = K[A]^2 [B]^0$

2) $r = K[A]^0 [B]^2$

3) $r = K[A]^2 [B]$

4) $r = K[A] [B]$

21. **Assertion** : For the reaction RCl + NaOH(aq) →ROH + NaCl, which flows S_n2 mechanism the rate of reaction is reduced to half on reducing the concentration of RCl to half.

Reason : The rate of reaction is represented by K[RCl] ie, it is a first order reaction

1) Both assertion and reason are true and reason is the correct explanation of assertion

2) Both assertion and reason are true and reason is not the correct explanation of assertion

3) Assertion is true but reason is false

4) Both assertion and reason are false

22. The inversion of cane sugar represented by $C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$ is a ..... reaction

1) unimolecular

2) second order

3) zero order

4) first order

23. How will the rate R = k[SO_2][O_2] of reaction, $2SO_2 + O_2 \rightarrow 2SO_3$, change if the volume of the reaction vessel is tripled?

1) It will be $\frac{1}{3}^{rd}$ of its initial value

2) It will be 3 times of its initial value

3) It will be 9 times of its initial value

4) It will be $\frac{1}{9}^{th}$ of its initial value

24. In pseudounimolecular reactions,

1) both the reactants are present in low concentration

2) both the reactants are present in same concentration

3) one of the reactant is present in excess

4) one of the reactant is non-reactive

25. Consider the following reactions

1) $H_2 + Cl_2 \xrightarrow{\text{sunlight}} 2HCl$

2) $H_2 + Br_2 \longrightarrow 2HBr$

3) $H_2 + I_2 \longrightarrow 2HI$

The order of the reaction is

1) 2, 1, 0 2) 0, 3/2, 2

3) 1, 2, 2 4) 2, 1, 1

26. The reaction, A_2 and B_2 follows the equation $A_2 + B_2 \longrightarrow 2AB$. The following data were observed

$[A_2]_0$	$[B_2]_0$	Initial rate of appearance of AB
0.1	0.1	2.5×10^{-4}
0.2	0.1	5×10^{-4}
0.2	0.2	10×10^{-4}

The value of rate constant for the above reaction is

1) 2.5×10^{-4} 2) 2.5×10^{-2}

3) 1.25×10^{-2} 4) None of these

27. The order and molecularity of the reaction step, $Cl_2 \xrightarrow{h\upsilon} 2Cl$ of the chain reaction

1) 2, 0 2) 0, 1

3) 1, 1 4) 3, 0

28. The units of rate of reaction and rate constant are same for a :

1) zero order reaction

2) first order reaction

3) second order reaction

4) third order reaction

29. The mechanism of the reaction : $Nu^- + R-X \rightarrow R-Nu + X^-$ is

$Nu^- + R-X \rightarrow$ [Transition state] (slow)

[Transition state] $\rightarrow Nu-R+X^-$ (fast)

The rate of reaction can be increased by

1) increasing the concentration of Nu^- only

2) increasing the concentration of R–X only

3) Increasing the concentrations of both Nu^- and R–X

4) decreasing the concentration of both Nu^- and R–X

30. For the reaction A→B, when concentration of A is made 1.5 times, the rate of reaction becomes 1.837 times. The order of reaction is (log 1.837 = 0.264, log 1.5 = 0.176)

1) 1 2) 1.5

3) 2 4) 2.5

31. The rate of reaction 2X + Y → Products, is given by, $-\frac{dY}{dt} = k[X]^2[Y]$, if X is present in large excess, the order of the reaction is

1) 0 2) 2

3) 1 4) 3

32. The value of rate constant of a pseudo first order reaction .....

1) depends on the concentration of reactants present in small amount

2) depends on the concentration of reactants present in excess

3) is independent of the concentration of reactants

4) depends only on temperature

33. The reaction $2NO+Br_2 \rightarrow 2NOBr$, obeys following mechanism $(i)\ NO + Br_2 \rightleftharpoons NOBr_2$; (fast)

$(ii)\ NOBr_2 + NO \xrightarrow{slow} 2NOBr$. The correct rate expression ?

1) rate=K[NOBr] [NO] 2) rate=K$[NO]^2$ $[Br_2]$

3) rate=K[NO] $[Br_2]$ 4) rate=K$[NOBr_2]^2$ [NO]

34. Alkaline hydrolysis of an ester is :

1) Bimolecular and first order

2) Zero molecular and second order

3) Bimolecular and third order

4) Bimolecular and second order

35. Order can be

1) fractional 2) –ve

3) whole number 4) all of these

36. In a multistep reaction, the overall rate of reaction is

1) equal to the rate of slowest step

2) equal to the rate of fastest step

3) equal to the average rate of various steps

4) equal to the rate of the last step

37. **Statement I** : Reactions with molecularity more than 3 are very rare.

Statement II : A reaction occuring in many steps have an overall molecularity.

1) Both Statement I and Statement II are correct

2) Both Statement I and Statement II are incorrect

3) Statement I is correct and Statement II is incorrect

4) Statement I is incorrect and Statement II is correct

38. Match the items of Column I and Column II.

Column-I		Column-II	
A	Mathematical expression for rate of reaction	1	Rate constant
B	Rate of reaction for zero order reaction is equal to	2	Rate law
C	Units of rate constant for zero order reaction is same as that of	3	Order of slowest step
D	Order of a complex reaction is determined by	4	Rate of reaction

1) A→2, B→1, C→4, D→3

2) A→2, B→1, C→3, D→4

3) A→1, B→2, C→4, D→3

4) A→3, B→1, C→3, D→4

39. Which is not an example of zero order reaction?

1) $2NH_3 \xrightarrow{Pt} N_2 + 3H_2$

2) $N_2O \xrightarrow{Pt} N_2 + \frac{1}{2}O_2$

3) $2HI \xrightarrow{Au} H_2 + I_2$

4) $H_2O_{(aq)} + 2I^-_{aq} + 2H^+ \rightarrow 2H_2O_{(\ell)} + I^-_3$

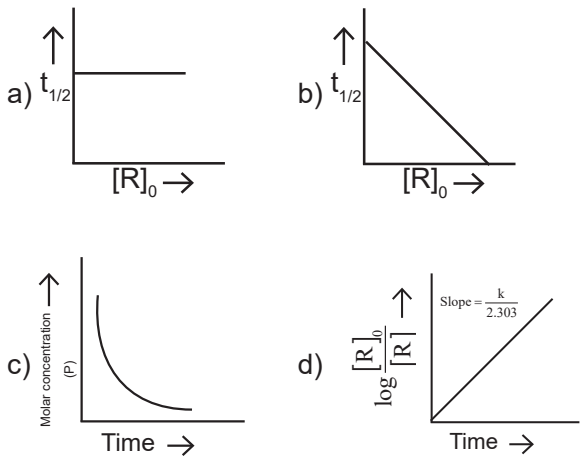
INTEGRATED RATE EXPRESSION

40. For the first order reaction, the plot of log C against t gives a straight line with slope equal to

1) $\frac{K}{2.303}$ 2) $\frac{-K}{2.303}$

3) $\frac{\ln K}{2.303}$ 4) –K

41. Which of the following graphs are correct for a first order reaction R→P?



1) a and c only 2) a and d only

3) a, c and d only 4) b,c and d only

42. In a first order reaction the amount of reactant decayed in three half lives (let a be its initial amount)

1) 7a/8 2) a/8

3) a/6 4) 5a/6

43. The rate constant for a reaction is $\frac{\ln 2}{10}\text{min}^{-1}$.

What will be the order of reaction and time taken to change concentration from 1M to 0.25 M

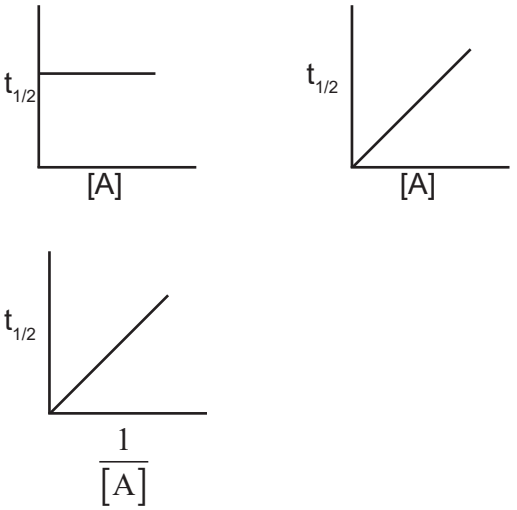
1) one, 10 min

2) zero, 10 min

3) one, 20 min

4) two , 20 min

44. Consider the plots given below, for the type of reaction nA →B + C



These plots respectively corresponds to the reaction orders

1) 0, 1, 2

2) 1, 2, 0

3) 1, 0, 2

4) None of these

45. In the first order reaction, the concentration of reactants is reduced to 25% in one hour. The half life period of the reaction is

1) 2 hr 2) 4 hr

3) 0.5 hr 4) 0.25 hr

46. For the irreversible proces, A + B →P, the rate is first order wrt A and second order w.r.t B. If 1 mol each of A and B introduced into a 1L vessel, and the initial rate was 1×10^{-2} mol L^{-1} s^{-1}, rate when half reactants have been turned into products is

1) 1.25×10^{-3} mol L^{-1} s^{-1}

2) 1×10^{-2} mol L^{-1} s^{-1}

3) 2.5×10^{-3} mol L^{-1} s^{-1}

4) 2×10^{-2} mol L^{-1} s^{-1}

47. Two substance A ($t_{½}$ = 5 min) and B ($t_{½}$ = 15 min) are taken in such a way that initially [A] = 4[B]. The time after which both the concentrations will be equal. (Assume the reaction is first order)

1) 5 min

2) 15 min

3) 20 min

4) concentration can never be equal

48. The pressure of a gas decomposing at the surface of a solid catalyst has been measured at different times and the results are given below

t/second	0	100	200	300
Pressure/Pa	4×10^3	3.5×10^3	3×10^3	2.5×10^3

Find the order, rate constant and half life period?

1) 0, 5, 400

2) 0, 400, 5

3) 0, 5, 200

4) 0, 200, 5

49. Predict the rate law using the given information for the reaction A + B→C

Experiment	[A]	[B]	Initial Rate
1	0.012	0.035	0.10
2	0.024	0.035	0.80
3	0.012	0.070	0.10
4	0.024	0.70	0.80

1) $r = K[B]^3$ 2) $r = K[A]^3$

3) $r = K[A][B]^4$ 4) $r = K[A]^2 [B]^2$

50. The decomposition of a substance 'R' takes place according to first order kinetics. Its initial concentration is reduced to $\frac{1}{8}^{th}$ in 24 s. The rate constant of the reaction is

1) $\frac{1}{24}s^{-1}$ 2) $\frac{0.69}{16}s^{-1}$

3) $\frac{\ln 2}{8}s^{-1}$ 4) $\frac{1}{8}s^{-1}$

51. At 500 K, the half life period of a gaseous reaction at the initial pressure of 80 Kpa is 350 sec. When the pressure is 40 Kpa, the half life period is 175 sec. The order of the reaction is

1) 0 2) 1

3) 2 4) 3

52. A substance 'A' decomposes in solution following the first order kinetics. Flask I contains 1L of 1M solution of A and flask II contains 100 mL of 0.6 M solution. After 8 hr, the concentration of A is flask I becomes 0.25 M. What will be the time for concentration of A in flask II to become 0.3 M?

1) 0.4 hr

2) 2.4 hr

3) 4 hr

4) Unpredictable as rate constant is not given

53. For a first order reaction, to obtain positive slope, we need to plot (where [A] is the concentration of reactant A)

1) $-\log_{10}[A]$ vs log t 2) $-\log_e[A]$ vs t

3) $\log_{10}[A]$ vs log t 4) [A] vs t

54. The decomposition of dinitrogen peroxide (N_2O_5) follows first order rate law. What will be the rate constant from the given data?

At t = 800 s $[N_2O_5] = 1.45$ mol L^{-1}

At t = 1600 s $[N_2O_5] = 0.88$ mol L^{-1}

1) 3.12×10^{-4} s^{-1} 2) 6.24×10^{-4} s^{-1}

3) 2.84×10^{-4} s^{-1} 4) 8.14×10^{-4} s^{-1}

55. Half-life of a reaction is found to be inversely proportional to the cube of initial concentration . The order of the reaction is

1) 4 2) 3

3) 5 4) 2

56. The half life of a second order process, 2A→Products, is

1) Independent of initial concentration

2) Directly proprotional to initial concentration of A

3) Inversely proportional to initial concentration of A

4) Inversely proportional to square of initial concentration

57. A sample of a radioactive substance undergoes 80% decomposition in 345 minutes. Its half life is ..... minutes

1) $\frac{\ln 2}{\ln 5} \times 345$ 2) $\frac{\ln 5}{\ln 2} \times 345$

3) $\frac{\ln 5}{\ln 4} \times 345$ 4) $\frac{\ln 4}{\ln 5} \times 345$

58. Half life for radioactive ^{14}C is 5760 years. In how many years 200 mg of ^{14}C will be reduced to 25mg?

1) 17280 years 2) 23040 years

3) 5760 years 4) 11520 years

59. Under the same reaction conditions, initial concentration 1.386 mol dm^{-3} of a substance becomes half in 40 seconds and 20 seconds through first order and zero order kinetics respectively. Ratio $\left(\frac{k_1}{k_0}\right)$ of the rate constant for first order (k_1) and zero order (k_0) of the reaction is

1) 0.5 mol^{-1} dm^3 2) 1 mol dm^{-3}

3) 1.5 mol dm^{-3} 4) 2 mol^{-1} dm^{-3}

60. During nuclear explosion one of the products is $^{90}_{38}Sr$ with a half life of 28.1 years. If 1μg of $^{90}_{38}Sr$ was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 84.3 years?

1) 0.250 μg 2) 0.875 μg

3) 0.125 μg 4) 0.750 μg

61. In the following consecutive reactions:

$$A \xrightarrow{K=2\times10^{-4}\,min^{-1}} B \xrightarrow{K=6\times10^{-6}\,min^{-1}} C \xrightarrow{K=3\times10^{-3}\,min^{-1}} D$$

Which of the following steps is the rate determining step?

1) A→B 2) B→C

3) C→D 4) A→D

62. Which among the following is wrong for first order reaction

1) $t_{99.9\%} = \frac{3}{2} t_{99\%}$ 2) $t_{99.9\%} = 10\ t_{1/2}$

3) $t_{99.9\%} = 3t_{90\%}$ 4) $t_{96.875\%} = 6t_{1/2}$

63. A radioactive element gets spilled over the floor of a room. Its half life period is 30 days. If the initial activity is ten times the permissible value, after how many days will it be safe to enter the room?

1) 100 days 2) 1000 days

3) 300 days 4) 10 days

64. The half life period of a gaseous substance undergoing thermal decomposition was measured for various initial pressure 'p' with the following result.

p (mm)	250	300	400	450
$t_{1/2}$(min)	136	112.5	85	75.5

The order of the reaction is :

1) 1 2) 2

3) 1/2 4) 3

65. Thermal decomposition of a compound is of first order. If 50% of a sample of the compound is decomposed in 120 minute, show how long will it take for 90% of the compound to decompose?

1) 396 min 2) 810 min

3) 250 min 4) 120 min

66. Calculate the half-life of the first-order reaction $C_2H_4O_{(g)} \rightarrow CH_{4(g)} + CO_{(g)}$ if the initial pressure of $C_2H_4O(g)$ is 80 mm and the total pressure at the end of 20 minutes is 120 mm

1) 40 min 2) 120 min

3) 20 min 4) 80 min

67. For a first order reaction A→Product, which of the following is not correct?

1) the integrated rate expression is $\frac{1}{[A]} - \frac{1}{[A]_o} = kt$

2) the unit of rate constant is s^{-1}

3) the reaction in principle is never completed

4) the half-life is 0.693/k

68. For any reaction A + B $\rightarrow$C+D; Rate law obtained as Rate = k[A] [B]. Select the correct option

1) Reaction must be elementary

2) Reaction must be complex

3) Reaction may be elementary or complex

4) None of these

69. Half life of a first order and a zero order reactions are same. Then the ratio of the initial rate of the first order reaction to that of zero order reaction (Both reactants have same initial concentration).

1) $\frac{1}{0.693}$ 2) 2 × 0.693

3) 0.693 4) $\frac{2}{0.693}$

70. For a reaction, it is observed that $t_{15/16} = 4 \times t_{1/2}$

What is the order of the reaction?

1) 0 2) 1

3) 2 4) 3

71. For a zero order reaction, time required to complete 10% of reaction is 20 minute. Find the time required to complete the reaction upto 60%

1) 100 min 2) 120 min

3) 140 min 4) 160 min

72. For a first order reaction, the time required for 99.9% of the reaction to take place is nearly

1) 10 times that required for half of the reaction

2) 100 times that required for two-thirds of the reaction

3) 10 times that required for one-fourth of the reaction

4) 20 times that required for half of the reaction

EFFECT OF TEMPERATURE & COLLISION THEORY

73. The rate constant, activation energy and the frequency factor of a chemical reaction at 25°C are 3×10^{-4} s^{-1}, 104.4 $kJmol^{-1}$ and 6×10^{14} s^{-1} respectively. The value of rate constant as $T \rightarrow \infty$ is

1) 2×10^{18} s^{-1} 2) 6×10^{14} s^{-1}

3) ∞ 4) 3.6×10^{30} s^{-1}

74. A chemical reaction was carried out at 300 K and 280 K. The rate constants were found to be k_1 and k_2 respectively. Then

1) $k_2 = 4k_1$ 2) $k_2 = 2k_1$

3) $k_2 = 0.25\ k_1$ 4) $k_2 = 0.5\ k_1$

75. The rate constant k_1 and k_2 for two different reactions are $10^{16}\ e^{-2000/T}$ and $10^{15}\ e^{-1000/T}$ respectively. The temperawture at which $k_1 = k_2$ is

1) 1000 K 2) $\frac{2000}{2.303}$K

3) 2000 K 4) $\frac{1000}{2.303}$K

76. The first order rate constant k is related to temperature as $\log k = 15 - \frac{10^6}{T}$. Which of the following pair of values is correct?

1) A = 10^{15} and E = 1.9×10^4 kJ

2) A = 10^{-15} and E = 40 kJ

3) A = 10^{15} and E = 40 kJ

4) A = 10^{-15} and E = 1.9×10^4 kJ

77. The slope of the plot of log k vs $\frac{1}{T}$ for a certain reaction was found to be -5.4×10^3. Calculate the energy of activation of the reaction?

1) 30.5 cal mol^{-1} 2) 50 cal mol^{-1}

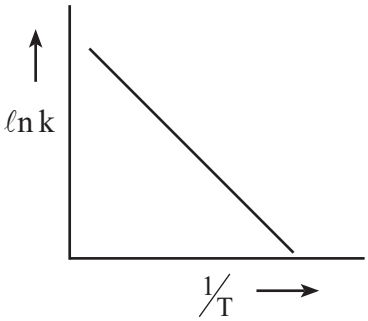
3) 24.6 cal mo^{-1} 4) 15.5 cal mol^{-1}

78. Temperature coefficient of a reaction is 3. How many times the rate of reaction would increase if temperature is raised by 30 K

1) 3 2) 9

3) 27 4) 81

79. The temperature dependence of reaction rate is represented by the Arrhenius equation. Which of the following is wrong about the plot shown below? (k = rate constant)



1) intercept of the line = ln A, where A is the frequency factor

2) Slope of the line = $\frac{E_a}{R}$. Where E_a is the activation energy

3) Reaction with high activation energy is more temperature sensitive than that of low activation energy

4) Large slope of the line corresponds to small activation energy

80. The dependence of the rate constant for a reaction on temperature is given by the equation $k = Ae^{-E_a/RT}$. Under what conditions is the rate constant k the smallest?

1) High T and large E_a

2) High T and small E_a

3) Low T and large E_a

4) Low T and small E_a

81. An exothermic reaction A→B has an activation energy of 17 kJ/mole of A. The heat of reaction is –40 kJ/mol. The activation energy for the reverse reaction B→A is

1) 75 kJ/mol 2) 67 kJ/mol

3) 57 kJ/mol 4) 17 kJ/mol

82. The temperature coefficient of a reaction is :

1) The rate constant

2) The rate constant at a fixed temperature

3) The ratio of rate constant at two temperature

4) The ratio of rate constants differing by 10°C preferably k_{308}/k_{298}

83. Which of the following statement is correct?

1) Saponification of ester is a first order reaction

2) Acid hydrolysis of an ester is first order with respect to H^+ and first order with respect to ester

3) An elementary step has an order equal to its molecularity

4) The order of a reaction is never greater than two

84. In the upper atmosphere H_2O and O react bimolecularly to form two OH radicals. ΔH for this reaction is 72 kJ at 50 K, and Ea is 77 kJ/mol. Then Ea for the bimolecular recombination of two OH radicals to form H_2O and O is

1) 3 kJ

2) 4 kJ

3) 5 kJ

4) 149 kJ

85. The rate of reaction doubles when its temperature changes from 300K to 310K. Activation energy of such a reaction will be : (R = 8.314Jk^{-1} mol^{-1} and log 2=0.301)

1) 53.6 kJmol^{-1}

2) 88.6 kJmol^{1}

3) 78.5 kJmol^{-1}

4) 20.5 kJmol^{-1}

86. The activation energies of two reactions are Ea_1 and Ea_2 with $Ea_1 > Ea_2$. If the temperature of the systems is increased from T_1 to T_2, the rate constant of the reactions changes from k_1 to k_1' in the first reaction and k_2 to k_2' in the second reaction. Predict which of the following expression is correct?

1) $\frac{k_1'}{k_1} = \frac{k_2'}{k_2}$ 2) $\frac{k_1'}{k_1} > \frac{k_2'}{k_2}$

3) $\frac{k_1'}{k_1} < \frac{k_2'}{k_2}$ 4) $\frac{k_1'}{k_1} < 2\frac{k_2'}{k_2}$

87. Which of the following is not a correct form of Arrehenius equation?

1) $k = Ae^{-Ea/RT}$

2) $\ell nk = \ell nA - \frac{Ea}{RT}$

3) $k=Ae^{Ea/RT}$

4) $\log k = \log A - \frac{Ea}{2.303\ RT}$

88. How enzymes increases the rate of reactions?

1) By lowering activation energy

2) By increasing activation energy

3) By changing equilibrium constant

4) By forming enzyme substrate complex

89. The chemical reactions in which the reactants require high amount of activation energy are generally

1) slow 2) fast

3) instantaneous 4) spontaneous

90. Which of the following is not correct about catalyst?

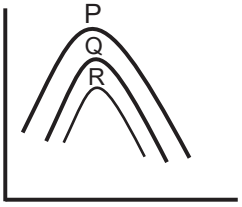
1) Catalyst alters activation energy

2) It can catalyse both spontaneous and nonspontaneous reactions

3) It doesn't change equilibrium constant

4) A small amount of catalyst can catalyse a large amount of reactants.

91. If a homogenous catalytic reaction can take place through three alternative paths as given below, the catalytic efficiency of P. Q. R is



1) P > Q > R 2) Q > P > R

3) R > Q > P 4) P > R > Q

92. **Assertion (A):** The enthalpy of reaction remains constant in the presence of a catalyst

Reason (R) : A catalyst participating in the reaction, forms different activated complex and lowers down the activation energy but the difference in energy of reactant and product remains the same. Choose the correct option

1) Both A and R are correct but R is the correct explanation of A

2) Both A and R are correct but R is not the correct explanation of A

3) A is correct but R is incorrect

4) A is incorrect but R is correct

93. Which of the following factors are responsible for the increase in the rate of a surface catalysed reaction?

a) A catalyst provides proper orientation for the reactant molecules to react

b) Heat of adsorption of reactants on a catalyst helps reactant molecules to overcome activation energy

c) The catalyst increases the activation energy of the reaction

1) a and c 2) a and b

3) b and c 4) a, b and c

94. Which of the following statements about catalyst is true?

1) A catalyst makes the reaction feasible by making ΔG more negative

2) A catalyst makes equilibrium constant more favourable for forward reaction

3) A catalyst accelerate rate of reaction by bringing down the activation energy

4) A catalyst accelerate rate of reaction by increasing the activation energy.

95. Consider the endothermic reaction X→Y with the activation energies E_b and E_f for backward and forward reactions, respectively. In general

1) $E_b < E_f$ 2) $E_b > E_f$

3) $E_b = E_f$

4) there is no definite relation between E_f and E_b

96. **Assertion:** All collision of reactant molecules lead to product formation.

Reason: Only those collisions in which molecules have correct orientation and sufficient kinetic energy lead to compound formation.

1) Both assertion and reason are correct and the reason is correct explanation of assertion.

2) Both assertion and reason are correct, but reason does not explain assertion.

3) Assertion is correct, but reason is incorrect.

4) Assertion is incorrect, but reason is correct.

97. The minimum amount of energy required by the reactant molecules at the time of collision in order to produce effective collision is called :

1) threshold energy

2) activation energy

3) internal energy

4) potential energy

98. Identify the wrong statement regarding the collision theory of chemical reactions from the following

1) it considers atoms/molecules as hard spheres and ignores their structural aspects

2) All collisions do not lead to the formation of products

3) Activation energy and proper orientation of molecules together determine the rate of a chemical reaction

4) For a reaction A + B → Product, Rate = $PZ_{AB}e^{E_a/RT}$, where P is the steric factor and Z_{AB} is the collision frequency

99. The rate constant is given by the equation $K = PZe^{-E_a/RT}$. Which factor should register a decrease for the reaction to proceed more rapidly

1) T

2) Z

3) E_a

4) P

100. For a certain reaction large fraction of molecules has energy more than the threshold energy, still the rate of reaction is very slow. The possible reason for this could be

1) the colliding molecules could be larger in size

2) the colliding molecules must not be properly oriented for effective collisions

3) the rate of reaction could be independent of the energy

4) one of the reactants could be in excess

SAMPLE QUESTIONS

1. For a first order reaction A→B, the reaction rate at concentration of 0.01 M is found to be 2×10^{-5} mol L^{-1} s^{-1}. The halfe life period of reaction is

1) 30 s
2) 220 s
3) 300 s
4) 347 s

2. For the reaction, $2A + B \rightarrow 3C + D$, which of the following does not express the reaction rate?

1) $\frac{-d[A]}{2dt}$

2) $\frac{-d[C]}{3dt}$

3) $\frac{-d[B]}{dt}$

4) $\frac{d[D]}{dt}$

3. Which is the activation energy for a reaction if the rate is doubled, when the temperature is raised from 20°C to 35°C

(R = 8.314 J mol^{-1} K^{-1})

1) 151 $kJmol^{-1}$

2) 342 $kJmol^{-1}$

3) 269 $kJmol^{-1}$

4) 34.7 $kJmol^{-1}$

4. The half life period of a reaction is halved as the initial concentration of the reactant is doubled. The order of reaction is

1) 0.5
2) 1
3) 2
4) 0

5. A plot of lnk vs $\frac{1}{T}$ for a reaction gives the slope -1×10^4 K. The energy of activation of the reaction is (Given R = 8.314 JK^{-1} mol^{-1})

1) 8314 $Jmol^{-1}$

2) 1.202 kJ mol^{-1}

3) 12.02 J mol^{-1}

4) 83.14 kJ mol^{-1}

6. $X \xrightarrow{\text{Step I}} Y \xrightarrow{\text{Step II}} Z$ is a complex reaction.

Total order of reaction is 2 and step II is the slowest step. What is the molecularity of step II?

1) 1
2) 3
3) 2
4) 4

7. The plot of $t_{1/2}$ vs $[R_0]$ for a reaction is straight line parallel to x-axis. The unit of rate constants for the reaction is

1) mol L^{-1} s

2) mol L^{-1} s^{-1}

3) L mol^{-1} s^{-1}

4) s^{-1}

8. Decomposition of H_2O_2 follows first order reaction. In fifty minutes the concentration of H_2O_2 decreases from 0.5 M to 0.125 M in one such decomposition when the concentration of H_2O_2 reaches 0.05 M, the rate of formation of O_2 will be

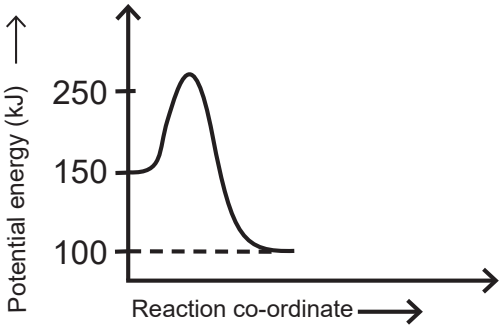
1) 6.93×10^{-2} mol min^{-1}

2) 6.93×10^{-4} mol L^{-1} min^{-1}

3) 2.66 L min^{-1} at STP

4) 1.34×10^{-2} mol min^{-1}

9. Based upon the curve for a chemical reaction given, match the entries in column-I with those in column-II and find the correct match



	Column-I		Column-II
P	Activation energy	1	250 kJ
Q	Threshold energy	2	150 kJ
R	Enthalpy change	3	100 kJ
S	Activation energy for backward reaction	4	50 kJ

1) P→3; Q→4; R→2; S→1

2) P→3; Q→2; R→4; S→1

3) P→3; Q→1; R→4; S→2

4) P→2; Q→4; R→3; S→1

10. A gaseous hypothetical chemical equation $2A \rightleftharpoons 4B + C$ is carried out in a closed vessel. The concentration of B is found to increase by 5×10^{-3} mol L^{-1} in 10 second. The rate of appearance of B is

1) 5×10^{-4} mol L^{-1} s^{-1}

2) 5×10^{-5} mol L^{-1} sec^{-1}

3) 6×10^{-5} mol L^{-1} s^{-1}

4) 4×10^{-4} mol L^{-1} sec^{-1}

11. Velocity constant of a reaction at 290 K was found to be 3.2×10^{-3}. At 310 K it will be about

1) 1.28×10^{-2} 2) 9.6×10^{-3}

3) 6.4×10^{-3} 4) 3.2×10^{-4}

12. A substance with initial concentraiton of 'a' mol dm^{-3} react according to zero order kinetics. The time it takes for the completion of the reaction is (K = rate constant)

1) K/a 2) a/2K

3) a/K 4) 2K/a

13. The rate constant for a first order reaction is 6.909 min^{-1}. Therefore, the time required in minutes for the participation of 75% of the initial reactant is ?

1) $\frac{2}{3}\log 2$

2) $\frac{2}{3}\log 4$

3) $\frac{3}{2}\log 2$

4) $\frac{3}{2}\log 4$

14. The rate constant k, for the reaction

$N_2O_{5(g)} \rightarrow 2NO_{2(g)} + \frac{1}{2}O_{2(g)}$ is 2.3×10^{-2} s^{-1}.

Which equation given below describes the changes of $[N_2O_5]$ with time?

1) $[N_2O_5]_t = [N_2O_5]_O + Kt$

2) $[N_2O_5]_o = [N_2O_5]_t + e^{Kt}$

3) $\log_{10}[N_2O_5]_t = \log_{10}[N_2O_5]_0 - Kt$

4) $\ln\frac{[N_2O_5]_0}{[N_2O_5]_t} = Kt$

15. The alkaline hydrolysis of ethyl acetate is represented by the equation

$CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$. Experimentally it is found that rate for the reaction is $\frac{dx}{dt} = K[CH_3COOC_2H_5][NaOH]$

Then the reaction is

1) Bimolecular and first order

2) Bimoleular and second order

3) Pseudo bimolecular

4) Pseudo unimolecular

16. Diazonium salt decomposes as

$C_6H_5N_2^+ + Cl^- \longrightarrow C_6H_5Cl + N_2$. At 0°C, the evolution of N_2 becomes two times faster when the initial concentration of the salt is doubled. Therefore it is

1) a first order reaction w.r.t. salt

2) second order w.r.t. salt

3) independent of initial concentration of the salt

4) zero order w.r.t. salt

17. **Assertion:** Molecularity has no meaning for a complex reaction

Reason: The overall order of a complex reaction is equal to the molecularity of the slowest step

1) A and R are true and R is the correct explanation of A

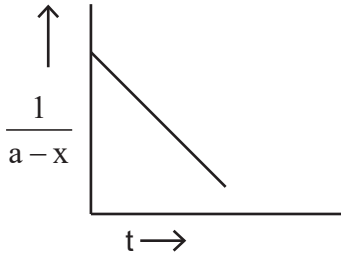
2) A and R are true and R is not the correct explanation of A

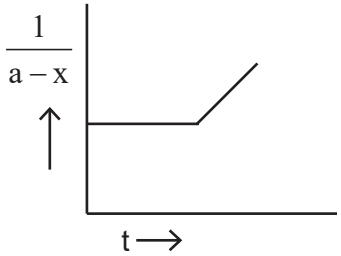
3) A and R are wrong

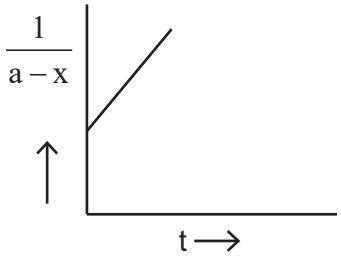
4) Assertion is false but reason is correct

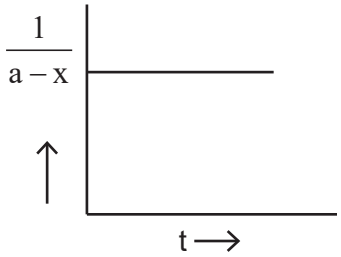
18. For the reaction A→Product

$k = \frac{1}{t}\left[\frac{1}{a-x} - \frac{1}{a}\right]$ where k is rate constant (in $mol^{-1} s^{-1}$) a and (a – x) are the concentration of A at the start and after time interval t sec. A graph between $\frac{1}{a-x}$ and time t is of the following:-

1) 

2) 

3) 

4) 

19. The rate constant, activation energy and the Arrhenius parameter of a chemical reaction at 25°C are 3×10^{-4} s^{-1}, 104.4 $kJmol^{-1}$ and 6×10^{14} s^{-1} respectively. The value of rate constant as $T \rightarrow \infty$ is

1) 2×10^{18} s^{-1}
2) 6×10^{14} s^{-1}
3) Infinity
4) 3.6×10^{30} s^{-1}

20. A zero order reaction A→Product, with an initial concentration $[A_0]$ has a half life of 0.2 s. If one starts with the concentration of $2[A_0]$ then half life is

1) 0.1 s
2) 0.4 s
3) 0.2 s
4) 0.8 s

21. In Pseudo-order reactions

1) The actual order of reaction is different from that expected using rate law expression

2) The concentration of atleast one reactant is taken in large excess

3) The concentration of reactant taken in excess may be taken as constant

4) All of these

22. In Arrhenius equation for a certain reaction the value of A and E_a are 4×10^{13} sec^{-1} and 98.6 kJ mol^{-1} respectively. At what temperature, the reaction will have specific rate constant 1.1×10^{-3} sec^{-1}? (log 1.1 = 0.041)

1) 250 K
2) 310 K
3) 400 K
4) 450 K

23. For a reaction $E_a = 0$ and $K = 3.2 \times 10^4$ s^{-1} at 300 K. The value of K at 310 K would be

1) 64×10^4 s^{-1}

2) 3.2×10^4 s^{-1}

3) 3.2×10^8 s^{-1}

4) 32×10^5 s^{-1}

24. The rate of a gaseous reaction is given by the expression $k[A]^2[B]^3$. The volume of the reaction vessel is suddenly reduced to one half of the initial volume. The reaction rate relative to initial rate will be

1) $\frac{1}{24}$
2) $\frac{1}{32}$
3) 32
4) 24

25. Inversion of cane sugar in dilute acid is

1) Bimolecular reaction

2) Pseudo-unimolecular reaction

3) Unimolecular reaction

4) Trimolecular reaction

26. The bromination of acetone that occurs in acid solution is represented by

$$CH_3COCH_3 + Br_2 \rightarrow CH_3COCH_2Br + H^+ + Br^-.$$

These kinetic data were obtained for given reaction concentrations

Initial concentrations (M)			Initial rate of disappearane of Br_2, Ms^{-1}
$[CH_3COCH_3]$	$[Br_2]$	$[H^+]$	
0.30	0.05	0.05	5.7×10^{-5}
0.30	0.10	0.05	5.7×10^{-5}
0.30	0.10	0.10	1.2×10^{-4}
0.40	0.30	0.20	3.1×10^{-4}

Based on these data, rate equation is

1) Rate = $k[CH_3COCH_3][Br_2][H^+]^2$

2) Rate = $k[CH_3COCH_3]$ $[Br_2]$ $[H^+]$

3) Rate = $k[CH_3COCH_3]$ $[H^+]$

4) Rate = $k[CH_3COCH_3]$ $[Br_2]$

27. The half life period of a first order reaction is 1 min 40 seconds. Calculate its rate constant?

1) 6.93×10^{-3} min^{-1}

2) 6.93×10^{-3} sec^{-1}

3) 6.93×10^{3} min^{-1}

4) 6.93×10^{3} sec^{-1}

28. In hydrogenation reaction at 25°C, it is observed that hydrogen gas pressure falls from 2 atm to 1.2 atm in 50 min. Calculate the rate of reaction in molarity per second?

1) 1.09×10^{-5} 2) 10.9×10^{-5}

3) 2.1×10^{-5} 4) 21×10^{-5}

29. I) E_a = 15 kJ mol^{-1}; ΔH = –70 kJ mol^{-1}

II) E_a = 30 kJ mol^{-1}; ΔH = –15 kJ mol^{-1}

III) E_a = 60 kJ mol^{-1}; ΔH = +20 kJ mol^{-1}

If above reactions are at same frequency factor then fastest and slowest reactions are

1) III is fastest, II is slowest

2) I is fastest, III is slowest

3) II is fastest, III is slowest

4) III is fastest, I is slowest

30. Under the same reaction conditions, initial concentration of 1.386 mol dm^{-3} of a substance becomes half in 40 seconds and 20 seconds through first order and zero order kinetics respectively. Ratio $\left(\frac{K_1}{K_0}\right)$ of the rate constant for first order (K_1) and zero order (K_0) for the reaction is

1) 0.5 mol^{-1} dm^{3} 2) 1 mol^{-1} dm^{-3}

3) 1.5 mol^{-1} dm^{-3} 4) 2 mol^{-1} dm^{3}

31. For $X \rightarrow Y; k = 10^{10}\, e^{-500/T}$ and for $W \rightarrow Z$, $k = 10^{12}\, e^{-1000/T}$ at what temperature 'T' both reactions will have same value of k?

1) 500 K 2) 1500 K

3) $\frac{500}{4.606}$ K 4) $\frac{2.303}{5000}$ K

32. For the reaction

$2H_{2(g)} + 2NO_{(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$, the observed rate expression is rate = $K_f[NO]^2[H_2]$. The rate expression for the reverse reaction is

1) $\frac{K_b[N_2][H_2O]^2}{[H_2]}$ 2) $K_b[N_2][H_2O]$

3) $K_b[N_2][H_2O]^2$ 4) $\frac{K_b[N_2][H_2O]^2}{[NO]}$

33. Higher order (>3) reactions are rare due to

1) Shifting of equilibrium towards reactants due to elastic collisions

2) Loss of active species on collision

3) Low probability of simultaneous collision of all the reacting species

4) Increase in entropy and activation energy as more molecules are involved

34. The half life for the thermal decomposition of acetone is 80 s and is independent of initial concentration of acetone. The time required for the reaction to go to 80% decomposition is (log 2 = 0.30)

1) 186.1 s 2) 206.1 s

3) 1501.1 s 4) 226.1 s

35. In a gaseous reaction, $A_{2(g)} \rightarrow B_{(g)} + \frac{1}{2}C_{(g)}$.

The increase in pressure from 100 mm to 120 mm is noticed in 5 minutes. The rate of disappearance of A_2 in mm min^{-1} is

1) 4 2) 8

3) 16 4) 2

36. For the homogeneous elementary reactions A + B →C, the unit of rate constatn is

1) s^{-1} 2) s^{-1} mol L^{-1}

3) s^{-1} mol^{-1} L 4) s

37. Assuming an elementary reaction, $H_2O_2 + 3I^- + 2H^+ \rightarrow 2H_2O + I_3^-$. The effect on the rate of this reaction brought about by doubling the concentration of I^- without changing the order

1) the rate would increase by a factor of 3

2) the rate would increase by a factor of 8

3) the rate would decrease by a factor of 1/3

4) the rate would increase by a factor of 9

38. **Assertion** : The rate constant of reaction normally increases by a factor of 2-3 for every 10° rise in temperature.

Reason : Increase of temperature increases the number of effective collision.

1) A and R are correct and R is the correct explanation of assertion

2) A and R are correct and R is not the correct explanation of assertion

3) A is correct but R is incorrect

4) A is incorrect but R is correct

39. For a reaction if activation energy of forward and backward reaction are equal then

1) $\Delta H = 0$ 2) $\Delta S = 0$

3) Order = 0 4) $E_a = 0$

40. The value of rate constant of a pseudo first order reaction

1) depends on the concentration of reactants present in small amount

2) depends on concentration of reactants present in excess

3) independent of concentration of reactants

4) Depends only on temperature

41. The time required to decompose SO_2Cl_2 to half of its initial amount is 69.3 minutes. If the decomposition follows first order kinetics then rate constant (in min^{-1}) is

1) 1.2×10^{-2} 2) 10^{-2}

3) 1.5×10^{-2} 4) 10^{2+}

42. The activation energy of the reaction A+B→C+D + 38 Kcal is 20 Kcal. What would be the activation energy of C + D →A + B?

1) 20 kcal 2) 18 kcal

3) 58 kcal 4) 64 kcal

43. For the reaction $xA + yB \rightarrow zC$. If $\frac{-d[A]}{dt} = \frac{-d[B]}{dt} = \frac{1.5d[C]}{dt}$, then x, y and z are

1) 1, 1, 1 2) 3, 2, 3

3) 3, 3, 2 4) 2, 2, 3

44. The rate constant is given by the equation $K = PZe^{-E_a/RT}$. Which factor should register a decrease for the reaction to proceed more rapidly

1) T 2) Z

3) P 4) Ea

45. In pseudo unimolecular reactions

1) both reactants are present in low concentration

2) both reactants are present in same concentration

3) one of the reactant is present in excess

4) one of the reactant is non reactive

ANSWER KEY

1.	3	21.	3	41.	2	61.	2	81.	3
2.	1	22.	4	42.	1	62.	4	82.	4
3.	4	23.	4	43.	3	63.	1	83.	3
4.	4	24.	3	44.	3	64.	2	84.	3
5.	4	25.	2	45.	3	65.	1	85.	1
6.	3	26.	2	46.	1	66.	3	86.	2
7.	3	27.	2	47.	2	67.	1	87.	3
8.	1	28.	1	48.	1	68.	3	88.	1
9.	4	29.	3	49.	2	69.	2	89.	1
10.	2	30.	2	50.	3	70.	2	90.	2
11.	4	31.	3	51.	1	71.	2	91.	3
12.	3	32.	2	52.	3	72.	1	92.	1
13.	2	33.	2	53.	2	73.	2	93.	2
14.	2	34.	4	54.	2	74.	3	94.	3
15.	3	35.	4	55.	1	75.	4	95.	1
16.	3	36.	1	56.	3	76.	1	96.	4
17.	3	37.	3	57.	1	77.	3	97.	1
18.	4	38.	1	58.	1	78.	3	98.	4
19.	4	39.	4	59.	1	79.	4	99.	3
20.	4	40.	1	60.	3	80.	3	100.	2

SAMPLE QUESTIONS

1.	4	10.	1	19.	2	28.	1	37.	2
2.	2	11.	1	20.	2	29.	2	38.	1
3.	4	12.	3	21.	4	30.	1	39.	1
4.	3	13.	1	22.	2	31.	3	40.	2
5.	4	14.	4	23.	2	32.	1	41.	2
6.	3	15.	2	24.	3	33.	3	42.	3
7.	4	16.	1	25.	2	34.	1	43.	3
8.	2	17.	2	26.	3	35.	2	44.	4
9.	3	18.	3	27.	2	36.	3	45.	3

WORK BOOK

Chapter 16

d AND f BLOCK ELEMENTS

QUESTIONS

GENERAL PROPERTIES OF d-BLOCK ELEMENTS

1. The general outer electronic configuration of transition element

1) $(n-1)d^{1-5}$ 2) $(n-1)d^{1-10}ns^{1}$

3) $(n-1)d^{1-10}ns^{1-2}$ 4) $(n-1)d^{0-10}ns^{1-2}$

2. Electronic configuration of a transition element X in +2 oxidation state is $[Ar]3d^5$. What is its atomic number

1) 25 2) 26

3) 27 4) 24

3. Total number of elements which show exceptional electronic configuration excluding 6d series in d block is:

1) 2 2) 7

3) 11 4) 12

4. The number of unpaired electrons in gaseous species of Mn^{3+}, Cr^{3+} and V^{3+} respectively are ——— and most stable species is ———

1) 4, 3, 2 and V^{3+} 2) 3, 3, 2 and Cr^{3+}

3) 3, 4, 2 and Cr^{3+} 4) 4, 3, 2 and Cr^{3+}

5. Which of the following is not the characterisation of transition metal

1) In these elements the outermost penultimate shells are incomplete

2) Pd has configuration $5s^{o}\ 4d^{10}$

3) Show variable oxidation state always differ by one unit

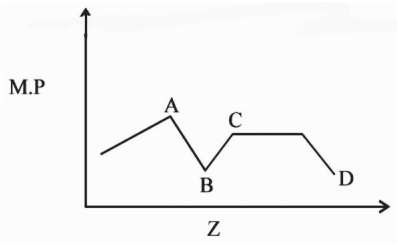
4) Silver is not a transition metal because electronic configuration of Ag^{+} is $5s^{0}4d^{10}$

6. In which of the following elements, the ground state configuration is not according to Auf-bau rule?

1) Ni, Pd, Pt 2) Sc, Ti, Zr

3) Pd, Pt, Cu 4) Fe, Cr, Mn

7. Trends in melting points of transition metals are given as in the following diagram:



A, B, C, D are respectively are:

1) Mn, Fe, Co, Ni 2) Mn, Fe, Co, Zn

3) Cr, Mn, Fe, Cu 4) Cr, Mn, Fe, Zn

8. Elements of which groups will exhibit cubic close packing at normal temperatures:

1) 3, 4, 5 2) 5, 6, 7

3) 7, 8, 9 4) 9, 10, 11

9. Which among the following is incorrect

1) $Mn^{2+} > Fe^{2+} > Co^{2+} > Ni^{2+}$: Ionic size

2) K > Ca > Sc > Ti : Density

3) V < Cr > Mn : Melting point

4) Fe $\simeq$ Co $\simeq$ Ni : Atomic size

10. The lanthanoid contraction is responsible for the fact that

1) Zr and Y have about the same radius

2) Zr and Nb have similar oxidation state

3) Zr and Hf have about the same radius

4) Zr and Zn have the same oxidation state

11. Which of the following transition metal has the lowest density?

1) Copper 2) Nickel

3) Scandium 4) Zinc

12. The highest oxidation state is achieved by which of the following

1) $(n-1)d^5ns^2$ 2) $(n-1)d^5ns^1$

3) $(n-1)d^3ns^2$ 4) $(n-1)d^8ns^2$

13. Which is incorrect regarding the oxidation state of transition elements?

1) Stability : $VF_2 < VF_3 < VF_4 < VF_5$

2) Sc(II) is virtually unknown

3) Ti(IV) is more stable than Ti(III) and Ti(II)

4) Oxidising power : $CrO_3 < MoO_3 < WO_3$

14. Which of the following oxidation state is normally not observed for chromium in aqueous solution

1) +1 2) +2

3) +3 4) +6

15. The nature of Mn_2O_7, V_2O_5 and CrO are respectively

1) Acidic, acidic and basic

2) Basic, amphoteric and acidic

3) Acidic, amphoteric and basic

4) Acidic, basic and amphoteric

16. Following statements are related to the trends in stability of higher oxidation states. The incorrect statement is

1) The higher oxidation state is exhibited in oxoanions, fluorides and oxides

2) Copper(I) compounds are unknown in solution

3) Cu^{2+} oxidise I^- to I_2

4) Oxidising power : $VO_2^+ < Cr_2O_7^{2-} > MnO_4^-$

17. Which of the following is wrong about the stability of particular oxidation state in aqueous solution

1) $Sc^{3+} > Sc^{2+}$

2) $Ti^{4+} > Ti^{3+}$

3) $Fe^{3+} > Fe^{6+}$

4) $Cu^+ > Cu^{2+}$

18. The oxidation state of Cr in $K_2Cr_2O_7$ is:

1) +5 2) +3

3) +6 4) +7

19. Mn^{2+} compounds are more stable than Fe^{2+} compounds towards oxidation to their +3 state, because

1) Mn^{2+} is more stable with high 3rd ionisation energy

2) Mn^{2+} is bigger in size

3) Mn^{2+} has completely filled d-orbitals

4) Mn^{2+} does not exist

20. Which among the following transition metals does not show variable oxidation states

1) Cu 2) Fe

3) Ni 4) Sc

21. **Statement I** : Copper dissolves in dilute nitric acid but not in dilute HCl.

Statement II : Copper has positive E^0 (SRP).

In the light of the statements, choose the most appropriate answer from the options given below.

1) Both statements I and statement II are incorrect

2) Both statement I and statement II are correct

3) Statement I is correct but statement II is incorrect

4) Statement I is incorrect but statement II is correct

22. Match the properties given in Column I with the metals given in Column II.

Column I (Property)		Column II (Metal)	
i)	Element with highest second ionisation enthalpy	a)	V
ii)	Element with highest third ionisation enthalpy	b)	Cr
iii)	M in $M(CO)_6$ is	c)	Cu
iv)	Element with highest heat of atomisation	d)	Zn
		e)	Ni

1) i-c, ii- d, iii-b, iv-a

2) i-a, ii- d, iii-b, iv-c

3) i-d, ii- c, iii-b, iv-a

4) i-d, ii- b, iii-a, iv-c

23. Study the following table. All values are in kJ mol^{-1}

Element	$\Delta_a H$	$\Delta_i H_1 + \Delta_i H_2$	$\Delta_{hyd} H$
Co	427	2397	-2079
Ni	431	2486	-2121
Cu	339	2705	-2121
Zn	130	2638	-2059

The +2 state is least stable for:

1) Co 2) Ni

3) Cu 4) Zn

24. d-d transition is responsible for the colour of:

1) $KMnO_4$ 2) V_2O_5

3) $K_2Cr_2O_7$ 4) $CuSO_4$

25. Identify the metal that forms colourless compounds

1) Iron (Z = 26)

2) Chromium (Z = 24)

3) Vanadium (Z = 23)

4) Scandium (Z = 21)

26. Among the following, the compound that is both paramagnetic and coloured is

1) $K_2Cr_2O_7$ 2) $K_3[Cu(CN)_4]$

3) $(NH_4)_2[TiCl_6]$ 4) $VOSO_4$

27. Which of the following statements is not correct

1) Copper liberates hydrogen from acids

2) In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine

3) Mn^{3+} and Co^{3+} are oxidising agents in aqueous solution

4) Ti^{2+} and Cr^{2+} are reducing agents in aqueous solution

28. One of the following is diamagnetic:

1) Cu 2) Cu^{+}

3) Cu^{2+} 4) Both 1 & 3

29. Arrange the following ions in order of their magnetic moment

i) V^{4+}

ii) Mn^{4+}

iii) Fe^{3+}

iv) Ni^{2+}

1) ii > iii > i > iv 2) iii > iv > ii > i

3) i > iv > iii > ii 4) iii > ii > iv > i

30. Many transition metals and their compounds exhibit:

1) Ferrimagnetic behaviour

2) Vander Waal's behaviour

3) Paramagnetic behaviour

4) Diamagnetic behaviour

31. The spin only magnetic moment [in units of Bohr magneton] of Ni^{2+} in aqueous solution would be

1) 0 2) 1

3) 1.73 4) 2.84

32. The catalytic activity of the transition metals and their compounds is described to:

1) their chemical reactivity

2) their magnetic behaviour

3) their unfilled d-orbitals

4) their ability to adopt multiple oxidation states and their complexing ability

33. Which of the following statements is incorrect

1) Iron (III) catalyses the reaction between iodide and persulphate ions

2) Interstitial compounds are non-stoichiometric

3) Alloy formation is due to similar radii

4) Basic nature : TiO < VO < CrO < MnO < FeO

COMPOUNDS OF d-BLOCK ELEMENTS - $K_2Cr_2O_7$ and $KMnO_4$

34. In the dichromate ion, correct statement is

1) There are 8 Cr – O bonds and 13 bond angles

2) Cr – O – Cr bridge bond angle = 126^0

3) Six Cr – O – bonds are equivalent (163 pm)

4) All are true

35. Which of the following statement is false

1) $Cr_2O_7^{2-}$ has Cr – O – Cr bond

2) CrO_4^{2-} is tetrahedral in shape

3) $Na_2Cr_2O_7$ is primary standard in volumetry

4) $Na_2Cr_2O_7$ is more soluble than $K_2Cr_2O_7$

36. The oxidation state of Cr in $K_2Cr_2O_7$ is:

1) +5 2) +3

3) +6 4) +7

37. In the dichromate ion, which of the following is incorrect?

1) There are eight Cr – O bonds

2) Cr – O – Cr bridged bond angle = 126^0

3) Six Cr – O bonds are equivalent (163 pm)

4) Oxidation state of Cr is +3

38. When $K_2Cr_2O_7$ is heated with KOH solution the colour becomes:

1) Red 2) Orange

3) Yellow 4) Pink

39. In neutral or faintly alkaline medium $KMnO_4$ oxidises I^- to

1) I_2 2) IO_3^-

3) IO_4^- 4) I_3^-

40. When acidified $K_2Cr_2O_7$ solution is added to Sn^{2+} salt then Sn^{2+} changes to

1) Sn 2) Sn^{3+}

3) Sn^{4+} 4) Sn^+

41. What happens when a solution of potassium chromate is treated with aqueous dilute nitric acid?

1) CrO_4^{2-} is reduced to +3 state of Cr

2) Cr_4^{2-} is oxidised to +7 state of Cr

3) Cr^{3+} and $Cr_2O_7^{2-}$ are formed

4) $Cr_2O_7^{2-}$ and H_2O are formed

42. The reddish brown gas produced by heating KCl with $K_2Cr_2O_7$ (solid) and conc. H_2SO_4 is

1) Cl_2 2) CrO_2Cl_2

3) CrO_3 4) H_2CrO_4

43. Which of the following statement is incorrect for $KMnO_4$

1) It is an oxidising agent

2) It is used as antiseptic

3) It is used as bleaching agent in textile industries

4) It is dark purple coloured amorphous substance

44. $KMnO_4$ shows three equivalent mass as $\frac{M}{5}, \frac{M}{3}$ and M. The media respectively are:

1) acidic, neutral, strongly alkaline

2) neutral, acidic, basic

3) basic, acidic, neutral

4) acidic, basic, neutral

45. How is sodium chromate converted into sodium dichromate in the manufacture of potassium dichromate from chromite ore

1) By the action of concentrated sulpuric acid

2) By roasting with soda ash

3) By the action of sodium hydroxide

4) By the action of the stone

46. On addition of small amount of $KMnO_4$ to concentrated H_2SO_4, a green oily compound is obtained which is high explosive in nature. Identify the compound from the following

1) Mn_2O_7 2) MnO_2

3) $MnSO_4$ 4) Mn_2O_3

47. When dil. H_2SO_4 is added to aqueous solution of potassium chromate, yellow colour of solution turns to orange colour, it indicate:

1) Chromate ions are reduced

2) Chromate ions are oxidised

3) Monocentric complex is converted into dicentric complex

4) Oxygen gets removed from chromate ions

48. The number of moles of $KMnO_4$ that will be needed to react with one mole of sulphite ion in acidic medium is

1) 2/5 2) 3/5

3) 4/5 4) 1

49. Which of the following statement(s) is (are) correct when a mixture of NaCl and $K_2Cr_2O_7$ is gently warmed with conc. H_2SO_4?

a) A deep red vapour is evolved

b) The vapour when passed into NaOH solution gives a yellow solution of Na_2CrO_4

c) Chlorine gas is evolved

d) Chromyl chloride is formed

1) a, b & d only 2) a, b & c only

3) b, c & d only 4) b & d only

50. Which is false reagarding $KMnO_4$?

1) Prepared from pyrolusite & oxidative fusion of purple green K_2MnO_4

2) Powerful oxidant in acidic, basic & neutral media

3) It oxidises I^- to IO_3^- in basic/neutral media

4) It has no reaction with SO_2

51. **Statement I** : $K_2Cr_2O_7$ is used as primary standard in volumetric analysis.

Statement II : It has good solubility in water.

In the light of the statements, choose the most appropriate answer from the options given below:

1) Statement I is correct but statement II is incorrect

2) Statement I is in incorrect but statement II is correct

3) Both statement I and statement II are correct

4) Both statement I and statement II are incorrect

52. Which of the following contains $p\pi - d\pi$ bonds

1) MnO_4^- 2) CrO_4^{2-}

3) Mn_2O_7 4) All of them

53. $FeO.Cr_2O_3 + K_2CO_3 + O_2 \xrightarrow{\Delta} (A) + Fe_2O_3 + CO_2$

compound A is

1) $K_2Cr_2O_7$ 2) K_2CrO_4

3) CrO_5 4) CrO_3

LANTHANOIDS AND ACTINOIDS

54. Ce, Pr, Tb, Dy and Nd can exhibit ——— oxidation state.

1) +4 2) +1

3) zero 4) +6

55. Most common oxidation states of Ce (Cerium) are:

1) +3, +4 2) +2, +3

3) +2, +4 4) +3, +5

56. The transition element present in Misch metal is:

1) Cu 2) Mn

3) Fe 4) Ag

57. $E^0_{Ln^{3+}/Ln}$ values of lanthanoids are in the range of –2.2 to –2.4 V except:

1) Ce 2) Eu

3) Gd 4) Lu

58. Separation of Lanthanoid is possible by:

1) distillation

2) fractional crystallisation

3) fractional distillation

4) ion-exchange method

59. Non-lanthanide atom is

1) La 2) Lu

3) Pr 4) Pm

60. Which one of the following alloys contains some of the lanthanoid metals?

1) Misch metall

2) Brass

3) Bronze

4) Ziegler-Natta

61. The reaction for stability of Gd^{3+} ion is:

1) 4f-subshell-half filled

2) 4f-subshell-completely filled

3) possess electronic configuration of a noble gas

4) 4f-subshell-empty

62. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state. Which of the following statements is incorrect?

1) The ionic sizes of Ln(III) decrease in general with increasing atomic number

2) Ln (III) compounds are generally colourless

3) Ln (III) hydroxides are mainly basic in character

4) Because of the large size of the Ln (III) ions, the bonding in its compounds is predominantly ionic in character

63. In aqueus solution, Eu^{2+} ion acts as

1) An oxidising agent

2) A reducing agent

3) Catalyst

4) Both 1 and 3

64. Which of the following is the correct order of size of M^{3+} ions of La(57), Sm (62), Dy(66) and Lu (71)?

1) La > Sm > Dy > Lu

2) Lu > Dy > Sm > La

3) La > Dy > Sm > Lu

4) La > Dy = Sm > Lu

65. **Statement I** : Ce^{+4} is a strong oxidant but Eu^{+2} is a strong reducing agent.

Statement II : All lanthanoid ion in +3 oxidation state are paramagnetic.

In the light of the statements, choose the most appropriate answer from the options given below:

1) Both statement I and statement II are incorrect

2) Both statement I and statement II are correct

3) Statement I is correct but statement II is incorrect

4) Statement I is incorrect but statement II is correct

66. Match the compounds/elements given in Column I with uses given in Column II.

Column I (Compound/ element)		Column II (Use)	
i)	Lanthanoid oxide	a)	Production of iron alloy
ii)	Lanthanoid	b)	Television screen
iii)	Misch metall	c)	Petroleum cracking
iv)	Magnesium based alloy is constituent of	d)	Lanthanoid metal + iron
v)	Mixed oxides of lanthanoids are employed	e)	Bullets
		f)	In X-ray screen

1) i-b, ii-a, iii-d, iv-e, v-c

2) i-c, ii-a, iii-d, iv-e, v-b

3) i-d, ii-e, iii-b, iv-a, v-c

4) i-e, ii-c, iii-d, iv-a, v-b

67. Ln (Lanthanoid) $\xrightarrow[\text{Halogen}]{\text{with}}[X]$

$Ln(\text{Lanthanoid}) \xrightarrow[O_2]{\text{Burns with}}[Y]$

$Ln(\text{Lanthanoid}) \xrightarrow[N_2]{\Delta \text{ with}}[Z]$; X, Y and Z are resepectively

1) LnX_3, Ln_2O_3, Ln_3N

2) LnX_3, Ln_2O_3, LnN

3) LnX_2, LnO, LnN

4) LnX_2, Ln_2O_3, Ln_3N

68. The only radioactive element among the lanthanoid is

1) Gadolinium 2) Holmium

3) Promethium 4) Neodynium

69. Actinoids which exhibit +7 oxidation states are

1) $_{90}Th - _{97}Bk$ 2) $_{91}Pa - _{95}Am$

3) $_{92}U - _{95}Am$ 4) $_{93}Np - _{94}Pu$

70. Which of the following is the correct outer electronic configuration of Th (Z = 90)?

1) $5f^0 6d^2 7s^2$

2) $-5f^1 6d^1 7s^2$

3) $-5f^2 6d^0 7s^2$

4) $-5f^2 6d^1 7s^2$

71. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state. Which of the following statements is incorrect?

1) The ionic sizes of Ln(III) decrease in general with increasing atomic number

2) Ln(III) compounds are generally colourless

3) Ln(III) hydroxides are mainly basic in character

4) Because of the large size of the Ln(III) ions, the bonding in its compounds is predominantly ionic in character

72. The correct statement is:

1) The earlier members of lanthanoid series resemble calcium in their chemical properties

2) The extent of actinoid contraction is almost the same as lanthanoid contraction

3) In general, lanthanoid and actinoids do not show variable oxidation states

4) Ce^{4+} in aqueous solution is not known

73. Which statements are incorrect?

1) Ionic radii is in the order $Yb^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$

2) Lu^{3+} has least tendency to form complexes

3) The only (+IV) and (+II) states which have any Aq. chemistry are Ce^{4+}, Sm^{2+}, Eu^{2+} and Yb^{2+}

4) E^0 for $Ln^{3+}_{(aq)} + 3e^- \rightarrow Ln_{(s)}$ varies from -2.2 V to - 2.4 V except Eu (-2.0 V)

74. Identify the correct statements

1) Tb^{4+} and Eu^{2+} have $4f^7$ configuration

2) $E^{\ominus}$ for $Ln^{3+}_{(aq)} + 3e^- \rightarrow Ln_{(s)}$ varies from –2.2V to –2.4 V except Eu(–2.0 V)

3) Lu^{3+} has more ionic character

4) Sm^{2+} is a reducing agent

1) A, B, C, D

2) B, C, D

3) A, B, D

4) A, B, C

75. The actinoid with $5f^0$ configuration in the ground state

1) $_{90}Th$ 2) $_{95}Am$

3) $_{96}Cm$ 4) $_{102}No$

76. The spin magnetic moment of Gd^{3+} is ——— BM.

1) $\sqrt{63}$ 2) $\sqrt{35}$

3) $\sqrt{48}$ 4) $\sqrt{24}$

SAMPLE QUESTIONS

1. In first transition series, the melting point of Mn is low because

1) Due to d^{10} configuration, metallic bonds are strong

2) Due to d^7 configuration, metallic bonds are weak

3) Due to d^5 configuration, metallic bonds are weak

4) None of these

2. The lanthanide contraction is responsible for the fact that

1) Zr and Y have about the same radius

2) Zr and Nb have similar oxidation state

3) Zr and Hf have about the same radius

4) Zr and Zn have the same oxidation state

3. The actinoids showing +7 oxidation state are:

1) U, Np 2) Pu, Am

3) Np, Pu 4) Am, Cm

4. The transition metals which do not form amalgams are:

1) Zn 2) Fe

3) Cd 4) Na

5. In acidic medium, CrO_4^{2-} changes to

1) $Cr_2O_7^{2-}$ 2) Cr^{3+}

3) Cr[IV] 4) Cr_2O_3

6. The highest oxidation state by any transition metal is

1) +5 2) +6

3) +7 4) +8

7. When acidified $K_2Cr_2O_7$ solution is added to Sn^{2+} salt then Sn^{2+} changes to

1) Sn 2) Sn^{3+}

3) Sn^{4+} 4) Sn^{+}

8. Which of the following pairs of transition metal ions are the stronger oxidising agent in aqueous solution?

1) V^{2+} and Fe^{2+} 2) Mn^{3+} and Co^{3+}

3) Ti^{2+} and Cr^{2+} 4) V^{2+} and Cr^{2+}

9. In which of the following ions, d-d transition is not possible?

1) Ti^{4+} 2) Cr^{3+}

3) Mn^{2+} 4) Cu^{2+}

10. $_{62}Sm$ and $_{96}Cm$ are characterised by ——— configuration:

1) $4f^2, 5f^0$ 2) $4f^4, 5f^4$

3) $4f^6, 5f^7$ 4) $4f^7, 5f^8$

11. Which substance can be used in preparation of marking ink:

1) Ag 2) $AgNO_3$

3) AgBr 4) Pb

12. Arrange the following ions in order of their magnetic moment

i) V^{4+} ii) Mn^{4+}

iii) Fe^{3+} iv) Ni^{2+}

1) ii > iii > i > iv 2) iii > iv > ii > i

3) i > iv > iii > ii 4) iii > ii >iv > i

13. Choose the incorrect statement regarding the colour of ions?

1) Sc^{3+} and Ti^{4+} are colourless pair

2) TiF_6^{2-} and Cu_2Cl_2 are colourless

3) Ti^{3+}, V^{3+}, Fe^{3+}, Mn^{2+} are all coloured

4) Zn(II) and Cu(I) are coloured

14. Arrange Ce^{+3}, La^{+3}, Pm^{+3} and Yb^{+3} in increasing order of their ionic radii

1) $Yb^{+3} < Pm^{+3} < Ce^{+3} < La^{+3}$

2) $Ce^{3+} < Yb^{+3} < Pm^{+3} < La^{+3}$

3) $Yb^{+3} < Pm^{+3} < La^{+3} < Ce^{+3}$

4) $Pm^{+3} < La^{+3} < Ce^{+3} < Yb^{+3}$

15. The atomic number of cerium (Ce) is 58. The correct electronic configuration of Ce^{3+} ion is

1) $[Xe]4f^1$ 2) $[Kr]4f^1$

3) $[Xe]4f^{13}$ 4) $[Kr]4d^1$

16. Actinoids which exhibit +7 oxidation states are

1) $_{90}Th$ - $_{97}Bk$ 2) $_{91}Pa$ - $_{95}Am$

3) $_{92}U$ - $_{95}Am$ 4) $_{93}Np$ - $_{94}Pu$

17. Which of the following pair of compounds is expected to exhibit same colour in aqeous solution?

1) $FeCl_3$, $CuCl_2$ 2) $VOCl_2$, $CuCl_2$

3) $VOCl_2$, $FeCl_2$ 4) $FeCl_2$, $MnCl_2$

18. The d-electron configuration of Cr^{2+}, Mn^{2+}, Fe^{2+} and Co^{2+} are d^4, d^5, d^6 and d^7 respectively. Which one of the following will exhibit minimum paramagnetic behaviour?

1) $[Cr(H_2O)_6]^{2+}$ 2) $[Mn(H_2O)_6]^{2+}$

3) $[Fe(H_2O)_6]^{2+}$ 4) $[Co(H_2O)_6]^{2+}$

19. Which of the following pairs has the same size?

1) Fe^{2+}, Ni^{2+} 2) Zr^{4+}, Ti^{4+}

3) Zr^{4+}, Hf^{4+} 4) Zn^{2+}, Hf^{4+}

20. Which one of the following outer orbital configuration may exhibit the highest number of oxidation states?

1) $3d^5$, $4s^1$ 2) $3d^5$, $4s^2$

3) $3d^2$, $4s^2$ 4) $3d^3$, $4s^2$

21. The spin only magnetic moment (in units of Bohr Magneton) of Ni^{2+} in Aqueous solution would be (Z = 28)

1) 2.84 2) 4.90

3) 04) 1.73

22. Identify which of the following oxidation reaction is not possible?

1) $Cr_2O_7^{2-} + I^- \xrightarrow{H^+}$

2) $Cr_2O_7^{2-} + H_2S \xrightarrow{H^+}$

3) $Cr_2O_7^{2-} + CO_3^{2-} \xrightarrow{H^+}$

4) $Cr_2O_7^{2-} + Sn^{2+} \xrightarrow{H^+}$

23. Which of the following compound exhibit temperature dependent weak paramagnetism?

1) K_2MnO_4 2) $KMnO_4$

3) MnO_2 4) MnF_4

24. The behaviour of Samarium (Sm) is very much like:

1) Gd 2) Eu

3) Tb 4) Yb

25. Paramagnetism is observed as maximum in which of the lanthanoids in free sate?

1) Nd 2) Eu

3) Gd 4) Yb

26. Abnormally low value of the third ionisation enthalpy is observed for which of the following set of lanthanoids?

1) La, Ce, Gd

2) La, Pr, Eu

3) La, Gd, Lu

4) La, Eu, Yb

27. The main reason for larger number of oxidation states exhibited by the actinoids than the corresponding lanthanoids is

1) Lesser energy difference between 5f and 6d orbitals than between 4f and 5d orbitals

2) Larger atomic size of actinoids than the lanthanoids

3) More energy difference between 5f and 6d orbitals than between 4f and 5d orbitals

4) Greater reactive nature of the actinoids than the lanthanoids

28. Which of the following oxidation state is not possible for any actinoid?

1) +2

2) +3

3) +6

4) +7

29. Match column I with column II

Column I (Compound)	Column II (Uses)
a) TiO	i) UK silver coins
b) MnO_2	ii) Oxidation of ethyne
c) Cu/Ni alloy	iii) Pigment industry
d) $PdCl_2$	iv) Dry cell

1) a-iii, b-ii, c-i, d-iv

2) a-iv, b-ii, c-i, d-iii

3) a-iv, b-iii, c-i, d-ii

4) a-iii, b-iv, c-i, d-ii

30. Which of the following transition metal has highest first ionisation enthalpy?

1) Sc 2) Y

3) Zn 4) Hg

31. Match the columns.

	Column I		Column II
A)	Compound formed when yellow CrO_4^{2-} is acidified	p)	Acidified MnO_4^-
B)	Reagent oxidises Fe^{2+} to Fe^{3+}	q)	$Cr_2O_7^{2-}$
C)	Compound produced when MnO_2 is fused with KNO_3	r)	K_2MnO_4
D)	Compound having dark purple crystals isostructural with $KClO_4$	s)	$KMnO_4$

1) A - (q), B - (p), C - (r), D - (s)

2) A - (p), B - (q), C - (r), D - (s)

3) A - (q), B - (r), C - (p), D - (s)

4) A - (q), B - (p), C - (s), D - (r)

32. Which of the following statement is incorrect?

1) Ce^{3+} has spin only magnetic moment of 1.73 μ_B

2) Highest degree of paramagnetism/mol of the compound at 298 K is for $MnSO_4.4H_2O$

3) The increasing order of spin only magnetic moment in B.M is $Cr^{3+} < Fe^{2+} < Mn^{2+}$

4) The spin only magnetic moment of mercuric cobalt (II) thiocyanate (deep blue), Hg $[Co(SCN)_4]$ is $\sqrt{24}$

33. Higher oxidation state of manganese in fluoride is +4 (MnF_4) but higest oxidation state in oxides is +7 (Mn_2O_7) because

1) Fluorine more electronegative than oxygen

2) Fluorine does not possess d-orbitals

3) Fluorine stabilises lower oxidation state

4) In covalent compounds, fluorine can form single bond only while oxygen forms double bonds

34. MnO_4^{2-} (1 mole) in neutral aqueous medium disproportionates to

1) $\frac{2}{3}$ mole of MnO_4^- and $\frac{1}{3}$ mole of MnO_2

2) $\frac{1}{5}$ mole of MnO_4^- and $\frac{2}{3}$ mole of MnO_2

3) $\frac{1}{5}$ mole of Mn_2O_7 and $\frac{1}{3}$ mole of MnO_2

4) $\frac{2}{3}$ mole of Mn_2O_7 and $\frac{1}{3}$ moles of MnO_2

35. Which is not the correct statement about the chemistry of 3d and 4f series elements

1) 3d elements show more oxidation states than 4f series elements

2) The energy difference between 3d and 4s orbitals is very little

3) Europium (II) is more stable than Ce(II)

4) The paramagnetic character in 3d series elements increases from scandium to copper

36. Which of the following is a transition element as per the ground state electronic configuration

1) Au 2) Hg

3) Cd 4) Zn

37. $\left[Sc(H_2O)_6\right]^{3+}$ ion is

1) Colourless and diamagnetic

2) Coloured and octahedral

3) Coloured and paramagnetic

4) Colourelss and paramagnetic

38. Reason of lanthanoid contraction is

1) Decreasing nuclear charge

2) Decreasing screening effect

3) Negligible screening effect of 'f' orbitals

4) Increasing nuclear charge

39. $KMnO_4$ can be prepared from K_2MnO_4 as per the reaction

$$3MnO_4^{2-} + 2H_2O \rightleftharpoons 2MnO_4^- + MnO_2 + 4OH^-$$

The reaction can go to completion by removing OH^- ions by addings

1) SO_2 2) HCl

3) KOH 4) CO_2

40. Identify the incorrect statement.

1) $Cr^{2+}(d^4)$ is a stronger reducing agent than $Fe^{2+}(d^6)$ in water

2) The transition metals and their compounds are known for their catalytic activity due to their ability to adopt multiple oxidation states and to form complexes

3) Interstitial compounds are those that are formed when small atoms like H, C or N are trapped inside the crystal lattices of metals

4) The oxidation states of chromium in CrO_4^{2-} and $Cr_2O_7^{2-}$ are not the same

41. Which of the following option is the correct order for the basic stength of metallic hydroxides

1) $Al(OH)_3 < Lu(OH)_3 < Ce(OH)_3 < Ca(OH)_2$

2) $Ca(OH)_2 < Al(OH)_3 < Lu(OH)_3 < Ce(OH)_3$

3) $Lu(OH)_3 < Ce(OH)_3 < Al(OH)_3 < Ca(OH)_2$

4) $Lu(OH)_3 < Ce(OH)_3 < Ca(OH)_2 < Al(OH)_3$

42. Which of the following oxidation state is common for all lanthanoids

1) +2 2) +3

3) +4 4) +5

43. Which has +II and +III oxidation state common

1) La

2) Nd

3) Ce

4) Eu

44. The maximum oxidation state exhibited by actinide ions is

1) +5

2) +4

3) +7

4) +8

45. The maximum configuration of Eu (Atomic number = 63) , Gd (Atomic number = 64) and Tb (Atomic number = 65) are

1) [Xe] $4f^7 6s^2$, [Xe] $4f^8 6s^2$ and [Xe]$4f^5$ $5d^1$ $6s^2$

2) [Xe] $4f^7$ $5d^1$ $6s^2$, [Xe] $4f^7$ $5d^1$ $6s^2$ and [Xe]$4f^9$ $6s^2$

3) [Xe] $4f^6$ $5d^1$ $6s^2$, [Xe] $4f^7$ $5d^1$ $6s^2$ and [Xe]$4f^8$ $5d^1$ $6s^2$

4) [Xe] $4f^7$ $6s^2$, [Xe] $4f^7$ $5d^1$ $6s^2$ and [Xe]$4f^9$ $6s^2$

ANSWER KEY

1.	3	20.	4	39.	2	58.	4
2.	1	21.	2	40.	3	59.	1
3.	3	22.	1	41.	4	60.	1
4.	4	23.	3	42.	2	61.	1
5.	4	24.	4	43.	4	62.	2
6.	3	25.	4	44.	1	63.	2
7.	3	26.	4	45.	1	64.	1
8.	4	27.	1	46.	1	65.	3
9.	2	28.	2	47.	3	66.	1
10.	3	29.	4	48.	1	67.	2
11.	3	30.	3	49.	1	68.	3
12.	1	31.	4	50.	4	69.	4
13.	4	32.	4	51.	1	70.	1
14.	1	33.	4	52.	4	71.	2
15.	3	34.	4	53.	2	72.	1
16.	4	35.	3	54.	1	73.	1
17.	4	36.	3	55.	1	74.	3
18.	3	37.	4	56.	3	75.	1
19.	1	38.	3	57.	2	76.	1

SAMPLE QUESTIONS

1.	3	10.	3	19.	3	28.	1	37.	1
2.	3	11.	2	20.	2	29.	4	38.	3
3.	3	12.	4	21.	1	30.	1	39.	4
4.	2	13.	4	22.	3	31.	1	40.	4
5.	1	14.	1	23.	2	32.	4	41.	1
6.	4	15.	1	24.	2	33.	4	42.	2
7.	3	16.	4	25.	1	34.	1	43.	4
8.	2	17.	2	26.	3	35.	4	44.	3
9.	1	18.	4	27.	1	36.	1	45.	4

WORK BOOK

Chapter 17

COORDINATION COMPOUNDS

QUESTIONS

TERMINOLOGY, NAMING

1. Which of the following is a coordination compound?

1) $FeSO_4.(NH_4)_2SO_4.6H_2O$

2) $KCl.MgCl_2.12H_2O$

3) $K_4[Fe(CN)_6]$

4) $KAl(SO_4)_2.12H_2O$

2. Match the complex species given in Column I with the oxidation state of cobalt present in it (given in Column II) and assign the correct code.

Column-I (Compound)	Column-II (Oxidation state of Co)
A) $[Co(NCS)(NH_3)_5](SO_3)$	1) +4
B) $[Co(NH_3)_4Cl_2]SO_4$	2) 0
C) $Na_4[Co(S_2O_3)_3]$	3) +1
D) $[Co_2(CO)_8]$	4) +2
	5) +3

1) A - 1; B - 2; C - 4; D - 5

2) A - 4; B - 3; C - 2; D - 1

3) A - 5; B - 1; C - 4; D - 2

4) A - 4; B - 1; C - 2; D - 3

3. A Hexadentate ligand among the following is

1) $EDTA^{4-}$ 2) CO

3) CN^- 4) H_2O

4. Which of the following is not a chelating ligand?

1) $edta^{4-}$

2) oxalate

3) ethylene diamine

4) pyridine

5. Which among the following are ambidentate ligands?

1) NO_2^- 2) NO_3^-

3) $edta^{2-}$ 4) $C_2O_4^{2-}$

5) H_2O 6) SCN^-

1) 1 & 2 2) 3 & 4

3) 1 & 5 4) 1 & 6

6. Which of the following is a neutral ligand?

1) NO^+ 2) ONO^-

3) en 4) NO_2^-

7. Which of the following species is not expected to be a ligand?

1) NO 2) NH_4^+

3) $NH_2CH_2CH_2NH_2$ 4) CO

8. The formula of the complex tris(ethane-1,2-diamine) cobalt(III) sulphate is

1) $[Co(en)_2SO_4]$ 2) $[Co(en)_3SO_4]$

3) $[Co(en)_3]SO_4$ 4) $[Co(en)_3]_2(SO_4)_3$

9. As per IUPAC nomenclature, the name of the complex $[Co(NH_3)_2(H_2O)_4]Cl_3$ is

1) Tetraaquadiamine cobalt (III) chloride

2) Tetraaquadiammine cobalt (III) chloride

3) Diaminetetraaquacobalt (II) chloride

4) Diamminetetraaquacobalt (III) chloride

10. Which of the following in aqueous solutions of the same concentration has the highest molar conductivity?

1) Diamminedichloridoplatinum (II)

2) Hexaaquachromium(III) bromide

3)Tetramminedichloridoplatinum (IV) chloride

4) Potassium hexacyanidoferrate (II)

11. Match the column and choose the correct option from the codes given below

Column-I (Co-ordination compound)	Column-II (Structure)
A) Potassium tetrahydroxidozincate (II)	1) $K_3[Al(C_2O_4)_3]$
B) Potassiumtrioxalato aluminate (III)	2) $[Ni(CO)_4]$
C) Dichloridobis (ethane-1, 2-diamine) cobalt(III) ion	3) $[CoCl_2(en)_2]^+$
D) Tetracarbonyl nickel (0)	4) $K_2[Zn(OH)_4]$

1) A→1; B→2; C→3; D→4

2) A→2; B→4; C→1; D→3

3) A→3; B→2; C→1; D→4

4) A→4; B→1; C→3; D→2

12. The brown ring complex is represented as $[Fe(H_2O)_5NO]SO_4$. The oxidation state of iron is

1) +1 2) +2

3) +3 4) +4

13. The number of ions produced by a molecule of $K_3[Fe(C_2O_4)_3]$ is

1) 2 2) 3

3) 4 4) 5

14. The IUPAC name of $K_3[Fe(CN)_6]$ is

1) Potassium ferrocyanide

2) Potassium ferricyanide

3) Potassium hexacyanoferrate(III)

4) Potassium hexacyanidoferrate(II)

15. The IUPAC name of the compound

$[CoF_2(en)_2]ClO_4$ is

1) Ethylene diamine fluoro cobalt(III) chlorate

2) Bis(ethylenediamine)fluorocobalt(III) perchlorate

3) Bis(ethylenediamine)difluorocobalt(III) perchlorate

4) Bis(ethylene diamine) difluorocobalt(II) perchlorate

16. The isomerism exhibited by $[Cu(NH_3)_4][PtCl_4]$ and $[Cu(NH_3)_3Cl][Pt(NH_3)Cl_3]$ is

1) Position

2) Linkage

3) Ionisation

4) Coordination

17. **Statement I** : $[Co(NH_3)_5Br]SO_4$ gives white precipitate with barium chloride.

Statement II : The complex $[Co(NH_3)_5Br]SO_4$ dissociates in the solution to give Br^-.

1) Both statement I and statement II are correct.

2) Both statement I and statement II are incorrect.

3) Statement I is correct but statement II is incorrect.

4) Statement I is incorrect but statement II is correct.

18. Match the complex species given in Column I with the possible isomerism given in Column II and assign the correct code.

Column-I (Complex species)	Column-II (Isomerism)
A) $[Co(NH_3)_4Cl_2]^+$	1) Optical
B) cis-$[Co(en)_2Cl_2]^+$	2) Ionisation
C) $[Co(NH_3)_5(NO_2)]Cl_2$	3) Co-ordination
D) $[Co(NH_3)_6][Cr(CN)_6]$	4) Geometrical

1) A - 1; B - 2; C - 4; D - 5

2) A - 4; B - 3; C - 2; D - 1

3) A - 4; B - 1; C - 3; D - 3

4) A - 4; B - 1; C - 2; D - 3

19. Linkage isomerism is not possible, in coordination compounds, when the ligand present in it is

1) NO_2^-

2) SCN^-

3) OH^-

4) CN^-

20. Which kind of isomerism is shown by the complex $[Co(NH_3)_5(ONO)]SO_4$?

1. Ionisation isomerism

2. Linkage isomerism

3. Geometrical isomerism

4. Optical isomerism

1) 1, 2, 3 and 4

2) 1, 3 and 4

3) 1 and 2

4) 2, 3 and 4

21. Which of the following shows optical isomerism?

1) trans-$[CoCl_2(en)_2]^+$

2) $[Co(NH_3)_4Cl_2]^+$

3) $[PtCl_4]^{2-}$

4) $[Co(en)_3]^{3+}$

22. The complex that exists as a pair of enantiomers is

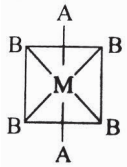
1) trans- $[Co(H_2NCH_2CH_2NH_2)_2Cl_2]^+$

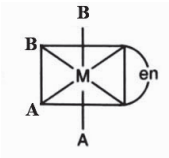
2) $[Co(H_2NCH_2CH_2NH_2)_3]^{3+}$

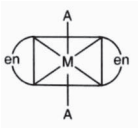
3) $[Pt(NH_4)_2\ Cl_2]$

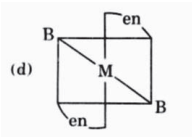
4) cis- $[Co(NH_3)_4Cl_2]^+$

23. The phenomenon of optical activity will be shown by

1) 

2) 

3) 

4) 

24. Due to the presence of ambidentate ligands coordination compounds show isomerism. Palladium complexes of the type $[Pd(C_6H_5)_2(SCN)_2]$ and $[Pd(C_6H_5)_2(NCS)_2]$ are

1) Linkage isomers

2) Coordination isomers

3) Ionisation isomers

4) Geometrical isomers

25. The compounds $[Co(SO_4)(NH_3)_5]Br$ and $[Co(SO_4)(NH_3)_5]Cl$ shows

1) Linkage isomerism

2) Ionisation isomerism

3) Co-ordination isomerism

4) No isomerism

26. Which of the following does not show geometrical isomerism?

1) $\left[Pt(NH_3)_2Cl_2\right]$

2) $\left[Pt(NH_3)Cl_2(py)\right]$

3) $\left[Co(NH_3)_4Cl_2\right]^+$

4) $\left[Co(NH_3)_5Cl\right]^{2+}$

27. $[Co(NH_3)_4(NO_2)_2]$ Cl exhibits

1) linkage , ionisation & geometrical isomerism

2) Ionisation, geometrical & optical isomerism

3) linkage , geometrical & optical isomerism

4) linkage, ionisation & optical isomerism

28. Fac - Mer isomerism is associated with which of the following complexes? [A-A → symmetrical bidentate, A-B → unsymmetrical bidentate, a, b, c, d → monodentate]

1) $[M(A\text{-}A)_3]$

2) $[M(A\text{-}A)_2]$

3) [Mabcd]

4) $[Ma_3b_3]$

29. The pair of compounds $[Co(NH_3)_6][Cr(CN)_6]$ & $[Cr(NH_3)_6][Co(CN)_6]$ illustrate

1) Linkage isomerism

2) Co-ordination isomerism

3) Geometrical isomerism

4) Optical isomerism

30. Geometrical as well as optical isomerism is possible with

1) $[Pt(NH_3)_2Cl_2]$

2) $[Cr(en)_3]^{3+}$

3) $[Co(NH_3)_3Cl_3]$

4) $[Pt(en)_2Cl_2]^{2+}$

31. Geometrical isomerism is not observed for

1) Tetrahedral complexes

2) Octahedral complexes

3) Square planar complexes

4) Both 1 and 3

Werner's co-ordination theory and VBT

32. According to Werner's theory, the secondary valency of the central metal atom corresponds to its

1) coordination number

2) oxidation number

3) charge on the ligands

4) charge on the complex ion

33. Which is not a postulate of Werner's theory?

1) A metal possess two types of valencies

2) Secondary valency is equal to coordination number

3) Primary valency is satisfied by negative ion

4) Secondary valency corresponds to oxidation state of metal

34. Number of moles of AgCl precipitated when excess of silver nitrate solution is added to A, B and C respectively.

A = $CoCl_3.\ 6NH_3$(Yellow)

B = $CoCl_3.\ 5NH_3$(Purple)

C = $CoCl_3.\ 4NH_3$(Violet)

1) 1, 2 and 3 moles respectively

2) 2, 1 and 3 moles respectively

3) 3, 2 and 1 moles respectively

4) 2, 2 and 2 moles respectively

35. How many moles of AgCl are obtained when excess $AgNO_3$ is added to one mole of $[Pt(NH_3)_4Cl_2]Cl_2$?

1) 0

2) 1

3) 2

4) 3

36. Both Co^{2+} & Pt^{4+} have a coordination number of 6. Which of the following pairs of complexes will show approximately the same electrical conductances in their 0.001M aq. solutions?

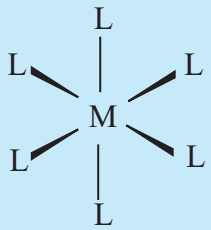
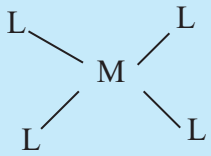
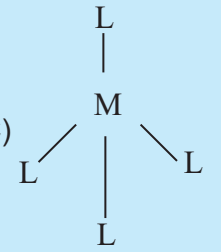
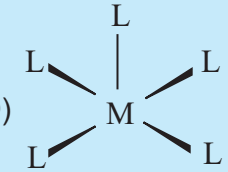
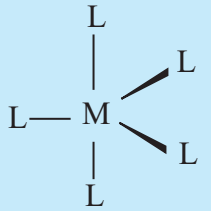
1) $CoCl_3.4NH_3$ & $PtCl_4.4NH_3$

2) $CoCl_3.3NH_3$ & $PtCl_4.5NH_3$

3) $CoCl_3.6NH_3$ & $PtCl_4.3NH_3$

4) $CoCl_3.6NH_3$ & $PtCl_4.5NH_3$

37. Match the Column and choose the correct options from the codes given below.

Column-I	Column-II
A) 	1. Square planar
B) 	2. Square pyramidal
C) 	3. Octahedral
D) 	4. Tetrahedral
E) 	5. Trigonal bypyramidal

1) A→1; B→2; C→3; D→4; E→5

2) A→5; B→4; C→3; D→2; E→1

3) A→3; B→1; C→4; D→2; E→5

4) A→4; B→5; C→1; D→3; E→2

38. Which of the following is an inner orbital complex?

1) $[FeF_6]^{3-}$ 2) $[CoF_6]^{3-}$

3) $[Fe(CN)_6]^{3-}$ 4) All the above

39. Which of the following statements about the complex $[CoF_6]^{3-}$ is correct?

1) Co involves d^2sp^3 hybridisation

2) Co involves sp^3d^2 hybridisation

3) F is in zero oxidation state

4) Co is in +2 oxidation state

40. Which of the following complexes have square planar shape?

A) Cis-$[Pt(NH_3)_2Cl_2]$

B) $[Ni(CN)_4]^{-2}$

C) $[NiCl_4]^{2-}$

D) $[ZnCl_4]^{-2}$

1) (A), (B) and (C) 2) (A) and (B)

3) (B) and (D) 4) (A) and (C)

41. Which of the following is an outer orbital entity?

1) $[Fe(CN)_6]^{3-}$ 2) $[FeF_6]^{3-}$

3) $[Fe(CN)_6]^{4-}$ 4) $[Co(ox)_3]^{3-}$

42. **Statement I** : $K_2[Ni(EDTA)]$ is more stable than $[Cr(H_2O)_6]Cl_3$

Statement II : $[Co(NH_3)_6]^{3+}$ is a low spin complex, whereas $[CoF_6]^{3-}$ is a high spin complex.

1) Both statement I and statement II are incorrect.

2) Both statement I and statement II are correct.

3) Statement I is correct but statement II is incorrect.

4) Statement I is incorrect but statement II is correct.

43. Match the column

Column-I (Complex ion)	Column-II (Hybridisation & no.of unpaired electron)
1) $[Co(NH_3)_6]^{+3}$	a) dsp^2, 0
2) $[Fe(CN)_6]^{3-}$	b) dsp^2, 1
3) $[Ni(CN)_4]^{2-}$	c) d^2sp^3, 0
4) $[Co(CN)_4]^{2-}$	d) d^2sp^3, 1

1) 1 - c, 2 - a, 3 - d, 4 - b

2) 1 - c, 2 - d, 3 - b, 4 - a

3) 1 - c, 2 - d, 3 - a, 4 - b

4) 1 - a, 2 - c, 3 - d, 4 - b

44. Which of the following are the limitations of VBT?

I. It does not distinguish between weak and strong ligands

II. It does not explain the colour exhibited by coordination compounds

III. It does not give a quantitative interpretation of the thermodynamic and kinetic stabilities of coordination compounds

Identify the correct option from the choices given below.

1) I, II and III 2) II and III only

3) I and III only 4) I and II only

45. Which is correctly matched?

1) $[Cu(NH_3)_4]^{2+}$ sp^3 2) $[Cu(en)_2]^{2+}$ sp^3

3) $[Cu(H_2O)_4]^{2+}$ sp^3 4) $[PtCl_4]^{2-}$ dsp^2

46. Which of the following is paramagnetic ?

1) $\left[Ni(CN)_4\right]^{2-}$ 2) $\left[Ni(CO)_4\right]$

3) $\left[Fe(CN)_6\right]^{3-}$ 4) $\left[Fe(CN)_6\right]^{4-}$

(Atomic number Fe = 26, Ni = 28)

47. Which of the following is an inner orbital, diamagnetic complex?

1) $\left[Cr(NH_3)_6\right]^{3+}$

2) $\left[V(NH_3)_6\right]^{2+}$

3) $\left[Co(NH_3)_6\right]^{3+}$

4) $\left[Ni(NH_3)_6\right]^{2+}$

(Atomic number V = 23, Cr = 24, Co = 27, Ni = 28)

48. Which of the following statements is not correct about the complexes $\left[Ni(CN)_4\right]^{2-}$ and $\left[NiCl_4\right]^{2-}$?

1) Do not differ in the primary valency of Ni

2) Do not differ in the secondary valency of Ni

3) Differ in the state of hybridisation of Ni

4) Do not differ in the magnetic properties

49. The complex ion which has the spin only magnetic moment of 2.84 BM is

1) $\left[CoF_6\right]^{3-}$

2) $\left[Mn(CN)_6\right]^{3-}$

3) $\left[MnBr_4\right]^{2-}$

4) $\left[Fe(CN)_6\right]^{4-}$

(Atomic number Mn = 25, Fe = 26, Co = 27, Cu= 29)

50. The spin only magnetic moment of the complex ion $[FeF_6]^{3-}$ is :

1) 1.7 BM 2) 2.8 BM

3) 3.8 BM 4) 5.9 BM

51. Which of the following complexes are not correctly matched with the hybridisation of their central metal ion

1) $[Ni(CO)_4]$ - sp^3

2) $[Ni(CN)_4]^{2-}$ - sp^3

3) $[CoF_6]^{3-}$ - d^2sp^3

4) $[Fe(CN)_6]^{3-}$ - sp^3d^2

1) 1 and 2 only

2) 1 and 3 only

3) 2 and 4 only

4) 2, 3 and 4 only

Crystal field theory

52. The crystal field splitting in a tetrahedral field is related to octahedral field as

1) $\Delta_t = \frac{4}{9}\Delta_0$ 2) $\Delta_t = \frac{1}{9}\Delta_0$

3) $\Delta_t = \frac{2}{9}\Delta_0$ 4) $\Delta_t = \frac{5}{9}\Delta_0$

53. In which of the following coordination entities the magnitude of Δ_0 maximum ?

1) $[Co(NH_3)_6]^{3+}$ 2) $\left[Co(H_2O)_6\right]^{3+}$

3) $\left[CoF_6\right]^{3-}$ 4) $\left[Co(CN)_6\right]^{3-}$

54. Which of the following complex ions is expected to absorb visible light ?

1) $\left[Sc(NH_3)_3(H_2O)_3\right]^{3+}$

2) $\left[Ti(NH_3)_2(en)_2\right]^{4+}$

3) $\left[Cr(NH_3)_6\right]^{3+}$

4) $\left[Zn(NH_3)_6\right]^{2+}$

(Atomic Number, Sc = 21, Ti = 22, Cr = 24, Zn = 30)

55. Which of the following complex does not absorbs light from visible region?

1) $[CoCl(NH_3)_5]^{2+}$

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

3) $[Sc(H_2O)_6]^{3+}$

4) $[Cu(H_2O)_4]^{2+}$

56. CN^- is a strong field ligand. This is due to the fact that

1) It forms high spin complexes with metal species

2) It carries negative charge

3) It is a monodentate ligand

4) It can accept electrons from metal species

57. The d electron configuration of Cr^{2+}, Mn^{2+}, Fe^{2+}, Co^{2+} & Ni^{2+} are $3d^4$, $3d^5$, $3d^6$, $3d^7$ & $3d^8$ respectively. Considering H_2O as a weak field ligand which of the following aqua complexes will have the minimum paramagnetic behaviour?

1) $\left[Cr(H_2O)_6\right]^{2+}$

2) $\left[Mn(H_2O)_6\right]^{2+}$

3) $\left[Co(H_2O)_6\right]^{2+}$

4) $\left[Ni(H_2O)_6\right]^{2+}$

58. The spin only magnetic moment of a d^8 metal ion in a square planar ligand field is

1) 0.0BM

2) 1.7 BM

3) 2.8 BM

4) 3.9 BM

59. Which of the following facts are related to CFT?

I. The five d- orbitals in an isolated gaseous metal atom/ion have same energy, i.e, they are degenerate.

II. If a spherically symmetrical field of negative charges surrounds the metal atom/ion, the degeneracy is maintained.

III. When the negative field is due to ligands in a complex, it becomes asymmetrical and the degeneracy of the d-orbitals is lifted.

IV. The pattern of splitting depends upon the nature of the crystal field.

The correct set of statements is

1) I , II, III and IV
2) II, III and IV
3) I, II and III
4) I, III and IV

60. What is the **correct** electronic configuration of the central atom in $K_4[Fe(CN)_6]$ based on crystal field theory?

1) $t_{2g}^4 e_g^2$
2) $t_{2g}^6 e_g^0$
3) $e^3 t_2^3$
4) $e^4 t_2^2$

61. A complex of certain metal has the magnetic moment of 4.91BM whereas another complex of the same metal with same oxidation state has zero magnetic moment. The metal ion could be (Octahedral field)

1) Co^{2+}
2) Mn^{2+}
3) Fe^{2+}
4) Fe^{3+}

62. The crystal field splitting for Cr^{3+} ion in octahedral field changes for ligands I^-, H_2O, NH_3, CN^- and the increasing order is:

1) $I^- < H_2O < NH_3 < CN^-$
2) $CN^- < I^- < H_2O < NH_3$
3) $CN^- < NH_3 < H_2O < I^-$
4) $NH_3 < H_2O < I^- < CN^-$

63. **Assertion** : Generally the colour of complexes of different metal ions with same ligand are different.

Reason : The crystal field splitting energy depends on nature of metal ions and ligands.

1) Both (A) and (R) are correct and (R) is the correct explanation of (A).
2) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
3) (A) is correct but (R) is not correct.
4) (A) is not correct but (R) is correct.

64. **Statement I** : $[Ti(H_2O)_6]Cl_3$ on heating becomes colourless.

Statement II : Water is removed on heating $[Ti(H_2O)_6]Cl_3$.

1) Statement I is correct but statement II is incorrect.
2) Statement I is incorrect but statement II is correct.
3) Both statement I and statement II are correct.
4) Both statement I and statement II are incorrect.

65. Match the complex ions given in Column I with the colours given in Column II and assign the correct code:

Column-I (Complex ion)	Column-II (Colour)
A) $[Co(NH_3)_6]^{3+}$	1) Violet
B) $[Ti(H_2O)_6]^{3+}$	2) Green
C) $[Ni(H_2O)_6]^{2+}$	3) Pale blue
D) $[Ni(H_2O)_4(en)]^{2+}_{(aq)}$	4) Yellowish orange
	5) Blue

1) A - 1; B - 2; C - 4; D - 5

2) A - 4; B - 3; C - 2; D - 1

3) A - 3; B - 2; C - 4; D - 1

4) A - 4; B - 1; C - 2; D - 3

66. The colour of the coordination compounds depends on the crystal field splitting. What will be the correct order of absorption of wavelength of light in the visible region, for the complexes, $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$, $[Co(H_2O)_6]^{3+}$

1) $[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+}$

2) $[Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+} > [Co(CN)_6]^{3-}$

3) $[Co(H_2O)_6]^{3+} > [Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-}$

4) $[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+}$

67. In the complexes $[Fe(H_2O)_6]^{3+}$, $[Fe(CN)_6]^{3-}$, $[Fe(C_2O_4)_3]^{3-}$ and $[FeCl_6]^{3-}$, more stability is shown by

1) $[Fe(H_2O)_6]^{3+}$ 2) $[Fe(CN)_6]^{3-}$

3) $[Fe(C_2O_4)_3]^{3-}$ 4) $[FeCl_6]^{3-}$

68. For d^4 (high spin) octahedral correct electronic configuration according to CFT is

1) $t_{2g}^4\ e_g^0$ 2) $t_{2g}^2 e_g^2$

3) $t_{2g}^3\ e_g^1$ 4) $t_{2g}^1\ e_g^3$

69. Which of the following is weakest ligand?

1) $C_2O_4^{2-}$ 2) F^-

3) OH^- 4) S^{2-}

Metal carbonyls and applications of co-ordination compounds

70. Match the column and choose the correct option from the codes given below.

Column-I (Coordination compounds)	Column-II (Elements)
A) Chlorophyll	1) Cobalt
B) Vitamin B_{12}	2) Iron
C) Haemoglobin	3) Magnesium

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

71. If the octahedral sites in the mineral Beryl , $(Be_3Al_2Si_6O_{18})$ are occupied by Cr^{3+} ions, the mineral is known as

1) Ruby

2) Emerald

3) Diamond

4) Zeolite

72. Match the Column-I and Column-II and choose the correct option from codes given below.

Column-I (Co-ordination compound)	Column-II (Uses in medicinal chemistry)
A) cis-platin	1) Removal of excess of Cu
B) EDTA	2) Removal of excess of Fe
C) Desferrioxime B	3) Lead poisoning
D) D-penicillamine	4) Tumours

1) A→1; B→2; C→3; D→4

2) A→2; B→4; C→1; D→3

3) A→3; B→1; C→4; D→2

4) A→4; B→3; C→2; D→1

73. Which of the following complex is associated with Black and White photography?

1) $[Ag(CN)_2]^+$

2) $[Ag(S_2O_3)_2]^{3-}$

3) $[AgBr_4]^{3-}$

4) AgBr

74. Shape of $Fe(CO)_5$ is

1) Triagonal planar

2) Linear

3) Tetrahedral

4) Triagonal bipyramidal

75. Ruby, the gemstone

I. is aluminium oxide (Al_2O_3).

II. contains 0.5 – 1%Cr^{3+}ions(d^3)

III. Cr^{3+} ions are randomly distributed in positions normally ocupied by Al^{3+},

The true statement(s) is/are

1) I and II 2) Only III

3) II and III 4) I, II and III

76. Which is a cobalt(II) complex?

1) Chlorophyll 2) Haemoglobin

3) Vitamin B_{12} 4) Cisplatin

77. Extraction of one of the following metals from its ore makes use of complex formation. The metal is:

1) Zn

2) Fe

3) Ag

4) Na

78. DMG is used for the detection and estimation of .....in aqueous solutions:

1) Al^{3+}

2) Mg^{2+}

3) Ag^+

4) Ni^{2+}

79. **Statement I :** The metal to ligand bonding creates a synergic effect which strengthen the bond between CO and the metal.

Statement II : The complex with d^0 and d^{10} configuration show d–d transition.

1) Statement I is correct but statement II is incorrect.

2) Statement I is incorrect but statement II is correct.

3) Both statement I and statement II are correct.

4) Both statement I and statement II are incorrect.

80. Incorrect statement regarding tetracarbonylnickel(0) is

1) It is a homoleptic complex

2) It does not have a Ni-Ni bond

3) In the purification of Ni, impure Ni is converted as tetracarbonylnickel (0)

4) Oxidation number of Ni is +2

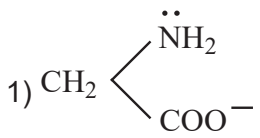
81. Number of M–M bonds in $Mn_2(CO)_{10}$ is

1) 1 2) 2

3) 3 4) 4

SAMPLE QUESTIONS

1. Glycinato ligand is :

1) 

2) Bidentate ligand

3) Two donor sites N and O

4) 1, 2 and 3

2. Which is the pair of ambidentate ligand?

1) $CN^{\ominus}$, $NO_2^{\ominus}$

2) $NO_3^{\ominus}$, $SCN^{\ominus}$

3) $N_3^{\ominus}$, $NO_2^{\oplus}$

4) $NCS^{\ominus}$, $C_2O_4^{2-}$

3. Both geometrical and optical isomerism are shown by

1) $\left[Co(en)_2 I_2\right]^{\oplus}$

2) $[Co(NH_3)_6I]^{2+}$

3) $[Cr(OX)_3]^{3-}$

4) $\left[Co(NH_3)_4 I_2\right]^{\oplus}$

4. Considering H_2O as a weak field ligand, the no. of unpaired electrons in $[Mn(H_2O)_6]^{2+}$ is

1) 2

2) 3

3) 4

4) 5

5. The primary and secondary valencies of Cr in the complex ion dichloridodioxalatochromate (III) are respectively

1) 3 and 4

2) 3 and 6

3) 4 and 3

4) 6 and 3

6. Which of the following is a hetroleptic complex?

1) $K_4\left[Fe(CN)_6\right]$

2) $Na_3\left[Cr(C_2O_4)_3\right]$

3) $K_2\left[PtCl_6\right]$

4) $\left[Cr(NH_3)_3Cl_3\right]$

7. In a certain isomer of $\left[Cr(NH_3)_4Cl_2\right]$, the Cl–Cr–Cl angle is 180°. The isomer is known as

1) trans isomer

2) linkage isomer

3) cis isomer

4) coordination isomer

8. Which of the following compounds is not coloured ?.

1) $Na_2\left[CuCl_4\right]$

2) $\left[Sc(H_2O)_6\right]Cl_3$

3) $K_4\left[Fe(CN)_6\right]$

4) $K_3\left[Fe(CN)_6\right]$

9. Total number of optical isomers possible for the complex $[Co(NH_3)_3(NH_2)_3]$

1) 2

2) 1

3) 3

4) 0

10. Which of the following IUPAC names is incorrect?

1) $[Co(NH_3)_4(H_2O)Cl]Cl_2$ – Tetraamineaqua chloridocobalt (III) chloride

2)$K_2[Zn(OH)_4]$ – Potassiumtetrahydroxyl zincate(II)

3)$K_3[Al(C_2O_4)_3]$ – Potassiumtrioxalatoaluminate (III)

4) $[CoCl_2(en)_2]+$ – Dichloridobis(ethane - 1, 2 -diamine)cobalt (III) ion

11. Which of the following is paramagnetic?

1) $[Co(NH_3)_6]^{3+}$ 2) $[Ni(CO)_4]$

3)$[Ni(NH_3)_6]^{2+}$ 4) $[Ni(CN)_4)]^{2-}$

12. The colour in the coordination compounds can be explained in terms of

1) Valence bond theory

2) Crystal field theory

3) Molecular orbital theory

4) None of these

13. The green colour of emerald is due to the presence of

1) Cr^{3+} 2) Fe^{3+}

3) Ni^{2+} 4) Ag^{+}

14. Both Cr^{3+} and Pt^{4+} have a coordination number of 6. Which of the following pairs of complexes will show appoximately the same electrical conductance for their 0.1 M aqueous solutions?

1) $CrCl_3.4NH_3$ and $PtCl_4.4NH_3$

2) $CrCl_3.3NH_3$ and $PtCl_4.5NH_3$

3) $CrCl_3.6NH_3$ and $PtCl_4.5NH_3$

4) $CrCl_3.5NH_3$ and $PtCl_4.6NH_3$

15. The d-electron configurations of Mn^{2+}, Fe^{2+}, Co^{3+} and Ni^{2+} are $3d^5$, $3d^6$, $3d^6$, $3d^8$, respectively. Which of the following aqua complexes will exhibit the minimum paramagnetic behaviour?

1) $[Fe(H_2O)_6]^{2+}$

2) $[Co(H_2O)_6]^{3+}$

3) $[Mn(H_2O)_6]^{2+}$

4) $[Ni(H_2O)_6]^{2+}$

16. Which of the following is paramagnetic?

1) $[Ni(CO)_4]$ 2) $[Cr(CO)_6]$

3) $[Fe(CN)_6]^{4-}$ 4) $[Cr(NH_3)_6]^{3+}$

17. Hardness of water can be estimated by

1) dmg method

2) Conductivity method

3) Chromatographic method

4) EDTA titration

18. d_{xy}, d_{xz} and d_{yz} orbitals in an octahedral field are called ..... orbitals

1) e_g

2) t_{2g}

3) t_g

4) t_2

19. The value of 'spin only' magnetic moment for one of the following configuration is 2.84 B.M. The correct one is (Octahedral field)

1) d^8 (in a weak ligand field)

2) d^4 (in a weak ligand field)

3) d^3 (in a weak as well as strong ligands field)

4) d^5 (in a strong ligand field)

20. Which of the following will give a pair of enantiomer?

1) $[Co(NH_3)_4Cl_2]^+$ 2) $[Co(NH_3)_3Cl_3]$

3) $[Co(NH_3)_5Cl]^{2+}$ 4) $[CoCl_2(en)_2]^+$

21. The magnetic moment of an octahedral homoleptic complex of Mn(II) is 5.9 BM. The most likely ligands in the complex is :

1) SCN^- 2) en

3) CO 4) CN^-

22. Select the correct order of magnetic moment (in BM) from the following options:

I) $[MnCl_4]^{2-}$

II) $[CoCl_4]^{2-}$

III) $[Fe(CN)_6]^{4-}$

1) I > II > III 2) III > II > I

3) III > I > II 4) I > III > II

23. Which of the pair of complex compound is tetrahedral as well as diamagnetic?

1) $[Cu(H_2O)_4]^{2+}$

2) $[Pt(NH_3)_2\ Cl_2]$

3) $[Ni(CO)_4]$

4) $[PdCl_4]^{2-}$

24. Among $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$ and $[NiBr_4]^{2-}$ species, the hybridisation state of Ni atoms are respectively

1) sp^3, ds^2p, dsp^2 2) sp^3, dsp^2, sp^3

3) dsp^2, sp^3, sp^3 4) sp^3, sp^3, dsp^2

25. Arrange the following in order of decreasing number of unpaired electros.

I) $[Fe(H_2O)_6]^{2+}$ II) $[Fe(CN)_6]^{3-}$

III) $[Fe(CN)_6]^{4-}$ IV) $[Fe(H_2O)_6]^{3+}$

1) IV, I, II, III 2) I, II,III, IV

3) III, II, I, IV 4) II, III, I, IV

26. Geometry, hybridisation and magnetic moment of the ions $[Ni(CN)_4]^{2-}$, $[MnBr_4]^{2-}$, and $[FeF_6]^{2-}$, respectively are

1) Tetrahedral, square planar, octahedral: dsp^2, sp^3, sp^3d^2 : 0, 5.9, 4.9

2) Tetrahedral, square planar, octahedral: sp^3, dsp^2, sp^3d^2 : 5.9, 0, 4.9

3) Square planar, tetrahedral, octahedral: dsp^2, sp^3, d^2sp^3 : 5.9, 4.9, 0

4) Square planar, tetrahedral, octahedral : dsp^2, sp^3, sp^3d^2 : 0, 5.9, 4.9

27. The correct order of magnetic moment (spin values in BM) is (Atomic number Mn = 25, Fe = 26, Co = 27)

I) $[MnBr_4]^{2-}$ II) $[Fe(CN)_6]^{4-}$

III) $[CoBr_4]^{2-}$

1) II > III > I 2) I > II > III

3) II > I > III 4) I > III > II

28. A square planar complex is formed by hybridisation of which atomic orbitals?

1) s, p_x, p_y, d_{yz} 2) s, p_x, p_y, $d_{x^2-y^2}$

3) s, p_y, p_z, d_{xy} 4) s, p_x, p_y, d_{z^2}

29. The colour of a complex compound is due to

1) Promotion of 3d-electrons of the central atom/ion to 4p-orbitals

2) Promotion of 3d-electrons of the central atom/ion to 4s-orbitals

3) Promotion of 3d-electrons of the central atom/ion within d-orbitals

4) Promotion of 4s-electrons of the central atom/ion to 4p-orbitals

30. Which of the following complex has higher Δ_0 value?

1) $[Fe(H_2O)_6]^{2+}$ 2) $[Fe(H_2O)_6]^{3+}$

3) $[Fe(CN)_6]^{3-}$ 4) All have equal

31. Relative to the average energy in the spherical crystal field, the t_2 orbitals in tetrahedral field is

1) Raised by (2/5) Δ_t

2) Lowered by (2/5) Δ_t

3) Raised by (3/5) Δ_t

4) Lowered by (1/5) Δ_t

32. $[Cr(H_2O)_6]Cl_3$ (atomic number of Cr = 24) has a magnetic moment of 3.83 BM. The correct distribution of 3d-elections in the chromium present in the complex is

1) $3d^1_{xy}$, $3d^1_{yz}$, $3d^1_{zx}$

2) $3d^1_{xy}$, $3d^1_{yz}$, $3d^1_{z^2}$

3) $3d^1_{(x^2-y^2)}$, $3d^1_{z^2}$, $3d^1_{zx}$

4) $3d^1_{xy}$, $3d^1_{y(x^2-y^2)}$, $3d^1_{zx}$

33. In which of the following coordination entities, the magnitude of Δ_0 [CFSE in octahedral field] will be maximum?

1) $[Co(CN)_6]^{3-}$ 2) $[CoF_6]^{3-}$

3) $[Co(NO_2)_6]^{3-}$ 4) $[Co(NH_3)_6]^{3+}$

34. In which of of the following configurations will there be the possibility of both para and diamagnetism, depending on the nature of the ligands?

1) d^3 2) d^7

3) d^6 4) d^5

35. The increasing order of the crystal field splitting power of some common ligands is

1) $NH_3 < NO_2^{\ominus} < CN^{\ominus} < H_2O$

2) $H_2O < NO_2^{\ominus} < CN^{\ominus} < NH_3$

3) $H_2O < NH_3 < NO_2^{\ominus} < CN^{\ominus}$

4) $H_2O < NH_3 < CN^{\ominus} < NO_2^{\ominus}$

36. Which of the following complex is inner orbital as well as low spin complex?

1) $[Cr(H_2O)_6]^{3+}$ 2) $[Fe(CN)_6]^{3-}$

3) $[NiCl_4]^{2-}$ 4) $[Fe(H_2O)_6]^{3+}$

37. Ligand with two or more points of attachment to single metal atoms are called

1) Monodentate ligand

2) Chelating ligand

3) Ambidentate ligand

4) None of these

38. The number of ions produced by the complex $[Cr(NH_3)_4Cl_2]ClO_3$ is

1) 2 2) 3

3) 4 4) 6

39. A group of atoms can function as a ligand only when

1) It is a small molecule

2) It is capable of acting as donor of electron pair

3) It is a capable of acting as accepting of electron pair

4) It is a positively charged ion

40. Which of the following is nonionisable?

1) $[Co(NH_3)_3Cl_3]$

2) $[Co(NH_3)_6Cl_2]Cl$

3) $[Co(NH_3)_5Cl]Cl_2$

4) $[Co(NH_3)_6]Cl_3$

41. The compound $[PtBr_2(NH_3)_2]$ can form

1) Geometrical isomers

2) Coordination isomers

3) Optical isomers

4) Linkage isomers

42. Both geometrical and optical isomerisms are shown by

1) $[Co(en)_2I_2]^{\oplus}$

2) $[Co(NH_3)_6]^{2+}$

3) $[Cr(OX)_3]^{2-}$

4) $[Co(NH_3)_4I_2]^{\oplus}$

43. Which of the following complex compounds exhibits cis-trans isomerism?

1) $[PtCl_2(NH_3)_2]$

2) $[PdCl_2BrI]$

3) $[Pt(NH_3)(py)(Cl)(Br)]$

4) All of these

44. The complex used as an anticaner agent is

1) mer-$[Co(NH_3)_3Cl_3]$

2) cis-$[PtCl_2(NH_3)_2]$

3) $Na_2[CoCl_4]$

4) cis-$K_2[Pt(Cl_2Br_2)]$

45. Hardness of water is estimated by simple complex formation titration. Complex formed by cation in hard water during estimation of hardness is

1) $Na_2[Ca(PO_3)_6]$

2) $Na_2[Mg(EDTA)]$

3) $[Ca(SO_4)_2]^{2-}$

4) $Na_2[Pb(EDTA)]$

ANSWER KEY

1.	3	17.	3	33.	4	49.	2	65.	4
2.	3	18.	4	34.	3	50.	4	66.	3
3.	1	19.	3	35.	3	51.	4	67.	3
4.	4	20.	3	36.	4	52.	1	68.	3
5.	4	21.	4	37.	3	53.	4	69.	4
6.	3	22.	2	38.	3	54.	3	70.	2
7.	2	23.	2	39.	2	55.	3	71.	2
8.	4	24.	1	40.	2	56.	4	72.	4
9.	4	25.	4	41.	2	57.	4	73.	2
10.	4	26.	4	42.	2	58.	1	74.	4
11.	4	27.	1	43.	3	59.	1	75.	4
12.	1	28.	4	44.	1	60.	2	76.	3
13.	3	29.	2	45.	4	61.	3	77.	3
14.	3	30.	4	46.	3	62.	1	78.	4
15.	3	31.	1	47.	3	63.	1	79.	1
16.	4	32.	1	48.	4	64.	3	80.	4
								81.	1

SAMPLE QUESTIONS

1.	4	10.	2	19.	1	28.	2	37.	2
2.	1	11.	3	20.	4	29.	3	38.	1
3.	1	12.	2	21.	1	30.	3	39.	2
4.	4	13.	1	22.	1	31.	1	40.	1
5.	2	14.	3	23.	3	32.	1	41.	1
6.	4	15.	2	24.	2	33.	1	42.	1
7.	1	16.	4	25.	1	34.	3	43.	4
8.	2	17.	4	26.	4	35.	3	44.	2
9.	4	18.	2	27.	4	36.	2	45.	2

WORK BOOK

Chapter 18

HALOALKANES & HALOARENES AND STEREOCHEMISTRY

QUESTIONS

INTRODUCTION/NAMING/CLASSIFICATION

1. Which of the following is a haloalkane?

1) $C_nH_{2n-2}X$ 2) $C_nH_{2n+3}X$

3) $C_nH_{2n+1}X$ 4) $C_nH_{2n}X$

2. Which of the following is a monohaloalkane?

1) CH_3Cl 2) $CHCl_3$

3) CCl_4 4) $C_6H_6Cl_6$

3. Which of the following is a primary (1°) haloalkane?

1) CH_3CH_2Cl 2) $(CH_3)_2CHCl$

3) $(CH_3)_3CCl$ 4) $(CH_3)_2CHBr$

4. Which of the following is a secondary (2°) haloalkane?

1) CH_3Cl 2) $(CH_3)_2CHCl$

3) $(CH_3)_3CCl$ 4) $CHCl_3$

5. Which of the following is a tertiary (3°) haloalkane?

1) CH_3CH_2Cl 2) $(CH_3)_2CHCl$

3) $(CH_3)_3CCl$ 4) CH_4

6. Which of the following is an aryl halide?

1) C_6H_6Cl 2) CH_3CH_2Br

3) CH_2Br_2 4) CH_4

7. Benzyl chloride is classified as a:

1) Haloalkane 2) Haloarene

3) Benzylic halide 4) Vinyl halide

8. Which of the following is a vinylic halide?

1) $CH_2=CHCl$ 2) CH_3CH_2Cl

3) C_6H_6Cl 4) CH_3Br

9. The IUPAC name of $CH_3CH(Br)CH_3$ is:

1) 1- Bromopropane 2) 2- Bromopropane

3) 3-Bromopropane 4) Isobromopropane

10. The IUPAC name of CH_3CCl_3 is :

1) 1,1,1- Trichloroethane

2) 2,2,2- Trichloroethane

3) 1,1,1- Trichloropropane

4) Trichloromethane

11. What is the IUPAC name of $C_6H_4Cl_2$ (1,2-position) ?

1) 1,2-Dichlorobenzene

2) 1,3- Dichlorobenzene

3) 1,4- Dichlorobenzene

4) Benzyl chloride

12. What is the common name of $CH_3CH(Cl)CH_3$?

1) Isopropyl chloride

2) Tert- butyl chloride

3) Sec-butyl chloride

4) Ethyl chloride

13. What is the IUPAC name of $CH_3CBr(CH_3)CH_3$?

1) 2-Bromo-2-methylpropane

2) 1-Bromo-2-methylpropane

3) tert-butyl bromide

4) 2-Bromobutane

GENERAL METHODS OF PREPARATION

14. Which of the following is NOT a method for preparing haloalkanes or haloarenes?

1) Free radical halogenation of alkanes

2) Alcoholic oxidation

3) Reaction of alcohols with halogen acids

4) Sandmeyer reaction

15. Which of the following is used to prepare haloalkanes from alkanes?

1) Free radical substitution

2) Addition reaction

3) Nucleophilic substitution

4) Electrophilic substitution

16. What is the major product when excess methane reacts with chlorine under UV light?

1) CH_4Cl 2) CH_3Cl

3) CH_2Cl_2 4) CCl_4

17. Which reagent is used for the preparation of alkyl bromides from alcohols?

1) NaBr+ H_2SO_4 2) KBr+ NH_3

3) KBr+ NH_3 4) NaBr+ NaOH

18. What is the product when ethanol reacts with HCl in the presence of $ZnCl_2$?

1) Ethene 2) Chloroethane

3) Acetic acid 4) Methanol

19. Which of the following halides cannot be prepared using the reaction of alcohol with HX?

1) RCl 2) RBr

3) RI 4) RF

20. In the presence of PCl_5, which of the following products is formed from ethanol?

1) CH_3Cl 2) CH_3CH_2Cl

3) CH_3CH_2Br 4) CH_3CH_2OH

21. Which method is used to prepare alkyl chlorides using $SOCl_2$?

1) Swarts reaction 2) Darzens reaction

3) Finkelstein reaction 4) Wurtz reaction

22. What is the major organic product in the reaction of benzene diazonium chloride with Cu_2Cl_2?

1) Benzene 2) Chlorobenzene

3) Benzyl chloride 4) Benzyl alcohol

23. Which of the following is NOT suitable for preparing aryl chlorides?

1) Sandmeyer reaction

2) Gattermann reaction

3) Electrophilic substitution

4) Finkelstein reaction

24. Which of the following undergoes SN1 reaction the fastest?

1) CH_3Cl 2) CH_3CH_2Cl

3) $(CH_3)_3CCl$ 4) $CH_2= CHCH_2Cl$

25. What is the order of reactivity of alkyl halides in S_N2 reactions?

1) $3^o>2^o>1^o$ 2) $1^o>2^o>3^o$

3) $2^o>1^o>3^o$ 4) $3^o>1^o>2^o$

26. Which of the following conditions favour S_N1 reaction?

1) Polar protic solvent

2) Polar aprotic solvent

3) Strong nucleophile

4) High temperature

27. Which of the following is the best nucleophile in an S_N2 reaction?

1) H_2O 2) CH_3O^-

3) CH_3OH 4) NH_3

28. Which reaction occurs preferentially with a bulky base like t- BuOK?

1) S_N1 2) S_N2

3) E_1 4) E_2

29. Which of the following undergoes dehydrohalogenation the fastest?

1) CH_3CH_2Br 2) $CH_3CH_2CH_2Br$

3) $(CH_3)_3CBr$ 4) $CH_3CH_2CH_2CH_2Br$

30. Which metal is used in the fittig reaction?

1) Zn 2) Na

3) Cu 4) Fe

31. Which of the following is the major product in the nitration of chlorobenzene?

1) o-Nitrochlorobenzene

2) p-Nitrochlorobenzene

3) m-Nitrochlorobenzene

4) Both 1 and 2

32. Which halide is most reactive towards nucleophilic substitution?

1) CH_3F 2) CH_3Cl

3) CH_3Br 4) CH_3I

33. Which halide undergoes nucleophilic substitution the slowest?

1) C_6H_5Cl 2) CH_3CH_2Cl

3) $CH_3CH_2CH_2Cl$ 4) CH_3I

34. Which of the following statements is incorrect regarding S_N2 reaction?

1) It follows a second order rate law

2) It leads to inversion of configuration

3) It proceeds via carbocation formation

4) It occurs faster in primary alkyl halides

35. Which of the following statements about E_2 elimination reactions is correct?

1) They involve the removal of two atoms or groups from adjacent carbon atoms

2) They always follow a two-step mechanism

3) They occur only in the presence of strong nucleophiles

4) They do not involve the formation of a $\pi-$bond

36. Which of the following is a characteristic of E_2 elimination?

1) It occurs in one step

2) It involves the formation of a carbocation

3) It is favored by weak bases

4) It follows first-order kinetics

37. Which of the following statements about E_1 and E_2 mechanisms is incorrect?

1) E_1 follows first - order kinetics

2) E_2 follows second-order kinetics

3) E_1 is favoured in tertiary alkyl halides

4) E_2 is favoured in polar protic solvents

38. Which of the following conditions favours an E_2 reaction over an S_N2 reaction?

1) A strong bulky base
2) A weak base
3) A primary alkyl halide
4) Low temperature

39. Which halide undergoes elimination the slowest?

1) $CH_3CH_2CH_2Br$ 2) $CH_3CH_2CH_2Cl$
3) $CH_3CH_2CH_2I$ 4) $CH_3CH_2CH_2F$

40. Which of the following factors favors E_1 over E_2?

1) Strong base
2) Primary alkyl halide
3) Polar protic solvent
4) High concentration of base

41. In Saytzeff's rule, the major product is the alkene that is:

1) The least substituted
2) The most substituted
3) Formed with the lowest energy
4) Formed in the fastest reaction.

42. Which of the following bases is most likely to favor Hofmann elimination?

1) NaOH 2) $NaOCH_3$
3) $(CH_3)_3CO^-$ 4) CH_3COO^-

43. Which of the following statements about E_2 reactions is correct?

1) They require an anti-periplanar transition state.
2) They involve a carbocation intermediate
3) They are faster in polar protic solvents
4) They form the least substituted alkene

44. Which of the following alkyl halides undergo elimination with a strong base in an E_2 reaction?

1) $CH_3CH_2CH_2Cl$ 2) CH_3CH_2Cl
3) $CH_3CHClCH_3$ 4) CH_3CCl_3

45. What is the major product of dehydrohalogenation of 2- bromo-2-methylpentane with NaOEt?

1) 2- Methyl-1-pentene
2) 2-Methyl-2-pentene
3) 3- Methyl-2-pentene
4) 2-Methylpentane

46. Which product is formed when 2-chlorobutane undergoes elimination in the presence of a strong base?

1) 1- Butene 2) 2- Butene
3) 1- Buteanol 4) Butane

47. Which of the following is the best condition for elimination to dominate over substitution?

1) Low temperature, strong nucleophile
2) High temperature, strong base
3) Low temperature, weak base
4) High temperature , weak nucleophile

48. Which of the following undergoes E_1 elimination most readily?

1) 1-Chloropropane
2) 2- chlorobutane
3) 2-Chloro-2-methylpropane
4) Chloromethane

49. Which of the following bases will promote an E_2 reaction?

1) CH_3COO^- 2) H_2O
3) $NaNH_2$ 4) NH_3

50. In elimination reactions, what role does the base play?

1) Attacks the leaving group

2) Abstracts a proton from $\beta-$carbon

3) Stabilizes the carbocation

4) Increases the polarity of the solvent

51. What is Saytzeff's rule in elimination reactions?

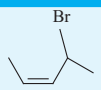
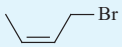
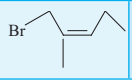
1) The least substituted alkene is formed preferentially

2) The most substituted alkene is formed preferentially

3) The formation of carbocation is necessary

4) The reaction occurs only in tertiary alkyl halides.

52. Give the correct match:

Column-I		Column-II (IUPAC Name)	
A)		i)	4-Bromopent-2-ene
B)		ii)	4-Bromo-3-methylpent-2-enee
C)		iii)	1-Bromobut-2-ene
D)		iv)	1-Bromo-2-methylpent-2-ene

	A	B	C	D
1)	ii	iii	iv	i
2)	i	ii	iii	iv
3)	i	iv	iii	ii
4)	iv	i	iii	ii

53. p- Dichlorobenzene has a higher melting point than those of o- and m -isomers because:

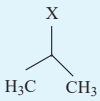
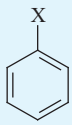
1) More energy is required to break the crystal lattice of m-dichlorobenzene.

2) More energy is required to break the crystal lattice of p-dichlorobenzene

3) More energy is required to break the crystal lattice of o-dichlorobenzene

4) None of the above

54. Give the correct match:

Column-I		Column-II	
A)		1)	Aryl halide
B)	$CH_2=CH-CH_2-X$	2)	Alkyl halide
C)		3)	Vinyl halide
D)	$CH_2=CH-X$	4)	Allylic halide

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

55. The C-Cl bond of chlorobenzene in comparison to the C–Cl bond in methyl chloride is:

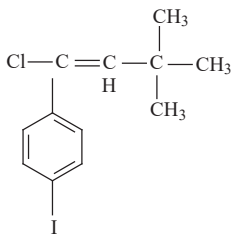
1) Shorter and weaker

2) Shorter and stronger

3) Longer and weaker

4) Longer and stronger

56. What is the correct IUPAC name of the below mentioned compound?



1) 1–Chloro–4–(1-iodophenyl)–3, 3- dimethylbut–1–ene

2) 1- Chloro-1-(4–iodophenyl)–3, 3-dimethylbut-1-ene

3) 1–Chloro–2–(3–iodophenyl)–3, 3-dimethylbut –1–en

4) 4–Chloro–1–(1–iodophenyl) –1, 1-dimethylbut –3–ene

57. Which of the following C–X bonds is the strongest

1) CH_3Br 2) CH_3Cl

3) CH_3I 4) CH_3F

58. Which of the following compounds has the lowest boiling point?

1) Pentyl chloride

2) tertiary-Butyl chloride

3) Isobutyl chloride

4) n-Butyl chloride

59. What is the correct order of boiling points for alkyl halides?

1) $C_2H_5Cl>C_2H_5Br>C_2H_5I$

2) $C_2H_5I>C_2H_5Br>C_2H_5Cl$

3) $C_2H_5I>C_2H_5Cl>C_2H_5Br$

4) $C_2H_5Br>C_2H_5I>C_2H_5Cl$

60. The reaction of tert butyl bromide with sodium methoxide produces mainly

1) isobutane

2) isobutene

3) tert-butyl methyl ether

4) sodium tert butoxide

61. Which of the following undergoes nucleophilic substitution exclusively by S_NI mechanism?

1) Tert. butyl chloride

2) Ethyl chloride

3) Chlorobenzene

4) Isopropyl chloride

62. The increasing order of nucleophilicity in polar protic?

1) $Cl^-<Br^-<I^-$ 2) $I^-<Cl^-<Br^-$

3) $Br^- <Cl^-<F^-$ 4) $I^-<Br^-<Cl^-$

63. Which of the following is most reactive towards S_NI reaction?

1) $C_6H_5C(CH_3)(C_6H_5)Br$

2) $C_8H_5CH_2Br$

3) $C_6H_5CH(C_6H_5)Br$

4) $C_6H_5CH(CH_3)Br$

64. Chlorobenzene reacts with Mg in dry ether to give a compound (A). 'A' and ethanol continue to react in order to produce?

1) Phenol 2) Ethyl benzene

3) Benzene 4) Phenyl ether

65. $CH_3CH_2CH_2Br + NaCN \rightarrow CH_3CH_2CH_2CN + NaBr,$

will be fastest in

1) ethanol

2) methanol

3) N, N-dimethylformamide

4) Water

66. A Grignard reagent may be made by reacting magnesium with

1) Methyl amine 2) Diethyl ether

3) Ethyl iodide 4) Ethyl alcohol

67. The R–X is converted into an alcohol by

1) addition

2) elimination

3) substitution

4) dehydrohalogenation

68. Which of the following is an example of aralkyl halide?

1) p-Chlorotoluene 2) Chlorobenzene

2) Allyl chloride 4) Benzyl chloride

69. Which of the following is not a primary halide?

1) iosbutyl bromide 2) neo-pentyl chloride

3) isopentyl bromide 4) isopropyl chloride

70. Which reagent cannot be used to prepare an alkyl chloride from an alcohol?

1) HCl+ anhyd.$ZnCl_2$ 2) NaCl

3) PCl_5 4) $SOCl_2$

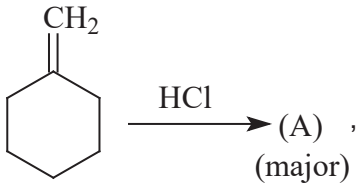
71. Benzyl chloride can be prepared by reacting

1) Toluene with Cl_2 in the presence of $FeCl_3$

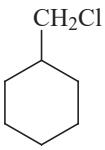
2) Benzene with CH_3Cl in the presence of $AlCl_3$

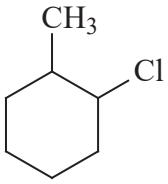
3) Toluene with Cl_2 in the presence of sunlight

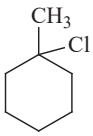
4) Benzene with Cl_2 in the presence of $FeCl_3$

72. 

, the product (A) is

1) 

2) 

3) 

4) All of these

73. A compound which is optically inactive even though it contains asymmetric carbon atom is called

1) Meso compound 2) Cis isomer

3) Trans isomer 4) Threo isomer

74. $CH_3-CH_2-CH_2-Cl \xrightarrow[KOH]{Alc.} B \xrightarrow{HBr} C \xrightarrow[ether]{Na} D$ is

In the above sequence of reaction, the product D is

1) Propane

2) 2-3-Dimethylbutane

3) Hexane

4) Allyl bromide

75. Which of the following groups is an ortho-para directing as well as deactivating group?

1) –OH 2) $–NH_2$

3) $–CH_3$ 4) –Cl

76. Which is incorrect in the physical properties of halogen compounds

1) R–I>R–Br>R-Cl> R–F - Boiling point

2) $CH_3–(CH_2)_2–CH_2–Cl > (CH_3)_2CH–CH_2–Cl > (CH_3)_3C–Cl$ - Boiling point

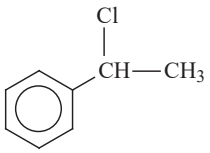
3) R–I>R–Br>R–Cl>R–F - density

4) $CH_3–F>CH_3–Cl> CH_3–Br>CH_3–I>CHCl_3$- dipole moment

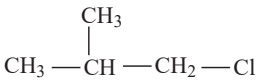
77. Which is incorrect about nucleophilic substitution reactions.

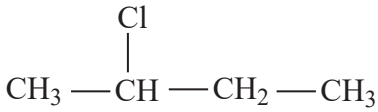
	S_N1	S_N2
1)	Favoured by polar protic solvent	Favoured by polar aprotic solvents
2)	$3^o>2^o>1^o>CH_3-X$ (order of reactivity)	$CH_3X>1^o>2^o>3^o$ (order of reactivity)
3)	Two steps	One step
4)	Inversion of configuration	Recemisation with some inversion

78. Which of the following compounds will undergo recemisation when solution of KOH hydrolyses

i) 

ii) $CH_3-CH_2-CH_2-Cl$

iii) 

iv) 

1) i & ii 2) ii & iii

3) ii & iv 4) i & iv

79. The order of reactivities of the following alkyl halides for S_N2 reaction is

1) RF>RCl>RBr>RI

2) RCl>RBr>Rf> RI

3) RF>RBr>RCl>RI

4) RI>RBr>RCl>RF

80. Which of the following is a primary halide?

1) Isopropyl iodide

2) Secondary butyl iodide

3) Tertiary butyl bromide

4) Neohexyl chloride

81. In which of the following conversions, phosphorus pentachloride is used as the reagent?

1) $H_2C=CH_2 \rightarrow CH_3CH_2Cl$

2) $CH_2CH_2OH \rightarrow CH_2CH_2Cl$

3) $H_3C-O-CH_3 \rightarrow CH_3Cl$

4) $CH\equiv CH \rightarrow CH_2=CHCl$

82. In the preparation of chlorobenzene from aniline, the most suitable reagent is

1) Chlorine in the presence of ultraviolet light

2) Chlorine in the presence of $AlCl_3$

3) Nitrous acid followed by heating with Cu_2Cl_2

4) HCl and Cu_2Cl_2

83. Which of the following compounds would be hydrolysed most easily?

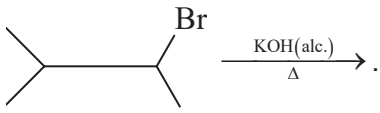
1) C_2H_5Cl 2) C_2H_5Br

3) C_2H_5F 4) C_2H_5I

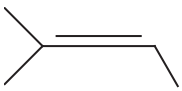
84. Which of the following would produce ethyl isocyanide as the major product on reaction with C_2H_5Br?

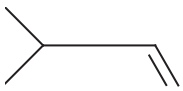
1) KCN 2) AgCN

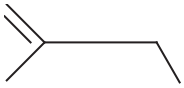
3) CH_3CN 4) CH_3NC

85. In the reaction, 

The predominant product is

1) 

2) 

3) 

4) None

86. The chemical reaction

$(CH_3)_3CBr \xrightarrow{Alc.KOH} (CH_3)_2C=CH_2$ is an example of

1) Nucleophilic substitution

2) α-elimination

3) γ-elimination

4) β-elimination

87. 'Pyrene' is the trade name of ——— when used as fire extinguisher

1) CO_2

2) $CHCl_3$

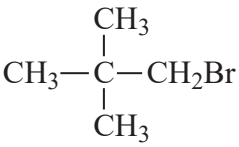
3) CCl_4

4) CH_3Cl_2

88. In a S_N2 reaction

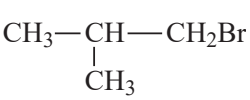
$$R-Br + Cl^- \xrightarrow{DMF} R-Cl + Br^-$$

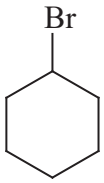
Which one of the following has the highest relative rate?

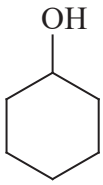
1) 

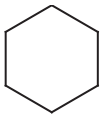
2) CH_3CH_2Br

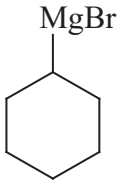
3) $CH_3CH_2CH_2Br$

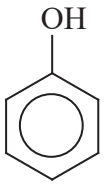
4) 

89.  + Mg $\xrightarrow{\text{dry ether}}$ P $\xrightarrow{H^+/H_2O}$ Q. The product Q is

1) 

2) 

3) 

4) 

90. The less reactivity of chlorine atom in $CH_2 = CH - Cl$ is due to

1) Inductive effect

2) Resonance effect

3) Electromeric effect

4) Hyperconjugation

STEREO CHEMISTRY

BASIC CONCEPTS OF OPTICAL ISOMERISM

91. Optical isomerism arises due to:

1) Different molecular formulas

2) Different connectivity of atoms

3) Asymmetry of molecule

4) Presence of isotopes

92. Which of the following compounds exhibits optical isomerism?

1) 2-Chloropropane

2) 2-Butanol

3) Benzene

4) Acetone

93. The correct statement about enantiomers is:

1) They are superimposable mirror images

2) They have different physical properties

3) They rotate plane-polarized light in opposite directions

4) They can be separated by simple distillation

94. A racemic mixture is optically inactive because:

1) The enantiomers decompose each other

2) The enantiomers cancel out each other's optical rotation

3) It contains only one enantiomer

4) It has no chiral center

95. How many optical isomers are possible for 2,3-dihydroxybutanoic acid?

1) 2 2) 4

3) 3 4) 1

96. If a reaction converts a chiral reactant into an achiral product, it is an example of:

1) Optical retention

2) Racemization

3) Optical inversion

4) Enantiomeric excess

97. Which of the following amino acids is achiral?

1) Glycine 2) Alanine

3) Valine 4) Leucine

98. Which of the following molecules is optically active?

1) Glucose 2) Benzene

3) Methane 4) Carbon dioxide

99. A chiral compound with two asymmetric carbons will have a maximum of:

1) 2 stereo isomers

2) 4 stereo isomers

3) 6 stereo isomers

4) 8 stereo isomers

100. The optical rotation of a compound depends on:

1) Concentration

2) Path length

3) Temperature

4) All of the above

101. Which of the following compounds is optically inactive?

1) Lactic acid 2) Glyceraldehyde

3) Meso-tartaric acid 4) 2-Chlorobutane

102. If an optically active compound undergoes racemization, what happens to optical rotation?

1) Increases 2) Decreases

3) Remains the same 4) Becomes zero

103. 1 : 1 mixture of two enantiomers is known as:

1) Meso compound

2) Racemic mixture

3) Diastereomeric mixture

4) Epimeric mixture

104. Which of the following statement is true?

1) Enantioners have different physical properties

2) Diastereomers are non-superimposable mirror images

3) Meso compounds are optically inactive due to symmetry

4) Racemic mixture show optical activity

105. The number of stereoisomers for 2,3-dibromobutane is:

1) 2 2) 3

3) 4 4) 6

106. Which reaction may leads to racemization?

1) S_N1

2) S_N2

3) E2

4) E1

107. The S_N2 reaction mechanism results in:

1) Retention of configuration

2) Racemization

3) Inversion of configuration

4) No change in stereo chemistry

SAMPLE QUESTIONS

1. Neopentyl alcohol on treatment with HBr gives

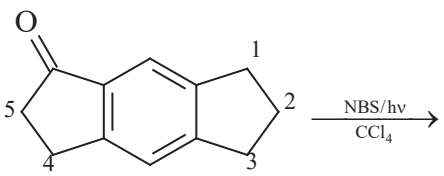
1) Neopentyl bromide

2) 2-Bromo-2-methylbutane

3) 2-Methyl-2-butene

4) 2-Methyl-1-butene

2. The carbon atoms at which bromination will take place are



1) 1, 2 and 3 2) 4 and 5

3) 1, 3, 4 and 5 4) 1, 3 and 4

3. **Statement I** : CH_3–F have greater dipole moment than CH_3–Cl

Statement II : C – Cl bond is more polar than C – F bond

1) Statement I is incorrect and statement II is correct

2) Both statement I and statement II are correct

3) Both statement I and statement II are incorrect

4) Statement I is correct and statement II is incorrect

4. Which of the following combinations is correctly matched

Compound	Reaction	Stereochemistry
1) $CH_3-C(H)(D)-Cl$	S_N1	Walden inversion
2) $Ph-C(C_2H_5)(CH_3)-Cl$	S_N1	Retention of configuration only
3) $Ph-C(C_2H_5)(CH_3)-Cl$	S_N1	Inversion of configuration only
4) $CH_3-C(H)(D)-Cl$	S_N2	Walden inversion

5. A dextrorotatory optically active alkyl halide undergo hydrolysis by S_N2 mechanism. The resulting alcohol is

1) Dextrorotatory

2) Laevorotatory

3) Optically inactive due to recemisation

4) May be dextrorotatory or laevorotatory

6. In which of the following solvents S_N1 reaction is maximum?

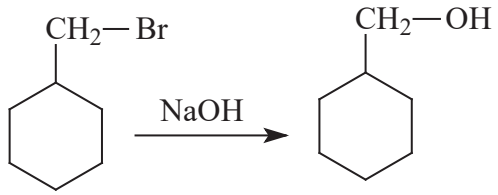
1) H_2O

2) Acetone

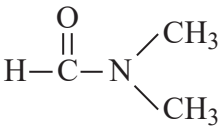
3) Any non polar solvent

4) CCl_4

7. Suggest a suitable solvent for the reaction given below



1) H_2O 2) CH_3-CH_2OH

3) 

4) C_6H_6

8. In the alkaline hydrolysis of an alkyl halide, when concentration of alkyl halide is tripled and the concentration of OH^- is reduced to half, the rate of S_N2 reaction will increase by

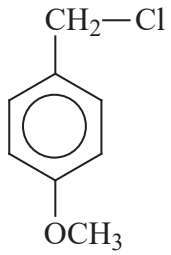
1) 3 times 2) 2 times

3) 1.5 times 4) 6 times

9. The increasing order of reactivity of the following halides for S_N1 reaction is

i) $CH_3-\underset{}{\overset{Cl}{\overset{|}{C}}}H-CH_2-CH_3$

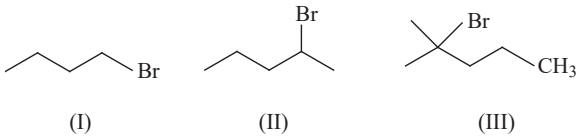
ii) $CH_3-CH_2-CH_2-Cl$

iii) 

1) iii < ii < i 2) ii < i < iii

3) i < iii < ii 4) ii < iii < i

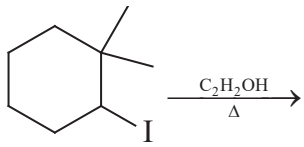
10. Dehydrobromination of the following is in the order

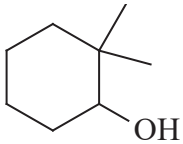


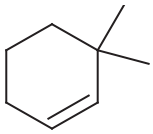
1) III > II > I 2) I > II > III

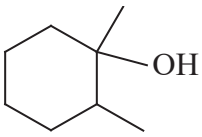
3) II > III > I 4) II > I > III

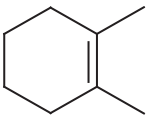
11. Find the major product of the following reaction is



1) 

2) 

3) 

4) 

12. $CH_3-CH_2-\overset{Cl}{\overset{|}{C}}H-CH_3 \xrightarrow{\text{Alc.KOH}} P$.

Major product P will be

1) $CH_3-CH_2-CH=CH_2$

2) $CH_3-CH=CH-CH_3$

3) $CH_3-\overset{OH}{\overset{|}{C}}H-CH_2-CH_3$

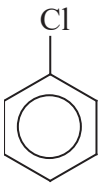
4) $CH_3-CH_2-\overset{OR}{\overset{|}{C}}H-CH_3$

13. In the given reaction $C_2H_5MgBr + D_2O \rightarrow P$. P will be

1) C_2H_5OH 2) C_2H_5OD

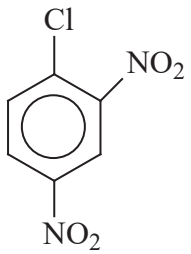
3) C_2H_6 4) $C_2H_5–D$

14. Order of reactivity towards nucleophilic substitution reaction of the compounds

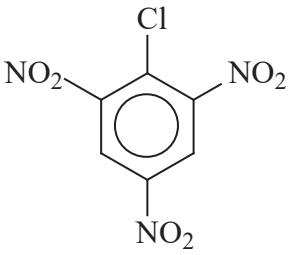


I

II



III

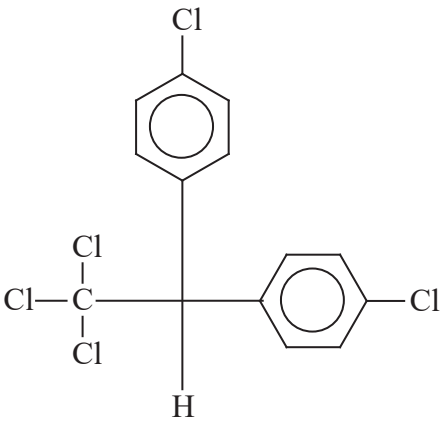


IV

1) I > II > III > IV 2) II > I > II > IV

3) IV > III > II > I 4) II > IV > II > I

15.



The given compound is

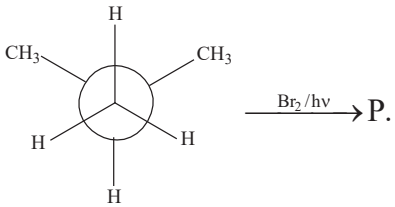
1) DDT

2) Insecticide proved by Paul Muller in 1939

3) Insecticide prepared in 1873

4) All of the above

16.



Major product P will be

1) $CH_3—\underset{}{\overset{CH_3}{\overset{|}{CH}}}—CH_2—Br$

2) $CH_3—\overset{CH_3}{\underset{Br}{C}}—CH_3$

3) $CH_3 – CH_2 – CH_2 – Br$

4) $CH_3—\overset{Br}{CH}—CH_3$

17. **Statement I** : Finkelstein reaction of alkyl chloride with NaI in acetone give alkyl iodide

Statement II : It is a halogen exchange reaction

1) Statement I is incorrect and statement II is correct

2) Both statement I and statement II are correct

3) Both statement I and statement II are incorrect

4) Statement I is correct and statement II is incorrect

18. The order of reactivity of the following halides towards S_N1 reaction is

I II III

1) II > III > I

2) III > II > I

3) III > I > II

4) I > III > II

19. (–)2-methylbutan-1-ol on heating with conc. HCl gives (+)1-chloro-2-methylbutane by S_N2 mechanism. Which of the following statements are correct?

I) reaction proceeds through retention of configuration at stereocentre

II) reaction proceeds inversion of configuration of stereocentre

III) reaction proceeds directly through a transition state

IV) reaction proceeds through carbocation intermediate

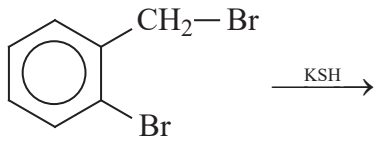
1) I and III

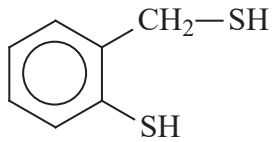
2) I and IV

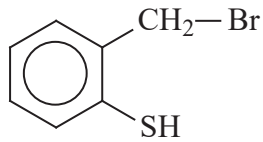
3) II and III

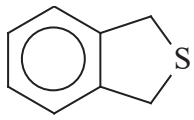
4) I, III and IV

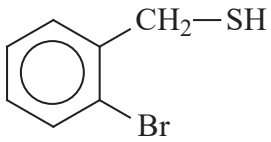
20. Find the major product of the following reaction

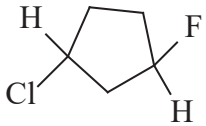


1) 

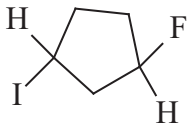
2) 

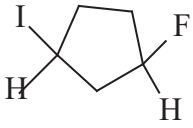
3) 

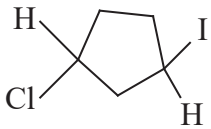
4) 

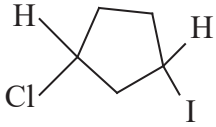
21. 

$\xrightarrow[\text{Acetone}]{\text{NaI(1mole)}}$ D. The major product D is

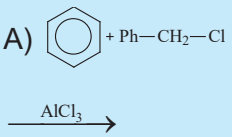
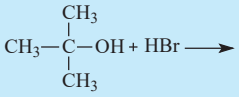
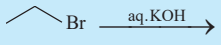
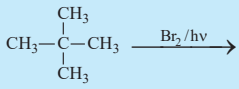
1) 

2) 

3) 

4) 

22. Match the items in column - I with those in column - II

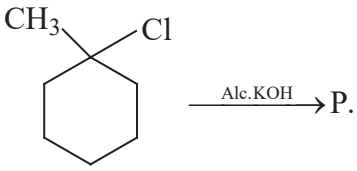
Column-I	Column-II
A) 	P) Nucleophilic substitution
B) 	Q) Electrophilic substitution
C) 	R) Cation intermediate
D) 	S) Free radical substitution

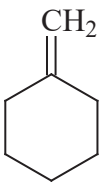
1) A-P, R; B-P, R; C-P; D-S

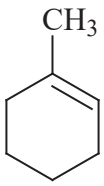
2) A-Q, R; B-P,R; C-P; D-S

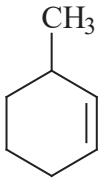
3) A-Q; B-Q; C-P; D-S

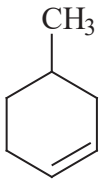
4) A-R,S; B-R,S; C-P; D-Q

23.  P. Major product P will be

1) 

2) 

3) 

4) 

24. **Statement-I** : Presence of $-NO_2$ group at o,p-positions increases the reactivity of aryl halides towards nucleophilic substitution reaction

Statement II : $-NO_2$ group decreases the electron density on aromatic ring.

1) Statement I is incorrect and statement II is correct

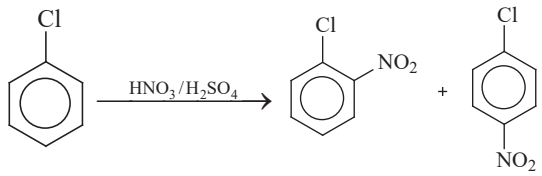
2) Both statement I and statement II are correct

3) Both statement I and statement II are incorrect

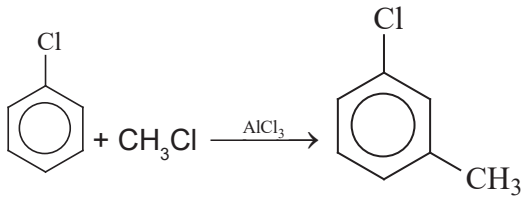
4) Statement I is correct and statement II is incorrect

25. Which of the following statements are correct about electrophilic substitution reactions of chlorobenzene?

1) Chlorine is meta directing deactivator

2) 

3) Chlorine is an o, p-directing deactivator

4) 

5) Reactivity of the ring is controlled by strong –I effect of chlorine and orientation of the electrophile is controlled by its weak +R effect

1) 2, 3 and 5 are correct

2) 1 only is correct

3) 2 and 3 are correct

4) 4 and 5 are correct

26. **Statement I** : Benzene react with ICl in presence of $AlCl_3$ to produce chlorobenzene.

Statement II : ICl reacts with $AlCl_3$ to produce Cl^+.

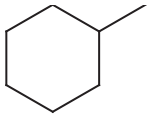
1) Statement I is incorrect and statement II is correct

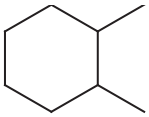
2) Both statement I and statement II are correct

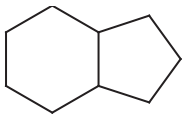
3) Both statement I and statement II are incorrect

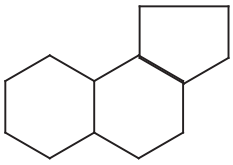
4) Statement I is correct and statement II is incorrect

27. Identify the number of chiral carbons in the following compounds

I) 

II) 

III) 

IV) 

1) 0, 2, 2, 4

2) 2, 2, 0, 4

3) 1, 2, 2, 4

4) 2, 2, 2, 4

28. Butan-2-ol is optically active because it contains

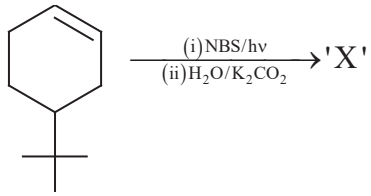
1) an asymmetric carbon atom

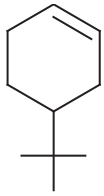
2) a plane of symmetry

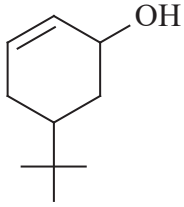
3) a hydroxyl group

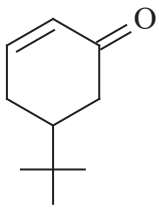
4) a centre of symmetry

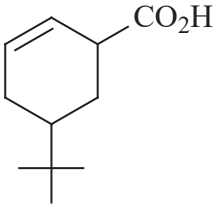
29. The product of the reaction given below is:



1) 

2) 

3) 

4) 

30. Match List I with List II and pick the correct matching from the codes given below:

List I (Haloalkane/ arene)		List II (Applications)	
A)	Iodoform	1)	Fire extinguisher
B)	DDT	2)	Antiseptic
C)	CCl_4	3)	Refrigeration
D)	Freons	4)	Insecticide

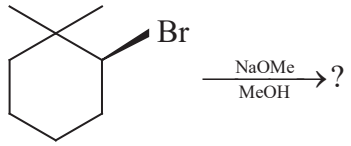
1) A-2, B-4, C-3, D-1

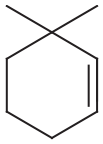
2) A-2, B-4, C-1, D-3

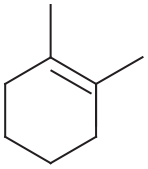
3) A-3, B-4, C-2, D-1

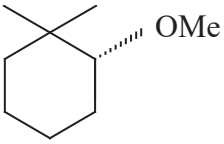
4) A-1, B-3, C-4, D-2

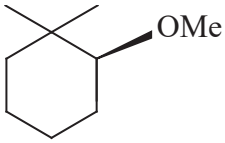
31. The major product of the following reaction is:



1) 

2) 

3) 

4) 

32. The major product obtained from E_2-elimination of 3-bromo-2-fluoro pentane is:

1) $CH_3-CH_2-\overset{\overset{Br}{|}}{C}H-CH=CH_2$

2) $CH_3-CH_2-\overset{\overset{Br}{|}}{C}=CH-CH_3$

3) $CH_3-CH_2-CH=\overset{\overset{CH_3}{|}}{C}-F$

4) $CH_3-CH=CH-\overset{\overset{F}{|}}{C}H-CH_3$

33. When 2-chloro-2-methylbutane is heated with alcoholic KOH, the possible product/s is/are:

i) $(CH_3)_2C = CH - CH_3$

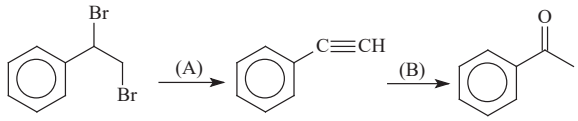
ii) $H_2C = C(CH_3)CH_2CH_3$

iii) $(CH_3)_2CH - CH = CH_2$

1) i, ii and iii 2) i and iii

3) ii and iii 4) i and ii

34. Identify the reagents in the following transformations:



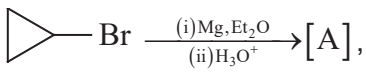
1) $NaNH_2$ and $KMnO_4/H^+$

2) $NaNH_2$ and H_2O, $HgSO_4$, H_2SO_4

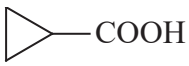
3) Alc. KOH and H_2O, $HgSO_4$, H_2SO_4

4) Alc. KOH and $KMnO_4/H^+$

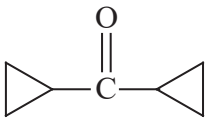
35. For the following reaction,



Product [A] is:

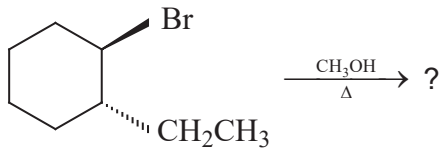
1) 

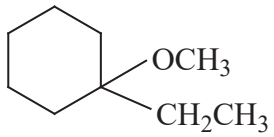
2)

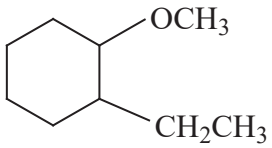
3) 

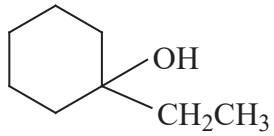
4)

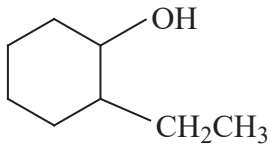
36. What will be the major product of the following reaction?



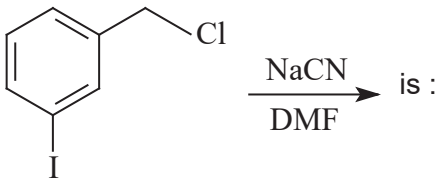
1) 

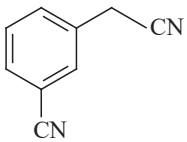
2) 

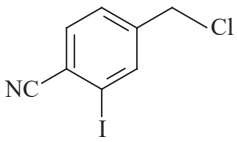
3) 

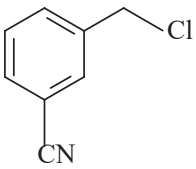
4) 

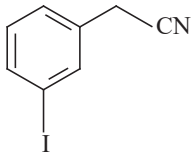
37. The structure of the major product formed in the following reaction;



1) 

2) 

3) 

4) 

38. Which of the following reaction(s) can be used for the preparation of alkyl halides?

i) $CH_3CH_2OH + HCl \xrightarrow{\text{anhyd.}ZnCl_2}$

ii) $CH_3CH_2OH + HCl \rightarrow$

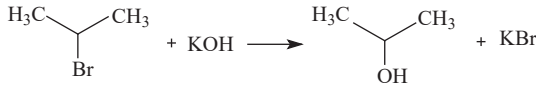
iii) $(CH_3)_3C-OH + \underset{(conc.)}{HCl} \rightarrow$

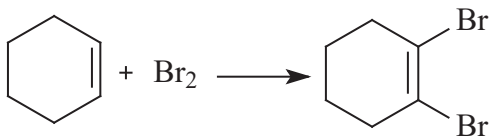
iv) $(CH_3)_2CHOH + \underset{(conc.)}{HCl} \xrightarrow{\text{anhyd.}ZnCl_2}$

1) i, iii and iv only
2) i and ii only
3) iv only
4) iii and iv only

39. For the following reactions :

(i) $CH_3CH_2CH_2Br + KOH \rightarrow CH_3 - CH = CH_2 + KBr + H_2O$

(ii) 

(iii) 

Which of the following statements is correct?

1) i and ii are elimination reactions and iii is addition reaction

2) i is elimination, ii is substitution and iii is addition reaction

3) i is elimination, ii and iii are substitution reactions

4) i is substitution, ii and and iii are addition reactions

40. Which of the following can be used as the halide component for Friedel-Crafts reaction?

1) Isopropyl chloride

2) Chlorobenzene

3) Bromobenzene

4) Chloroethene

41. Consider the reaction,

$CH_3CH_2CH_2Br + NaCN \rightarrow CH_3CH_2CH_2CN + NaBr$

This reaction will be fastest in:

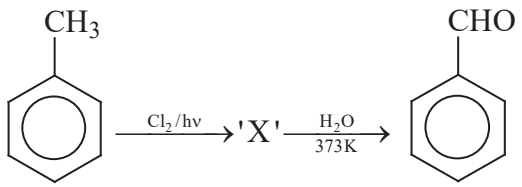
1) water

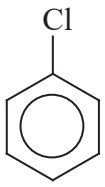
2) ethanol

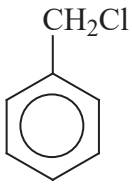
3) methanol

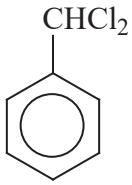
4) N, N'-dimethylformamide (DMF)

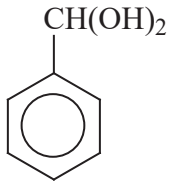
42. Identify compound 'X' in the following sequence of reactions:



1) 

2) 

3) 

4) 

43. Rate dehydrohalogenation by E_2 mechanism for the following haloalkanes.

CH_3-CH_2-Cl (I)

$CH_3-CH(CH_3)-Cl$ (II)

$CH_3-C(CH_3)_2-Cl$ (III)

1) I > II > III

2) III > II > I

3) I > III > II

4) III > I > II

44. Degree of unsaturation of DDT

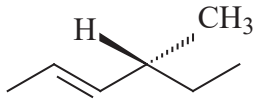
1) 2

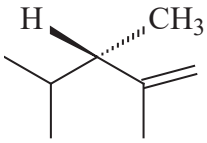
2) 4

3) 6

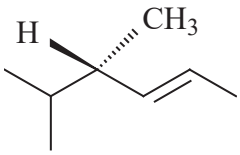
4) 8

45. Which of the following compounds produces an optically inactive compound on hydrogenation?

1) 

2) 

3)

4) 

ANSWER KEY

1. 3	23. 4	45. 2	67. 3	89. 2
2. 1	24. 3	46. 2	68. 4	90. 2
3. 1	25. 2	47. 2	69. 4	91. 3
4. 2	26. 1	48. 3	70. 2	92. 2
5. 3	27. 2	49. 3	71. 3	93. 3
6. 1	28. 4	50. 2	72. 3	94. 2
7. 3	29. 3	51. 2	73. 1	95. 2
8. 1	30. 2	52. 2	74. 2	96. 2
9. 2	31. 2	53. 2	75. 4	97. 1
10. 1	32. 4	54. 1	76. 4	98. 1
11. 1	33. 1	55. 2	77. 4	99. 2
12. 1	34. 3	56. 2	78. 4	100. 4
13. 1	35. 1	57. 4	79. 4	101. 3
14. 2	36. 1	58. 2	80. 4	102. 4
15. 1	37. 4	59. 2	81. 2	103. 2
16. 2	38. 1	60. 2	82. 3	104. 3
17. 1	39. 4	61. 1	83. 4	105. 2
18. 2	40. 3	62. 1	84. 2	106. 1
19. 4	41. 2	63. 1	85. 1	107. 3
20. 2	42. 3	64. 3	86. 4	
21. 2	43. 1	65. 3	87. 3	
22. 2	44. 3	66. 3	88. 2	

SAMPLE QUESTIONS

1. 2	10. 1	19. 1	28. 1	37. 4
2. 4	11. 4	20. 4	29. 2	38. 4
3. 3	12. 2	21. 2	30. 2	39. 2
4. 4	13. 4	22. 2	31. 1	40. 1
5. 4	14. 3	23. 2	32. 3	41. 4
6. 1	15. 4	24. 2	33. 4	42. 3
7. 3	16. 2	25. 1	34. 2	43. 2
8. 3	17. 2	26. 3	35. 4	44. 4
9. 2	18. 3	27. 1	36. 1	45. 2

WORK BOOK

Chapter 19

ALCOHOLS, PHENOLS AND ETHERS

QUESTIONS

CLASSIFICATION, NOMENCLATURE, STRUCTURE OF FUNCTIONAL GROUP

1. The compound containing $C_{sp^2} - OH$ bond is

1) vinyl alcohol 2) phenol

3) benzyl alcohol 4) both 1 & 2

2. Catechol, Resorcinol and Hydroquinone are

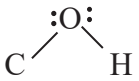
1) Chain isomers

2) Functional isomers

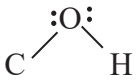
3) Ring-chain isomers

4) Position isomers

3. Select the incorrect statement

1) The bond angle  in alcohols is slightly less than 109° 28′

2) The carbon-oxygen bond length in methanol is 142 pm and that in phenol is 136 pm

3) The  bond angle in dimethyl ether is 111.7°

4) The carbon-oxygen bond length in dimethyl ether is 138 pm

4. IUPAC name of Glycerol is

1) Propane-1,2,3-trialcohol

2) Propane-1,2,3-triol

3) 1,2,3-Trihydroxy propane

4) Propan-1,2,3-triol

5. Which one of the following is a secondary alcohol?

1) Neopentyl alcohol

2) Isopropyl alcohol

3) Tert.butyl alcohol

4) Isobutyl alcohol

6. Resorcinol is

1) Benzene-1,3-diol

2) Benzene-1,4-diol

3) Benzene-1,2-diol

4) 3-Methylphenol

7. Which one of the following is a tertiary alcohol?

1) $CH_3CH_2CH_2OH$ 2) $CH_3CH(OH)CH_3$

3) $(CH_3)_2CHCH_2OH$ 4) $(CH_3)_3COH$

8. Which one is not an allylic halide?

1) 3-Chlorocyclohex-1-ene

2) 1-Chlorobut-1-ene

3) 1-Chloro but-2-ene

4) 3-Chloro prop-1-ene

9. t-Butyl alcohol is

1) 2-Methyl propan-2-ol

2) 2-Methyl propan-1-ol

3) 3-Methyl butan-1-ol

4) 3-Methyl butan-2-ol

Preparation of alcohol

10. Ethanol can be prepared by all methods except

1) $C_2H_5NH_2 + HNO_2 \rightarrow$

2) $C_2H_5MgBr + H_2O \rightarrow$

3) $C_2H_5I + KOH_{(aq)} \rightarrow$

4) $CH_3 - CHO \xrightarrow[2.H_2O]{I.NaBH_4}$

11. Which among the following gives the same alcohol on acid catalysed hydration, hydroboration-oxidation and oxymercuration-demercuration reactions

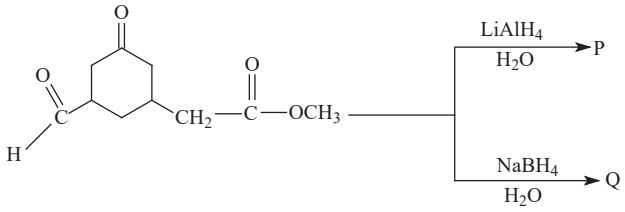
1) 1-methylcyclohexene

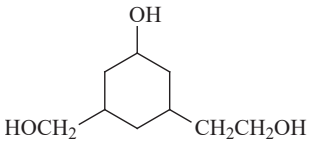
2) 2-methyl propene

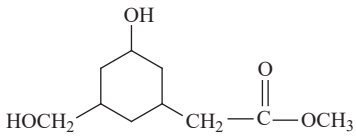
3) But-1-ene

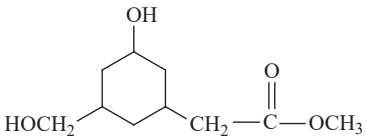
4) But-2-ene

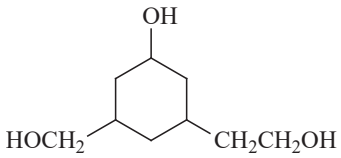
12. Identify the products P and Q

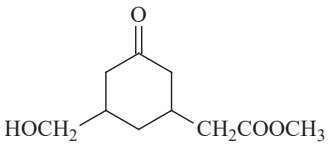


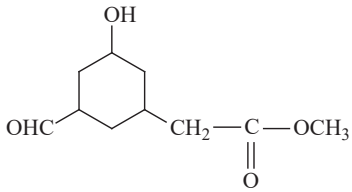
1) P : 

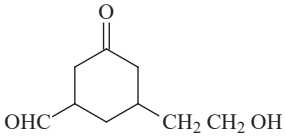
Q : 

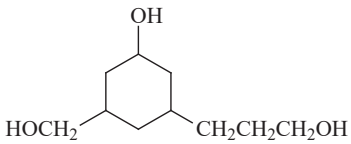
2) P : 

Q: 

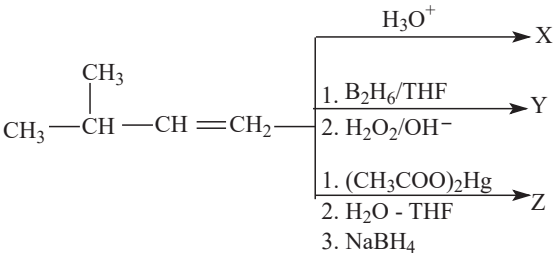
3) P : 

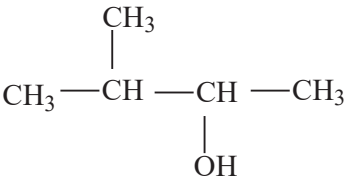
Q : 

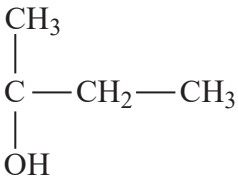
4) P : 

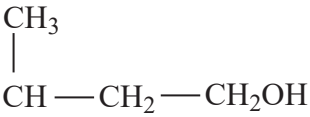
Q : 

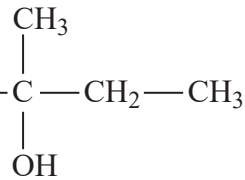
13. Identify X, Y and Z

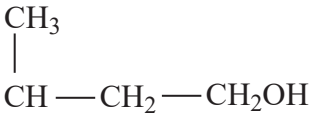


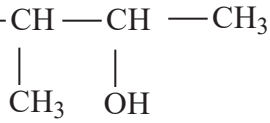
1) X = 

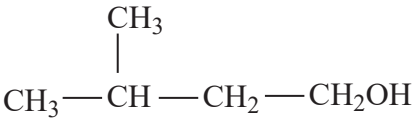
Y = 

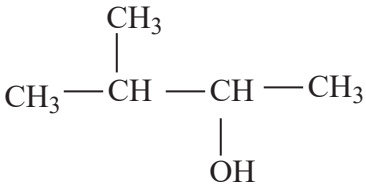
Z = 

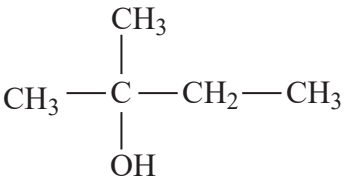
2) X = 

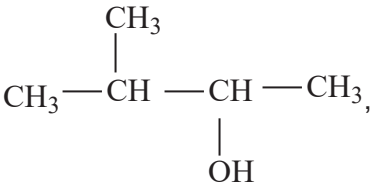
Y = 

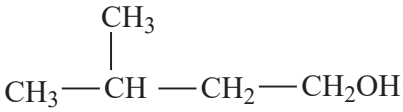
Z = 

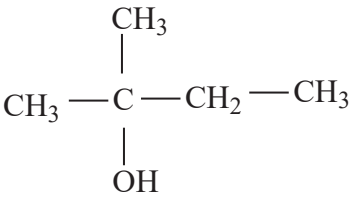
3) X = 

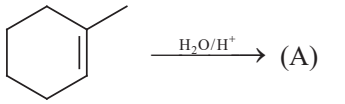
Y = 

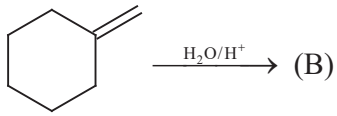
Z = 

4) X =  ,

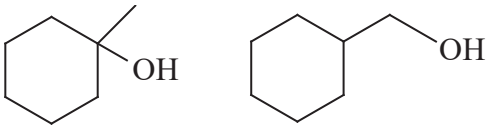
Y = 

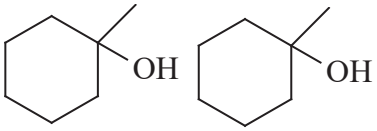
Z = 

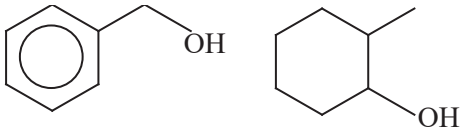
14. 

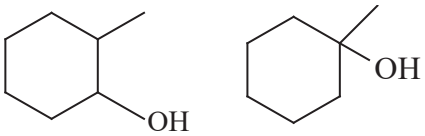


. A and B are respectively

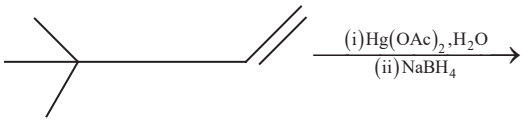
1) 

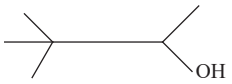
2) 

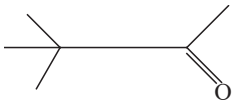
3) 

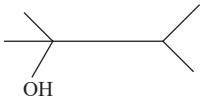
4) 

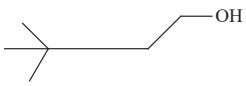
15. The major product in the following reaction



1) 

2) 

3) 

4) 

16. Methylmagnesiumbromide + X $\xrightarrow{H_2O}$ 2-methylpropan-2-ol.

Identify the structure of X

1) $CH_3 - CH_2 - CHO$

2) $CH_3-\overset{\overset{O}{||}}{C}-CH_3$

3) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CHO$

4) $CH_3-\underset{\underset{O}{||}}{C}-CH_2-CH_3$

17. Given below are two statements:

Statement I : 2-methylbutane on oxidation with $KMnO_4$ gives 2-methyl-butan-2-ol

Statement II: n-alkanes can be easily oxidized to corresponding alcohols with $KMnO_4$

Choose the correct option:

1) Both statements I and II are correct

2) Both statements I and II are incorrect

3) Statement I is correct, but statement II is incorrect

4) Statement I is incorrect, but statement II is correct

Preparation of phenol

18. **Assertion** : Commercially carboxylic acids are reduced to alcohols by converting them to the esters followed by their reduction using catalytic hydrogenation.

Reason : $LiAlH_4$ can also reduce carboxylic acids to primary alcohols but $LiAlH_4$ is an expensive reagent and used for preparing special chemicals only.

Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

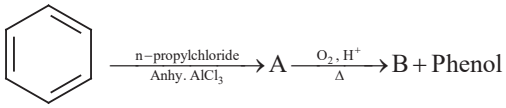
In the light of the statements, choose the most appropriate answer from the options given below :

1) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.

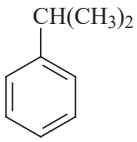
2) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**.

3) **(A)** is correct but **(R)** is not correct.

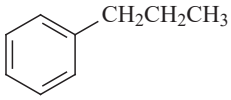
4) **(A)** is not correct but **(R)** is correct.

19. 

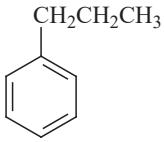
A and B respectively are

1) 

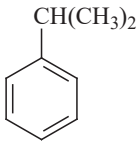
$+ CH_3 – CO– CH_3$

2) 

$+ CH_3 – CH_2 – CHO$

3) 

$+ CH_3 – CO – CH_3$

4) 

$+ CH_3 – CH_2 – CHO$

20. Benzene diazonium chloride on heating with water gives

1) Benzene

2) Orthochloro phenol

3) Phenol

4) Chlorobenzene

21. Which of the following aryl chlorides on warming with water forms the corresponding phenol?

1) 4-Methylchlorobenzene

2) 4-Nitrochlorobenzene

3) 2,4,6-Trinitrochlorobenzene

4) 2,4-Dinitrochlorobenzene

Physical and chemical properties of alcohols and phenols

22. Which of the following alcohol is least soluble in water?

1) Butan-2-ol

2) Butan-1-ol

3) Isobutyl alcohol

4) tert-Butyl alcohol

23. Among the given compounds boiling point is highest for

1) $CH_3CH_2C(CH_3)_2OH$

2) $CH_3CH_2CH_2CH(CH_3)OH$

3) $CH_3CH_2CH_2CH_2CH_2OH$

4) $CH_3CH_2 – O–CH_2–CH_3$

24. Alcohols have higher boiling point than parent hydrocarbons because of

1) Presence of carbon chain

2) Higher molecular masses

3) Presence of intermolecular hydrogen bonding

4) Presence of intra molecular hydrogen bonding

25. The pKa value of the following alcohols, Methanol [A], Butan-1-ol [B], 2-methyl propan-2-ol [C], Butan-2-ol [D] are in the order

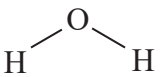
1) A > B > D > C

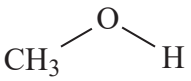
2) D > A > B > C

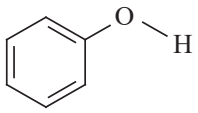
3) C > A > B > D

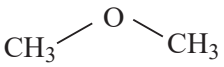
4) C > D > B > A

26. The compound that is most difficult to protonate is

1) 

2) 

3) 

4) 

27. The correct order of reactivity of 1°, 2° and 3° alcohols towards potassium metal is

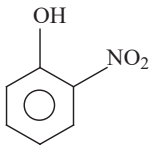
1) 3° > 2° > 1°

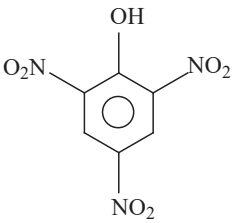
2) 2° > 3° > 1°

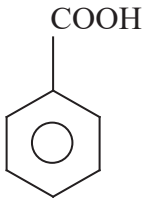
3) 1° > 2° > 3°

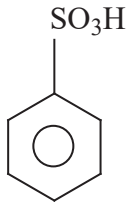
4) 1° > 3° > 2°

28. Which among the following is not likely to dissolve in $NaHCO_3$ solution?

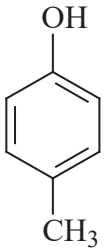
1) 

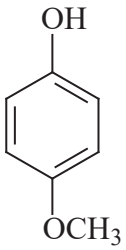
2) 

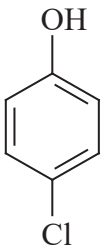
3) 

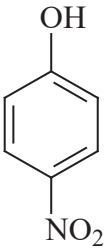
4) 

29. The correct order of decreasing acidity for p, q, r and s is

p) 

q) 

r) 

s) 

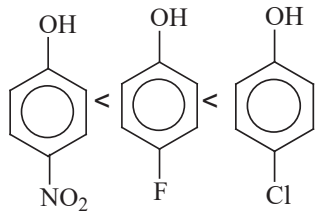
1) s > r > p > q

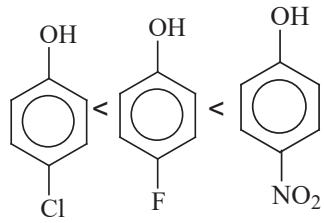
2) p > q > r > s

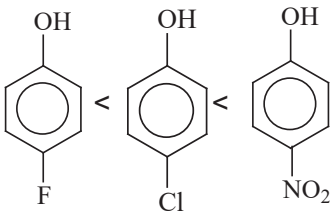
3) q > s > r > p

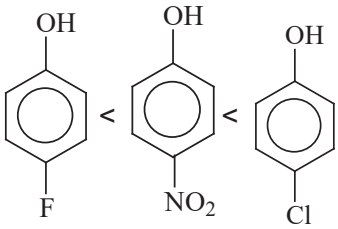
4) r > s > q > p

30. The correct order of acidic strength of the following substituted phenols is

1) 

2) 

3) 

4) 

31. **Statement I** : Picric acid is a strong acid inspite of absence of carboxylic group.

Statement II : Three $-NO_2$ groups in picric acid stabilises the phenolate ion

1) Both **statement I** and **statement II** are correct.

2) Both **statement I** and **statement II** are incorrect.

3) **Statement I** is correct but **statement II** is incorrect.

4) **Statement I** is incorrect but **statement II** is correct.

32. Why is the oxidation of primary alcohol with a mixture of sodium dichromate and conc. H_2SO_4, not a good method for the preparation of corresponding aldehyde?

1) Any aldehyde formed will be oxidised further

2) A mixture of sodium dichromate and sulphonic acid will not oxidise a primary alcohol

3) The product will be a corresponding ketone

4) The product will be an alkyl sulphonic acid, $R–SO_3H$

33. Consider the following sequence of reactions

$$\underset{(\text{excess})}{Ph-CH_3 + Cl_2} \xrightarrow{\Delta} A \xrightarrow{\text{aq.KOH}} B \xrightarrow{Na} C$$

$A + C \xrightarrow{\Delta} D$. Product D is

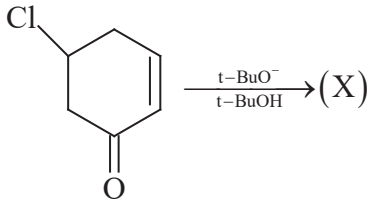
1) $Ph — CH_2 — O\ Ph$

2) $Ph — CH_2 — O — CH_2 — Ph$

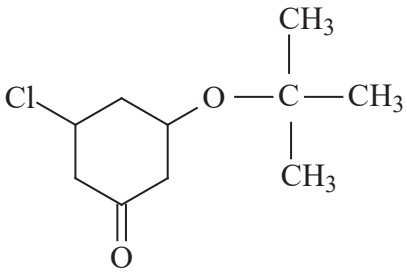
3) $Ph — CH_2 — CH_2 — Ph$

4) $Ph — CH_2 — \overset{\overset{O}{\|}}{C} — H$

34.



1)



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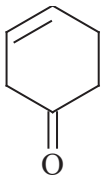

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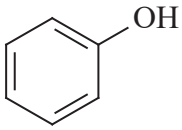

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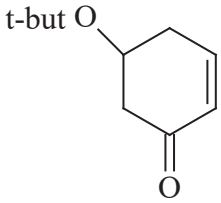


35. On oxidation, an alcohol gives an aldehyde having the same number of carbon atoms as that of alcohol. The alcohol is

1) 3°

2) 2°

3) 1°

4) may be 2° or 3°

36. The –OH group of methyl alcohol cannot be replaced by

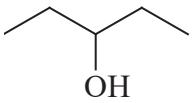
1) PCl_5

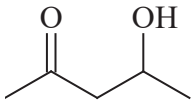
2) Cl_2

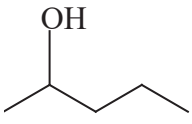
3) HCl

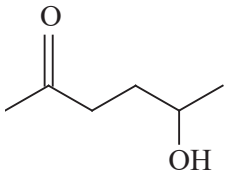
4) PCl_3

37. Which of the following will most readily dehydrated in acidic conditions?

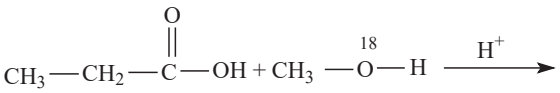
1) 

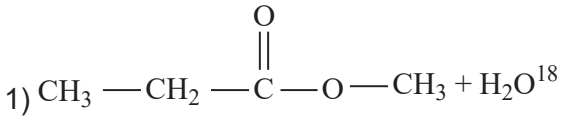
2) 

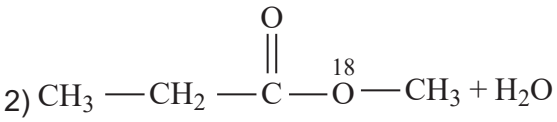
3) 

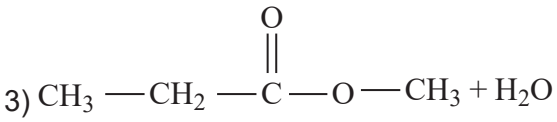
4) 

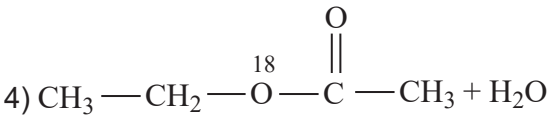
38. Product of the given reaction is



1) 

2) 

3) 

4) 

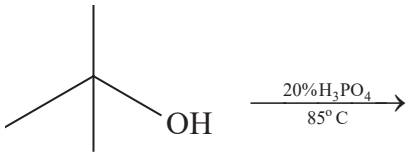
39. Compound A of molecular formula $C_4H_{10}O$ on treatment with Lucas reagent at room temperature gives compound B. When compound B is heated with alcoholic KOH, it gives isobutene. Compound A and B are respectively

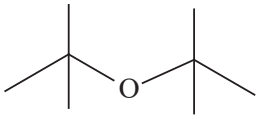
1) Butan-2-ol and 2-chlorobutane

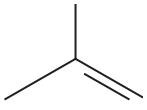
2) 2-methylpropan-1-ol and 2-methyl-2-chloropropane

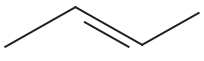
3) 2-methyl propan-1-ol and 1-chloro-2-methyl propane

4) 2-methyl propan-2-ol and 2-chloro-2-methyl propane

40.  product is

1) 

2) 

3) 

4) No reaction

41. The intermediate species involved in the acid catalysed dehydration of alcohol is

1) Free radical 2) Carbocation

3) Carbanion 4) Carbene

42. Which among the following will give a turbidity on shaking with Lucas reagent at room temperature

1) Butan-1-ol

2) 2-Phenyl ethanol

3) Phenyl methanol

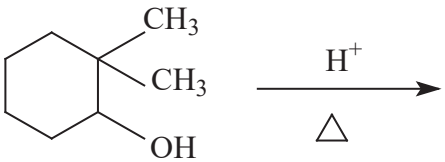
4) Carbinol

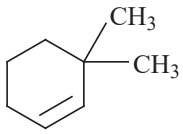
43. Which among the following alcohols, on dehydration will produce alkene that exhibit cis-trans isomerism?

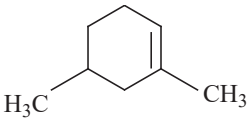
1) Propan-1-ol 2) Propan-2-ol

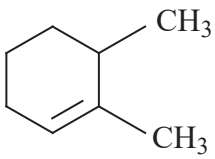
3) Pentan-3-ol 4) Isobutyl alcohol

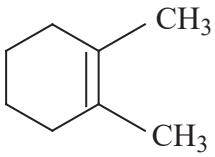
44. Find the product of the given reaction?



1) 

2) 

3) 

4) 

45. An unknown compound of MF $C_3H_8O_3$, on acetylation gave the acetylated product of MF $C_9H_{14}O_6$. The number of -OH groups present in the original compound is

1) 1 2) 2

3) 3 4) 4

46. **Assertion** : Addition of methyl alcohol to phenyl magnesium bromide gives benzene.

Reason : Methyl alcohol contains acidic hydrogen.

Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

In the light of the statements, choose the most appropriate answer from the options given below :

1) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.

2) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**.

3) **(A)** is correct but **(R)** is not correct.

4) Both **(A)** and **(R)** are not correct.

47. Slowest step in the dehydration of alcohols in acidic medium is

1) Step 1 (protonation of alcohol)

2) Step-2 (formation of carbocation)

3) Step 3 (formation of alkene by elimination of proton)

4) Rearrangement of carbocation

48. Ortho and para nitrophenol can be separated by

1) Simple distillation

2) Fractional distillation

3) Vacuum distillation

4) Steam distillation

49. The IUPAC name of the product obtained by the oxidation of phenol with the help of chromic acid is

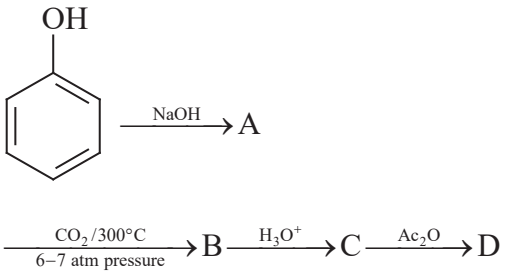
1) Cyclohexa-2,4-diene-1,4-diol

2) Cyclohexa-2,4-diene-1,4-dione

3) Cyclohexa-2,5-diene-1,4-diol

4) Cyclohexa-2,5-diene-1,4-dione

50.

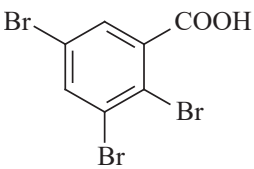


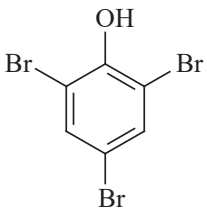
'D' is

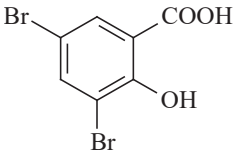
1) Salicylic acid 2) Aspirin

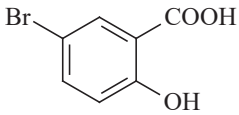
3) Cumene 4) Valine

51. The action of excess bromine water on salicylic acid results in the formation of

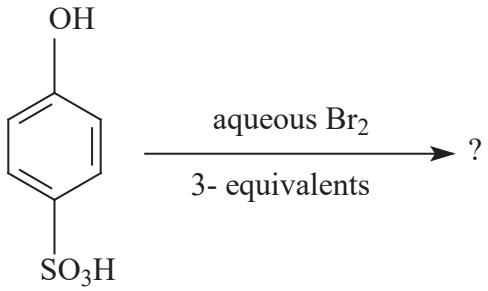
1) 

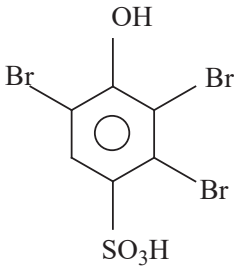
2) 

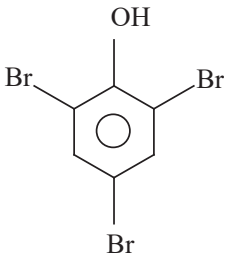
3) 

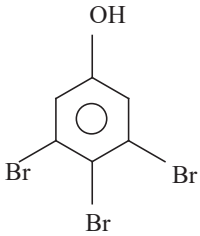
4) 

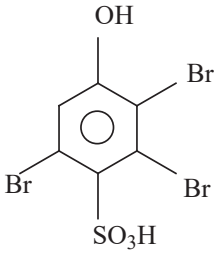
52. The major product of the following reaction is



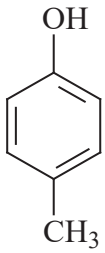
1) 

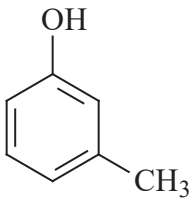
2) 

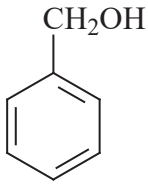
3) 

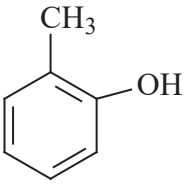
4) 

53. Which among the following gives a tribomoderivative on treatment with Br_2/H_2O

1) 

2) 

3) 

4) 

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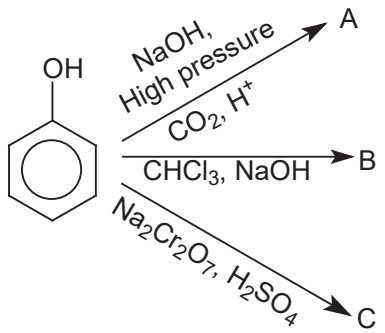


The product A, B, C are respectively

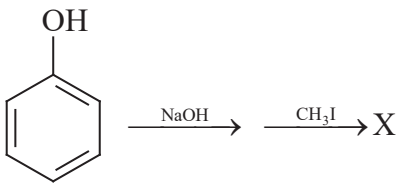
1) salicylic acid, salicylaldehyde, p-benzoquinone

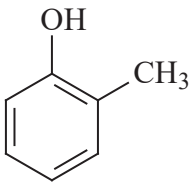
2) salicyl aldehyde, salicylic acid, p-benzoquinone

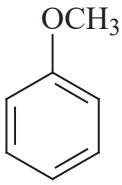
3) salicylic acid, salicylic acid, p-benzoquinone

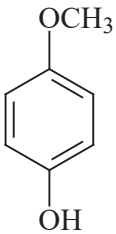
4) salicylaldehyde, salicylaldehyde, quinones

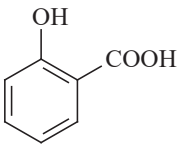
55. Identify X



1) X = 

2) X = 

3) X = 

4) X = 

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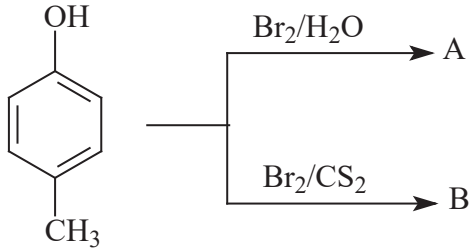
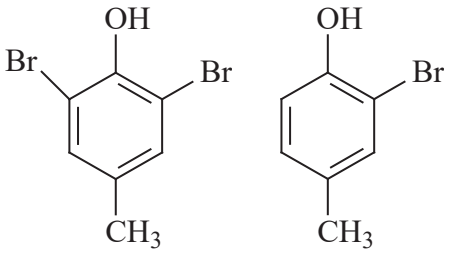
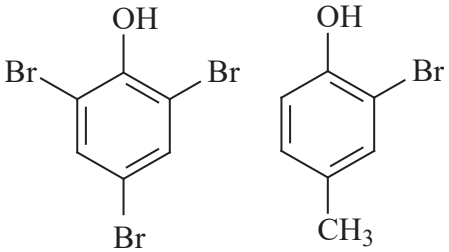
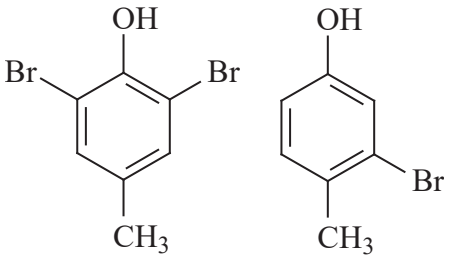
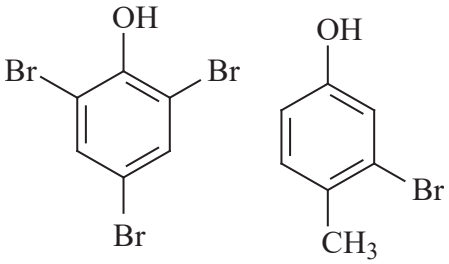


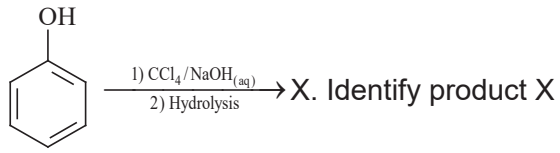
Predominant A and B respectively

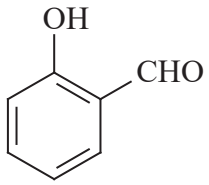
1) 

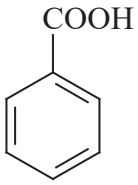
2) 

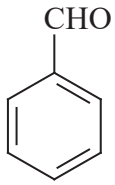
3) 

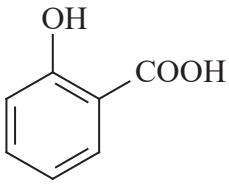
4) 

57. 

1) 

2) 

3) 

4) 

58. **Statement-I** : Phenol is more reactive than benzene towards electrophilic substitution reaction.

Statement-II : In case of phenol the intermediate carbocation is more resonance stabilized.

1) Statement-I is incorrect and Statement-II is correct

2) Both Statement-I and Statement-II are correct

3) Both Statement-I and Statement-II are incorrect

4) Statement-I is correct and Statement-II is incorrect

59. The major product expected during mononitration of 3-methyl phenol is

1) 3-methyl-4-nitrophenol

2) 3-methyl-2-nitrophenol

3) 2,3-dinitrophenol

4) 3-methyl-2,4-dinitrophenol

60. Which among the following statements is not correct.

1) Oxidation of phenol with chromic acid gives a conjugated diketone, known as benzoquinone

2) Phenol upon heating with zinc dust gives benzene

3) Phenoxide ion generated by treating phenol with sodium hydroxide is less reactive than phenol towards electrophilic aromatic substitution

4) o-hydroxy benzoic acid is formed as the major product of Kolbe's reaction.

61. **Assertion** : Bromination of phenol takes place even in the absence of Lewis acid.

Reason : In phenol, OH group attached to benzene ring has highly deactivating effect.

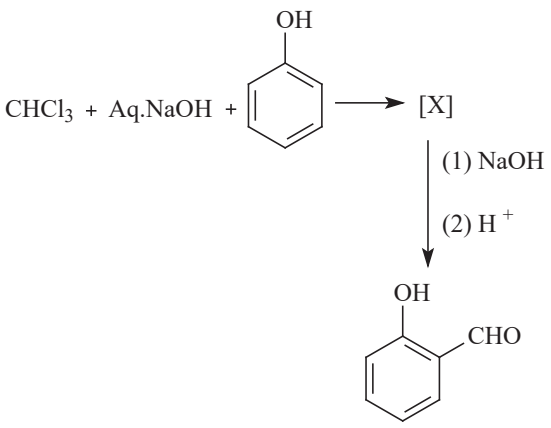
1) **(A)** is correct but **(R)** is not correct.

2) **(A)** is not correct but **(R)** is correct

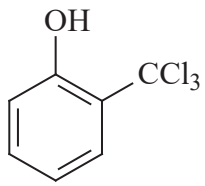
3) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.

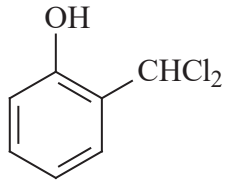
4) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**.

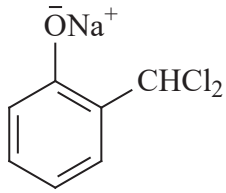
62. The intermediate X, in the reaction

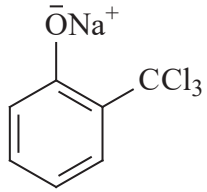


is:

1) 

2) 

3) 

4) 

63. The major product obtained when ethanol is heated with excess of conc. H_2SO_4 at 443 K is

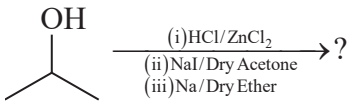
1) ethane

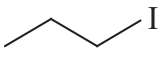
2) methane

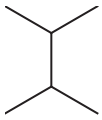
3) ethene

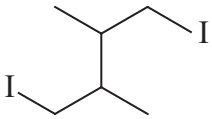
4) ethyne

64. Identify the major product formed from the following



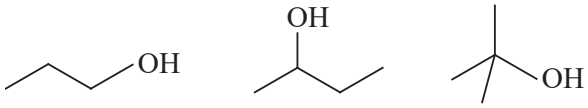
1) 

2) 

3) 

4)

65. Identify the correct trend of acidic strength for the given alcohols



(i) (ii) (iii)

1) i > iii > ii

2) i > ii > iii

3) iii > i > ii

4) iii > ii >i

66. The alcohol that produces turbidity immediately with Lucas reagent at room temperature is:

1) butan-1-ol

2) butan-2-ol

3) 2-methylpropan-2-ol

4) 2-methylpropan-1-ol

67. **Assertion** : Phenol undergo Kolbe reaction, ethanol does not.

Reason : Phenoxide ion is more basic than ethoxide ion.

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

68. The relative ease of dehydration of alcohols follows following order

1) tertiary > secondary > primary

2) primary > secondary > tertiary

3) secondary > tertiary > primary

4) tertiary > primary > secondary

69. Which reagent is used to convert Allyl alcohol to propenal?

1) PCC 2) O_3/H_2O-Zn(Powder)

3) DIBAL-H 4) All above

70. Which of the following alcohol has the highest boiling point?

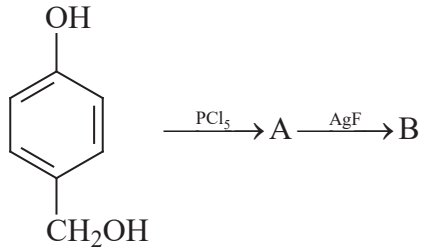
1) Butan-2-ol

2) 2-Methylpropan-2-ol

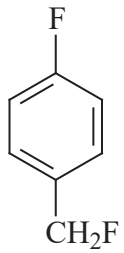
3) Propan-2-ol

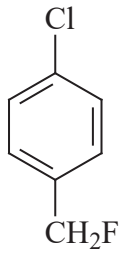
4) Butan-1-ol

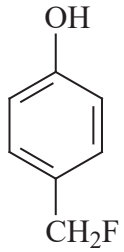
71.

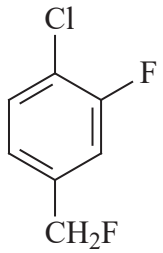


What is B in the above scheme?

1) 

2) 

3) 

4) 

72. Which one of the following is weakly acidic?

1) p-Cresol 2) Phenol

3) p-Nitrophenol 4) p-Chlorophenol

73. Phenol can be distinguished from ethylalcohol using

1) Na 2) $AlCl_3$

3) $NaHCO_3$ 4) $FeCl_3$

74. Phenols are highly acidic compared to alcohols due to

1) the higher molecular mass of phenols

2) the strongest hydrogen bonds in phenols

3) alkoxide ion is a strong conjugate base

4) phenoxide ion is resonance stabilized

75. An organic compound X on treatment with pyridinium chlorochromate in dichloromethane gives compound Y. Compound Y reacts with I_2 and alkali to form triiodomethane. The compound 'X' is

1) C_2H_5OH 2) CH_3CHO

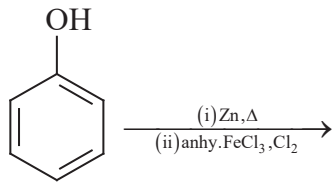
3) CH_3COCH_3 4) CH_3COOH

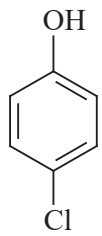
76. Reaction of ROH with R'MgX produces

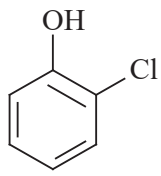
1) RH 2) R'H

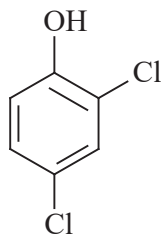
3) R–R 4) R'–R

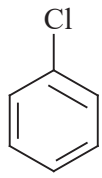
77. The major product of the following reaction is



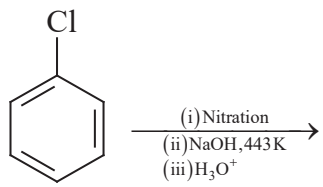
1) 

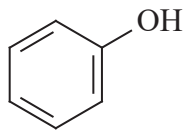
2) 

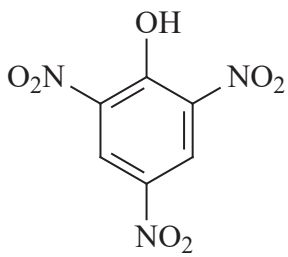
3) 

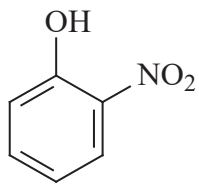
4) 

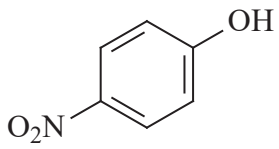
78. Identify the major product



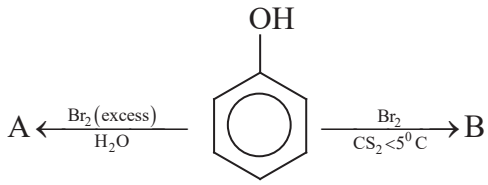
1) 

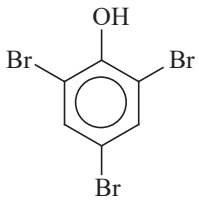
2) 

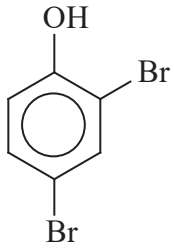
3) 

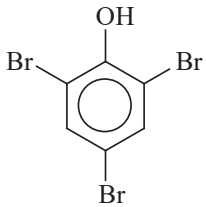
4) 

79. The correct options for the products A and B of the following reactions are

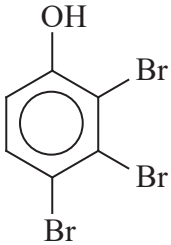


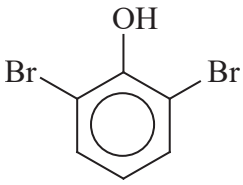
1) A = 

B = 

2) A = 

B =

3) A = 

B= 

4) A=

B=

Some commercially important alcohols

80. During the conversion of starch into ethanol by fermentation process, which of the following sets of enzymes work in succession in the order given?

1) Zymase, Diastase and Maltase

2) Diastase, Maltase and Zymase

3) Maltase, Zymase and Invertase

4) Maltase, Diastase and Zymase

81. Methanol is commercially produced by

1) Oxidation of CH_4 by steam at 900°C

2) Reduction of CH_2O using $LiAlH_4$

3) Reaction of HCHO with a solution of NaOH

4) Catalytic hydrogenation of CO at high temperature and pressure and in the presence of $ZnO–Cr_2O_3$ catalyst

82. Denaturation of alcohol is the

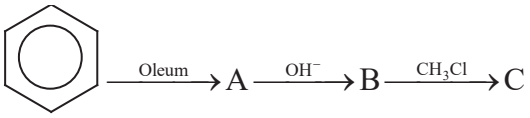
1) Mixing of $Cu(OAc)_2$ and pyridine to make the commercial alcohol unfit for drinking

2) Mixing of $CuSO_4$ (a foul smelling solid) and pyridine (To give the colour) to make the commercial alcohol unfit for drinking

3) Mixing of $CuSO_4$ (to give the colour) and pyridine (a foul smelling liquid) to make the commercial alcohol unfit for drinking

4) Mixing of $Cu(OAc)_2$ and ammonia to make the commercial alcohol unfit for drinking

Preparation of Ether

83. 

1) o-methyl phenol

2) Anisole

3) p-methyl phenol

4) Toluene

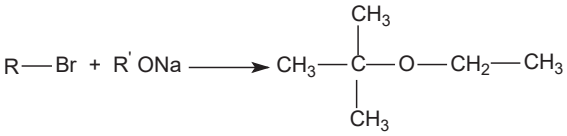
84. Which among the following reagents will give $CH_3 – O – C(CH_3)_3$ as the reaction product?

1) $(CH_3)_3CBr + CH_3CH_2ONa$

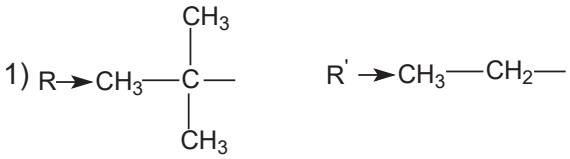
2) $CH_3Br + (CH_3)_3CONa$

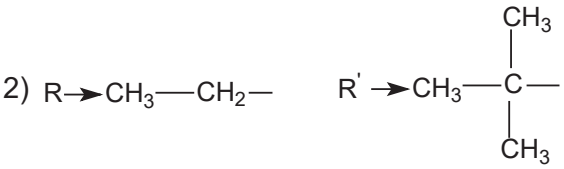
3) $(CH_3)_3CBr + CH_3ONa$

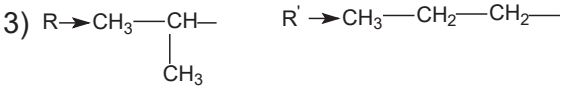
4) $CH_3 – CH_2Br + (CH_3)_3CONa$

85. 

R and R' must be

1) 

2) 

3) 

4) R $\rightarrow CH_3 – CH_2 – CH_2 – CH_2 –$

R'' $\rightarrow CH_3—CH_2—$

86. Williamson's synthesis of preparing dimethyl ether is a/an

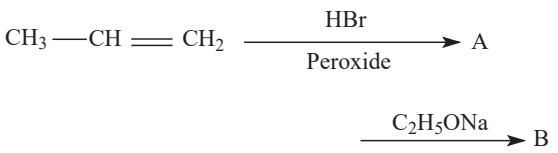
1) S_N1 reaction

2) Electrophilic addition

3) Electrophilic substitution

4) S_N2 reaction

87. Identify the final product 'B' in the following reaction sequence



. B is

1) $CH_3—CH_2—CH_2—O—CH_2—CH_3$

2) $CH_3—CH_2—CH_2—CH_2—O—CH_3$

3) $CH_3—CH(CH_3)—O—CH_2—CH_3$

4) $CH_3—CH(CH_3)—CH_2—O—CH_3$

88. **Assertion** : Phenol reacts with CH_3I in presence of NaOH to form methoxybenzene.

Reason : Phenoxide ion is a better nucelophile than phenol.

1) If both assertion and reason are correct and reason is the correct explanation of assertion

2) If both assertion and reason are correct but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

Physical properties of ethers

89. An ether is more volatile than alcohol having same molecular formula. This is due to

1) Intermolecular hydrogen bonding in ethers

2) Dipolar character of ethers

3) Absence of intermolecular hydrogen bonding in ether

4) Alcohols have resonance structures

Chemical reactions of ethers

90. The cleavage of an aryl alkyl ether with cold HI gives

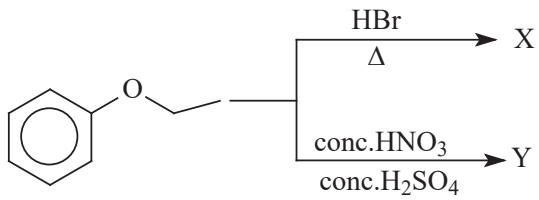
1) Alkyliodide and water

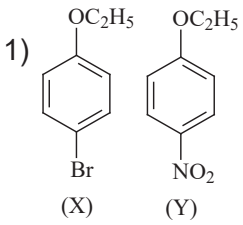
2) Aryl iodide and water

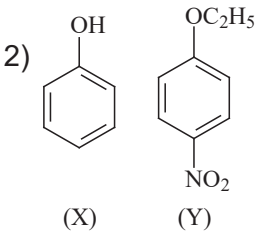
3) Alkyl iodide, aryl iodide and water

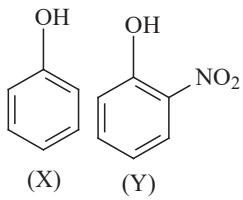
4) Phenol and alkyl iodide

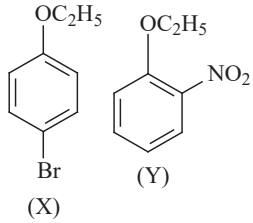
91. Predict the major product of the following reaction



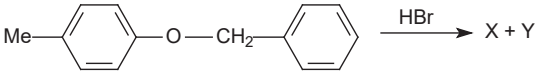
1) 

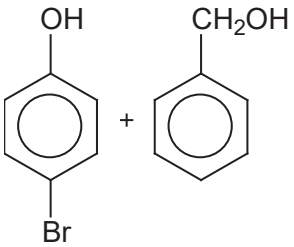
2) 

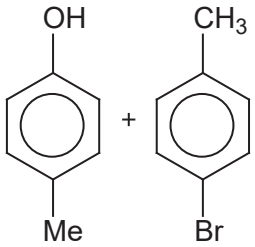
3) 

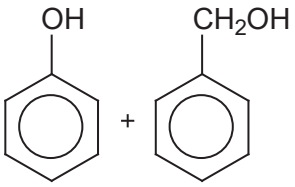
4) 

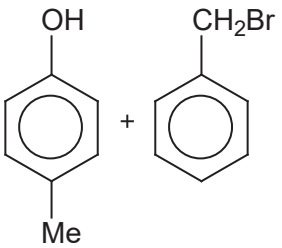
92. (X) and (Y) in the following reaction are respectively :



1) 

2) 

3) 

4) 

93. Identify the product of the following reaction.

$$CH_3CH_2CH_2CH_2OCH_3 + HBr \longrightarrow$$

1) $CH_3CH_2CH_2CH_2Br + CH_3OH$

2) $CH_3CH_2CH_2CH_2OH + CH_3Br$

3) $CH_3CH_2CH_2COOH + CH_3Br$

4) $CH_3CH_2CH_2CH_2Br + HCOOH$

94. **Assertion** : The cleavage of C-O bond in ethers takes place under drastic condition with excess of hydrogen halides.

Reason : Ethers are the most reactive among all the functional groups.

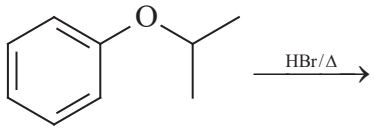
1) Both (A) and (R) are correct and (R) is the correct explanation of (A).

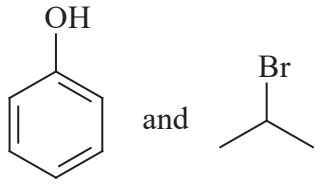
2) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

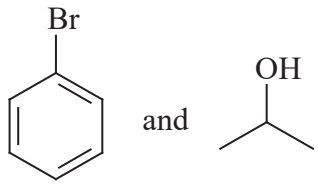
3) (A) is correct but (R) is not correct.

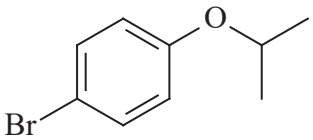
4) (A) is not correct but (R) is correct.

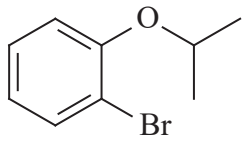
95. Identify the products formed in the following reaction



1) 

2) 

3) 

4) 

96. Which reagent is used for bromination of methylphenylether?

1) Br_2/Red P
2) Br_2/CH_3COOH
3) $Br_2/FeBr_3$
4) HBr/ Δ

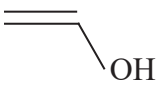
97. What are the products in the following reaction?

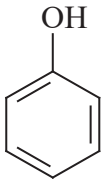
$$C_2H_5OC_2H_5 \xrightarrow[\text{Cold}]{\text{HI}} X + Y$$

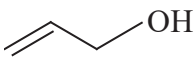
1) CH_3COOH, $CH_2 = CH_2$
2) CH_3CHO, $CH_2 = CH_2$
3) C_2H_5OH, C_2H_5I
4) None of the above

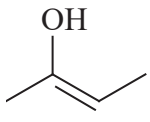
SAMPLE QUESTIONS

1. Identify the structure of allylic alcohol

1) 

2) 

3) 

4) 

2. Which of the following phenols is not dihydric?

1) m-Cresol
2) Catechol
3) Resorcinol
4) Quinol

3. Which of the following has the highest boiling point?

1) Propan-1-ol
2) Butan-1-ol
3) Butan-2-ol
4) Pentan-1-ol

4. Water is a _____ than alcohol.

1) better proton acceptor
2) stronger base
3) weaker acid
4) better proton donor

5. Aspirin is produced from the reaction between salicylic acid and which compound?

1) Benzoic acid
2) Acetic anhydride
3) Phenyl acetate
4) Benzoyl chloride

6. What is the catalyst X used in the following reaction?

$$2^0 \text{ alcohol} + HCl_{(conc.)} \xrightarrow{X} \text{chloroalkane} + H_2O$$

1) Anhydrous $AlCl_3$
2) Anhydrous $FeCl_3$
3) Anhydrous $ZnCl_2$
4) No catalyst required

7. The oxidation of alcohol involves the cleavage of _____ bonds.

1) O-H
2) C-H
3) O-H and C-H
4) Hydrogen

8. Which of the following compounds gives a ketone when its vapours are passes over heated copper are :

1) Propan-1-ol
2) Propan-2-ol
3) 2-Methylpropan-1-ol
4) 2-Methylpropan-2-ol

9. Compare acidity among

R– O – H, R – O – R and H_2O

1) R – O – H > R – O – R > H_2O

2) R – O – H > H_2O > R – OH

3) H_2O > R – O – H > R – O – R

4) H_2O > R – O – R > R – OH

10. Which of the following is incorrect regarding Kolbe's reaction?

1) The final product is Salicylic acid

2) CO_2 acts as an electrophile

3) Acidification of phenol leads to formation of main product

4) Phenoxide ion undergoes electrophilic attack

11. Ethylene glycol is

1) Ethane-1,2-diol

2) 2-methylpropan-1-ol

3) Propane-1,2,3-triol

4) Butane-1,2,4-triol

12. The final products formed when benzyl ethyl ether reacts with hydrogen iodide at a high temperature are :

1) 1-iodoethane and 1-phenylmethanol

2) Ethanol and o-iodotoluene

3) Benzyl iodide and ethanol

4) No reaction takes place

13. Formaldehyde reacts with the Grignard reagent and followed by hydrolysis gives

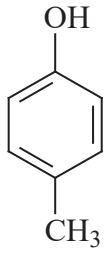
1) Secondary alcohol

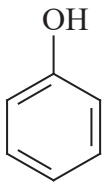
2) Tertiary alcohol

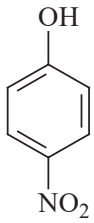
3) Ether

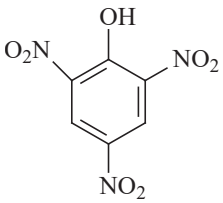
4) Primary alcohol

14. Which one is the most acidic compound?

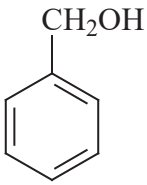
1) 

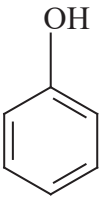
2) 

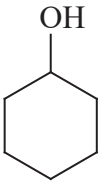
3) 

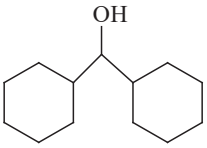
4) 

15. The most acidic compound among the following is :

1) 

2) 

3) 

4) 

16. Which one of the following on oxidation gives a ketone?

1) Primary alcohol

2) Secondary alcohol

3) Tertiary alcohol

4) All of these

17. Ethyl alcohol gives ethylchloride with the help of

1) $SOCl_2$ 2) NaCl

3) $CaCl_2$ 4) KCl

18. How many isomers of $C_5H_{11}OH$ will be primary alcohols?

1) 5 2) 4

3) 2 4) 3

19. n-propyl alcohol and isopropyl alcohol are the examples of

1) position isomerism

2) chain isomerism

3) tautomerism

4) geometrical isomerism

20. Allyl phenyl ether can be prepared by

1) $CH_2 = CH – CH_2 – ONa + C_6H_5CH_2 –Br$

2) $C_6H_5 – CH = CH – Br + CH_3 – ONa$

3) $CH_2 = CH – ONa + C_6H_5Br$

4) $CH_2 = CH – CH_2 – Br + C_6H_5ONa$

21. Which one of the following set of reaction gives ether as a main product?

1) Isopropyl bromide and sodium methoxide

2) Ethyl bromide and sodium tertiary butoxide

3) Tertiary butyl bromide and sodium isopropoxide

4) Bromo benzene and sodium phenoxide

22. Rectified spirit has ethanol

1) 5% 2) 95%

3) 100% 4) 80%

23. **Assertion :** p -nitrophenol is more acidic than phenol.

Reason : Nitro group helps in the stabilisation of the phenoxide ion by dispersal of negative charge due to resonance.

1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true and reason is not the correct explanation of assertion

3) If assertion is true but reason is false

4) If both assertion and reason are false

24. **Assertion :** Phenol forms 2, 4, 6-tribromo phenol on treatment with Br_2 in carbondisulphide at 273K.

Reason : 2,4,6-Tribromo phenol is called picric acid.

1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true and reason is not the correct explanation of assertion

3) If assertion is true but reason is false

4) If both assertion and reason are false

25. **Assertion :** Bond angle in ethers is slightly less than the tetrahedral angle.

Reason : There is a repulsion between the two bulky (–R) groups.

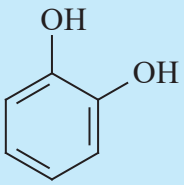
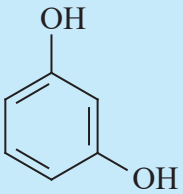
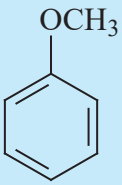
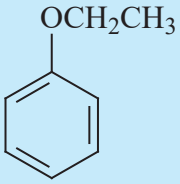
1) If both assertion and reason are true and reason is the correct explanation of assertion

2) If both assertion and reason are true and reason is not the correct explanation of assertion

3) If assertion is false but reason is true

4) If both assertion and reason are false

26. Match the following

Column I	Column II
i) 	1) Resorcinol
ii) 	2) Anisole
iii) 	3) Catechol
iv) 	4) Phenetole

1) i-3, ii-1, iii-2, iv-4

2) i-i, ii-2, iii-3, iv-4

3) i-3, ii-1, iii-4, iv-2

4) i-3, ii-4, iii-1, iv-2

27. Arrange the following compounds in the increasing order of acidic nature

CH_3OH 1° alcohol

2° alcohol 3° alcohol

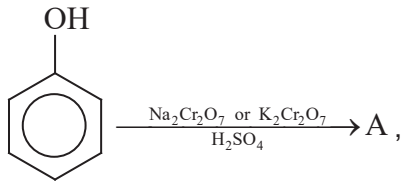
H_2O

1) H_2O > 1° > 2° > 3° > CH_3OH

2) CH_3OH > H_2O > 1° > 2° > 3°

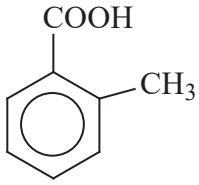
3) 2° > 3° > 1° > H_2O > CH_3OH

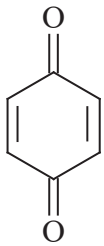
4) H_2O > CH_3OH > 1° > 2° > 3°

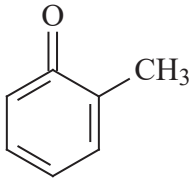
28. 

, find A from the following compounds

1)

2) 

3) 

4) 

29. **Statement I :** o-Nitrophenol is less acidic than the m-and p-isomers.

Statement II : m and p-Nitrophenol exist as associated molecules.

1) Both Statement-I and Statement-II are true but statement II not exact explanation of statementI

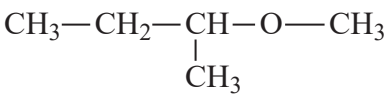
2) Both Statement-I and Statement-II are false

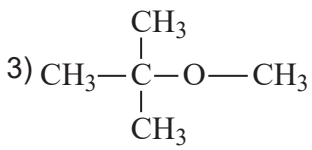
3) Statement-I is true, but Statement-II is false

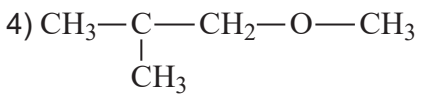
4) Statement-I is false, but Statement-II is true

30. Among the following ethers, which one will produce methyl alcohol on treatment with hot concentrated HI

1) $CH_3 - CH_2 - CH_2 - CH_2 - O - CH_3$

2) 

3) 

4) 

31. Propene, $CH_3CH = CH_2$ can be converted into 1-propanol by oxidation, indicate which set of reagents amongest the following is ideal to effect the above conversation?

1) $KMnO_4$(alkaline)

2) Osmium tetraoxide (OsO_4/CH_2Cl_2)

3) B_2H_6 and alk. H_2O_2

4) O_3/Zn

32. A compound of the formula $C_4H_{10}O$ reacts with sodium and undergoes oxidation to give a carbonyl compound which does not reduce Tollen's reagent, the original compound is

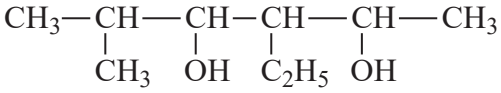
1) Diethyl ether

2) n-Butyl alcohol

3) Isobutyl alcohol

4) Sec. Butyl alcohol

33. Write the IUPAC name of the following compounds



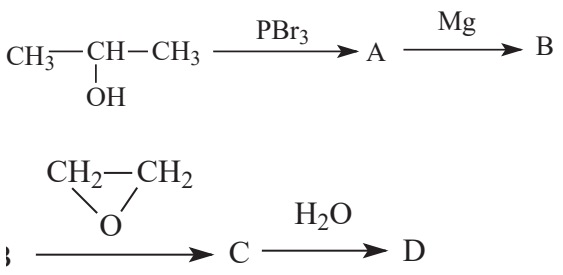
1) 3-Ethyl-5-methylhexane-2,4-diol

2) 4-Ethyl-2-methylhexane-2,4-diol

3) 3-Ethyl-5-methylhexane-2,4-triol

4) 3-Ethyl-5-methylpentane-2,4-diol

34.



Here D is

1) $CH_3-\underset{\underset{CH_3}{|}}{CH}-O-CH_2-CH_3$

2) $CH_3-O-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_3$

3) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2OH$

4) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2OH$

35. When alkyl aryl ether is heated with HI, it gives

1) alcohol and phenol

2) alcohol and aryl halide

3) phenol and alkyl halide

4) alkyl halide and aryl halide

36. Which of the following is the strongest acid?

1) $C_6H_5CH_2OH$

2) $C_6H_5COCH_3$

3) C_6H_5OH

4) CH_3OH

37. The increasing order of acidic character of phenol, p-cresol, m-nitrophenol and p-nitrophenol is

1) phenol < p-cresol < p-nitrophenol < m-nitrophenol

2) p-cresol < phenol < m-nitrophenol < p-nitrophenol

3) p-cresol < m-nitrophenol < phenol < p-nitrophenol

4) m-nitrophenol < phenol < p-cresol < p-nitrophenol

38. The reaction of 'tert-butyl methyl ether' with one equivalent of HI gives ———

1) tert-butyl iodide & methyl iodide

2) iso-butene & methyl iodide

3) iso-butene & methanol

4) tert-butyl iodide & methanol

39. The reaction used for the synthesis of ether is

1) Williamson's synthesis

2) Reimer-Tiemann reaction

3) Sandmeyer reaction

4) Finkelstein reaction

40. Phenol is converted into benzene in presence of

1) anhy.$AlCl_3$ 2) $Na_2Cr_2O_7$

3) Zn 4) Cu

41. Phenol can be distinguished from ethanol by the reagent

1) bromine water 2) sodium metal

3) iron metal 4) chlorine water

42. Phenol on oxidation in air gives:

1) quinone

2) catechol

3) resorcinol

4) o-cresol

43. Which one of the following alcohols is known as wood spirit?

1) Methanol

2) Ethanol

3) Propanol

4) Butanol

44. **Assertion** : tert-butyl methyl ether is not prepared by the reaction of tert-butyl bromide with sodium methoxide.

Reason : Sodium methoxide is a strong nucleophile.

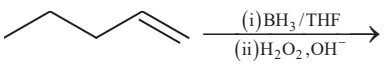
1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

45. The product of the following reaction is



1) 1-Pentanol 2) 2-Pentanol

3) Pentane 4) 1,2-Pentanediol

46. Carbolic acid is:

1) HCOOH

2) CH_3COOH

3) C_6H_5COOH

4) C_6H_5OH

47. Ether show isomerism with:

1) alcohol

2) ethane

3) halide

4) aldehyde

48. The reaction,

$C_6H_5OH \xrightarrow[\text{Pyridine}]{CH_3COCl} C_6H_5OCOCH_3$ is called

1) Reimer-Tiemann reaction

2) Schotten-Baumann reaction

3) Acetylation

4) Benzoylation

49. Lucas test is used for the detection of

1) alcohols

2) alkyl halides

3) phenols

4) aldehydes

50. A fruity smell is obtained by the reaction of ethanol with

1) CH_3COCH_3 2) PCl_5

3) CH_3COOH 4) CH_3CHO

ANSWER KEY

1. 4	21. 3	41. 2	61. 1	81. 4
2. 4	22. 2	42. 3	62. 3	82. 3
3. 4	23. 3	43. 3	63. 3	83. 2
4. 2	24. 3	44. 4	64. 2	84. 2
5. 2	25. 4	45. 3	65. 2	85. 2
6. 1	26. 3	46. 1	66. 3	86. 4
7. 4	27. 3	47. 2	67. 3	87. 1
8. 2	28. 1	48. 4	68. 1	88. 1
9. 1	29. 1	49. 4	69. 1	89. 3
10. 2	30. 3	50. 2	70. 4	90. 4
11. 4	31. 1	51. 2	71. 3	91. 2
12. 1	32. 1	52. 2	72. 1	92. 4
13. 2	33. 2	53. 2	73. 4	93. 2
14. 2	34. 3	54. 1	74. 4	94. 3
15. 1	35. 3	55. 2	75. 1	95. 1
16. 2	36. 2	56. 1	76. 2	96. 2
17. 3	37. 2	57. 4	77. 4	97. 3
18. 2	38. 2	58. 2	78. 4	
19. 1	39. 4	59. 1	79. 2	
20. 3	40. 2	60. 3	80. 2	

SAMPLE QUESTIONS

1. 3	11. 1	21. 2	31. 3	41. 1
2. 1	12. 3	22. 2	32. 4	42. 1
3. 4	13. 4	23. 1	33. 1	43. 1
4. 4	14. 4	24. 4	34. 3	44. 2
5. 2	15. 2	25. 3	35. 3	45. 1
6. 3	16. 2	26. 1	36. 3	46. 4
7. 3	17. 1	27. 2	37. 2	47. 1
8. 2	18. 2	28. 3	38. 4	48. 3
9. 3	19. 1	29. 2	39. 1	49. 1
10. 3	20. 4	30. 3	40. 3	50. 3

WORK BOOK

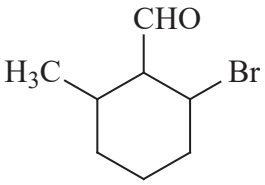
Chapter 20

ALDEHYDES AND KETONES

QUESTIONS

GENERAL INTRODUCTION & NOMENCLATURE

1. IUPAC name of the following compound



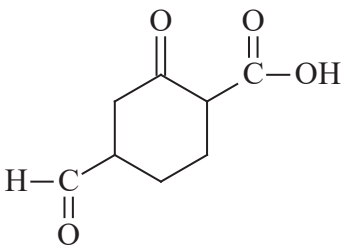
1) 2-Bromo-6-methylcyclohexanal

2) 2-Bromo-6-methylcyclohexanecarbaldehyde

3)2-Methyl-6-bromocyclohexanecarbaldehyde

4) 2-Methyl-6-bromocyclohexanal

2.



1) 2-oxo-4-formylcyclohexanoic acid

2) 2-oxo-4-formylcyclohexanecarboxylic acid

3) 4-formyl-2-oxocyclohexanecarboxylic acid

4) 4-formyl-2-oxocyclohexanoic acid

3. Aldehydes contains a carbonyl group connected to hydrogen and an alkyl group except in ease of

1) Acetaldehyde

2) Formaldehyde

3) Propionaldehyde

4) Valeraldehyde

4. **Statement I** : Aldehydes can be considered as derivatives of hydrocarbons in which two hydrogen atoms on end carbon atom have been replaced by a bivalent oxygen atom.

Statement II : Ketones can be considered as derivatives of hydrocarbons in which two hydrogen atoms on a carbon atom present in the middle of a carbon chain have been replaced by a bivalent oxygen atom.

1) Both Statement-I and Statement-II are true

2) Both Statement-I and Statement-II are false

3) Statement-I is true, but Statement-II is false

4) Statement-I is false, but Statement-II is true

5. Which of the following statement is not true?

1) Carbonyl group is similar to carbon-carbon double bond in alkenes, is composed of one σ bond and one π bond

2) Carbonyl carbon is sp^2 hybridised

3) A carbonyl group has a tetrahedral arrangement of electron pairs around it

4) Bond angle around a carbonyl group is 120^0

6. The following compounds are related as

I) $CH_3 – CH_2 – CHO$

II) $CH_2 = CH – CH_2 – OH$

1) chain isomers

2) Functional isomers

3) Position isomers

4) Tautomers

7. Match the following

Column I (Common names)		Column II (IUPAC names)	
a)	Divinyl ketone	p)	4-methylpent-3-en-2-one
b)	Isobutyraldehyde	q)	penta-1,4-dien-3-one
c)	Acrolein	r)	2-methylpropanal
d)	Mesityloxide	s)	prop-2-enal

1) a-q, b-r, c-s, d-p

2) a-q, b-r, c-p, d-s

3) a-r, b-q, c-p, d-s

4) a-s, b-q, c-p, d-r

8. The isomerism exhibited by butanal and tetrahydrofuran is

1) chain isomerism

2) position isomerism

3) functional isomerism

4) geometrical isomerism

9. Which of the following is not the correct IUPAC name of the given compounds:

1) CH_3COCH_3 - Propanone

2) $CH_3COCH_2CH_3$- Butan-3-one

3) $CH_3CH_2COCH_2CH_3$- Pentan-3-one

4) $CH_3—\underset{\underset{CH_3}{|}}{C}HCOCH_2CH_2CH_3$-

2-Methylhexan-3-one

10. IUPAC name of α-chloropropionaldehyde is

1) 2-chlorobutanal

2) 3-chlorobutanal

3) 2-chloropropanal

4) 3-chloropropanal

11. Common name of the first member of ketone family is

1) Formaldehyde 2) Acetaldehyde

3) Acetone 4) Diethylketone

12. Acetaldehyde and vinyl alcohol are related as

1) chain isomers 2) identical molecules

3) metamers 4) tautomers

13. IUPAC name of dimethylglyoxal is

1) Ethane-1,2-dial

2) 2-oxopropanal

3) Butane-2,3-dione

4) None of these

14. **Statement I** : Aldehydes with more than 3 carbon atoms can exhibit isomerism among themselves.

Statement II : Acetone and butanone are homologous

1) Both Statement-I and Statement-II are true

2) Both Statement-I and Statement-II are false

3) Statement-I is true, but Statement-II is false

4) Statement-I is false, but Statement-II is true

15. **Assertion (A)**: In carbonyl compounds, both carbonyl carbon and carbonyl oxygen are sp^2 hybridized

Reason (R) : Bond angle around carbonyl carbon is 120^0

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

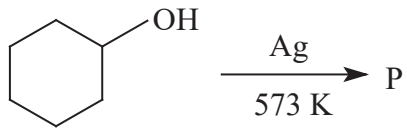
16. Find product X in the following reaction

$$CH_3-CH_2-CH=CH_2 \xrightarrow[\text{ii)}H_2O_2/OH^-]{\text{i)}B_2H_6/THF} \xrightarrow[DCM]{PCC} X$$

1) Valeraldehyde 2) Butyraldehyde

3) Butanone 4) Pentan-2-one

17. Consider the following reaction



Identify the major product P

1) Cyclohexene

2) Cyclohexanone

3) Cyclohexane

4) Cyclohexanecarbaldehyde

18. Consider the following reaction

$$CH_3-CH_2-COOH \xrightarrow{CaO} X \xrightarrow{\text{Dry distillation}} Y$$

Identify product Y from the following

1) $CH_3-\overset{\overset{O}{||}}{C}-CH_3$

2) CH_3-CH_2-CHO

3) $CH_3-CH_2-\overset{\overset{O}{||}}{C}-CH_2-CH_3$

4) $CH_3-\overset{\overset{O}{||}}{C}-CH_2-CH_2-CH_3$

19. Predict the product Q of the following reaction.

$$CH\equiv CH \xrightarrow{HCl(2\ eq.)} P \xrightarrow[\text{ii)}\Delta]{\text{i)aq.NaOH}} Q$$

1) CH_3-CH_2-OH

2) CH_3-CHO

3) $CH_3-\overset{\overset{O}{||}}{C}-CH_3$

4) CH_3-CH_2-CHO

20. The products obtained during the reductive ozonolysis of o-xylene is

1) $CH_3-\overset{O}{\overset{||}{C}}-\overset{O}{\overset{||}{C}}-CH_3$

2) $H-\overset{O}{\overset{||}{C}}-\overset{O}{\overset{||}{C}}-H$

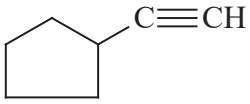
3) $CH_3-\overset{O}{\overset{||}{C}}-\overset{O}{\overset{||}{C}}-H$

4) All of these

21. Which of the following gives same product on hydration catalysed by Hg^{2+} salt as well as by hydroboration oxidation?

1) $CH_3-C\equiv C-CH_2-CH_3$

2) $CH_3-C\equiv C-CH_3$

3) 

4) $CH_3-\underset{\underset{CH_3}{|}}{C}-C\equiv CH$

22. $CH_3-CH_2-Cl \xrightarrow{\text{Ethanolic KCN}} X \xrightarrow[\text{Dry, ether}]{CH_3MgI} Y \xrightarrow{H_3O^{\oplus}} Z$

Identify product Z in above reaction

1) CH_3-CH_2-CHO

2) $CH_3-\overset{O}{\overset{||}{C}}-CH_3$

3) $CH_3-CH_2-\overset{O}{\overset{||}{C}}-CH_3$

4) $CH_3-CH_2-CH_2-CHO$

23. Predict the product (X) of the following reaction

$$H-\overset{O}{\overset{||}{C}}-OC_2H_5 \xrightarrow[\text{ii) } H_3O^{\oplus}]{\text{i) } CH_3CH_2CH_2MgBr} X$$

1) $H-\overset{O}{\overset{||}{C}}-CH_2CH_3$

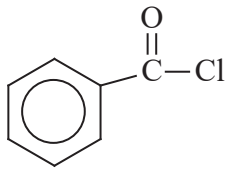
2) $H-\overset{O}{\overset{||}{C}}-\underset{\underset{CH_3}{|}}{CH}-CH_3$

3) $H-\overset{OH}{\overset{|}{C}}(CH_2CH_2CH_3)_2$

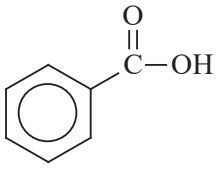
4) $CH_3-\overset{O}{\overset{||}{C}}-CH_2-CH_2-CH_3$

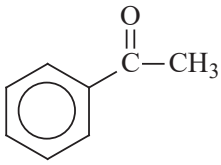
24. Consider the following reaction

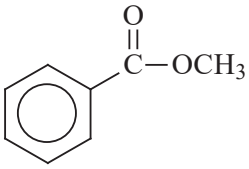
$$\underset{(2\,eq.)}{CH_3-MgCl} + \underset{(1\,eq.)}{CdCl_2} \xrightarrow[\text{ether}]{\text{Dry}} X + MgCl_2$$

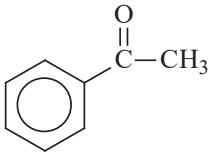
X +  $\xrightarrow[\text{ether}]{\text{Dry}} Y + CdCl_2$

Identify product X and Y

1) X = $CdCH_3$, Y = 

2) X = $Cd(CH_3)_2$, Y = 

3) X = $Cd(CH_3)_2$, Y = 

4) X = $Cd(CH_2CH_3)_2$, Y = 

25.

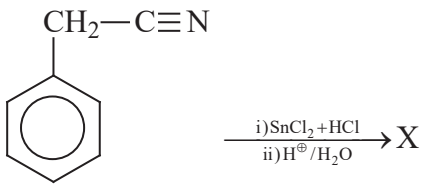
Suggest a suitable reagent combination for the above reaction

1) $SOCl_2$, $H_2/Pd/BaSO_4$

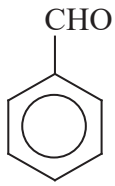
2) PCl_3, $LiAlH_4$

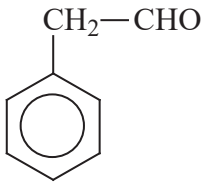
3) PCl_5, H_2/Ni

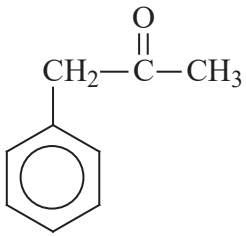
4) $LiAlH_4$

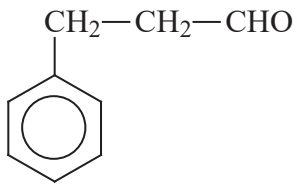
26. 

Identify product X in the above reaction

1) 

2) 

3) 

4) 

27. $CH_3-CH=CH-CH_2-CN \rightarrow$

$CH_3-CH=CH-CH_2-CHO$

Suggest a suitable reagent for the above conversion

1) H_2/Ni

2) $HAI(CH_2-\underset{CH_3}{\underset{|}{CH}}-CH_3)_2 / H_3O^{\oplus}$

3) CrO_2Cl_2/CS_2

4) CrO_3/Ac_2O

28. The product obtained when ethyl undecanoate is reduced with DIBAL-H followed by hydrolysis is

1) $CH_3-(CH_2)_8-\overset{O}{\overset{||}{C}}-H$

2) $CH_3-(CH_2)_9-\overset{O}{\overset{||}{C}}-H$

3) $CH_3-(CH_2)_8-\overset{O}{\overset{||}{C}}-CH_3$

4) $CH_3-(CH_2)_9-\overset{O}{\overset{||}{C}}-CH_3$

29. Predict the product (P) in the following reaction

$$CH_3-\overset{O}{\overset{||}{C}}-CH_2-\overset{O}{\overset{||}{C}}-O-CH_2-CH_3 \xrightarrow[ii)\Delta]{i)H_3O^{\oplus}} P$$

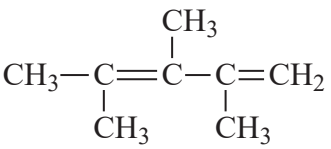
1) $CH_3-\overset{O}{\overset{||}{C}}-CH_2-\overset{O}{\overset{||}{C}}-H$

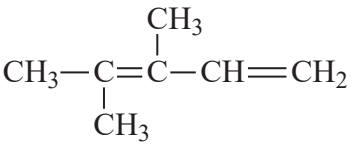
2) $CH_3-\overset{O}{\overset{||}{C}}-CH_3$

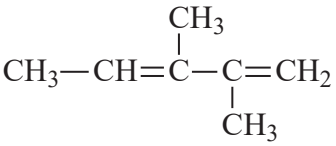
3) $CH_3-\overset{O}{\overset{||}{C}}-CH_2-\overset{O}{\overset{||}{C}}-CH_3$

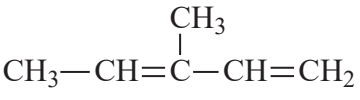
4) $CH_3-\overset{O}{\overset{||}{C}}-CH_2-CH_3$

30. A hydrocarbon on reductive ozonolysis gives formaldehyde dimethyl glyoxal and acetone. The structure of hydrocarbon could be

1) 

2) 

3) 

4) 

31. The product obtained during the reductive ozonolysis of 1-methylcyclohexene is

1) 6-oxohexanal

2) 5-oxohexanal

3) 6-oxoheptanal

4) 5-oxoheptanal

32. Which of the following alcohols donot give a carbonyl compound on heating with Cu or Ag?

1) Butan-2-ol

2) 2-methylpropan-2-ol

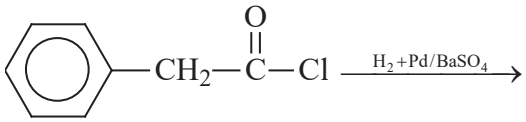
3) Butan-1-ol

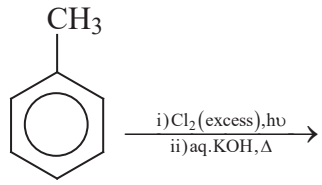
4) Neopentyl alcohol

33. Which of the following reaction is not going to give the corresponding carbonyl compound?

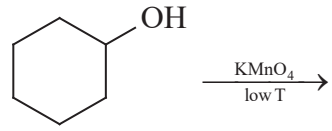
1) $CH_3 - CH = CH - CH_2 - CN \xrightarrow[\text{ii)}H_2O]{\text{i)DIBAL-H}}$

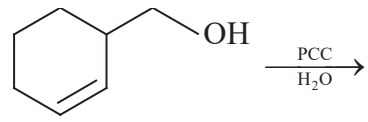
2) $CH_3-(CH_2)_8-\overset{O}{\overset{||}{C}}-OCH_2CH_3 \xrightarrow[\text{ii)}H_2O]{\text{i)DIBAL-H}}$

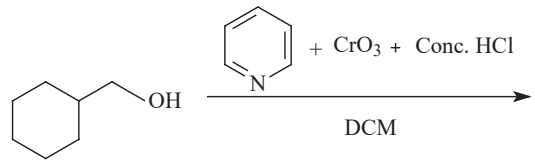
3) 

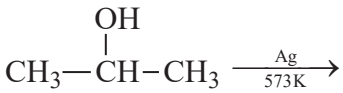
4) 

34. Which of the following doesn't give corresponding carbonyl compound?

1) 

2) 

3) 

4) 

35. Phenol on oxidation with potassium dichromate in an acidic media gives a diketone. The IUPAC name of the diketone will be

1) Cyclohexane-1,3-dione

2) Cyclohexa-2,5-diene-1,4-dione

3) Cyclohexa-1,3-diene-1,4-dione

4) None of these

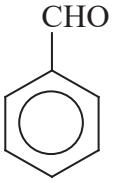
PHYSICAL & CHEMICAL PROPERTIES

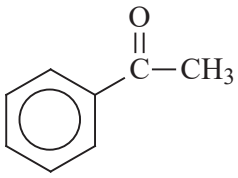
36. Which of the following has highest boiling point?

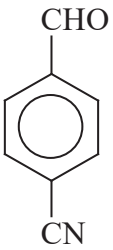
1) Butanone 2) Butyraldehyde

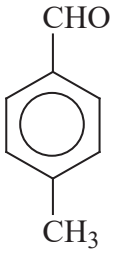
3) Ethoxyethane 4) Pentane

37. Which of the following is most reactive towards nucleophilic addition reaction?

1) 

2) 

3) 

4) 

38. **Assertion (A)**: Formaldehyde is the most reactive aldehyde in the homologous series of mono carbaldehyde towards nucleophilic addition reaction.

Reason (R) : In case of higher aldehydes the inductive and bulky nature of the alkyl groups hinders the attack of incoming nucleophile.

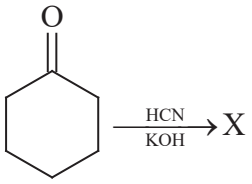
1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

39. The product obtained in the following reaction is:



1) 1-hydroxycyclohexane-2-carbonitrile

2) 1-hydroxycyclohexane-1-carbonitrile

3) 2-hydroxycyclohexanecarbonitrile

4) None of these

40. Which of the following doesnot give the white crystalline bisulphite addition product?

1) Butyraldehyde

2) Acetone

3) Phenylethylketone

4) Acetaldehyde

41. A carbonyl compound on reaction with propyl magnesium bromide followed by hydrolysis developed a 2-methylpentan-2-ol as the product. The carbonyl compound could be

1) $CH_3-\overset{\overset{O}{||}}{C}-CH_2-CH_3$

2) $CH_3-\overset{\overset{O}{||}}{C}-CH_3$

3) $CH_3-\overset{\overset{O}{||}}{C}-H$

4) $CH_3-\overset{\overset{O}{||}}{C}-CH_2-CH_2-CH_3$

42. Reaction of a carbonyl compound with ammonia derivatives giving an imine derivative is an example of

1) Electrophilic addition reaction

2) Nucleophilic addition elimination reaction

3) Electrophilic substitution reaction

4) Electrophilic elimination addition reaction

43. **Assertion (A)** : Nucleophilic addition reactions of ammonia derivatives with carbonyl compounds are usually carried in a slight acidic media.

Reason (R) : Acidic media increases the electrophilicity of carbonyl carbon.

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

44. Mixture of acetone and acetaldehyde treated with NH_2OH. Number of fractions obtained when the product is fractional distillated

1) 2 2) 3

3) 4 4) 6

45. Consider the following reaction

$$CH_3-CHO \xrightarrow[KCN]{HCN} P \xrightarrow{H^{\oplus}/H_2O} Q \xrightarrow[\Delta]{conc.H_2SO_4} R$$

The product R in the above reaction sequence is:

1) Acrylic acid

2) Lactic acid

3) Acetaldehyde cyanohydrin

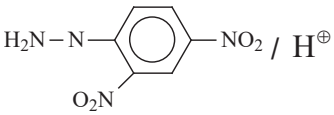
4) Acrolein

46. Which of the following gives a primary alcohol on reaction with Grignard reagent followed by hydrolysis?

1) Acetaldehyde 2) Acetone

3) Formaldehyde 4) Butyraldehyde

47. Which of the following can be used to detect the presence of an aldehyde functional group?

1) 

/ $H^{\oplus}$

2) Sodium bisulphite

3) $H_2N-NH-\overset{\overset{O}{||}}{C}-NH_2 / H^{\oplus}$

4) All of the above

48. **Statement I** : Schiff bases are substituted imines formed by reaction between a carbonyl compound and a primary amine in an acidic media

Statement II : Schiff bases are azomethines

1) Both Statement-I and Statement-II are true

2) Both Statement-I and Statement-II are false

3) Statement-I is true, but Statement-II is false

4) Statement-I is false, but Statement-II is true

49. **Statement I** : Not all ketones undergo the bisulphite addition reactions.

Statement II : Aliphatic ketones are more reactive than aliphatic aldehydes towards nucleophilic attack.

1) Both Statement-I and Statement-II are true

2) Both Statement-I and Statement-II are false

3) Statement-I is true, but Statement-II is false

4) Statement-I is false, but Statement-II is true

50. **Assertion (A)** : Nucleophilic addition reaction of butanone with methyl magnesium bromide will be faster if carried out in acetone as solvent rather than diethyl ether.

Reason (R) : Butanone is more reactive than acetone in nucleophilic addition reaction

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

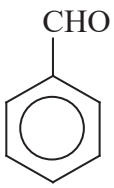
2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

51. Which of the following compound(s) gives a characteristic precipitate with ammoniacal silver nitrate?

1) $CH_3-\overset{\overset{O}{||}}{C}-H$

2) 

3) Fructose

4) All of these

52. Fehling's test is not given by

1) Acetone

2) Benzaldehyde

3) Acetophenone

4) All of these

53. Which of the following gives a characteristic precipitate on heating with iodine in presence of potassium hydroxide?

1) Acetone

2) Ethanol

3) Hydrolysed product of ethyl acetate

4) All of these

54. Consider the following reaction

$$CH \equiv CH \xrightarrow[20\%H_2SO_4]{1\%HgSO_4} X \xrightarrow[OH^-]{[Ag(NH_3)_2]^+} Y \quad +$$

Metallic silver. Identify product X and Y

1) X = CH_3CH_2OH, Y = $CH_3 - COOH$

2) X = CH_3CHO, Y = $CH_3 - COOH$

3) X = CH_3CHO, Y = CH_3COO^-

4) X = CH_3CH_2OH, Y = CH_3COO^-

55. + HCl + CO $\xrightarrow[CuCl]{Anhy.AlCl_3}$ X

$$CH_3 - C \equiv CH \xrightarrow[ii)H_2O_2/OH^-]{i)B_2H_6/THF} Y$$

X and Y can be distinguished by

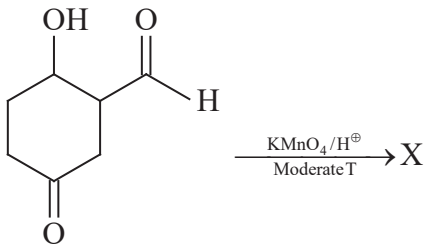
1) Tollen's test

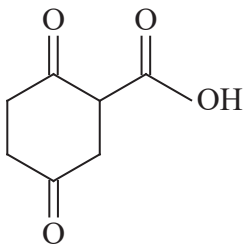
2) Fehling's test

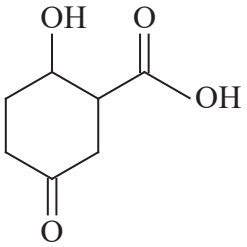
3) Borsche's reagent

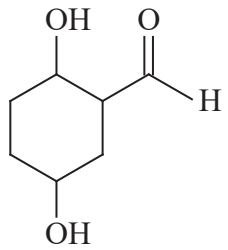
4) I_2/NaOH

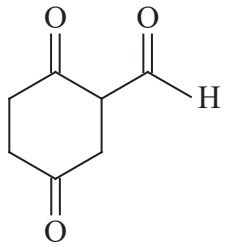
56. The product obtained in the following reaction



1) 

2) 

3) 

4) 

57. Tollen's reagent is:

1) alkaline mercuric chloride

2) alkaline potassium permanganate

3) ammoniacal silver nitrate

4) ammonium citrate

58. Fehling's solution is:

1) acidified copper sulphate solution

2) ammoniacal cuprous chloride solution

3) copper sulphate and Rochelle salt + NaOH

4) none of the above

59. When acetaldehyde is heated with Fehling's solution, it gives a red precipitate of:

1) Cu 2) CuO

3) $CuSO_4$ 4) Cu_2O

60. Hydrocarbons are formed when aldehydes and ketones are reduced with amalgamated zinc and conc. HCl. The reaction is called

1) Rosenmund reduction

2) Clemmensen's reduction

3) Stephen's reduction

4) Wolff-Kishner reduction

61. The compound that will not give iodoform test on treatment with alkali and iodine, is:

1) acetone 2) ethanol

3) diethyl ketone 4) isopropyl alcohol

62. Which of the following would undergo aldol condensation?

1) CH_3CHO 2) CCl_3CHO

3) HCHO 4) $(CH_3)_3CCHO$

63. Treatment of propionaldehyde with dil.NaOH gives:

1) $CH_3CH_2COOCH_2CH_2CH_3$

2) $CH_3CH_2CHOHCH_2CH_2CHO$

3) $CH_3CH_2CHOHCH(CH_3)CHO$

4) $CH_3CH_2COCH_2CH_2CHO$

64. A compound (A), $C_5H_{10}O$, forms a phenyl hydrazone and gives negative Tollen's and iodoform tests. The compound on reduction gives n-pentane. The compound (A) is:

1) Pentanal 2) Pentan-2-one

3) Pentan-3-one 4) Amyl alcohol

65. Wolff-Kishner reduction is:

1) reduction of carbonyl compounds into hydrocarbons

2) reduction of carbonyl compounds into alcohols

3) reduction of nitrobenzene into aniline

4) reduction of carbohydrates into alcohols

66. Clemmensen's reduction will convert cyclohexanone into:

1) n-hexane 2) benzene

3) cyclohexane 4) cyclohexanol

67. Acetaldehyde cannot show:

1) Iodoform test 2) Benedict's test

3) Tollen's test 4) Lucas test

68. Acetaldehyde is converted to ethane by Wolff-Kishner reduction. Acetaldehyde is treated with:

1) $LiAlH_4$

2) $NaBH_4$

3) NH_2NH_2 and strong base

4) H_2 with $Pd/BaSO_4$

69. Aldol condensation between which of the following compounds followed by dehydration gives mesityl oxide?

1) Two molecules of CH_3COCH_3

2) Two molecules of CH_3CHO

3) CH_3CHO and HCHO

4) CH_3CHO and CH_3COCH_3

70. If pentan-2-one is reacted with $NaBH_4$, followed by hydrolysis with D_2O, the product will be:

1) $CH_3CD(OD)CH_2CH_2CH_3$

2) $CH_3CD(OH)CH_2CH_2CH_3$

3) $CH_3CH(OH)CH_2CH_2CH_3$

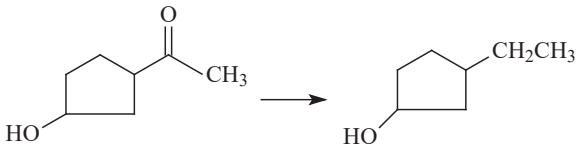
4) $CH_3CH(OD)CH_2CH_2CH_3$

71. Total number of product obtained when a mixture of acetaldehyde and acetone is heated with dilute sodium hydroxide

1) 2 2) 4

3) 6 4) 8

72.



is:

1) Zn(Hg), HCl 2) NH_2NH_2, OH^-

3) H_2/Ni 4) $NaBH_4$

73. Aldol condensation will not be observed in:

1) chloral

2) phenyl acetaldehyde

3) hexanal

4) acetophenone

74. Which of the following is not correctly matched?

1) $>C=O \xrightarrow[\text{Reduction}]{\text{Clemmensen's}} >CH_2$

2) $>C=O \xrightarrow[\text{Reduction}]{\text{Wolff–Kishner}} >CHOH$

3) $-COCl \xrightarrow[\text{Reduction}]{\text{Rosenmund's}} -CHO$

4) $-C\equiv N \xrightarrow[\text{Reduction}]{\text{Stephen's}} -CHO$

75. Cannizzaro's reaction is not given by

1) CH_3CHO

2) HCHO

3) benzaldehyde

4) triethyl acetaldehyde

SAMPLE QUESTIONS

1. The general formula of both aldehydes and ketones is:

1) $C_nH_{2n+2}O$ 2) $C_nH_{2n}O$

3) $C_nH_{2n-2}O$ 4) $C_nH_{2n+4}O$

2. Aldehydes are first oxidation products of:

1) primary alcohols

2) secondary alcohols

3) tertiary alcohols

4) monohydric alcohols

3. The reaction,

$$RCOCl + H_2 \xrightarrow{Pd/BaSO_4} RCHO + HCl$$ is called

1) Cannizzaro's reaction

2) Rosenmund's reaction

3) Haloform reaction

4) Clemmensen's reaction

4. The enolic form of acetone contains:

1) 9 sigma bonds, 1 pi bond and 2 lone pairs

2) 8 sigma bonds, 2 pi bonds and 2 lone pairs

3) 10 sigma bonds, 1 pi bond and 1 lone pair

4) 9 sigma bonds, 2 pi bonds and 1 lone pair

5. Match the following lists:

A) Grignard reagent	1) H_2/Pd-$BaSO_4$
B) Clemmensen's reduction	2) N_2H_4/KOH/ CH_2OH-CH_2OH
C) Rosenmund's reduction	3) CH_3MgX
D) Wolff-Kishner reduction	4) Zn-Hg/conc.HCl

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

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

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

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

6. Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions:

I) Ethanal II) Propanal

III) Propanone IV) Butanone

1) I < II < III < IV 2) IV < III < II < I

3) III < II < I < IV 4) II < I < III < IV

7. To distinguish between 2-pentanone and 3-pentanone which reagent can be used?

1) $NaOH/I_2$ 2) $SnCl_2$/HCl

3) $K_2Cr_2O_7/H^+$ 4) Zn–Hg, HCl

8. Cyanohydrin of which of the following gives lactic acid on hydrolysis?

1) CH_3COCH_3 2) CH_3CHO

3) $C_6H_5CH_2CHO$ 4) HCHO

9. During reduction of aldehydes with hydrazine and potassium hydroxide, the first is the formation of:

1) $RCH = NNH_2$ 2) $RCONH_2$

3) RCH = NH 4) $R-C\equiv N$

10. Reduction of acetonitrile in presence of $SnCl_2$/HCl, followed by hydrolysis gives:

1) HCHO 2) CH_3CHO

3) CH_3CH_2CHO 4) CH_3COCH_3

11. In the reaction,

$CH_3CHO + HCN \rightarrow CH_3CHOHCN$, a chiral centre is produced. The product is:

1) meso compound

2) laevo rotatory

3) dextro rotatory

4) racemic mixture

12. At room temperature, formaldehyde is:

1) a gas 2) a liquid

3) a solid 4) not known

13. A plastic bakelite is a compound of phenol with:

1) CH_3CHO 2) HCHO

3) acetal 4) chlorobenzene

14. If formaldehyde and KOH are treated together, we get:

1) methane 2) methanol

3) ethyl acetate 4) acetylene

15. In which of the following reactions, aldehydes and ketones are distinguished?

1) reaction with phenyl hydrazine

2) reaction with hydroxylamine

3) reaction with semicarbazide

4) reaction with silver nitrate mixed with ammonia

16. In the group $\begin{matrix} R \diagdown \\ R' \diagup \end{matrix} C{=}O$, the carbonyl carbon is joined to other atoms by:

1) two sigma and one pi bond

2) three sigma and one pi bond

3) two sigma and two pi bonds

4) three sigma and two pi bonds

17. **Assertion (A)** : Reaction of aldehydes with ammonia derivatives must be carried out in strong alkaline media.

Reason (R) : Strong alkaline media reduces the electrophilicity of carbonyl carbon.

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If assertion is incorrect but reason is correct

18. $CH_3CH = CHCHO$ is oxidised to $CH_3–CH=CHCOOH$, using oxidising agent as:

1) alkaline $KMnO_4/H^{\oplus}$

2) $K_2Cr_2O_7$/conc.H_2SO_4

3) ammoniacal $AgNO_3/H^{\oplus}$

4) dilute HNO_3

19. In the Cannizzaro's reaction given below,

$$2Ph-CHO \xrightarrow{OH^-} PhCH_2OH + PhCOO^-$$

the slowest step is:

1) the attack of OH^- at the carbonyl group

2) the transfer of hydride to the carbonyl group

3) the abstraction of proton from the carboxylic acid

4) the deprotonation of $Ph–CH_2OH$

20. Ozonolysis of C_7H_{14} gave 2-methylpentan-3-one.The alkene is:

1) 2-ethyl-3-methylbut-1-ene

2) 2-methyl-3-ethylbut-3-ene

3) 2,5-dimethyl-3,4-diethylhex-3-ene

4) 2-methyl-3-ethylbut-1-ene

21. How many litres of ozone at NTP is required for the complete reductive ozonolysis of 192 g of 2,4-dimethylpenta-1,3-diene?

(At NTP 1 mole occupies 22.4 L)

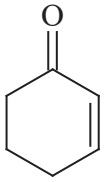
1) 44.8 L

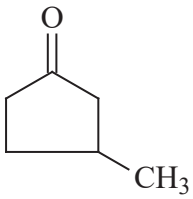
2) 89.6 L

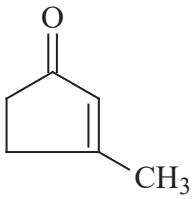
3) 67.2 L

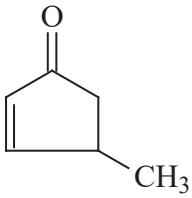
4) 22.4 L

22. The diketone $CH_3-\overset{O}{\overset{||}{C}}-(CH_2)_2-\overset{O}{\overset{||}{C}}-CH_3$ on intramolecular aldol condensation gives the final product:

1) 

2) 

3) 

4) 

23. $CH_3-\overset{CH_3}{\underset{CH_3}{C}}-CHO$ does not show aldol condensation because:

1) carbon is bounded by 3-heavy methyl groups

2) due to the absence of α-hydrogen

3) it is a neutral moelcule

4) due to hindrance created by methyl group for carbocation

24. The most suitable reagent for the conversion of primary alcohol into aldehyde with the same number of carbon is:

1) acidified $K_2Cr_2O_7$

2) acidified $KMnO_4$

3) alkaline $KMnO_4$

4) pyridinium chlorochromate

25. 3-Hydroxybutanal is formed when X reacts with Y in dilute Z solution. What are X, Y and Z?

1) X = CH_3CHO, Y = $(CH_3)_2CO$, Z = NaOH

2) X = CH_3CHO, Y = CH_3CHO, Z = NaCl

3) X = $(CH_3)_2CO$, Y = $(CH_3)_2CO$, Z = HCl

4) CH_3CHO, Y = CH_3CHO, Z = NaOH

26. Which of the following pathways produces 2-hexanone?

i) 1-Hexyne is treated with H_2SO_4, $HgSO_4$ and water

ii) 3-Methyl-2-heptene is treated with O_3 followed by hydrolysis

iii) n-Butyl magnesium bromide reacts with acetaldehyde followed by hydrolysis and then chromic acid oxidation

iv) Hydroboration oxidation of 1-hexyne

1) i, ii and iii 2) i and ii only

3) i and iii only 4) i, ii and iv

27. $CH_3COOH \xrightarrow{LiAlH_4} (X) \xrightarrow[300^0C]{Cu} (Y) \xrightarrow[NaOH]{dilute} (Z)$,

In the above reaction, (Z) is:

1) aldol 2) ketol

3) acetol 4) butanol

28. In the following reaction:

$$HC \equiv CH \xrightarrow[Hg^+]{H_2SO_4} 'P'$$

Product 'P' will not give

1) Tollen's reagent test

2) Brady's reagent test

3) Neutral ferric chloride test

4) Iodoform test

29. Consider following reaction,

$$HC \equiv CH \xrightarrow[H_2SO_4]{Hg^{2+}/HgSO_4} X \xrightarrow{CH_3MgBr} Y \xrightarrow{H_3O^+} Z$$

The compound Z is

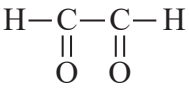
1) 1-propanol

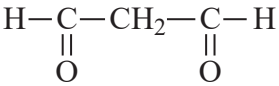
2) 2-propanol

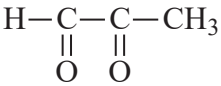
3) Propanol

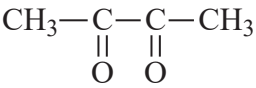
4) Propan-2-one

30. Which of the following product is not obtained when o-xylene on reductive ozonolysis?

1) 

2) 

3) 

4) 

31. Identify the products (I) and (III) observing the following sequence of reactions:

$$CH_3-C\equiv C-H \xrightarrow[1\%HgSO_4,60^0C]{20\%H_2SO_4} (I) \xrightarrow{NaOH/I_2(excess)} \underset{\text{yellow solid}}{(II)} \xrightarrow[\Delta]{Ag\,powder} III$$

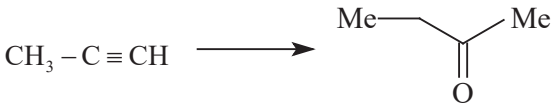
1) CH_3CH_2CHO, $CH \equiv CH$

2) $CH_3-\overset{O}{\overset{||}{C}}-CH_3$,

3) CH_3CH_2CHO, $CH_3-C\equiv CH$

4) $CH_3-\overset{O}{\overset{||}{C}}-CH_3$, $CH \equiv CH$

32. The reagents to carry out the following conversion are



1) $HgSO_4$/dil.H_2SO_4

2) BH_3; H_2O_2/NaOH

3) $KMnO_4$/KOH

4) $NaNH_2$/CH_3I; $HgSO_4$/dil.H_2SO_4

33. Consider the following reaction

$$P \xrightarrow[\Delta]{P_2O_5} Q \xrightarrow{SnCl_2/HCl} R \xrightarrow{H_3O^{\oplus}} CH_3-CH_2-CH_3$$

What could be the structure of reactant P?

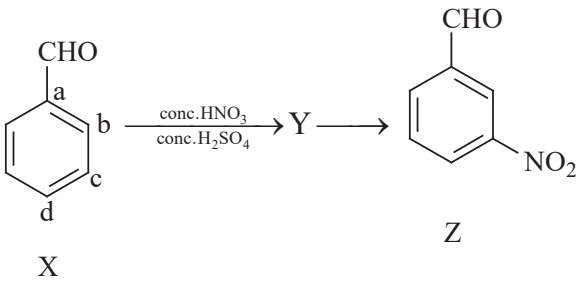
1) $CH_3-CH_2-\overset{\overset{O}{||}}{C}-Cl$

2) $CH_3-CH_2-\overset{\overset{O}{||}}{C}-H$

3) CH_3–CH_2–OH

4) $CH_3-CH_2-\overset{\overset{O}{||}}{C}-NH_2$

34. Consider the following reaction



During the conversion from X to Y which of the following carbon is likely to undergo a charge in hybridization?

1) a 2) b

3) c 4) d

35. IUPAC name of tropone is

1) Hepta-2,4,6-trien-1-one

2) Hepta-1,3,5-trien-7-one

3) Hexa-1,4-dien-2-one

4) None of these

36. One mole of alkene X on ozonolysis gave one mole of acetaldehyde and one mole of acetone. The IUPAC name of X is

1) 2-methyl-2-butene

2) 2-methyl-1-butene

3) 2-butene

4) 1-butene

37. Total number of isomers (structural) possible with the formula C_3H_6O is

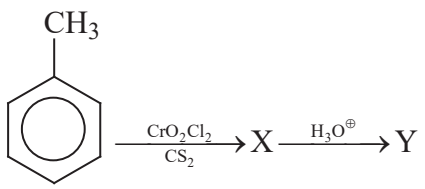
1) 6

2) 7

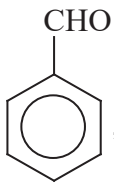
3) 8

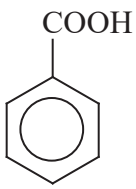
4) 9

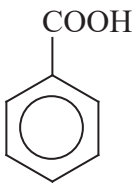
38. Consider the following reaction:

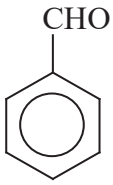


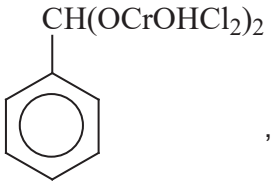
Identify products X and Y

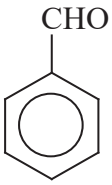
1) X = 

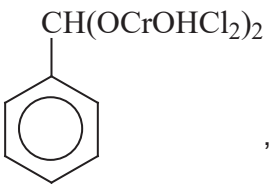
, Y = 

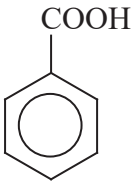
2) X = 

Y = 

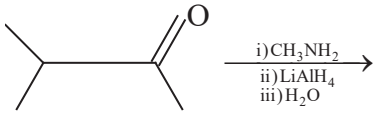
3) X = 

, Y = 

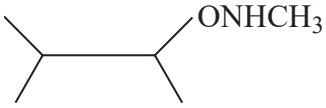
4) X = 

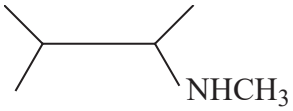
, Y = 

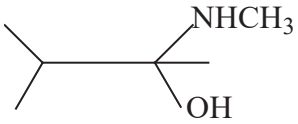
39. The major organic product formed from the following reaction

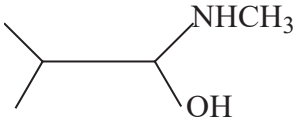


is:

1) 

2) 

3) 

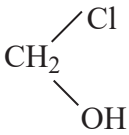
4) 

40. CH_2Cl_2 on heating with NaOH solution gives:

1) CH_3OH

2) HCOONa

3) HCHO

4) 

41. **Assertion (A)**: Formaldehyde is a planar molecule.

Reason (R) : Carbon atom in formladehyde is sp^2 hybridised

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

4) If both the assertion and reason are incorrect

42. **Assertion (A)** : Lower aldehyde and ketones are soluble in water but the solubility decreases as the molecular mass increases.

Reason (R) : Distinction between aldehydes and ketones can be made by Tollen's reagent.

1) If both assertion and reason are correct and the reason is the correct explanation of assertion

2) If both assertion and reason are correct, but reason is not the correct explanation of assertion

3) If assertion is correct but reason is incorrect

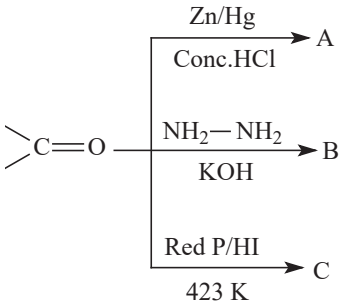
4) If both the assertion and reason are incorrect

43. DDT is prepared by heating chloroform with a compound X in presence of conc. H_2SO_4. The compound X is:

1) Acetaldehyde 2) Mesityl oxide

3) Chloral 4) Phthaldehyde

44. In the reaction:



1) A is an aldehydes; B is ketone and C is an alkene

2) A, B and C are alkenes

3) A, B and C are alkanes

4) A and B are alkenes while C is an alkane

45. An organic compound (A) of molecular formula $C_5H_{10}O$ forms a phenyl hydrazone and gives negative Tollen's and iodoform test. Compound (A) on reduction gives n-pentane. Compound (A) is:

1) pentanal

2) 2-methoxyhexanone

3) pentan-3-one

4) amyl alcohol

ANSWER KEY

1.	2	20.	4	39.	2	58.	3
2.	3	21.	2	40.	3	59.	4
3.	2	22.	3	41.	2	60.	2
4.	1	23.	3	42.	2	61.	3
5.	3	24.	2	43.	1	62.	1
6.	2	25.	1	44.	3	63.	3
7.	1	26.	2	45.	1	64.	3
8.	3	27.	2	46.	3	65.	1
9.	2	28.	2	47.	4	66.	3
10.	3	29.	2	48.	1	67.	4
11.	3	30.	1	49.	3	68.	3
12.	4	31.	3	50.	4	69.	1
13.	3	32.	2	51.	4	70.	4
14.	1	33.	4	52.	4	71.	3
15.	2	34.	2	53.	4	72.	2
16.	2	35.	2	54.	3	73.	1
17.	2	36.	1	55.	2	74.	2
18.	3	37.	3	56.	1	75.	1
19.	2	38.	1	57.	3		

SAMPLE QUESTIONS

1.	2	10.	2	19.	2	28.	3	37.	4
2.	1	11.	4	20.	1	29.	2	38.	3
3.	2	12.	1	21.	2	30.	2	39.	2
4.	1	13.	2	22.	3	31.	4	40.	3
5.	1	14.	2	23.	2	32.	4	41.	1
6.	2	15.	4	24.	4	33.	4	42.	2
7.	1	16.	2	25.	4	34.	3	43.	3
8.	2	17.	4	26.	1	35.	1	44.	3
9.	1	18.	3	27.	1	36.	1	45.	3

WORK BOOK

Chapter 21

CARBOXYLIC ACIDS

QUESTIONS

INTRODUCTION : ISOMERISM, NAMING

1. Succinic acid is a

1) Monobasic acid

2) Dibasic acid

3) Tribasic acid

4) Tetrabasic acid

2. The general formula of saturated monocarboxylic acid is

1) $C_nH_{2n}COOH$ 2) $C_nH_{2n+1}O_2$

3) $C_nH_{2n+2}O$ 4) $C_nH_{2n}O_2$

3. The IUPAC name of the compound

$$CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_2-\overset{\overset{\displaystyle O}{||}}{C}-OH$$ is

1) 1-hydroxybutane-1,3-dione

2) 2-acetylethanoic acid

3) 3-oxobutanoic acid

4) 2-oxobutanoic acid

4. Which of the following does not have carboxyl group ?

1) Malonic acid

2) Adipic acid

3) Acrylic acid

4) Picric acid

5. Which of the following is optically active ?

1) Lactic acid

2) Crotonic acid

3) Salicylic acid

4) Toluic acid

6. Mono carboxylic acids and esters are

1) Chain isomers

2) Position isomers

3) Functional isomers

4) Metamers

7. IUPAC name of valeric acid is

1) Butanoic acid

2) Pentanoic acid

3) Methanoic acid

4) Hexanoic acid

8. The IUPAC name of caproic acid is

1) Hexanoic acid

2) Heptanoic acid

3) Pentanoic acid

4) Octanoic acid

9. Which of the following acids is isomeric with phthalic acid ?

1) Salicylic acid

2) Methylbenzoate

3) Maleic acid

4) Benzene-1,4-dicarboxylic acid

10. How many acids and esters are possible for the compound with M.F $C_4H_8O_2$?

1) 2 acids + 4 esters

2) 4 acids + 4 esters

3) 2 acids + 2 esters

4) 3 acids + 3 esters

PREPARATION

11. Decarboxylation of sodium benzoate on heating with sodalime gives

1) Benzene 2) Benzoic acid

3) Benzaldehyde 4) Toluene

12. The acid S obtained through the following sequence of reaction is

$$C_2H_5Cl \xrightarrow[\Delta]{\text{alc.KOH}} P \xrightarrow[CCl_4]{Br_2} Q \xrightarrow[\text{excess}]{KCN} R \xrightarrow{H^+} S$$

1) Oxalic acid

2) Malonic acid

3) Maleic acid

4) Succinic acid

13. $CH_3–CH_2–CH_2–OH$ can be converted into $CH_3–CH_2–CH_2–COOH$. The correct sequence of reagents is

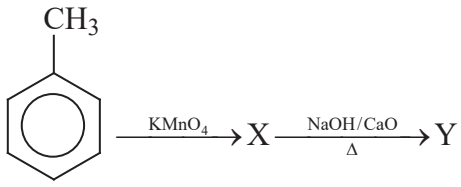
1) PBr_3, KCN, H^+

2) HCN, PBr_3, H^+

3) PBr_3, KCN, H_2

4) KCN, H^+

14. Predict the product Y in the following sequence of reactions :



1) Benzene

2) Benzoic acid

3) Benzaldehyde

4) Benzyl alcohol

15. RX + Mg $\xrightarrow[\text{ether}]{\text{dry}}$ A $\xrightarrow[\text{dry ether}]{CO_2}$ B $\xrightarrow{H_3O^+}$ RCOOH.

'B' in the above reaction is

1) $R-CO\overset{-}{O}\overset{+}{Mg}X$ 2) $(RCOO)_2Mg$

3) $RC\overset{-}{O}\overset{+}{Mg}X$ 4) $RCO\overset{-}{O}\overset{+}{X}$

16. Acetylene $\xrightarrow[1\%\ H_2SO_4]{Hg^{2+}}$ X $\xrightarrow{[O]}$ Y. Y is

1) Propanoic acid

2) Ethanoic acid

3) Ethanal

4) Propanone

17. Conversion of Butan-2-one to propanoic acid requires

1) Fehling's solution

2) Tollen's reagent

3) $NaOH/I_2/H^+$

4) $NaOH/NaI/H^+$

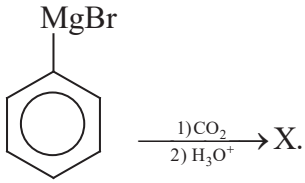
18. When 2-hydroxy benzoic acid is distilled with Zn dust, it gives

1) Benzoic acid

2) Phenol

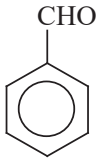
3) Benzaldehyde

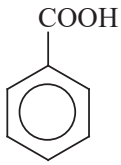
4) A polymeric compound

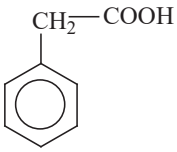
19. 

The product X is

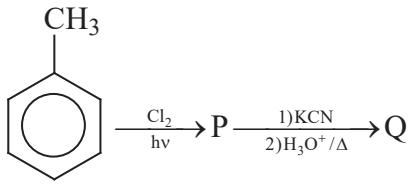
1)

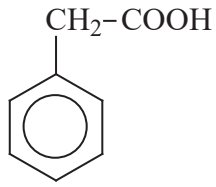
2) 

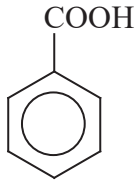
3) 

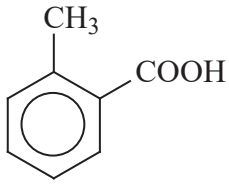
4) 

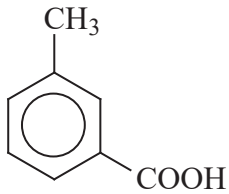
20. What is the final product Q in this sequence?

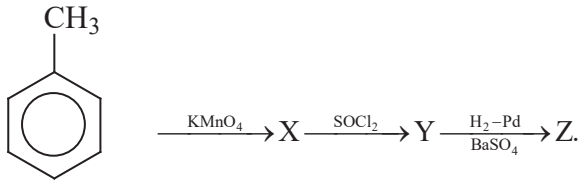


1) 

2) 

3) 

4) 

21. 

The product 'Z' is

1) C_6H_5–COOH

2) C_6H_5COCl

3) C_6H_5–CHO

4) $C_6H_5CH_2OH$

PHYSICAL PROPERTY AND ACIDIC CHARACTER

22. The correct order of acidic strength of carboxylic acids is

1) CH_3–COOH < C_6H_5COOH < HCOOH

2) HCOOH < C_6H_5COOH < CH_3–COOH

3) HCOOH < CH_3COOH < C_6H_5COOH

4) CH_3COOH < HCOOH < C_6H_5COOH

23. Correct order of boiling points of the following compounds

$\underset{I}{CH_3-CH_2-CH_2-CHO}$, $\underset{II}{CH_3-CH_2-CH_2-CH_2OH}$

$\underset{III}{CH_3-CH_2-CH_2-COOH}$

1) I > II > III
2) III > II > I
3) II > I > III
4) II > III > I

24. Incorrect statement among the following is

1) Electron withdrawing groups increase the acidity of carboxylic acids

2) Carboxylic acids are less acidic than phenols

3) Electron donating groups decrease the acidity of carboxylic acids

4) Carboxylic acids are weaker than mineral acids

25. The correct acidity order of the following is

$\underset{A}{\text{Benzoic acid}}$ $\underset{B}{\text{p-Toluic acid}}$

$\underset{C}{\text{Phenol}}$ $\underset{D}{\text{p-Chlorophenol}}$

1) A > B > D > C

2) A > C > D > B

3) D > B > A > C

4) C > B > A > D

26. The increasing order of acidity among the following compounds,

$\underset{A}{CH_3COOH}$, $\underset{B}{CF_3COOH}$

$\underset{C}{CHF_2-CH_2OH}$, $\underset{D}{C_2H_5OH}$

1) D < C < A < B

2) A < B < C < D

3) C < B < D < A

4) B < C < A < D

27. The correct acidity order is :

1) $Br-CH_2-COOH$ > $Cl-CH_2COOH$ > $F-CH_2-COOH$ > CH_3-COOH

2) $F-CH_2-COOH$ > $Cl-CH_2-COOH$ > $Br-CH_2-COOH$ > CH_3-COOH

3) CH_3-COOH > $Br-CH_2COOH$ > $F-CH_2-COOH$ > $Cl-CH_2-COOH$

4) $Cl-CH_2-COOH$ > CH_3-COOH > $Br-CH_2-COOH$ > $F-CH_2-COOH$

28. The pK_a of trifluoro acetic acid, benzoic acid, acetic acid and hydrochloric acid are respectively

1) 4.76, 4.19, 0.23 and –7.0

2) 0.23, 4.19, 4.76 and –7.0

3) 4.19, 4.76, –7.0 and 0.23

4) –7.0, 4.19, 4.76 and 0.23

29. The groups CF_3, Ph, CN, NO_2 attached to carboxyl group increases the acidity of carboxylic acids. Select the correct increasing order of acidity

1) Ph – COOH < NC – COOH < O_2N – COOH < F_3C – COOH

2) O_2N – COOH < F_3C – COOH < NC – COOH < Ph – COOH

3) F_3C – COOH < O_2N – COOH < NC – COOH < Ph – COOH

4) NC – COOH < Ph – COOH< O_2N – COOH < F_3C – COOH

30. Correct order of acidic strength is

1) R–COOH > HOH > CH ≡ CH > ROH

2) R–COOH > HOH > ROH > CH≡CH

3) R–COOH > ROH > HOH > CH ≡ CH

4) R –COOH > CH ≡ CH > HOH > ROH

31. p-nitrobenzoic acid is a stronger acid than benzoic acid. This is due to

1) direct resonance interaction between $-NO_2$ and –COOH groups

2) Strong inductive effect of $-NO_2$ group

3) $-NO_2$ group generates a strong electron withdrawing inducting effect due to +ve charge on meta position to –COOH group

4) $-NO_2$ group has strong electron withdrawing – R effect on para position

32. The molecular weight of acetic acid in vapour phase is

1) 60 2) 30

3) 240 4) 120

33. Which of the following acids has the smallest dissociation constant ?

1) $NC-CH_2-CH_2-COOH$

2) $CH_3-\underset{\underset{NO_2}{|}}{CH}-COOH$

3) $NO_2-CH_2-CH_2-COOH$

4) $Cl-CH_2-CH_2-COOH$

34. Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. This is due to

1) formation of carboxylate ion

2) formation of intramolecular H-bonding

3) formation of intermolecular H-bonding

4) more extensive association of carboxylic acid via vander waals force of attraction

35. Lower members of aliphatic carboxylic acids are soluble in water. This is due to

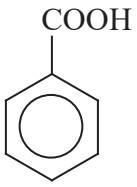
1) Van der waals association with water molecules

2) water is non electrolyte

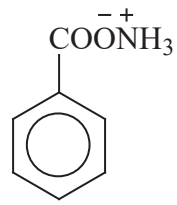
3) formation of hydrogen bonds with water

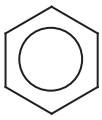
4) London forces

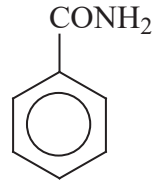
CHEMICAL PROPERTIES

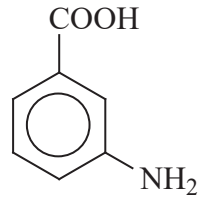
36. 

$\xrightarrow[\Delta]{NH_3}$ A . Identify A

1) 

2) 

3) 

4) 

37. Formic acid can reduce

1) Tollen's reagent

2) Fehling's solution

3) Mercuric chloride

4) All of these

38. $R\text{–}COOH \xrightarrow[P_2O_5]{\Delta} A$. Identify A

1) R–CO–R
2) R–COCl
3) $(R\text{–}CO)_2O$
4) $R-\overset{\overset{O}{||}}{C}-OR$

39. Which of the following compounds will react with $NaHCO_3$ solution to form sodium salt and CO_2 ?

1) Pentan-1-ol
2) Phenol
3) Propanoic acid
4) All

40. The ester formed by the reaction of benzoic acid and ethanol is :

1) Phenyl ethanoate
2) Ethyl ethanoate
3) Phenyl benzoate
4) Ethyl benzoate

41. $CH_3-CH_2-COOH \xrightarrow{LiAlH_4} X$

$X + CH_3-CH_2-COOH \xrightarrow{H^+} Y + H_2O$.

In the above reaction X and Y respectively are :

1) $CH_3\text{–}CH_2\text{–}CH_2OH$ and $CH_3\text{–}CH_2\text{–}COOC_3H_7$
2) $CH_3\text{–}CH_2\text{–}CHO$ and C_2H_5OH
3) $C_3H_7\text{–}OH + CH_3-CH_2-\overset{\overset{O}{||}}{C}-OC_2H_5$
4) $CH_3\text{–}CH_2\text{–}CH_2OH + CH_3\text{–}CH_2\text{–}CH_2\text{–}O\text{–}CH_2\text{–}CH_2\text{–}CH_3$

42. When acrolein is reduced with $LiAlH_4$, the compound formed will be

1) $CH_3\text{–}CH_2\text{–}COOH$
2) $CH_3\text{–}CH_2\text{–}CHO$
3) $CH_2= CH\text{–}CH_2OH$
4) $CO_2 + \begin{array}{c}COOH\\|\\COOH\end{array}$

43. $CH_3-\overset{\overset{O}{||}}{C}-OCH_3 \xrightarrow[H_2O^*]{Na\overset{*}{O}H}$

1) $CH_3-\overset{\overset{O}{||}}{C}-\overset{*}{O}H$
2) $CH_3-\overset{\overset{\overset{*}{O}}{||}}{C}-\bar{O}$
3) $CH_3-\overset{\overset{O}{||}}{C}-\overset{*}{O}^-$
4) $CH_3-CH_2-\overset{*}{O}-H$

44. The end product in the given reaction is :

$CH_3-CH_2-\overset{\overset{O}{||}}{C}-NH_2 \xrightarrow[\Delta]{P_2O_5} A \xrightarrow{H_2/Ni} B \xrightarrow{HNO_2}$

$C \xrightarrow[300^0]{Cu} D$

1) $CH_3\text{–}CH_2\text{–}CHO$
2) $CH_3\text{–}CH_2\text{–}COOC_2H_5$
3) $CH_3-\underset{\underset{O}{||}}{C}-CH_3$
4) $(CH_3\text{–}CH_2\text{–}CO)_2O$

45. The reaction $CH_3\text{–}CONH_2 \xrightarrow[\Delta]{NaOBr}$

1) $CH_3\text{–}NH_2$
2) $CH_3\text{–}Br$
3) CH_4
4) $CH_3\text{–}OBr$

46. $CH_3\text{–}CH_2\text{–}COOH \xrightarrow[Red\ P]{Br_2} X \xrightarrow{alc.\ KOH} Y$.

The compound Y is

1) $CH_2 = CH – COOH$
2) $CH_3 – CH_2 –COBr$
3) $CH_3 – CH_2 – OH$
4) $CH_3-\underset{\underset{Br}{|}}{CH}-COOH$

47. The compound which on reaction with $LiAlH_4$ gives two different alcohols is :

1) $CH_3–COOC_2H_5$ 2) $CH_3–COOCH_3$

3) CH_3 – CHO 4) $CH_3—\underset{\underset{O}{||}}{C}—CH_3$

48. In the preparation of an ester, from carboxylic acid & alcohol the commonly used catalyst is

1) P_2O_5

2) Anhy.$CaCl_2$

3) Anhy. $AlCl_3$

4) Conc. H_2SO_4

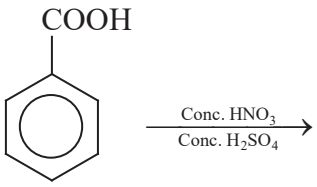
49. Which among the following statements is incorrect ?

1) $NaBH_4$ does not reduce carboxyl group

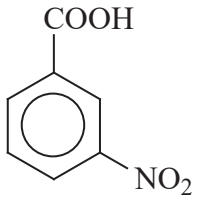
2) Soda lime is a mixture of NaOH and CaO in the ratio 3 : 1

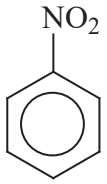
3) Diborane easily reduce functional groups such as ester, nitro group etc

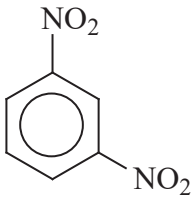
4) Carboxylic acids are reduced to 1^0 alcohols by $LiAlH_4$

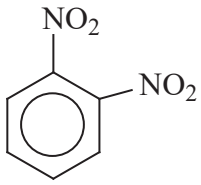
50. 

The product formed is

1) 

2) 

3) 

4) 

51. Correct statement is

1) Benzoic acid undergoes Friedel crafts reaction

2) Benzoic acid is stronger acid than formic acid

3) Benzoic acid on nitration gives o-nitrobenzoic acid

4) Benzoic acid does not undergo HVZ reaction

52. Reaction of but-2-ene with $KMnO_4/H^+$ gives

1) $CH_3–CH_2–OH$ 2) $CH_3–COOH$

3) $CH_3–CHO$ 4) H–COOH

53. Carboxylic carbon is less electrophilic than carbonyl carbon because of

1) Electromeric effect

2) Less polarity

3) Resonance effect

4) Inductive effect

54. HVZ reaction is used for the preparation of

1) α-halocarboxylic acid

2) β-halocarboxylic acid

3) Aromatic acids

4) Dicarboxylic acids

55. The acid used for the preparation of Nylon-6,6 is

1) Hexane-1,6-dioic acid

2) Glutaric acid

3) Benzoic acid

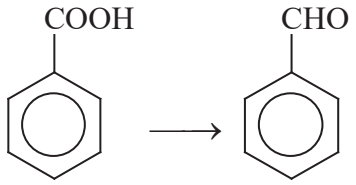
4) Fumaric acid

56. Which reagent will bring about the conversion of carboxylic acids to esters ?

1) $Al(OC_2H_5)_3$ 2) $LiAlH_4$

3) C_2H_5OH 4) C_2H_5OH/H^+

57. Get the correct sequence of reagents for the following conversion.



1) PCl_5, C_6H_5MgBr

2) CH_2N_2, $NaBH_4$

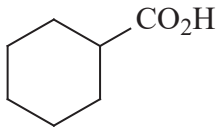
3) CO_2 + $LiAlH_4$

4) $SOCl_2$, H_2/Pd-$BaSO_4$

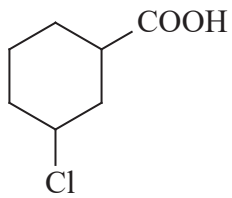
58. In the reaction $CH_3-COOH \xrightarrow{LiAlH_4} X \xrightarrow{PCl_5} Y \xrightarrow{alc.KOH} Z$. Product Z is

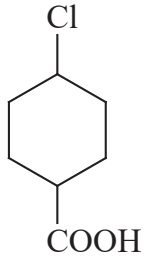
1) Acetylene 2) Acetaldehyde

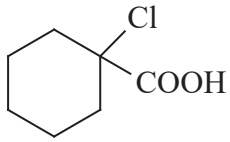
3) Acetylchloride 4) Ethene

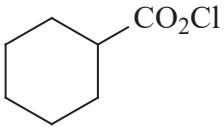
59. 

$\xrightarrow[2)H_2O]{1)P/Cl_2}$ A. A is

1) 

2) 

3) 

4) 

60. The correct order of decreasing reactivity of the given compounds towards hydrolysis under identical conditions is

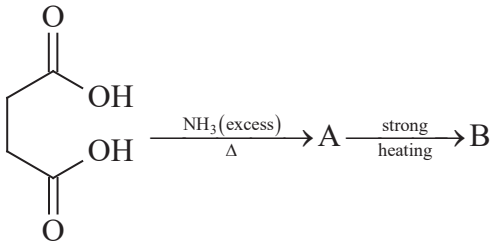
1) $(CH_3CO)_2O > CH_3COCl > CH_3-COOCH_3 > CH_3-CONH_2$

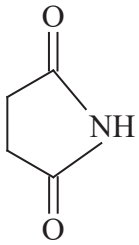
2) $CH_3-COCl > (CH_3CO)_2O > CH_3-COOCH_3 > CH_3CONH_2$

3) $CH_3-COCl > CH_3CONH_2 > CH_3COOCH_3 > (CH_3CO)_2O$

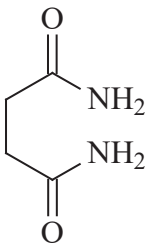
4) $CH_3-COOCH_3 > (CH_3CO)_2O > CH_3-COCl > CH_3-CONH_2$

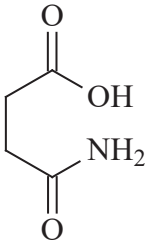
61. In the reaction sequence, the product 'B' is



1) 

2) CH_3-CH_3

3) 

4) 

62. Which of the following on soda lime decarboxylation gives propane?

1) $CH_3-CH=CH-COOH$

2) $CH_3-CH_2-CH_2-COOH$

3) CH_3CH_2COOH

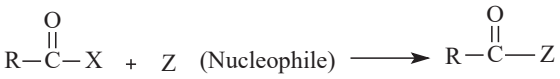
4) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2COOH$

63. Hydrolysis of esters in alkaline medium is known as

1) Alkalisation 2) Esterification

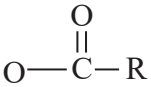
3) Hydrolysis 4) Saponification

64. The reaction



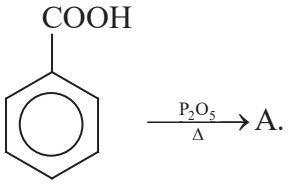
is fastest when X is

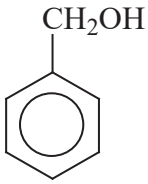
1) Cl 2) OC_2H_5

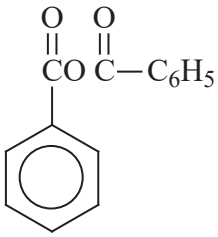
3) 

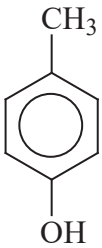
4) NH_2

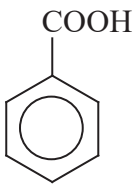
65. The product A of the reaction is



1) 

2) 

3) 

4) 

SAMPLE QUESTIONS

1. An optically active compound P has the M.F $C_4H_8O_3$. It evolves CO_2 with aq. $NaHCO_3$ and reacts with $LiAlH_4$ to form an achiral compound. The compound P is

1) $CH_3-\underset{\underset{OCH_3}{|}}{CH}-COOH$

2) $CH_3-\underset{\underset{CH_2OH}{|}}{CH}-COOH$

3) $CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-COOH$

4) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-COOH$

2. An organic compound A on react with NH_3 gives B. On heating, B gives C. C in presence of KOH reacts with Br_2 to give $CH_3–CH_2NH_2$. A is

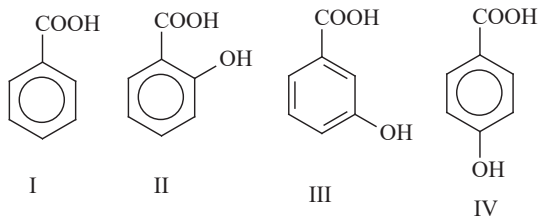
1) $CH_3–CH_2–COOH$

2) $CH_3–COOH$

3) $CH_3–CH_2–CH_2–COOH$

4) $CH_3-\underset{\underset{CH_3}{|}}{CH}-COOH$

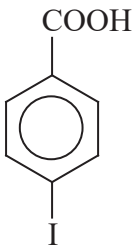
3. Give the correct order of acidic strength of the following compounds.

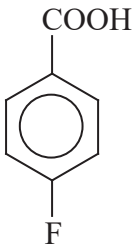


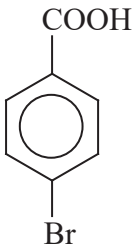
1) II > III > I > IV 2) I > II > III > IV

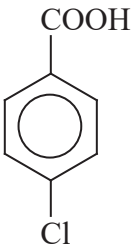
3) III > IV > II > I 4) IV > III > II > I

4. Among the following the weakest acid is

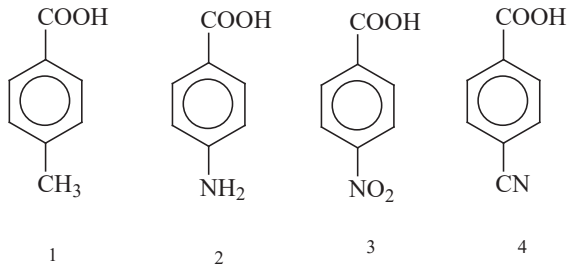
1) 

2) 

3) 

4) 

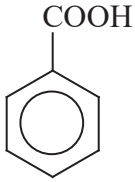
5. Select the correct order of acidic nature of

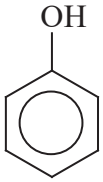


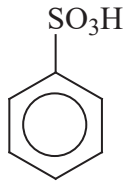
1) 3 > 4 > 1 > 2 2) 4 > 3 > 2 > 1

3) 2 > 3 > 1 > 4 4) 1 > 4 > 3 > 2

6. Give decreasing order of reaction with $NaHCO_3$

1) 

2) 

3) 

4)

1) 1 > 4 > 2 > 3 2) 4 > 3 > 2 > 1

3) 3 > 1 > 4 > 2 4) 2 > 3 > 1 > 4

7. $CH_3\text{–}COOH + PCl_5 \longrightarrow A \xrightarrow[\text{Anhy.}AlCl_3]{C_6H_6} B$

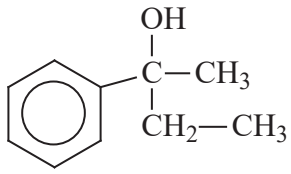
$\xrightarrow[2)\ H^+]{1)\ EtMgBr} C$

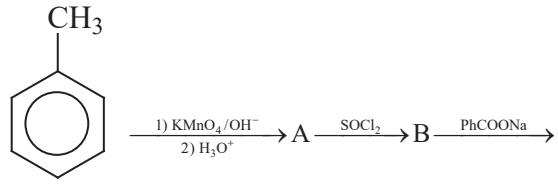
Product 'C' is

1) $CH_3-\underset{\underset{OH}{|}}{CH}-C_2H_5$

2) $CH_3-\underset{\underset{O}{||}}{C}-C_6H_5$

3) $CH_3-\underset{\underset{OH}{|}}{CH}-C_6H_5$

4) 

8. 

The compound C is

1) $(PhCO)_2O$

2) PhCOCl

3) $PhCONH_2$

4) Ph–COOH

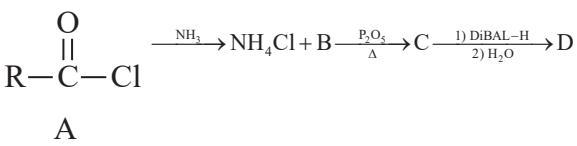
9. The addition of HBr to CH_2= CH–COOH results in the formation of

1) α-Bromopropionic acid

2) β-Bromopropionic acid as the major product

3) Both 1 and 2 in equal amounts

4) None of the above

10. 

The compound D is

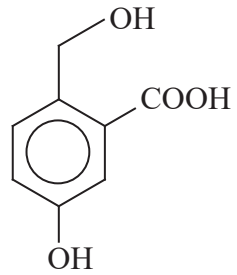
1) R–CHO

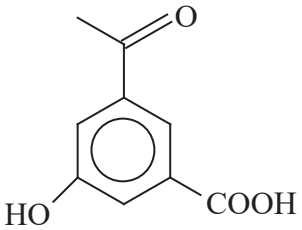
2) $R-C\equiv N$

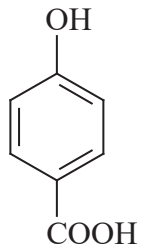
3) R–COOH

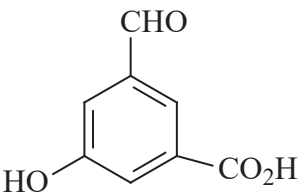
4) $R–CH_2OH$

11. Compound A evolves CO_2 gas with $NaHCO_3$ and evolves H_2 gas with Na. Compound A gives positive iodoform test. Structures of A is

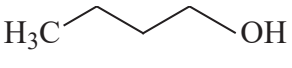
1) 

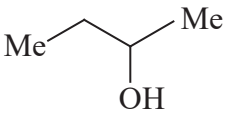
2) 

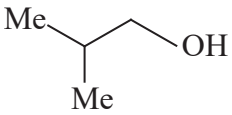
3) 

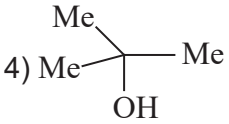
4) 

12. The decreasing order of rate of formation of ester for the following compounds with CH_3COOH in presence of H^+ ion is

1) 

2) 

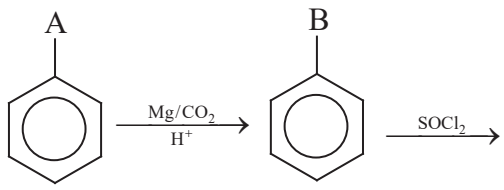
3) 

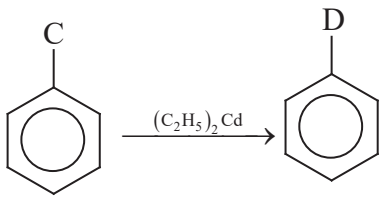
4) 

1) 3 > 2 > 4 > 1 2) 4 > 3 > 2 > 1

3) 1 > 3 > 2 > 4 4) 2 > 3 > 1 > 4

13. Consider the following sequence of reactions





Identify A, B, C and D

	A	B	C	D
1)	–F	–COOH	$–COCH_3$	$–COCH_2CH_2CH_3$
2)	–CHO	–COOH	–COCl	$–COCH_2–CH_3$
3)	–Br	–COOH	–COCl	$–COCH_2–CH_3$
4)	–Br	–COOH	–COCl	–CHO

14. Benzoic acid gives benzene on being heated with X and phenol gives benzene on being heated with Y. X and Y are respectively

1) Soda lime and copper

2) Soda lime and Zn dust

3) Zinc dust and soda lime

4) Zinc dust and NaOH

15. $X \xleftarrow[HI]{Red\ P} CH_3COOH \xrightarrow{LiAlH_4} Y.$

What does not true for X and Y

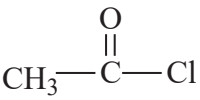
1) X is hydrocarbon of G.F C_nH_{2n+2} while Y belong to alkanol

2) X can be obtained by reducing CH_3CH_2Cl while Y by hydrolysis

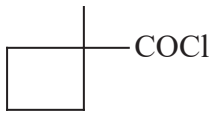
3) X gives +ve litmus test but Y does not

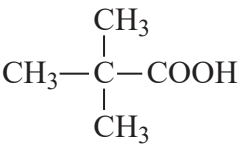
4) X and Y both belong to different homologous series

16. HVZ reaction is given by

1) 

2) Ph–COCl

3) 

4) 

17. When HCOONa is heated with soda lime it forms

1) C_2H_2

2) C_2H_6

3) CH_4

4) H_2

18. Which of these do not contain –COOH group?

1) Aspirin

2) Carboxylic acid

3) Benzoic acid

4) Salicylic acid

19. Which among the following acid is isomeric with terephthalic acid?

1) picric acid

2) maleic acid

3) benzene-1,3-dicarboxylic acid

4) ethyl benzoic acid

20. Identify the major product (Z) in the following reaction

$$Ca\overset{*}{C}O_3 \xrightarrow{HCl} X_{(g)} \xrightarrow[Et_2O]{CH_3CH_2MgBr} Y \xrightarrow{H_3O^+} Z$$

1) $CH_3-\overset{*}{C}H_2-COOH$

2) $CH_3-CH_2-\overset{*}{C}OOH$

3) $\overset{*}{C}H_3-CH_2-COOH$

4) $CH_3-\overset{*}{C}H_2-COOH$

21. Correct order of acidic strength is

1) NO_2–CH_2–COOH > HCOOH > CF_3–COOH > NC–CH_2–COOH

2) CF_3–COOH > NO_2–CH_2–COOH > NC–CH_2–COOH > HCOOH

3) NC–CH_2–COOH > NO_2 –CH_2–COOH > CF_3–COOH > HCOOH

4) HCOOH > CF_3–COOH > NO_2–CH_2–COOH > NC–CH_2–COOH

22. Carboxylic acids undergo ionisation beacuse

1) High reactivity of α-hydrogen

2) Hydrogen bonding

3) Resonance stabilisation of carboxylate anion

4) Dimerisation

23. Which of the following is expected to be most highly ionised in water ?

1) CH_3–CH_2–CHCl–COOH

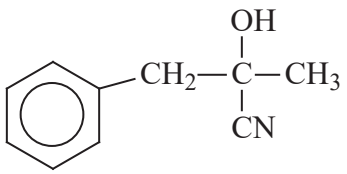
2) CH_3–CCl_2–CH_2–COOH

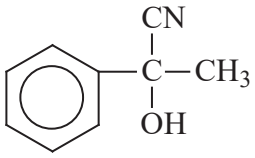
3) Cl–CH_2–CH_2–COOH

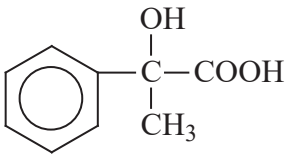
4) CH_3–CH_2–CCl_2–COOH

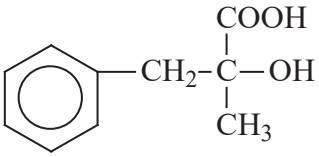
24. Select the end product T

$$CH \equiv CH \xrightarrow[\text{2) Oxidation}]{\text{1)}H_3O^+/Hg^{2+}} P \xrightarrow{SOCl_2} Q \xrightarrow[\text{anhy.}AlCl_3]{\text{Benzene}} R \xrightarrow{HCN} S \xrightarrow{H_3O^+} T$$

1) 

2) 

3) 

4) 

25. Correct order of acidic strength is

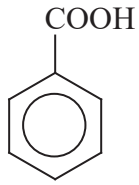
1) R–COOH > R–OH > $CH \equiv CH$ > CH_4

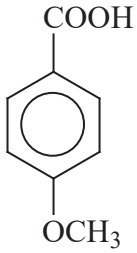
2) R–COOH > $CH \equiv CH$ > ROH > CH_4

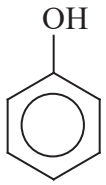
3) R–COOH > CH_4 > ROH > $CH \equiv CH$

4) R–COOH > CH_4 > $CH \equiv CH$ > ROH

26. The correct acidity order of the following is

1) 

2) 

3) 

4)

1) 1 > 2 > 4 > 3 2) 4 > 2 > 3 > 1

3) 3 > 2 > 1 > 4 4) 2 > 4 > 3 > 1

27. Benzoic acid and phenol can be distinguished by using

1) Tollen's reagent 2) aq. NaOH

3) Neutral $FeCl_3$ 4) Benedict's solution

28. During the ester test for the detection of carboxl function in the compound, the role of addition of aqueous Na_2CO_3 solution is

1) to provide a strong alkaline medium

2) to neutralise excess sulphuric acid and excess carboxylic acid

3) to prevent hydrolysis of carboxylic acid

4) to prevent hydrolysis of alcohol

29. The major product of the following reaction is

Phthalic acid + $NH_3 \xrightarrow[\text{heating}]{\text{strong}}$

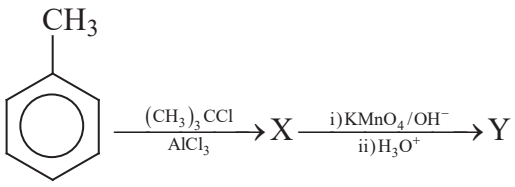
1) 2-carbamyl benzoic acid

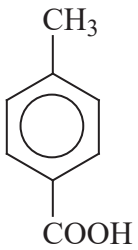
2) 2-amino benzoic acid

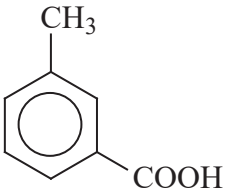
3) Aniline

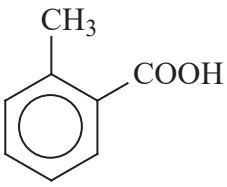
4) Phthalimide

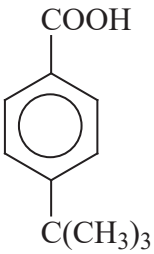
30. The end product is



1) 

2) 

3) 

4) 

31. Order of hydrolysis for the following

1) $(R–CO)_2O$ 2) $R–CONH_2$

3) $R-\underset{\underset{O}{\|}}{C}-Cl$ 4) $R-\underset{\underset{O}{\|}}{C}-OR'$

1) 3 > 1 > 4 > 2 2) 1 > 2 > 4 > 3

3) 2 > 3 > 4 > 1 4) 4 > 3 > 2 > 1

32. Correct combination is

1)	Benzene-1,2-di-carboxylic acid	a)	Formic acid
2)	Hexane-1,6-dio-ic acid	b)	Acetic acid
3)	Methanoic acid	c)	Adipic acid
4)	Ethanoic acid	d)	Phthalic acid

1) $\frac{1\ 2\ 3\ 4}{d\ c\ a\ b}$

2) $\frac{1\ 2\ 3\ 4}{b\ c\ a\ d}$

3) $\frac{1\ 2\ 3\ 4}{a\ b\ c\ d}$

4) $\frac{1\ 2\ 3\ 4}{c\ b\ d\ a}$

33. Reduction of CH_3COOH with $LiAlH_4$ followed by hydrolysis gives

1) CH_4

2) CH_3CH_3

3) CH_3CH_2OH

4) CH_3OH

34. $CH_3-COOH \longrightarrow (CH_3CO)_2O$

This reaction is carried out by treating

1) Acetic acid and magnesium

2) Acetic acid and ethanol

3) Acetic acid with sodalime

4) acetic acid and P_2O_5

35. Decan-1-ol → Decanoic acid
The reagent for this conversion is

1) Zn + HCl

2) $LiAlH_4$

3) CrO_3/H_2SO_4

4) C_2H_5OH/Na

36. When propanoic acid is treated with aq. $NaHCO_3$, CO_2 is liberated. The 'C' of CO_2 is comes from

1) Bicarbonate

2) –COOH group

3) Methyl group

4) Methylene group

37. Identify the correct order of boiling points of the following compounds :

a) $CH_3–CH_2–CH_2–CH_2–OH$

b) $CH_3–CH_2–CH_2–COOH$

c) $CH_3–CH_2–CH_2–CH_3$

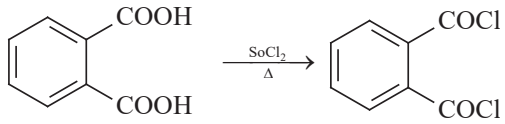
1) b > a > c

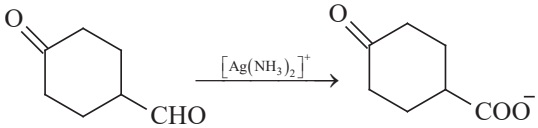
2) c > b > a

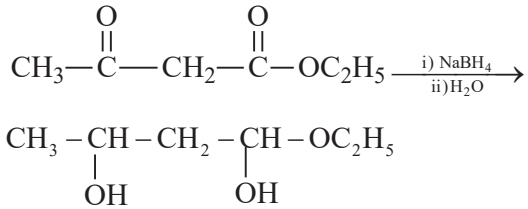
3) a > b > c

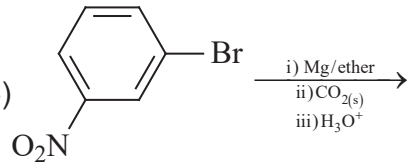
4) c > a > b

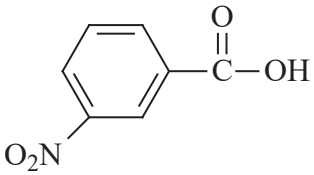
38. Which of the reaction represent incorrect product formation?

1) 

2) 

3) 

4) 



39. A compound undergoes the following sequence of reactions

$$C_3H_5N \xrightarrow{\text{Hydrolysis}} \underset{A}{C_3H_6O_2} \xrightarrow{Cl_2/P} \underset{B}{C_3H_5O_2Cl}$$

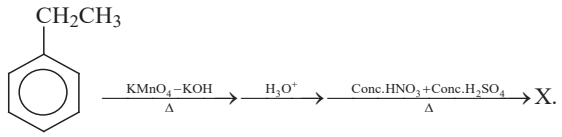
The compound B is

1) Propanoyl chloride

2) 2-chloropropanoic acid

3) 3-chloropropanoic acid

4) Propanoic anhydride

40. 

Number of π bonds in X is

1) 3

2) 4

3) 5

4) 8

41. $CH_3-CH_2-\overset{O}{\overset{||}{C}}-OH + CH_3\overset{18}{O}H \xrightarrow{H^+} X + Y$

The products X + Y is

1) $CH_3CH_2-\overset{O}{\overset{||}{C}}-\overset{18}{O}-CH_3 + H_2O$

2) $CH_3CH_2-\overset{O}{\overset{||}{C}}-O-CH_3 + H_2\overset{18}{O}$

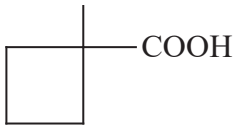
3) $CH_3CH_2-\overset{O}{\overset{||}{C}}-\overset{18}{O}-CH_3 + H_2\overset{18}{O}$

4) $CH_3-\overset{O}{\overset{||}{C}}-OCH_2CH_3 + H_2\overset{18}{O}$

42. The number of compounds undergo HVZ reaction is

1) CH_3-CH_2-COOH 2) $Ph-CH_2-COOH$

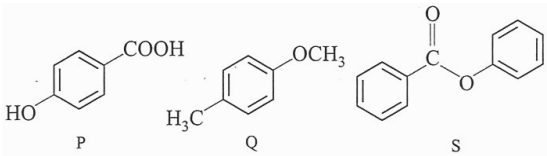
3) $Ph-\underset{\underset{O}{||}}{C}-Cl$ 4) $CH_3-\underset{\underset{O}{||}}{C}-OH$

5) $CH_3-\underset{\underset{CH_3}{|}}{CH}-COOH$ 6) 

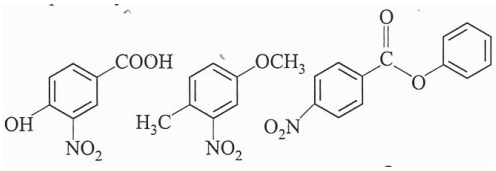
1) 4 2) 5

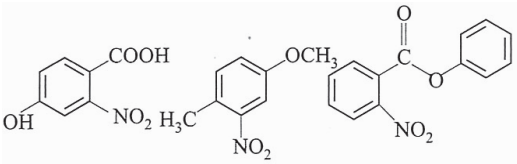
3) 3 4) 6

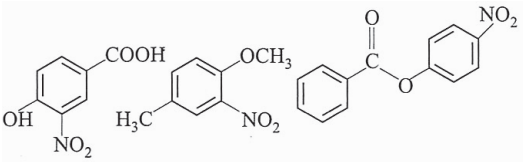
43. The compound P, Q and S

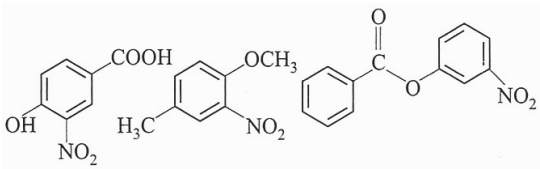


were separately subjected to nitration using HNO_3/H_2SO_4 mixture. The major product formed in each case respectively is

1) 

2) 

3) 

4) 

44. **Assertion (A)**: In sodium formate, both the C–O bonds have same value of bond length

Reason (R) : Equal bond length is due to the phenomenon of resonance.

1) Both A and R are correct but R is not the correct explanation of A

2) A is correct but R is not correct

3) A is not correct but R is correct

4) Both A and R are correct and R is the correct explanation of A

45. **Assertion (A)**: p-Hydroxybenzoic acid has a lower boiling point than o-hydroxybenzoic acid.

Reason (R) : o - Hydroxybenzoic acid has intramolecular hydrogen bonding.

1) Both A and R are correct but R is not the correct explanation of A

2) A is correct but R is not correct

3) A is not correct but R is correct

4) Both A and R are correct and R is the correct explanation of A

ANSWER KEY

1.	2	14.	1	27.	2	40.	4	53.	3
2.	4	15.	1	28.	2	41.	1	54.	1
3.	3	16.	2	29.	1	42.	3	55.	1
4.	4	17.	3	30.	2	43.	1	56.	4
5.	1	18.	1	31.	4	44.	1	57.	4
6.	3	19.	3	32.	4	45.	1	58.	4
7.	2	20.	1	33.	4	46.	1	59.	3
8.	1	21.	3	34.	3	47.	2	60.	2
9.	4	22.	1	35.	3	48.	4	61.	1
10.	1	23.	2	36.	3	49.	3	62.	2
11.	1	24.	2	37.	4	50.	1	63.	4
12.	4	25.	1	38.	3	51.	4	64.	1
13.	1	26.	1	39.	3	52.	2	65.	2

SAMPLE QUESTIONS

1.	2	10.	1	19.	3	28.	2	37.	1
2.	1	11.	2	20.	2	29.	4	38.	3
3.	1	12.	3	21.	2	30.	4	39.	2
4.	2	13.	3	22.	3	31.	1	40.	3
5.	1	14.	2	23.	4	32.	1	41.	1
6.	3	15.	3	24.	3	33.	3	42.	1
7.	4	16.	1	25.	3	34.	4	43.	3
8.	1	17.	4	26.	1	35.	3	44.	4
9.	2	18.	2	27.	3	36.	1	45.	3

WORK BOOK

Chapter 22

AMINES

QUESTIONS

INTRODUCTION AND NOMENCLATURE

1. Give the correct match

1) Adrenalin and ephedrine	a) 3^0 amino group
2) Novocain	b) Surfactants
3) Benadryl	c) 2^0 amino group
4) Quaternary ammonium salts	d) anaesthetic

1) $\frac{1234}{abcd}$ 2) $\frac{1234}{bcda}$

3) $\frac{1234}{dbca}$ 4) $\frac{1234}{cdab}$

2. Hybridisation of nitrogen atom in ammonia is

1) sp 2) sp^2

3) sp^3 4) sp^3d

3. Bond angle in $(CH_3)_3N$ is

1) $109^0 28'$ 2) 108^0

3) 120^0 4) 180^0

4. A tertiary amine is

1) A compound in which all the three hydrogen atoms of ammonia have been replaced by alkyl or aryl groups

2) A compound with two $-NH_2$ groups

3) A compound with one – NH– group

4) A compound having three $-NH_2$ groups

5. Total number of structurally isomeric 2° amines possible for the compound with molecular formula $C_4H_{11}N$ is

1) 4

2) 6

3) 3

4) 8

6. The IUPAC name for

$CH_3-CH_2-N(CH_3)-CH_2-CH_2-CH_3$ is

1) N-Methylpentan-2-amine

2) N,N-Dimethylpropan-1-amine

3) N,N-Diethylpropan-1-amine

4) N-Ethyl-N-methylpropan-1-amine

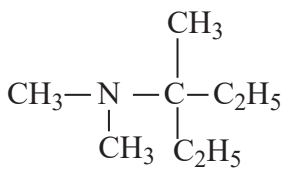
7. Which is incorrectly named?

1) $NH_2(CH_2)_6NH_2 \rightarrow$ Hexane-1,6-diamine

2) $CH_2=CH-CH_2NH_2 \rightarrow$ Prop-1-en-3-amine

3) $CH_3-CH=CH-CH_2-\underset{\underset{NH_2}{|}}{CH}-CH_2-COOH$

3-Aminohept-5-enoic acid

4) 

N,N-3-Trimethylpentan-3-amine

METHODS OF PREPARATION

8. Select the correct statement regarding ammonolysis

1) It is nucleophilic substitution reaction

2) It is a best method to prepare 1^0 amines

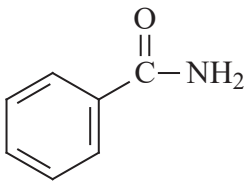
3) It is carried out in sealed tube at 373 K

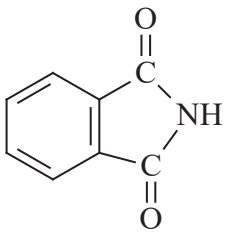
4) It is the process of cleavage of the C–X bond by the ammonia molecule

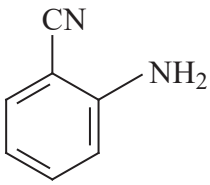
1) 2 and 3 2) 1, 3, 4

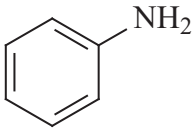
3) 1, 3, 4 4) 1, 2 and 3

9. The increasing order of reactivity of the following compounds towards reaction with alkyl halides directly is:

A) 

B) 

C) 

D) 

1) B < A < D < C 2) B < A < C < D

3) B < A < D < C 4) A < C < D < B

10. In the given reaction,

$$NH_3 + R-X \rightarrow RNH_2 \xrightarrow{RX} R_2NH \xrightarrow{RX} R_3N \xrightarrow{RX} R_4N^+X^-$$

Select an appropriate statement(s) about the reaction?

1) In this reaction, RX acts as a nucleophile

2) In this reaction, NH_3 acts as a nucleophile

3) Both NH_3 and R–X acts as nucleophile

4) $R_4N^+X^-$ is called quarternary ammonium salt

1) 2, 4 2) 1, 2, 3

3) 1, 3, 4 4) 1, 4

11. For the conversion,

$CH_3 - CH_2 - CN \rightarrow CH_3CH_2CH_2NH_2$

Select the correct option

1) It is an oxidation reaction

2) This reaction is used to decrease the number of carbon atoms

3) Reagents that can be used in this reaction are

$LiAlH_4$, H_2/Ni, Na(Hg)/EtOH

4) All of the above

12. Gabriel's phthalimide reaction is used for the preparation of

1) Primary aromatic amines

2) Secondary amines

3) Aliphatic primary amines

4) Tertiary amines

13. $$CH_3-CH_2-\overset{O}{\overset{||}{C}}-NH_2 \xrightarrow[NaOH]{Br_2} X$$

$$CH_3-CH_2-C\equiv N \xrightarrow{LAH} Y$$

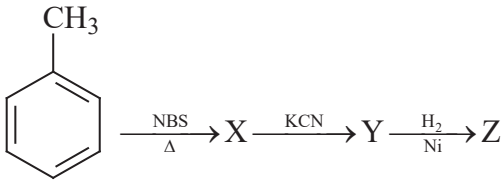
The relation between X and Y is

1) Functional isomers

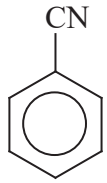
2) Chain isomers

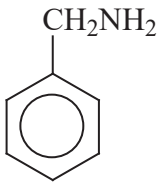
3) Identical

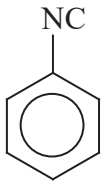
4) Homologues

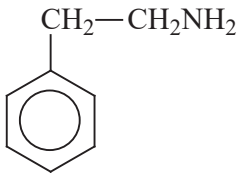
14. 

The product Z is

1) 

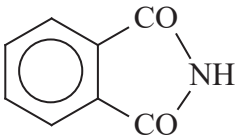
2) 

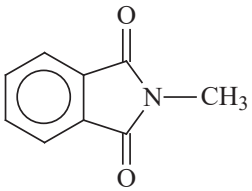
3) 

4) 

15. Phthalimide $\xrightarrow{KOH}$ A $\xrightarrow{CH_3-Br}$ B

The major product B is

1) 

2) 

3) CH_3NH_2

4) $CH_3CH_2NH_2$

16. Number of moles of NaOH cosumed in Hoffmann bromamide reaction is

1) 2 2) 3

3) 4 4) 5

17. Benzylamine may be alkylated, as shown in the following equation:

$C_6H_5\ CH_2NH_2 + RX \rightarrow C_6H_5CH_2NHR$

Which of the following alkyl halides is best suited for this reaction through the S_N1 mechanism?

1) $CH_3–CH_2Br$ 2) CH_3Br

3) $C_6H_5 – Br$ 4) $C_6H_5CH_2Br$

18. The source of nitrogen in Gabriel synthesis of amines is

1) Sodium nitrite

2) Potassium cyanide

3) Potassium phthalimide

4) Both 1 and 2

19. Amongst the given reactants, the most appropriate for preparing 2^0 amine is

1) 1^0 R–X + AgCN

2) 1^0 R– NH_2 + R – CHO followed by H_2/Pt

3) 2^0 RX + NH_3

4) 2^0 R–X + NaCN followed by H_2/Pt

20. Which of the following reagents would be a good choice for reducing an aryl nitro compound to an amine?

1) Fe + HCl 2) Sn + HCl

3) $LiAlH_4$/ether 4) H_2(excess) /Pt

21. Select X, Y and Z

1) $CH_3-CH_2-Br \xrightarrow[2)H_2/Pt]{1)AgCN} X$

2) $C_2H_5I \xrightarrow[\substack{2)\text{Partial hydrolysis} \\ 3)Br_2/NaOH}]{1)NaCN} Y$

3) $CH_3-COOH \xrightarrow[\substack{2)P_2O_5 \\ 3)Na/NaOH}]{1)NH_3/\Delta} Z$

	X	Y	Z
1)	$CH_3-CH_2-CH_2-NH_2$	$C_2H_5-CH_2-Br$	$CH_3-COO-C_2H_5$
2)	$CH_3-CH_2-NH-CH_3$	$C_2H_5-NH_2$	$CH_3-CH_2-NH_2$
3)	$CH_3-CH_2-NH-CH_2-CH_3$	$C_2H_5-NH-C_2H_5$	CH_3-NH_2
4)	$CH_3-CH_2-CH_2-NH_2$	$CH_3-CH_2-CH_2-CH_2-NH_2$	$C_2H_5-COO-CH_3$

22. $R-\overset{\overset{O}{||}}{C}-NH_2 \xrightarrow[\Delta]{ND_3} X \xrightarrow[KOH]{Br_2} Y$

The product Y is

1) $R - NH_2$

2) $R-\overset{\overset{O}{||}}{C}-R$

3) $R-\overset{\overset{O}{||}}{C}-OH$

4) $R–ND_2$

23. Which of the following statements are correct regarding Hoffmann bromamide reaction?

1) 2^0 amines can be prepared by this reaction

2) 1^0 amine formed has one carbon less than that of 1^0 amide used

3) Aromatic 1^0 amines are not prepared by this method

4) It is used to differentiate 1^0 aromatic and 1^0 aliphatic amines

24. Number of isomeric aromatic amines with molecular formula $C_8H_{11}N$, which can be synthesised by Gabriel phthalimide synthesis is ——

1) 8

2) 6

3) 5

4) 4

25. $R-\overset{\overset{O}{||}}{C}-NH_2 + Br_2 + NaOH \rightarrow R - NH_2$

In this reaction, carbonyl group is lost as

1) HCO_3^-

2) CO_3^{2-}

3) CO_2

4) CO

26. **Assertion** : Aromatic primary amines can't be prepared by Gabriel's phthalimide synthesis.

Reason : Aryl halides do not undergo electrophilic substitution with phthalimide anions

1) If both assertion and reason are true and the reason is the correct explanation of assertion

2) If both assertion and reason are true, and the reason is not the correct explanation of assertion

3) If the assertion is true, but the reason is false

4) If both assertion and reason are false

PHYSICAL PROPERTIES

27. Which one is most volatile?

1) $(CH_3)_3N$ 2) $CH_3 – CH_2 – NH_2$

3) $(CH_3)_2NH$ 4) $CH_3 – OH$

28. Lower aliphatic amine are highly soluble in

1) Diethyl ether 2) Water

3) Benzene 4) CCl_4

29. Identify the incorrect statement

1) Solubility of amines in water decreases with increase in molar mass

2) The lower aliphatic amines are gases with fishy smell

3) Aniline and other arylamines are usually colourless but get coloured in storage due to atmospheric oxidation

4) Butan-1-amine is more soluble in water than Butan-2-ol

30. Which of the following statements is correct?

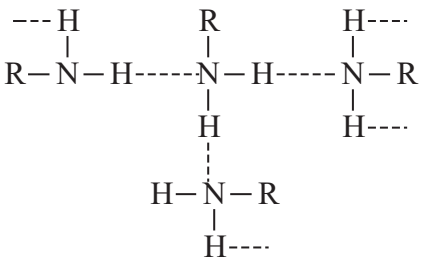
1) Higher amines are soluble in water

2) Aromatic amines are insoluble in organic solvents

3) Amines can't exhibit intermolecular hydrogen bonding

4) Electronegativity of oxygen in alcohol and nitrogen in amine is 3.5 and 3 respectively

31. Regarding the given figure,



Select the true statement

1) Intramolecular hydrogen bonding present in primary amines

2) Intermolecular hydrogen bonding present in primary amines

3) Intramolecular hydrogen bonding is present in 2^0 amines

4) Intermolecular hydrogen bonding in present in tertiary amines

32. Choose the correct order of the boiling points of amines

1) $1^0 > 2^0 > 3^0$ 2) $2^0 > 3^0 > 1^0$

3) $3^0 > 1^0 > 2^0$ 4) $3^0 > 2^0 > 1^0$

33. **Assertion (A)**: The correct boiling point order of isomeric amines is primary > secondary > tertiary.

Reason (R) : The intermolecular H-bonding in primary amine is maximum due to two hydrogens available for more association but in tertiary amine there is no hydrogen available for H-bond.

1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

2) Both (A) and (R) are correct and (R) is not the correct explanation of (A)

3) A is correct but (R) is not correct

4) Both A and R are not correct.

34. Which among the following statements is wrong?

1) Among isomeric amines, the order of boiling point is 1° > 2° > 3°

2) $CH_3–NH_2$ is more soluble in water than $CH_3CH_2NH_2$

3) Aniline is highly soluble in water

4) Amines have lower boiling point than corresponding alcohols

BASIC CHARACTER

35. Arrange the following in decreasing order of pK_b values in aqueous solution

A) $C_2H_5NH_2$ B) $C_6H_5NH–CH_3$

C) $(C_2H_5)_2NH$

D) $C_6H_5NH_2$

1) D > B > A > C 2) A > B > C > D

3) B > A > D > C 4) C > D > B > A

36. Arrange the following in increasing order of basic strength in aqueous solution

A) $C_6H_5NH_2$ B) $C_6H_5N(CH_3)_2$

C) $(C_2H_5)_2NH$

D) $CH_3–NH_2$

1) C < D < B < A 2) A < B < D < C

3) B < D < A < D 4) D < C < A < B

37. Arrange the following in the increasing order of basic strength

A) Aniline

B) p-Nitroaniline

C) p-Toluidine

1) C < B < A 2) B < C < A

3) C < A < B 4) B < A < C

38. Correct order of basic strength of the following compounds is

A) $C_6H_5NH_2$

B) $C_6H_5NHCH_3$

C) $C_6H_5CH_2NH_2$

1) A < B < C 2) C < A < B

3) B < A < C 4) A < C < B

39. Arrange the following in decreasing order of basic strength in gaseous phase

A) $C_2H_5NH_2$

B) $(C_2H_5)_2NH$

C) $(C_2H_5)_3N$

D) NH_3

1) C > B > A > D 2) C > A > B > D

3) A > B > C > D 4) C > D > B > A

40. Arrange the following in increasing order of basic strength in aqueous solution

A) $(CH_3)_3N$

B) $(CH_3)_2NH$

C) CH_3NH_2

1) C < A < B 2) A < B < C

3) C < A < B 4) B < A < C

41. Arrange the following in decreasing order of their basic strength:

A) $C_6H_5 - NH_2$

B) $C_2H_5 - NH_2$

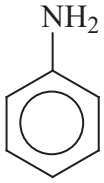
C) $(C_2H_5)_2NH$

D) NH_3

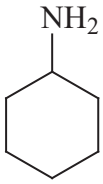
1) C > B > D > A 2) C > D > A > B

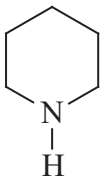
3) D > B > C > A 4) B > D > C > A

42. Which of the following is the weakest Bronsted base?

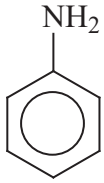
1) 

2) CH_3NH_2

3) 

4) 

43. Strongest base is

1) 

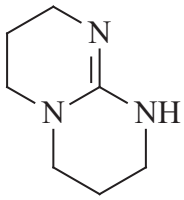
2) $CH_2 = CH - CH_2 - NH_2$

3) $CH_3 - CH_2 - CH_2 - NH_2$

4) $CH \equiv C - CH_2 - NH_2$

44. The increasing order of pK_b for the following compounds will be:

A) $NH_2 - CH = NH$

B) 

C) $CH_3 - \ddot{N}H - CH_3$

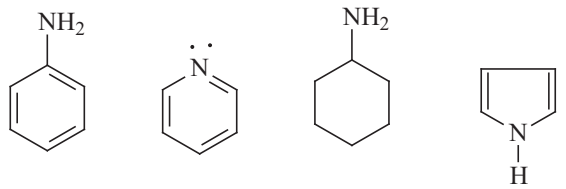
1) A < B < C

2) B < C < A

3) B < A < C

4) C < A < B

45. The decreasing order of basicity of the following amines is:

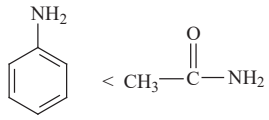


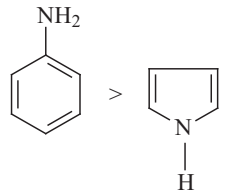
1 2 3 4

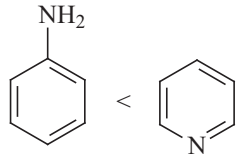
1) 3 > 1 > 2 > 4 2) 3 > 2 > 1 > 4

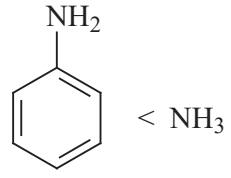
3) 2 > 3 > 4 > 1 4) 1 > 3 > 4 > 2

46. Which one of the following is incorrect about the order of basicity?

1) 

2) 

3) 

4) 

47. **Assertion** : Aliphatic amines are weaker bases than ammonia and aromatic amines are stronger bases than ammonia

Reason : +I effect of alkyl groups on aliphatic amines increase the electron density of N atom. Aromatic amines are weaker bases due to electron donating nature of the aryl group

1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

2) Both (A) and (R) are correct and (R) is not the correct explanation of (A)

3) A is correct but (R) is not correct

4) Both A and R are not correct.

REACTIONS OF AMINES

48. A primary aliphatic amine an reaction with nitrous acid in cold (273 K) and thereafter raising the reaction temperature to room temperature (298 K), gives a/an

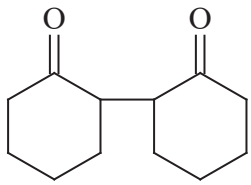
1) nitrile

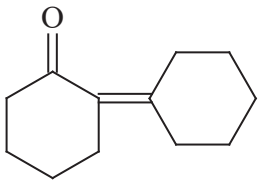
2) alcohol

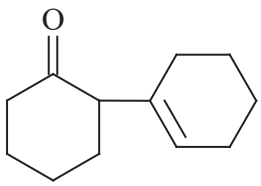
3) diazonium salt

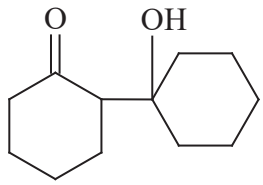
4) secondary amine

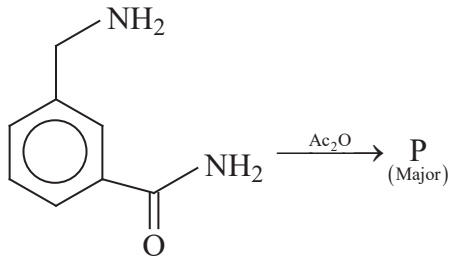
49. Cyclohexylamine when treated with nitrous acid yields (P). On treating P with PCC results in Q. When Q is heated with dil.NaOH 'R' is formed. The final product R is

1) 

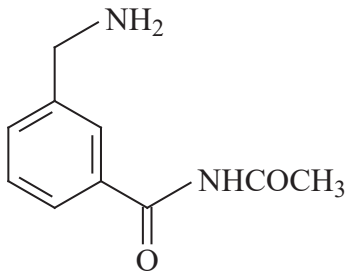
2) 

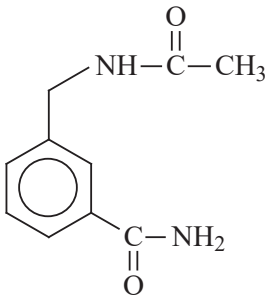
3) 

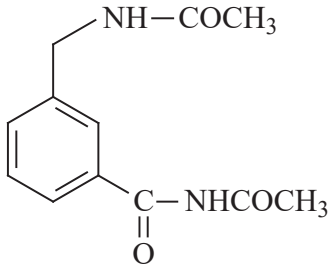
4) 

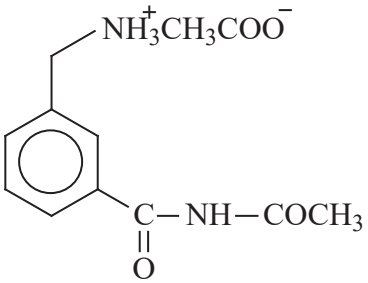
50. 

The major product in the above reaction is:

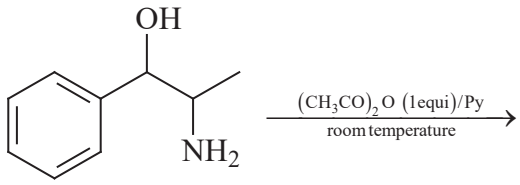
1) 

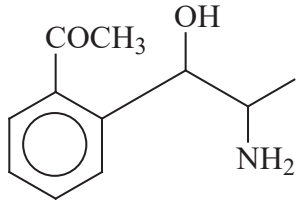
2) 

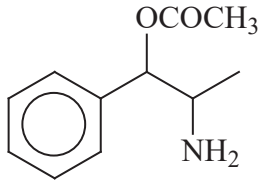
3) 

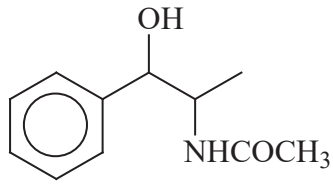
4) 

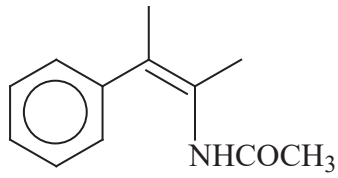
51. The major product obtained in the following reaction is:

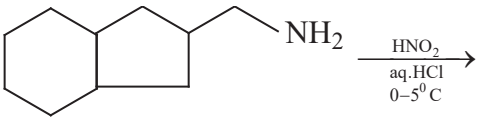


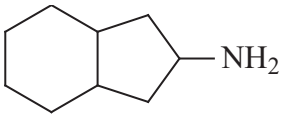
1) 

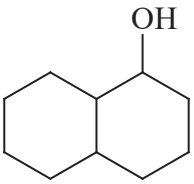
2) 

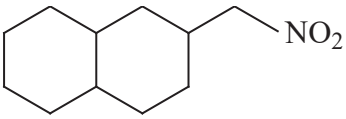
3) 

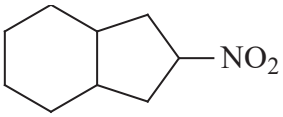
4) 

52. 

1) 

2) 

3) 

4) 

53 A compound with molecular mass 180 is acytylated with CH_3COCl to get a compound with molecular mass 390. The number of amino groups present per molecules of the former compound is

1) 6 2) 2

3) 5 4) 4

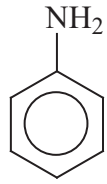
54. An organic compound A on reacting with NH_3, gives B. On heating B, it gives C. C in presence of KOH reacts with Br_2 to give $CH_3 – CH_2 – NH_2$. A is

1) $CH_3 – COOH$

2) $CH_3 – CH_2 – COOH$

3) $CH_3—\underset{\underset{CH_3}{|}}{CH}—COOH$

4) $CH_3 – CH_2 – CH_2 – CH_2 – COOH$

55. 

$\xrightarrow[0-5^0 C]{HNO_2}$ A. A is stable below 5^0C due to

1) Resonance

2) Inductive effect

3) Hyper conjugation

4) Electromeric effect

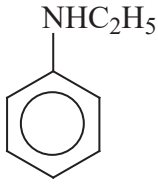
56. $CH_3NH_2 \xrightarrow[0-5^0 C]{HNO_2} P$

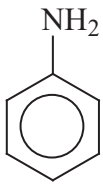
The product P is

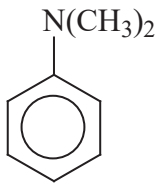
1) CH_3OH 2) CH_3CH_2OH

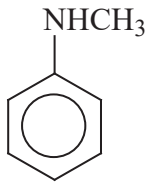
3) $CH_3CH_2NH_2$ 4) CH_3COOH

57. Which of the following will give the carbylamine test?

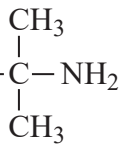
1) 

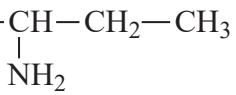
2) 

3) 

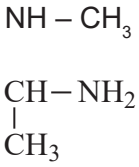
4) 

58. The compound does not respond to carbylamine reaction

1) 

2) 

3) $C_2H_5 - NH - CH_3$

4) 

59. Hinsberg reagent is

1) C_6H_5COCl

2) $CH_3 - COCl$

3) $C_6H_5 - CH_2 - Cl$

4) $C_6H_5SO_2Cl$

60. Which of the following amine does not react with Hinsberg reagent?

1) Ethylmethtyl amine

2) Isopropyl amine

3) Triethtyl amine

4) Neopentyl amine

61. The compound obtained by heating a mixture of primary amine and $CHCl_3$ with ethanolic KOH is

1) An amide

2) An alkyl halide

3) An alkyl isocyanide

4) An amide and nitro compound

62. A compound X has the molecular formula C_7H_7NO. On treatment with Br_2 and KOH, X gives an amine Y. The latter gives carbylamine test. Y upon diazolisation and coupling with phenol gives an azo dye. X is

1) $C_6H_5CONH_2$

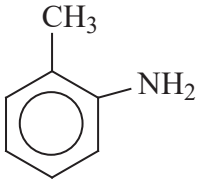
2) $C_6H_5CH_2NO$

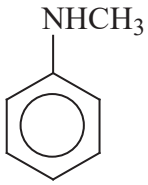
3) $C_6H_5COONH_4$

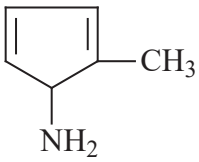
4) All of these

63. The compound X (C_7H_9N) reacts with benzene sulphonyl chloride to give Y($C_{13}H_{13}NO_2S$) which is insoluble in alkali. The compound X is

1)

2) 

3) 

4) 

64. An amine reacts with $C_6H_5SO_2Cl$ and the product is soluble in alkali, amine is

1) 1^0 amine

2) 2^0 amine

3) 3^0 amine

4) all of these

65. Phenyl isocyanides are prepared by which of the following reaction?

1) Reimer-Tiemann reaction

2) Carbylamine reaction

3) Wurtz reaction

4) Rosenmund's reaction

66.

$$R-NH_2 + CHCl_3 + KOH \longrightarrow A$$

$$R-\overset{\overset{O}{||}}{C}-NH_2 + Br_2 + NaOH \longrightarrow B$$

A and B are respectively

1) R–CN, R–NH_2 2) R–NC, R–NH_2

3) R–CN, R–NC 4) R–NH_2, R–NH_2

67. $CH_3CH_2NH_2$ and $(CH_3CH_2)NH$ can be distinguished by

1) Tollens test 2) Lucas test

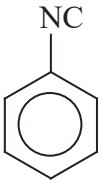
3) Carbylamine test 4) Iodoform test

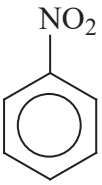
METHODS OF PREPARATION OF ANILINE

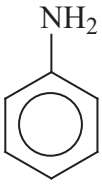
68. $A \xrightarrow{\text{Reduction}} B \xrightarrow[\text{KOH}]{CHCl_3} C \xrightarrow{\text{Reduction}}$

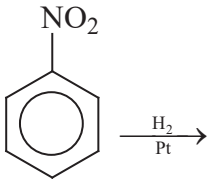
N-Methylaniline. Then A is

1) $CH_3 - NH_2$

2) 

3) 

4) 

69. 

1) Benzene 2) Toluene

3) Azobenzene 4) Aniline

70. Aniline can be obtained by the reduction of nitrobenzene with

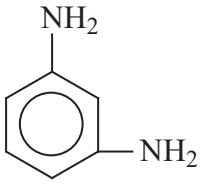
1) Fe + HCl 2) Sn + HCl

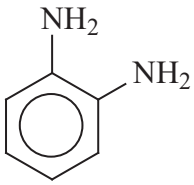
3) H_2/Pt 4) All of these

REACTIONS OF ANILINE

71.

Product

1) 

2) 

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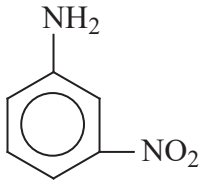
4) 

72. Aniline $\xrightarrow[CCl_4]{Br_2}$?

The product is

1) Only orthobromoaniline

2) o and p-Bromoaniline

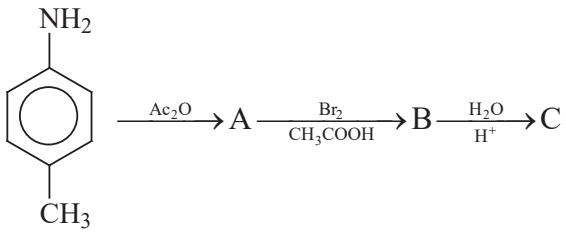
3) Only p-Bromoaniline

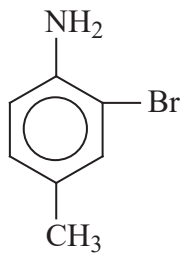
4) 2,4,6-Tribromoaniline

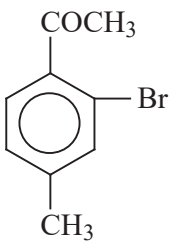
73. Aniline $\xrightarrow[H_2O]{Br_2}$

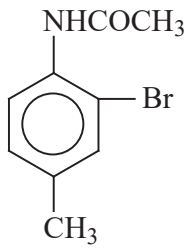
1) 2,4,6-Tribromoaniline
2) p-Bromoaniline
3) m-Bromoaniline
4) o-Bromoaniline

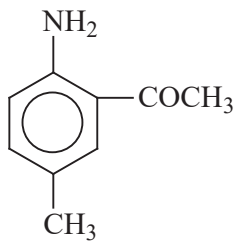
74. The final product C obtained in this reaction would be

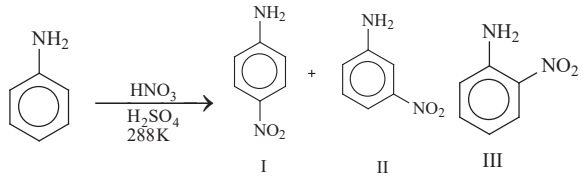


1) 

2) 

3) 

4) 

75. 

Select the percentage in which these amine derivatives are formed in the reaction mixture along with the reason

1) I → 2%, II → 47%, III → 51%

In the acidic medium, aniline is protonated to form the anilinium ion which is ortho directing

2) I → 51%, II → 2%, III → 47%

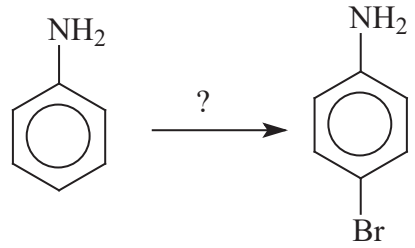
In the acidic medium, aniline is protonated to form the anilinium ion which is para directing

3) I → 51%, II → 47%, III → 2%

In the acidic medium, aniline is protonated to form anilinium ion which is meta directing

4) I → 50%, II → 20%, III → 20%

In acidic medium, aniline is protonated to form the anilinium ion which is ortho directing

76. 

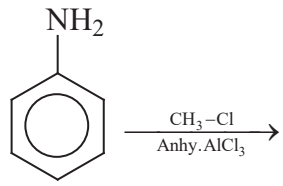
Which of the following reagent systems will be most suitable for this conversion?

1) $\xrightarrow{Br_2/FeBr_3}$

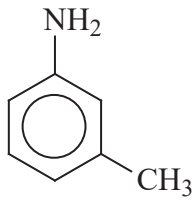
2) $\xrightarrow[\substack{3)\,dil.H_2SO_4/\Delta \\ 4)\,Br_2}]{\substack{1)\,H_2SO_4 \\ 2)\,Ac_2O}}$

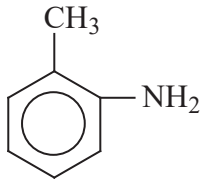
3) $\xrightarrow[3)\,dil.H_2SO_4/\Delta]{\substack{1)\,Ac_2O \\ 2)\,Br_2/FeBr_3}}$

4) $\xrightarrow[3)\,HBr]{\substack{1)\,Ac_2O \\ 2)\,dil.H_2SO_4}}$

77. 

Product will be

1) 

2) 

3)

4) None of the above

DIAZONIUM COMPOUNDS

78. Aniline on treatment with nitrous acid at 0^0C, forms

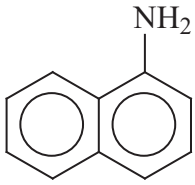
1) Benzene diazonium chloride

2) Phenol

3) Nitrobenzene

4) Nitrosobenzene

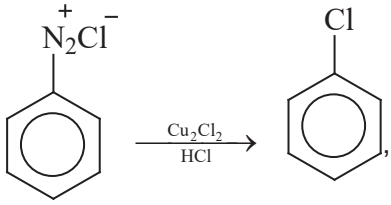
79. Which will not form stable diazonium salt?

1) 

2) $C_6H_5NH_2$

3) $C_6H_5CH_2–NH_2$

4)

80. 

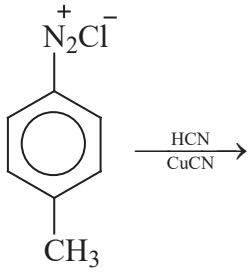
, the reaction is

1) Sandmeyer's reaction

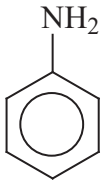
2) Carbylamine reaction

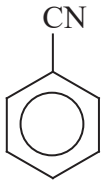
3) Chlorination

4) Gattermann reaction

81. 

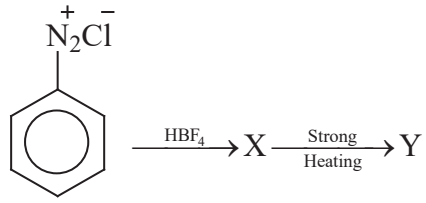
Product is

1) 

2) 

3)

4)

82. 

The product Y is

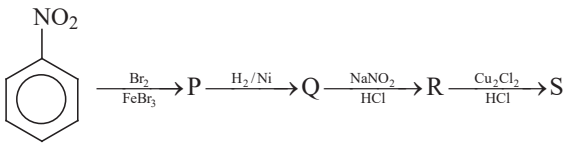
1) Benzene

2) Fluorobenzene

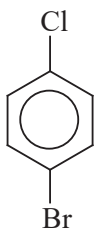
3) 1,2-Difluorobenzene

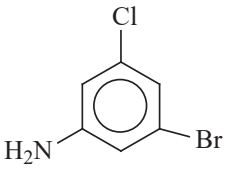
4) 1,3-Difluorobenzene

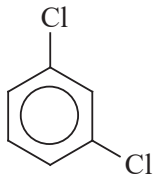
83. Get the end product

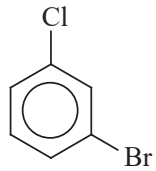


S is

1) 

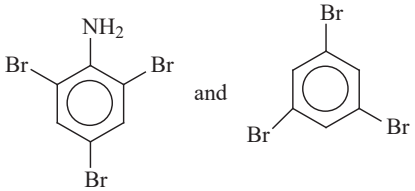
2) 

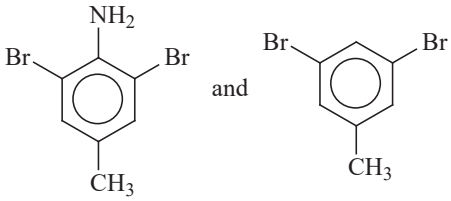
3) 

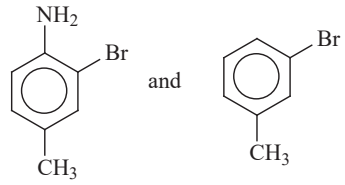
4) 

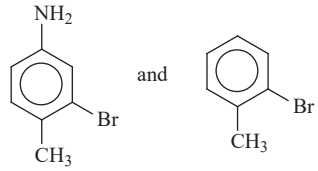
84. In the following reaction sequence, the compound P and Q respectively are:

p-Toluidine $\xrightarrow[Br_2/H_2O]{Excess}$ P $\xrightarrow[2)H_3PO_2]{1)HNO_2}$ Y

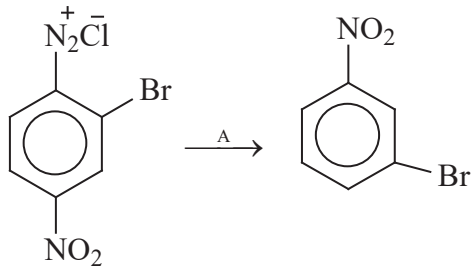
1) 

2) 

3) 

4) 

85. In the reaction,



A is

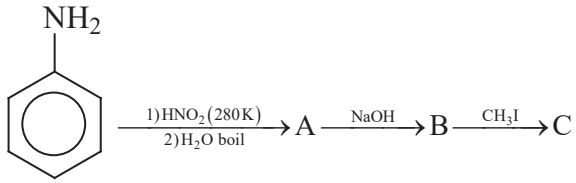
1) H_3PO_2

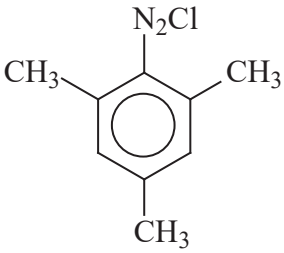
2) Cu_2Cl_2

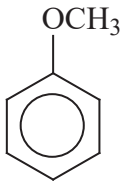
3) H^+/H_2O

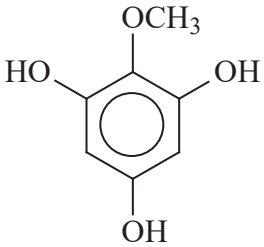
4) $HgSO_4/H_2SO_4$

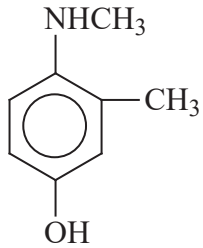
86. Identify C in the reaction given below:



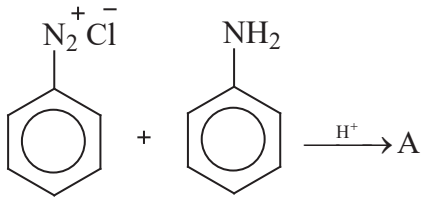
1) 

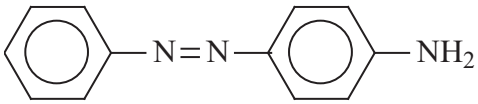
2) 

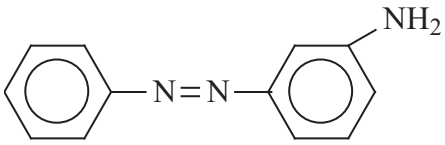
3) 

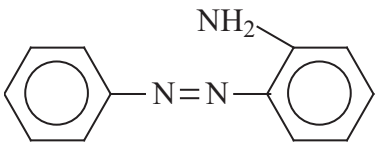
4) 

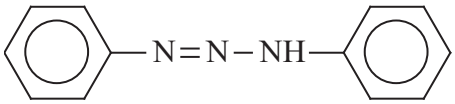
87. What will be the product (A) in the following reaction?

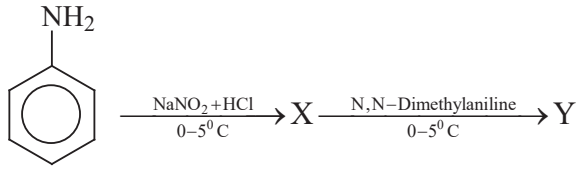


1) 

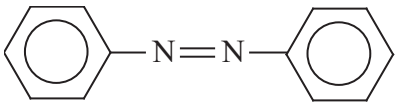
2) 

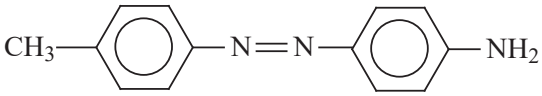
3) 

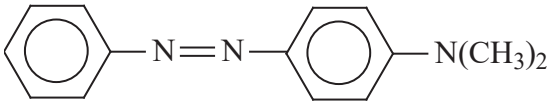
4) 

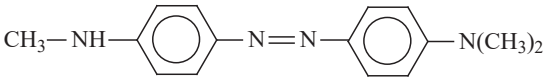
88. 

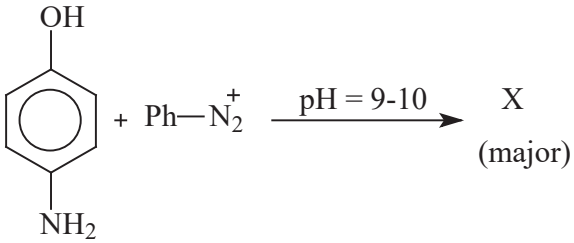
Y is

1) 

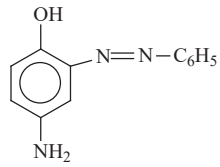
2) 

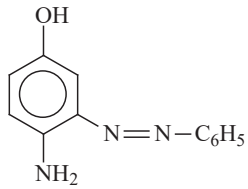
3) 

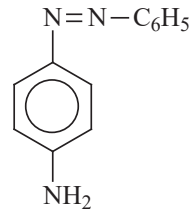
4) 

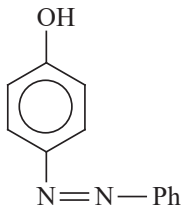
89. 

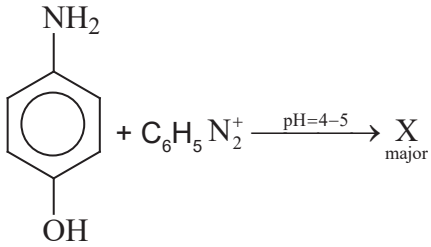
X will be

1) 

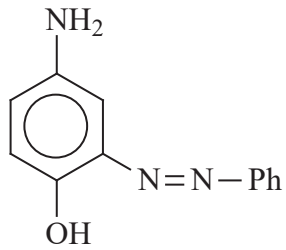
2) 

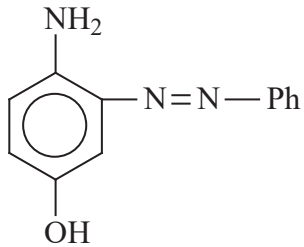
3) 

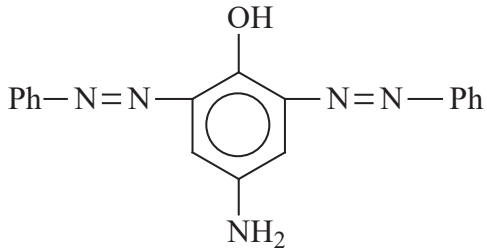
4) 

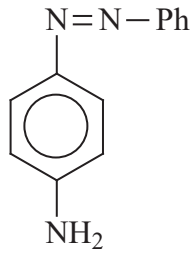
90. 

X will be

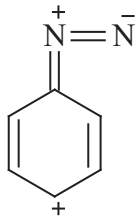
1) 

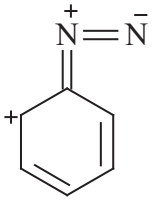
2) 

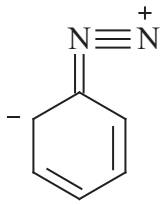
3) 

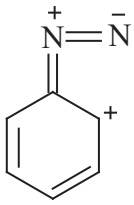
4) 

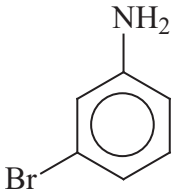
91. The stability of arene diazonium ion is explained on the basis of resonance. Which of the following resonating structure is incorrect?

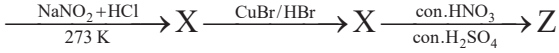
1) 

2) 

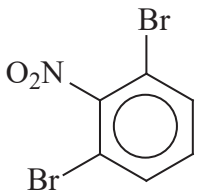
3) 

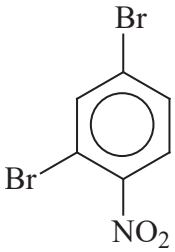
4) 

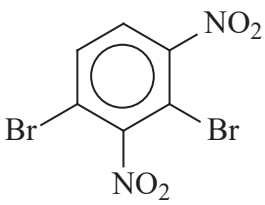
92. 

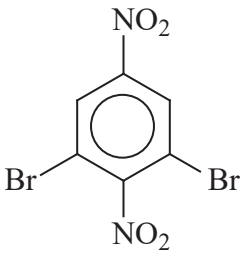


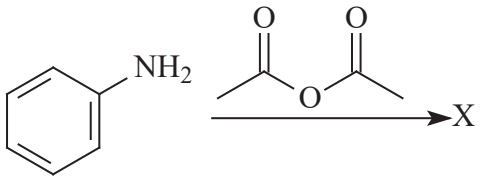
Major product Z is

1) 

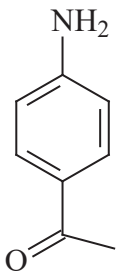
2) 

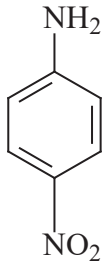
3) 

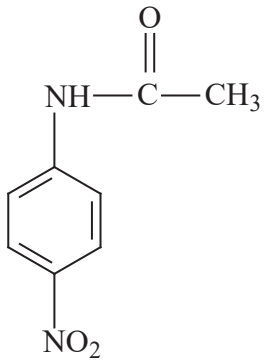
4) 

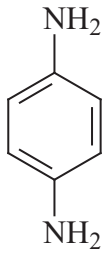
93. 

$\xrightarrow[\text{conc.}H_2SO_4]{\text{conc.}HNO_3} Y \xrightarrow{\text{Aq.NaOH}} Z$

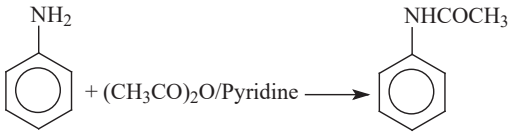
1) 

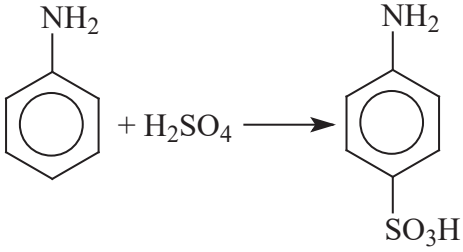
2) 

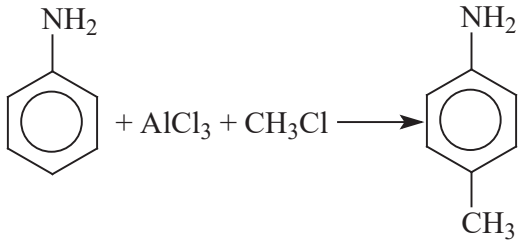
3) 

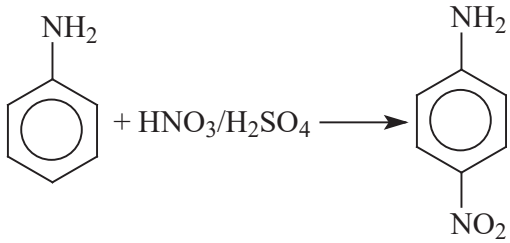
4) 

94. Which one of the following reactions does not occur?

1) 

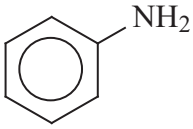
2) 

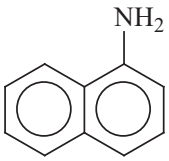
3) 

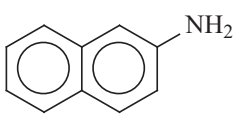
4) 

95. Which of the following cannot form an azodye?

1) $CH_3CH_2NH_2$

2) 

3) 

4) 

96. **Statement-I** : To get p-nitroaniline, nitration of aniline can be conveniently done by protecting the amino group by acetylation.

Statement-II : Acetylation of aniline increases the electron density in the benzene ring.

1) Both statement-I and statement-II are correct

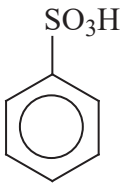
2) Both statement-I and statement-II are incorrect

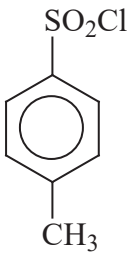
3) Statement-I is correct but statement-II is incorrect

4) Statement-I is incorrect but statement-II is correct

97. The reagent used to distinguish 1°, 2° and 3° amines is

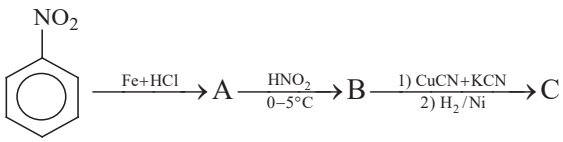
1) $C_6H_5SO_2Cl$

2) 

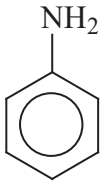
3) 

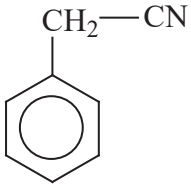
4) Both 1 and 3

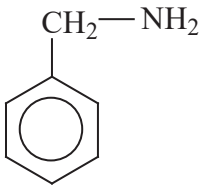
98. Consider the following reaction

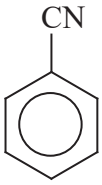


The product C is

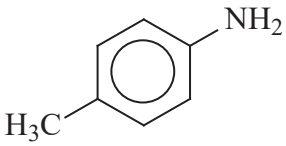
1) 

2) 

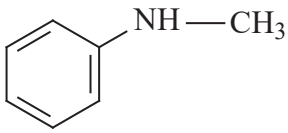
3) 

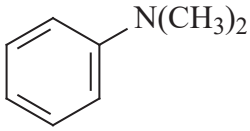
4) 

99. Which of the following will react with KNO_2 and HCl to form an alcohol?

1) 

2) $(CH_3)_2CH–NH_2$

3) 

4) 

100. Assertion : Arene diazonium salts are more stable than alkane diazonium salts

Reason : Positive charge is dispersed on the ring in arene diazonium ion.

1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

2) Both (A) and (R) are correct and (R) is not the correct explanation of (A)

3) A is correct but (R) is not correct

4) Both A and R are not correct.

SAMPLE QUESTIONS

1. General formula for aliphatic saturated amines is

1) $C_nH_{2n}N$ 2) $C_nH_{2n+1}N$

3) $C_nH_{2n+2}N$ 4) $C_nH_{2n+3}N$

2. How many structural isomeric amines are possible for the formula $C_4H_{11}N$

1) 5 2) 7

3) 8 4) 9

3. Which of the following is not a primary amine?

1) Ethyl amine 2) Sec. Butyl amine

3) Tert.Butyl amine 4) Diethyl amine

4. Which of the following reactions does not yield an amine?

1) $R-CONH_2 \xrightarrow{LiAlH_4}$

2) $R-CN+H_2O \rightarrow$

3) $R-X+NH_3 \rightarrow$

4) $R-CH=N-OH \xrightarrow{Na/Ethanol}$

5. $C_6H_5CH_2Cl \xrightarrow{aq.NaCN} X \xrightarrow{H_2/Ni} Y$. The product Y is

1) $C_6H_5CH_2CH_2NH_2$ 2) $C_6H_5CH_2CONH_2$

3) $C_6H_5CH_2NH_2$ 4) $C_6H_5CH_2NHCH_3$

6. Acetaldoxime on catalytic hydrogenation gives

1) n-butylamine 2) Isopropyl amine

3) Ethanamine 4) Acetamide

7. N-Methylpropanamide $\xrightarrow{LiAlH_4} X$

The product X is

1) $(CH_3CH_2)_2NH$

2) $CH_3CH_2CH_2NH_2$

3) $CH_3CH_2CH_2NHCH_3$

4) $CH_3CH_2CONH_2$

8. $R-CONH_2 \xrightarrow[KOH]{Br_2} RNH_2$. This reaction is

1) Hoffmann bromamide reaction

2) Carbylamine reaction

3) Sandmeyer's reaction

4) Gattermann reaction

9. To prepare a 1^0 amine from 1^0 alcohol three methods are given below

$RCH_2OH \rightarrow$

1) i) $\xrightarrow{PBr_3}$ ii) KCN iii) H_2/Ni

2) i) $\xrightarrow[\Delta]{Cu}$ ii) NH_3/Δ iii) H_2/Ni

3) i) $KMnO_4$ ii) $SOCl_2$ iii) NH_3/Δ iv) $\bar{O}B\bar{r}$

Which method should be followed so that the number of carbon atoms is less than in alcohol?

1) 1 and 3 2) 2 only

3) 3 only 4) 1 and 2

10. Consider the reaction:

$$CH_3CH_2Br \xrightarrow{aq.KOH} A \xrightarrow[H^+]{KMnO_4} B \xrightarrow[\Delta]{NH_3} C \xrightarrow[Alkali]{Br_2} D$$. D is

1) CH_3Br

2) CH_3CONH_2

3) CH_3NH_2

4) $CHBr_3$

11. Which one of the following isomeric amines has the highest boiling point?

1) $CH_3CH_2NHCH_2CH_3$

2) $CH_3CH_2CH_2NHCH_3$

3) $(CH_3)_2CHNHCH_3$

4) $CH_3CH_2CH_2CH_2NH_2$

12. Choose the incorrect statement:

1) Amines have lower boiling points as compared to alcohols of comparable molecular mass

2) Isopropylamine is a secondary amine

3) Primary amine shows intermolecular hydrogen bonding

4) Tertiary amines do not show intermolecular hydrogen bonding

13. The strongest base in aqueous solution among the following is

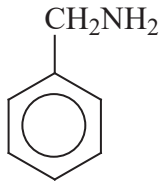
1) Ethanamine

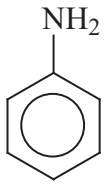
2) N-Methylethanamine

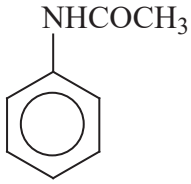
3) N,N-Diethylethanamine

4) N-Ethylethanamine

14. Which of the following is most basic

1) 

2) 

3) 

4)

15. Among the following amines

A) $C_6H_5NH_2$ B) $CH_3CH_2NH_2$

C) $(CH_3CH_2)_2NH$ D) $(CH_3CH_2)_3N$

The order of basicity is

1) A < B < D < C 2) D < C < B < A

3) A > B > C > D 4) B < C < D < A

16. Most basic in aqueous solution is

1) $CH_3-\overset{O}{\overset{||}{C}}-NH_2$ 2) $CH_3-\overset{S}{\overset{||}{C}}-NH_2$

3) $CH_3-\overset{NH}{\overset{||}{C}}-NH_2$ 4) $CH_3-\overset{CH_2}{\overset{||}{C}}-NH_2$,

17. Consider the reaction

$$C_6H_5NO_2 \xrightarrow{Sn+HCl} X \xrightarrow{C_6H_5COCl} Y$$. Y is

1) Acetanilide

2) Benzanilide

3) Azobenzene

4) Hydrazobenzene

18. $C_6H_5NH_2 + CHCl_3 + 3KOH \rightarrow A + 2B + 3C.$

What is A.

1) Chloro benzene

2) Phenyl cyanide

3) Phenyl chloride

4) Phenyl isocyanide

19. The amine which will not liberate N_2 on reaction with HNO_2 is

1) Isopropyl amine

2) Triethyl amine

3) Ter-butyl amine

4) Sec-butyl amine

20. The reagent that is used to distinguish between 2^0 and 3^0 amines is/are

1) Benzene sulphonyl chloride

2) Lucas reagent

3) p-Toluenesulphonylchloride

4) Both 1 and 3

21. Aniline hydrogen sulphate on heating with H_2SO_4 at 453-473 K gives

1) Aniline

2) Sulphanilic acid

3) Benzene sulphonic acid

4) Anthranilic acid

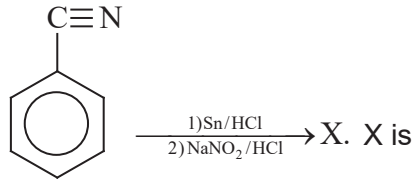
22. Aniline is treated with B_2/H_2O to give an organic compound 'X' which when treated with $NaNO_2$/HCl at 0^0C gives a water soluble compound Y. Y on treatment with Cu_2Cl_2 and HCl gives compound Z. Compound Z is

1) 2,4,6-Tribromochlorobenzene

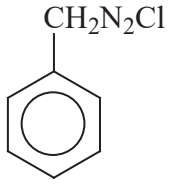
2) 2,4,6-Tribromophenol

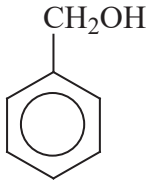
3) o-Bromochlorobenzene

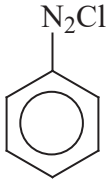
4) p-Bromochlorobenzene

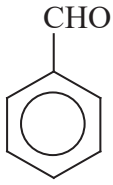
23. 

X. X is

1) 

2) 

3) 

4) 

24. An organic compound (C_3H_9N) (A), when treated with nitrous acid, gave an alcohol and N_2 gas was evolved. (A) on warming with $CHCl_3$ and caustic postash gave (C) which on hydrolysis gave isopropylamine. Predict the structure of (A)

1) $(CH_3)_2CH-NH_2$

2) $CH_3–CH_2–NH–CH_3$

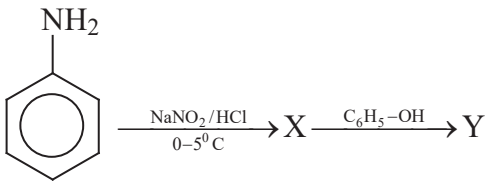
3) $CH_3-N(CH_3)-CH_3$

4) $CH_3 – CH_2 – CH_2 – NH_2$

25. Reaction of aniline with nitrous acid followed by treatment with dilute acid gives

1) C_6H_5–OH
2) C_6H_5–NH–NH_2
3) C_6H_6
4) C_6H_5–NH–OH

26. In the reaction



Y is

1) Azobenzene
2) p-Hydroxyazobenzene
3) Phenylenediamine
4) o-Hydroxyazobenzene

27. Which one of the following is not the correct reaction of aryl diazonium salt?

1) $C_6H_5N_2^+Cl^- + Cu_2Cl_2 \rightarrow C_6H_5Cl$
2) $C_6H_5N_2^+Cl^- + HBF_4 \rightarrow C_6H_5F$
3) $C_6H_5N_2^+Cl^- + H_3PO_2 \rightarrow C_6H_5PO_4$
4) $C_6H_5N_2^+Cl^- \xrightarrow[HCl]{SnCl_2} C_6H_5NHNH_2$

28. Consider the following reaction

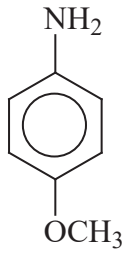
$$CH_3-CH_2-NC \xrightarrow{H_3O^+} \underset{(Amine)}{A} + \underset{(Acid)}{B}$$

Which one of the following statements about A is incorrect?

1) A is more basic than C_6H_5–NH_2
2) A has more boiling point than $(CH_3)_2NH$
3) A is more soluble in water than aniline
4) A is more basic than $(CH_3)_2NH$

29. The compound which is most difficult to diazotise is

1)

2) 

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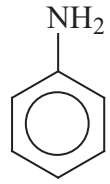
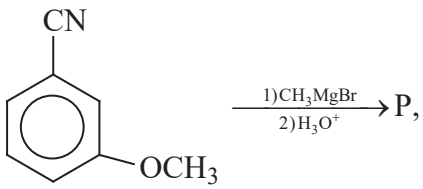
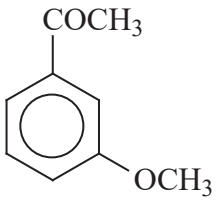
4) 

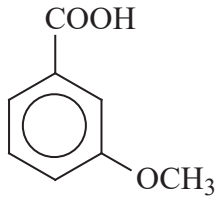
30. Which one of the following compound is more soluble in water?

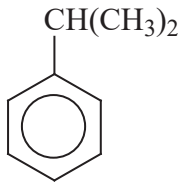
1) Pentan-1-amine
2) Pentane
3) Butan-1-ol
4) Butan-1-amine

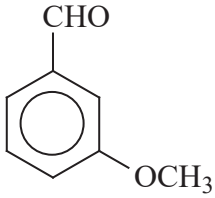
31. The product of the reaction, P is



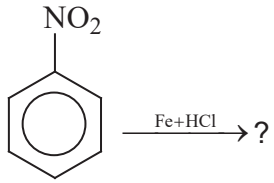
1) 

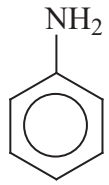
2) 

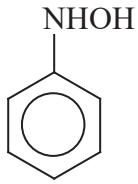
3) 

4) 

32. The product of the reaction



1) 

2) 

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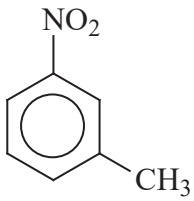
4) 

33. Acetonitrile has the formula

1) C_2H_5NC 2) C_2H_5CN

3) CH_3NC 4) CH_3CN

34. The end product of the reaction is

$$CH_3CH_2Cl \xrightarrow{\text{ethanolic NaCN}} A \xrightarrow{\text{reduction}} B$$

1) CH_3CH_2OH 2) $CH_3CH_2NH_2$

3) $CH_3CH_2CH_2NH_2$ 4) CH_3CH_2COOH

35. Alkylation is possible in

1) Primary amine

2) Secondary amine

3) Tertiary amine

4) Both primary and secondary amines

36. Which of the following exists as Zwitter ion?

1) p-Aminophenol

2) Salicylic acid

3) Sulphanilic acid

4) p-Aminoacetophenone

37. Benzene diazonium chloride with anilines in acidic medium gives

1) Orange dye 2) Red dye

3) Yellow dye 4) Black dye

38. In the following reaction; X is

$$X \xrightarrow{Br_2/H_2O} Y \xrightarrow{NaNO_2/HCl} Z \xrightarrow[\Delta]{C_2H_5OH}$$

Tribromobenzene

1) Benzoic acid 2) Salicylic acid

3) Phenol 4) Aniline

39. Choose the amide which on reduction with $LiAlH_4$ gives a 2^0 amine

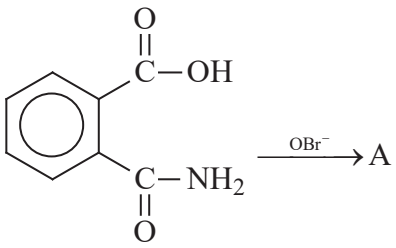
1) Ethanamide

2) N-Methylethanamide

3) N,N-Dimethylethanamide

4) Phenylmethanamide

40. The major product of the reaction A is

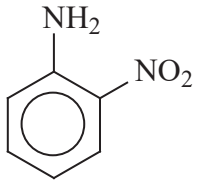


1) Salicylic acid 2) Phthalic acid

3) Benzoic acid 4) Anthranilic acid

41. The most basic among the following compounds is

1)

2) 

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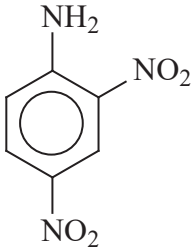
4) 

42. What is wrong about aniline?

1) $-NH_2$ group in aniline is o, p directing and an activating group

2) It does not undergo Friedel-Crafts reaction

3) It couples with benzene diazonium chloride giving a coloured compound

4) It is strongly basic in nature

43. What is the product of the reaction

$$CH_3CH_2NH_2 \xrightarrow{HNO_2} A \xrightarrow{PI_3} B \xrightarrow{KCN} C \xrightarrow{LAH} D$$

1) CH_3CH_2OH

2) $CH_3CH_2CH_2CH_3$

3) $CH_3CH_2NHCH_3$

4) $CH_3CH_2CH_2NH_2$

44. The product obtained when C_2H_5MgBr reacts with CH_3NH_2 is

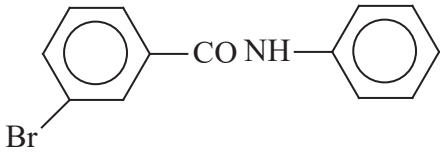
1) C_2H_6

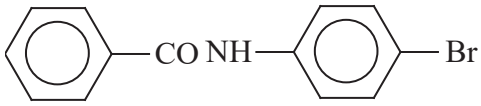
2) CH_4

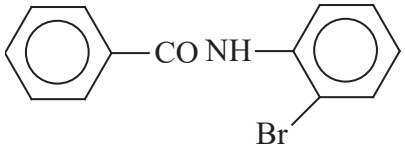
3) $CH_3CH_2CH_3$

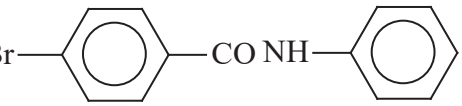
4) $(CH_3)_2NH$

45. The major product of bromination of N-Phenylbenzamide with Br_2/Fe is

1) 

2) 

3) 

4) 

ANSWER KEY

1.	4	21.	2	41.	1	61.	3	81.	3
2.	3	22.	4	42.	1	62.	3	82.	2
3.	2	23.	2	43.	3	63.	1	83.	4
4.	1	24.	2	44.	2	64.	3	84.	2
5.	3	25.	2	45.	2	65.	1	85.	1
6.	4	26.	3	46.	1	66.	2	86.	2
7.	2	27.	1	47.	4	67.	3	87.	1
8.	3	28.	2	48.	2	68.	3	88.	3
9.	2	29.	4	49.	2	69.	4	89.	1
10.	1	30.	4	50.	2	70.	4	90.	2
11.	3	31.	2	51.	3	71.	1	91.	3
12.	3	32.	1	52.	2	72.	2	92.	2
13.	4	33.	1	53.	3	73.	1	93.	2
14.	2	34.	3	54.	2	74.	1	94.	3
15.	2	35.	1	55.	1	75.	3	95.	1
16.	3	36.	2	56.	1	76.	3	96.	3
17.	4	37.	4	57.	2	77.	4	97.	4
18.	3	38.	1	58.	3	78.	1	98.	3
19.	2	39.	1	59.	4	79.	3	99.	2
20.	1	40.	1	60.	3	80.	1	100.	1

SAMPLE QUESTIONS

1.	4	10.	3	19.	2	28.	4	37.	3
2.	3	11.	4	20.	4	29.	3	38.	4
3.	4	12.	2	21.	2	30.	1	39.	2
4.	2	13.	4	22.	1	31.	1	40.	4
5.	1	14.	1	23.	2	32.	1	41.	1
6.	3	15.	1	24.	1	33.	4	42.	4
7.	3	16.	3	25.	1	34.	3	43.	4
8.	1	17.	2	26.	2	35.	4	44.	1
9.	3	18.	4	27.	3	36.	3	45.	2

WORK BOOK

Chapter 23

BIOMOLECULES

QUESTIONS

1. CARBOHYDRATES

1. Which of the following statement is incorrect about carbohydrates?

1) Most of them have general formula $C_x(H_2O)_y$

2) These are hydrates of carbon

3) These are stored in the body as glycogen

4) These are generally optically inactive

2. **Assertion:** Acetic acid is not a carbohydrate

Reason: Acetic acid fits into general formula of carbohydrates $C_x(H_2O)_y$

1) Assertion and reason both are correct statements but reason is not the correct explanation for assertion

2) Assertion is correct statement but reason is wrong statement

3) Assertion and reason both are correct statements and reason is correct explanation for assertion

4) Assertion and reason both are wrong statements

3. Which of the following monosaccharide is a pentose

1) Glucose 2) Galactose

3) Fructose 4) Arabinose

4. Monosaccharide usually contain ..... carbon atoms

1) C_3 to C_{10} 2) C_1 to C_6

3) C_3 to C_7 4) C_4 to C_7

5. Which of the following compound is found abundantly in earth

1) Fructose 2) Glucose

3) Starch 4) Cellulose

6. Glucose is found to exist in two different crystalline forms. These formation can be obtained by

i) The α-glucose is obtained by crystallisation from concentrated solution of glucose at 303 K

ii) The β-glucose is obtained by crystallisation from concentrated solution of glucose at 303 K

iii) β-Glucose is obtained by crystallisation from hot and saturated aqueous solution at 371 K

iv) α-glucose is obtained by crystallisation from hot and saturated aqueous solution at 371 K

1) i and iii 2) ii and iv

3) ii and iii 4) i and iv

7. Which of the following statement is not true about glucose

1) It is an aldohexose

2) It is called dextrose

3) It is a ketohexose

4) It does not give 2, 4-DNP test

8. **Statement-I** : Lactose is present in the milk.

Statement-II : There are two monosaccharide units present in the lactose molecule ie. β-D-galactose and β-D-glucose

In the light of the above statements, choose the most appropriate option

1) Statement-I and II both are correct

2) Statement-I is correct but II is incorrect

3) Statement-I is incorrect but II is correct

4) Both statement-I and II are incorrect

9. Which of the following statements are incorrect?

i) Maltose contain one glucose and fructose units

ii) Cellulose and sucrose are polysaccharides

iii) Polysaccharides are not sweet in taste

iv) Polysaccharides are also called non-sugars

1) i and ii 2) ii and iii

3) iii and iv 4) All

10. Sucrose which is dextrorotatory in nature after hydrolysis gives glucose and fructose, among which

i) Glucose is laevorotatory and fructose is dextrorotatory

ii) Glucose is dextrorotatory and fructose is laevorotatory

iii) The mixture is laevorotatory

iv) Both are dextrorotatory

1) i and iii 2) ii and iii

3) iii and iv 4) iii only

11. Which is the least stable form of glucose

1) α-D-glucose

2) β-D-glucose

3) Open chain structure

4) All are equally stable

12. **Assertion:** β-glycosidic linkage is present in maltose.

Reason: Maltose is composed of two glucose units in which C-1 of one glucose unit is linked to C-4 of another glucose unit.

1) Assertion is correct statement and reason is wrong statement

2) Assertion and reason both are correct statements and reason is correct explanation of assertion

3) Assertion and reason both are wrong statements

4) Assertion is wrong statement and reason is correct statement

13. Glycosidic linkage is an

1) Amide linkage

2) Ether linkage

3) Ester linkage

4) Phosphodiester linkage

14. In which disaccharide, glycosidic linkage formed between anomeric –OH of glucose and anomeric –OH of fructose

1) Lactose 2) Maltose

3) Sucrose 4) Cellobiose

15. The reducing part of lactose

1) β-D-glucose 2) β-D-galactose

3) α-D-glucose 4) α-D-galactose

16. Which is wrong about starch

i) Starch contain 2 components-amylose and amylopectin

ii) Amylopectin is water soluble

iii) Amylose is branched chain with 200-1000 α-D(+) glucose units

iv) In both amylose and amylopectin have C_1 – C_4 glycosidic linkage

1) ii and iii 2) iii and iv

3) i and iv 4) All

17. The main structural component of starch is

1) α-glucopyranose

2) β-fructofuranose

3) β-glucosopyranose

4) both 1 and 3

18. Which of the following statement is wrong about cellulose?

1) It is a polymer of β-D-glucose

2) It is most abundant organic substance in plant kingdom

3) It is an unbranched polysaccharide with C_1-C_4 glycosidic linkage

4) All are correct

19. Cellulose on complete hydrolysis gives

1) D-Fructose 2) D-Ribose

3) D-Glucose 4) L-Glucose

20. Polysaccharide stored in the liver of animals is

1) Starch 2) Cellulose

3) Glycogen 4) All the above

2. AMINOACIDS

21. **Assertion:** α-Aminoacids exist as internal salt in solution as they have $–NH_2$ and –COOH groups in near vicinity.

Reason: H^+ ion given by –COOH is captured by $–NH_2$ group having lone pair of electrons.

1) Assertion and reason are correct and reason is the correct explanation for assertion

2) Assertion and reason are correct but reason is not the correct explanation for assertion

3) Assertion is correct but reason is wrong

4) Both assertion and reason are wrong

22. Amino acids

1) contain amino group and carboxyl group

2) contain carboxyl group only

3) May contain other functional groups like –OH, –SH

4) 1 and 3

23. Which aminoacid has no chiral carbon

1) Glycine 2) Alanine

3) Proline 4) Tryptophane

24. Which of the following is wrong about amino acids

1) Glycine is the only naturally occuring amino acid which is optically inactive

2) Most of naturally occuring amino acids have D configuration

3) Alanine has one amino group and one carboxyl group

4) Amino acids are monomer of proteins

25. Which of the following is basic aminoacid

1) Lysine 2) Glycine

3) Isoleucine 4) Threonine

26. Which of the following is acidic amino-acid

1) Glutamic acid 2) Aspartic acid

3) Proline 4) Both 1 and 2

27. Which one is neutral amino acid

1) Lysine 2) Arginine

3) Histidine 4) Leucine

28. Which amino acid cannot be synthesised by our body

1) Serine 2) Valine

3) Alanine 4) Glutamine

29. Which amino acid can be synthesised by our body

1) Proline 2) Leucine

3) Tryptophan 4) Methionine

30. Which of the following is heterocyclic amino acid

1) Tryptophan 2) Phenylalanine

3) Alanine 4) Asparagine

31. Which of the following amino acid contain sulphur

1) Methionine 2) Cysteine

3) Tyrosine 4) Both 1 and 2

32. Which of the following is aromatic amino acid

1) Histidine 2) Tryptophan

3) Glutamine 4) Both 1 and 2

33. Amino acids are

1) liquids

2) volatile solids

3) Non-volatile crystalline compounds

4) Water insoluble solids

34. Which of the following is the incorrect statement

1) There are ten essential amino acids

2) L-amino acids are represented by writing the $-NH_2$ group on the left side

3) Only β-aminoacids, are obtained by the hydrolysis of protein

4) The amino acids which are synthesised in the body are known as non-essential amino acids

35. **Assertion (A):** The one letter code for threonine, tyrosine and tryptophan is T.

Reason (R) : Threonine is an essential amino acid

1) Both A and R are correct and R is the correct explanation of A

2) Both A and R are correct and R is not the correct explanation of A

3) A is correct but R is incorrect

4) A is incorrect but R is correct

3. PROTEINS

36. Proteins are condensation polymer of

1) α -amino acids

2) β-amino acids

3) α-hydroxy acids

4) β-hydroxy acids

37. Most abundant biomolecules of the living system

1) Carbohydrates 2) Proteins

3) Vitamins 4) Nucleic acids

38. In a protein molecule various amino acids are linked together by

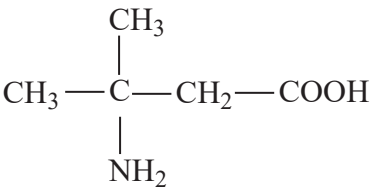
1) Glycosidic linkage

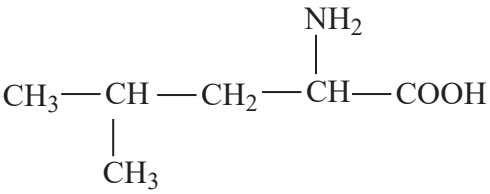
2) Peptide linkage

3) Phospho ester linkage

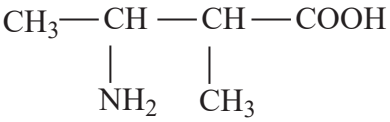
4) Phosphodiester linkage

39. A protein W with molecular mass of 70,000 u on hydrolysis give amino acids. One of these amino acid is

1) 

2) 

3) $H_2N - CH_2 - CH_2 - CH_2 - COOH$

4) 

40. The peptide linkage is

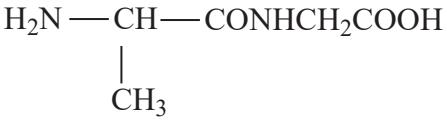
1) –CO–NH–

2) –O–

3) –SO–NH–

4) –CO–O–

41. Name of the dipeptide



1) Glycylglycine 2) Alanylglycine

3) Glycinealanine 4) Glycylalanine

42. **Statement-I :** Proteins are macromolecules made up of amino acids joined by amide bond called as peptide bond.

Statement-II : Proteins are required for growth and development of the body.

1) Both statement-I and II are true

2) Statement-I is true but Statement-II is false

3) Statement-I is false but Statement-II is true

4) Both statement-I and II are false

43. Number of aminoacids in insulin

1) 31 2) 41

3) 51 4) 61

44. Number of water molecules eliminated when a pentapeptide formed from its amino acids

1) 3 2) 4

3) 5 4) 6

45. Select the correct option from the examples of fibrous proteins

i) Insulin ii) Keratin

iii) Albumin iv) Myoisn

1) i and ii 2) ii and iv

3) i and iii 4) i and iv

46. Globular proteins are

1) Soluble in water

2) Insoluble in water

3) Spherical shape

4) Both 1 and 3

47. Which of the following indicates the order in which amino acids are linked together in a protein

1) Primary structure

2) Secondary structure

3) Tertiary structure

4) Quarternary structure

48. Which of the following is not true about secondary structure of protein?

1) The α-helix and β-pleated sheet structure are examples of secondary structure of protein

2) The ability of peptide bonds to form intramolecular H-bonding is important to secondary structure

3) It refers to the shape in which a long polypeptide chain can exist

4) The two major molecular shapes in secondary structure of protein are fibrous and globular

49. Which of the following term represents the overall three dimensional shape of a protein

1) Primary structure

2) Secondary structure

3) Tertiary structure

4) Quaternary structure

50. Main forces which are stabilises 2° and 3° structures

i) H-bond

ii) disulphide bond

iii) van der waal's bond

iv) Electrostatic force of attraction

1) All 2) i and ii

3) ii and iii 4) i and iv

51. **Statement-I** : Some of the proteins are composed of two or more polypeptide chains referred as sub units.

Statement-II : The spatial arrangement of these sub unis with respect to other is called quarternary structure

1) Both statement-I and II are right

2) Both statement-I and II are wrong

3) Statement-I is true but statement-II is wrong

4) Statement-I is wrong but statement-II is true

52. **Assertion** : Disruption of native form of a protein is called denaturation.

Reason : The change in colour and appearance of egg during cooking is due to denaturation.

1) Assertion is not correct but reason is correct

2) Both assertion and reason are correct and reason is the correct explanation of assertion

3) Both assertion and reason are correct but reason is not the correct explanation of assertion

4) Assertion is correct but reason is not correct

53. During denaturation of proteins, the structure which are destroyed

1) 1° and 2°

2) 2° and 3°

3) 1° and 3°

4) 1°, 2° and 3°

4. ENZYMES

54. Which statement is incorrect about enzymes

1) Almost all enzymes are globular proteins

2) Enzymes are least reactive at optinum temperature

3) Enzymes are denatured by uv light and at high temperature

4) Enzymatic activity is specific

55. Which of the following statements are correct about enzymes

i) Enzymes are mostly proteinous in nature

ii) Enzymes are essential as biocatalyst

iii) Enzymes have high efficiency

iv) Enzymatic action is not specific

1) i, ii, iii 2) i and iii

3) All 4) ii and iv

56. $\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} \xrightarrow{X} \underset{\text{Glucose}}{2C_6H_{12}O_6}$

In this reaction, X acts as a catalyst. X is

1) Maltase 2) Invertase

3) Zymase 4) Diastase

57. The proteins present in food materials are hydrolysed to amino acids during the digestion. The two enzymes involved in this process proteins $\xrightarrow{\text{Enzyme A}}$ Polypeptides $\xrightarrow{\text{Enzyme B}}$ Aminoacids. Enzyme A and Enzyme B are respectively

1) Pepsin and Trypsin

2) Invertase and zymase

3) Diastase and lipase

4) Amylase and maltase

58. Match the following:-

Enzyme		Reaction	
i	Invertase	p.	Decomposition of urea into NH_3 and CO_2
ii.	Maltase	q.	Conversion of glucose into ethanol
iii.	Urease	r.	Hydrolysis of maltose into glucose
iv.	Zymase	s.	Hydrolysis of cane sugar

1) i→s; ii→p; iii→r; iv→q

2) i→s; ii→r; iii→q; iv→p

3) i→s; ii→r; iii→p; iv→q

4) i→s; ii→q; iii→p; iv→r

59. Activation energy in kJ mol^{-1} of hydrolysis of sucrose in the presence of enzyme sucrase

1) 12.5 2) 2.15

3) 6.22 4) 5.12

60. Activation energy in kJ mol^{-1} of hydrolysis of sucrose in the absence of enzyme sucrase

1) 12.5 2) 2.15

3) 6.22 4) 5.12

61. Enzyme reduces

i) Activation energy of reaction

ii) Threshold energy of reaction

iii) Enthalpy of reaction

iv) Average energy of reactants and products

1) i and ii 2) All

3) ii and iii 4) iii and iv

62. The function of enzyme in the living system

1) Transport O_2

2) Provide energy

3) Provide immunity

4) Catalyse biochemical reactions

63. **Assertion(A) :** The enzymes which catalyse the oxidation of one substrate with simultaneous reduction of another substrate are named as oxidoreductase enzyme.

Reason(R): Sometimes, enzymes are also named after the reaction, where they are used

1) A is correct but R is incorrect

2) A is incorrect but R is correct

3) Both A and R are correct and R is the correct explanation of A

4) Both A and R are correct but R is not the correct explanation of A

64. The enzyme which converts glucose and fructose into ethyl alcohol is

1) Diastase 2) Zymase

3) Invertase 4) Sucrase

65. Enzyme are not

1) Proteins

2) Carbohydrates

3) Specific for a particular reaction/substrate

4) Biocatalytes

66. Enzymes

1) Consist of amino acids

2) Have optimum activity at body temperature

3) Accelerate biochemical reactions

4) Have all these properties

67. Which of the following reaction is catalysed by enzyme diastase

1) Starch → maltose

2) Maltose →glucose

3) Lactose →glucose + galactose

4) Sucrose →glucose + fructose

68. Name the enzyme which convert cane sugar into glucose and fructose

1) Zymase 2) Maltase

3) Invertase 4) Pepsin

5. VITAMINS

69. The human body does not produce

1) Enzyme 2) Vitamins

3) DNA 4) Hormones

70. Which is water soluble vitamin

1) E 2) D

3) K 4) B

71. Which is fat soluble vitamin

1) A 2) B

3) C 4) Both 2 and 3

72. Vitamin A is also called

1) Retinol 2) Ascorbic acid

3) Tocopherol 4) Calciferol

73. Which of the following is not a vitamin

1) Pyridoxine 2) Thiamine

3) Riboflavin 4) Guanine

74. Which of the following is true about vitamins

i) Vitamins are required in large amounts in our diet

ii) Vitamins are secreted by ductless glands

iii) Vitamins are synthesised by a human body but plants cannot synthesise them

iv) These are necessary to perform the specific biological functions for the normal maintenance of optimum growth and health of the organism

1) i and ii 2) i, ii, iii

3) iv only 4) All

75. Cheilosis and digestive disorder are due to the deficiency of

1) Thiamine 2) Ascorbic acid

3) Riboflavin 4) Pyridoxine

76. **Assertion** : Vitamin D can be stored in liver and adipose tissues.

Reason : Vitamin D is fat soluble vitamin.

1) Both assertion and reason are true and reason explains the assertion

2) Both assertion and reason are wrong

3) Both assertion and reason are correct but reason does not explain assertion

4) Assertion is correct but reason is wrong

77. Which of the following B group vitamin can be stored in our body

1) B_1 2) B_2

3) B_6 4) B_{12}

78. Why vitamin C must be supplied regularly in diet?

1) It is fat soluble vitamin hence stored in the body and cannot be used on regular basis

2) It is water soluble vitamin hence excreted in urine and cannot be stored in the body

3) It is required in a large amount by the body

4) It is water soluble vitamin hence used by the body on daily basis and is to be supplied regularly

79. Choose the correct match

Vitamins	Deficiency diseases
1) Vitamin E	Muscular weakness
2) Vitamin A	Beri beri
3) Vitamin B_2	Pernicious anemia
4) Vitamin B_{12}	Scurvy

80. Which of the following disease is caused by the deficiency of vitamin D

1) Pernicious anaemia

2) Scurvy

3) Rickets

4) Night blindness

81. Vitamin responsible for coagularion of blood

1)A 2) B

3) E 4) K

82. Which is not true about vitamin B_{12}

1) It has a cobalt atom

2) It occurs in plants

3) It also present in rain water

4) It is needed for human body in very small amount

83. Fat soluble vitamins are stored in

1) Liver 2) Blood

3) Adipose tissues 4) Both 1 and 3

6. NUCLEIC ACIDS

84. The base guanine occurs in

1) DNA 2) RNA

3) DNA and RNA 4) Protein

85. In DNA, the complementary bases are

1) Uracil and adenine, Cytosine and guanine

2) Adenine and thymine, Guanine and cytosine

3) Adenine and Thymine, Guanine and Uracil

4) Adenine and Guanine, Thymine and cytosine

86. Which substance is not present in nucleic acid

1) Uracil 2) Cytosine

3) Adenine 4) Guanidine

87. The pentose sugar in DNA and RNA has

1) Open chain structure

2) Pyranose structure

3) Furanose structure

4) None of the above

88. Which of the following combination is correct between nuclei acid its respective sugar

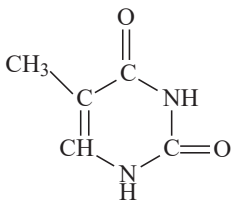
1) DNA : α–D–2-deoxyribose

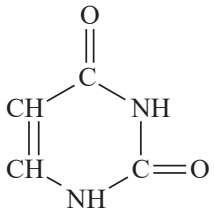
2) DNA : β-D-Ribose

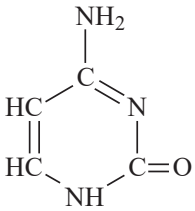
3) RNA : β-D-2-deoxyribose

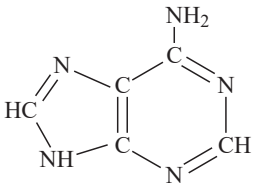
4) RNA : β-D-Ribose

89. Which of the followig bases is absent in RNA

1) 

2) 

3) 

4) 

90. Nucleic acids are the polymer of

1) Nucleoside

2) Nucleotide

3) Base

4) Pentose sugar

91. Sugar moiety in DNA and RNA molecules respectively

1) β-D-2-deoxyribose, β-D-deoxyribose

2) β-D-2-deoxyribose, β-D-ribose

3) β-D-ribose, β-D-2-deoxyribose

4) β-D-deoxyribose, β-D-deoxyribose

92. **Statement-I** : A unit formed by the attachment of a base to 1' position of sugar is called nucleoside.

Statement-II : When nucleoside is linked to phosphoric acid at 5' position of sugar moeity, we get nucleotide

1) Both statement-I and II are correct

2) Both statement-I and II are incorrect

3) Statement-I is correct but statement-II is incorrect

4) Statement-I is incorrect but statement-II is correct

93. **Assertion** : DNA is responsible for maintaining the identity of different species of organisms over millions of years.

Reason : DNA molecule is capable of self duplication during cell division and identical DNA strands are transferred daughter cells

1) Both assertion and reason are false

2) Both assertion and reason are true and the reason is the correct explanation of assertion

3) Both assertion and reason are true and the reason is not the correct explanation of assertion

4) Assertion is true but reason is false

94. What will be the sequence of complementary strand of DNA, if the one strand of DNA has the sequence of TATGACTG

1) ATACTCGA 2) ACGTTGAC

3) ATACTGAC 4) ATACTGCA

95. The linkage hold together the monomers of DNA and RNA

1) Glycosidic link

2) Phosphodiester link

3) Peptide link

4) Disulphide link

96. Consider the given expressions

i) Nucleoside = Base + X

ii) Nucleotide = Nucleoside + Y

X and Y represent

1) Sugar and N-base

2) N-base and phosphate unit

3) Sugar and phosphate unit

4) Phosphate unit and N-base

97. In DNA, if 20% (mole percentage) thymine is present, amount of cytosine

1) 20 2) 60

3) 30 4) 10

98. The reason for double helix structure of DNA is

1) Vander Waal's force

2) H-bond

3) Dipole-Dipole interaction

4) Electrostatic force of attraction

7. HORMONES

99. Choose the incorrect statement about hormones

1) These are molecules that act as intercellular messengers

2) These are produced by endocrine gland in the body and are poured directly in the blood stream

3) These help to maintain the balance of biological activities in the body

4) Insulin is a steroid hormone

100. The major role of insulin

1) To decrease the glucose level in human body

2) To keep the blood glucose level within the narrow limit

3) To regulate growth

4) To transport minerals

101. Choose the correct statement about steroid hormone

1) Epinephrine is an example of steroid hormone

2) These are produced by adrenal cortex and gonads

3) Glucocorticoids control the level of excretion of water and salt by kidney

4) Mineralo corticoid control the carbohydrate metabolism

102. The function of gluco corticoid

1) Control the carbohydrate metabolism

2) Modulate inflammatory reactions

3) Involved in reactions to stress

4) All the above

103. Which of the following hormones is an iodinated derivative of aminoacid tyrosine

1) Thyroxine 2) Estrogen

3) Estradiol 4) Epinephinine

104. Assertion: Abnormally low level of thyroxine leads to hypothyroidism.

Reason: Hypothyroidism is largely controlled by adding sodium iodide to commercial table salt.

1) Both assertion and reason are correct and reason is the correct explanation of assertion

2) Both assertion and reason are correct and reason is not the correct explanation of assertion

3) Both assertion and reason are incorrect

4) Assertion is correct but reason is incorrect

105. Addison's disease is treated by

1) Norepinephrine

2) Epinephrine

3) Glucocorticoid and mineralocorticoid

4) Thyroxine

106. The hormone responsible for preparing the uterus for implantation of fertilised egg is

1) Testosterone 2) Progesterone

3) Glucocorticoid 4) Estrodiol

107. If adrenal cortex does not function properly then one of the result may be

1) Hypothyroidism 2) Hypoglycemia

2) Deep voice 4) Facial hair

108. The hormone that helps in the conversion of glucose to glycogen

1) Insulin 2) Tyrosine

3) Cortisone 4) Adrenaline

109. The hormone which control the level of excretion of water and salt by kidney

1) Glucocorticoids

2) Mineralocorticoids

3) Insulin

4) Epinephrine

110. Which of the following contain iodine

1) Testosterone

2) Adrenaline

3) Thyroxine

4) Insulin

111. Peptide hormone is

1) Insulin 2) Endorphins

3) Estrogens 4) 1 and 2

112. The chemical messengers produced by ductless glands are

1) Lipids

2) Hormones

3) Antibodies

4) Cellular membrane

113. Which of the following is a male sex hormone

1) Progesterone 2) Estorgens

3) Epinephrine 4) Testosterone

SAMPLE QUESTIONS

1. Choose the correct statements:

i) Biomolecles in the body do not interact with each other

ii) Living system are made up of various complex biomolecules like carbohydrates, proteins, nucleic acid, etc

iii) A living system is composed of non-living atoms and molecules

iv) Simple molecles like vitamins, minerals also play an important role in functions of organism

1) i, ii and iii

2) ii, iii and iv

3) ii and iii

4) all of the above

2. Why are polysaccharides called non-sugars

1) They yield large number of monosaccharides on hydrolysis

2) They do not taste sweet

3) They are reducing sugars

4) They are non-reducing sugars

3. Choose the correct statement from the following:-

1) Glucose is reducing but fructose and galactose are non-reducing sugars

2) Glucose and fructose are reducing but galactose is non-reducing sugar

3) Galactose and fructose are reducing but glucose is non-reducing sugar

4) Glucose, galactose and fructose are reducing sugar

4. Match the following

Column-I		Column-II	
i)	$\begin{array}{l}CHO\\ \vert\\ (CHOH)_4\\ \vert\\ CH_2OH\end{array} \xrightarrow{NH_2OH}$	p.	$\begin{array}{l}COOH\\ \vert\\ (CHOH)_4\\ \vert\\ CH_2OH\end{array}$
ii)	$\begin{array}{l}CHO\\ \vert\\ (CHOH)_4\\ \vert\\ CH_2OH\end{array} \xrightarrow{HCN}$	q.	$\begin{array}{l}CH{=}NOH\\ \vert\\ (CHOH)_4\\ \vert\\ CH_2OH\end{array}$
iii)	$\begin{array}{l}CHO\\ \vert\\ (CHOH)_4\\ \vert\\ CH_2OH\end{array} \xrightarrow{Br_2\ water}$	r.	$\begin{array}{l}CH\begin{array}{l}\diagup CN\\ \diagdown OH\end{array}\\ \vert\\ (CHOH)_4\\ \vert\\ CH_2OH\end{array}$

1) i→q; ii→r; iii→p 2) i→q; ii→p; iii→r

3) i→p; ii→r; iii→q 4) i→r; ii→q; iii→p

5. Name the reagents used to oxidise

i) Glucose to gluconic acid

ii) Gluconic acid to saccharic acid respectively

1) Br_2 water and HNO_3

2) HNO_3 and Br_2 water

3) Br_2 water and Fehling solution

4) Fehling solution and Tollen's reagent

6. Consider the following statements:-

i) Five membered cyclic structure of glucose is pyranose structure

ii) Pyran is a cyclic organic compound with one oxygen atom and five carbon atoms

iii) Furan is a cyclic organic compound with one oxygen atom and four carbon atoms

iv) The cyclic structure of glucose is correctly represented by Haworth structure.

Which of the above statements are true

1) i, ii and iii 2) ii, iii and iv

3) i only 4) All

7. What is the relation between the two hemiacetal forms of glucose

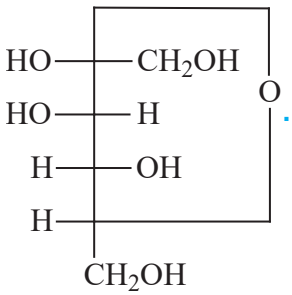
1) Isomers 2) Pyranose

3) Epimer 4) Anomers

8. Which of the following carbohydrate is sweetest?

1) Glucose 2) Fructose

3) Cane sugar 4) Milk sugar

9. 

The structure is

1) α-D(–)-glucose

2) α-D(+)-glucose

3) α-D(–)-fructose

4) β-D(–)-fructose

10. α-D-(–) fructose and β-D(–)-fructose are

1) Anomer

2) Enantiomers

3) Geometrical isomers

4) Epimers

11. Total number of oxygen atoms in cyclic structure of glucose

1) 6 2) 5

3) 4 4) 3

12. Which is true about maltose

1) Maltose is composed of 2-β-D-glucose

2) Maltose is non-reducing

3) In maltose, C_1 of one α-D-glucose is linked to C_4 of another α-D-glucose

4)In maltose, C_1 of each α-D-glucose is linked to form the glycosidic linkage

13. **Assertion (A):** The product mixture obtained after the hydrolysis of sucrose is called invert sugar

Reason (R) : On hydrolysis, sucrose bring the change in the sign of rotation from laevo to dextro

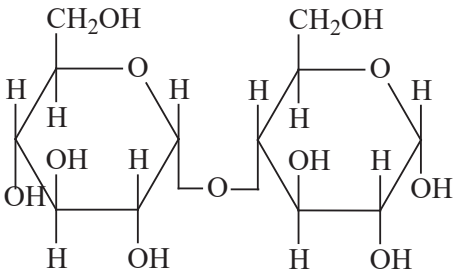
1) Both A and R are correct and R is not the correct explanation of A

2) Both A and R are correct and R is the correct explanation of A

3) A is correct but R is incorrect

4) A is incorrect but R is correct

14.



I II

1) I and II are α-D(+)-glucose

2) I and II are β-D(+)-glucose

3) I is α-D(+)-glucose and II is α-D(+)-galactose

4) I is β-D(+)-glucose and II is β-D(+)-galactose

15. During curdling of milk, what heppen to sugar present in it

1) Lactose converts to glucose and galactose

2) Lactose converts to lactic acid

3) Lactose converts to glucose and fructose

4) Lactose converts to maltose

16. Which is true about starch

1) It is a polymer of β-glucose

2) It consists of two components-water insoluble amylose and water soluble amylopectin

3) In amylose C_1–C_1 α-link exist

4) In amylopectin, branch is due to C_1–C_6 α-glycosidic link

17. Which is incorrect statement?

1) Amylopectin is insoluble in water

2) Fructose is reducing sugar

3) Cellulose is the polymer of β-D-glucose

4) D-Ribose sugar preent in DNA

18. Cellulose is composed of

1) α-D-glucose

2) β-D-glucose

3) β-D-galactose

4) α-D-galactose

19. **Assertion (A):** Cellulose is not digestable in the human body.

Reason (R) : The human system contain cellulose enzyme which hydrolyse cellulose into glucose.

1) Both A and R are incorrect

2) A is correct but R is incorrect

3) A is incorrect but R is correct

4) Both A and R are correct and R is the correct explanation of A

20. Which of the following polymer is stored in the cell wall

1) Cellulose 2) Amylose

3) Amylopectin 4) Glycogen

21. Choose the correct statement:-

1) Amylose is a component of cellulose

2) Starch is a polymer of α-D-glucose

3) Proteins are compounds of only one type of aminoacids

4) In cyclic structure of fructose, there are four carbon atoms and one oxygen atom

22. Which of the following is basic as well as essential aminoacid

1) Asparagine 2) Leucine

3) Isoleucine 4) Lysine

23. The α-amino acid which does not contain the aromatic side chain

1) Proline 2) Tyrosine

3) Histidine 4) Tryptophan

24. Secondary amino groups is present in

1) Proline 2) Asparagine

3) Glutamine 4) Glutamic acid

25. In aqueous solution, amino acid mostly exist as

1) $H_2N–CHR–COOH$

2) $H_2N–CHR–COO^-$

3) $H_3N^+ – CHR –COOH$

4) $H_3N^+ –CHR – COO^-$

26. Which of the following amino acid contain alcohol functional group in its structure

1) Valine 2) Serine

3) Cysteine 4) Proline

27. Which of the following statement is not true?

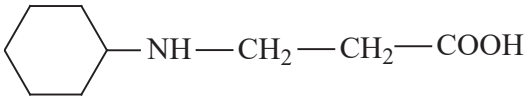
1) Any change in 1° structure creates a different protein

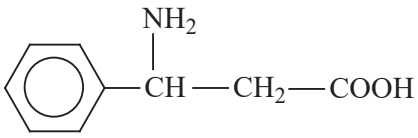
2) Proteins may or may not have same 2° structure throughout its length

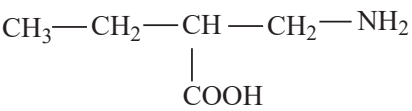
3) The α-helix and β-pleated structure of proteins referred as 2° structure

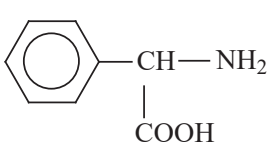
4) In quaternary structure of proteins, the sub units are held together by covalent bond

28. Which of the following is an α-amino acid?

1) 

2) 

3) 

4) 

29. Proteins are

1) Polyamides

2) Polyesters

3) Polycarboxylic acids

4) Polyhydroxy acids

30. The 2° structure of protein refers to

1) globular structure

2) hydrophobic interaction

3) Sequene of α-amino acid

4) Fixed configuraiton of the polypeptide backbone

31. Each polypeptide in a protein has amino acids linked with each other in a specific sequence and this sequence of amino acid is said to be the

1) primary structure

2) secondary structure

3) tertiary structure

4) quaternary structure

32. Match the following:-

Column-I		Column-II	
i	Glycosidic linkage	p.	Globular protein
ii.	Maltase	q.	Connects two monosaccharides
iii.	Peptide bond	r.	Monomeric unit of nucleic acid
iv.	Nucleotide	s.	Connect two amino acids

1) i →q; ii→p; iii→s; iv→r

2) i→q; ii→s; iii→p; iv→r

3) i→q; ii→p; iii→r; iv→s

4) i→q; ii→r; iii→s; iv→p

33. Which among the following is formed of globular protein?

1) Invertase

2) Zymase

3) Urease

4) All of the above

34. **Assertion (A):** Vitamin A, D, E and K are stored in liver and adipose tissues.

Reason (R) : Vitamin A, D, E and K are soluble in fats and oils

1) Both A and R correct and R is correct explanation of A

2) Both A and R are correct and R is not the correct explanation of A

3) Both A and R are incorrect

4) A is correct but R is incorrect

35. Match the following:-

List-I		List-II	
i)	Vitamin B_{12}	p)	Increased blood clotting time
ii)	Vitamin C	q)	Pernicious anaemia
iii)	Vitamin D	r)	Scurvy
iv)	Vitamin K	s)	Rickets and Osteomalacia

1) i →s; ii→r; iii→q; iv→p

2) i →s; ii→r; iii→p; iv→q

3) i →p; ii→r; iii→s; iv→q

4) i →q; ii→r; iii→s; iv→p

36. **Assertion (A) :** The term vitamin is replaced by vitamin now a days.

Reason (R) : Vitamin came from the word, vital + amine and it was identified that most of them did not contain amino groups.

1) Both A and R are incorrect

2) Both A and R are correct and R is the correct explanation of A

3) Both A and R are correct and R is not the correct explanation of A

4) A is incorrect but R is correct

37. **Statement-I :** Fresh tomatoes are better source of vitamin C than those which have been stored for sometime.

Statement-II : On prolonged exposure to air, vitamic C is destroyed due to aerial oxidation.

1) Both statement-I and II are true

2) Both statement-I and II are false

3) Statement-I is true but statement-II is false

4) Statement-I is false but statement-II is true

38. The presence or absence of –OH group on which carbon atom of sugar differentiate RNA and DNA

1) 1 2) 2

3) 3 4) 4

39. **Statement-I :** Thymine is present in RNA

Statement-II : RNA undergoes replication

1) Both statement-I and Ii are true

2) Statement I is true and II is wrong

3) Both statement-I and II are wrong

4) Statement-I is wrong but statement-II is true

40. Which of the following is not true

1) In DNA, the complementary base of adenine is thymine

2) In DNA, the complementary base of cytosine is guanine

3) Adenine and guanine are purine bases

4) The base occurs only in RNA is cytosine

41. Which of the following is correct about H-bonding in DNA

1) A = T, C ≡ G

2) A ≡ T, C = G

3) A ≡T, C ≡G

4) A = T, C = G

42. A sample of DNA has the ratio of $\frac{AT}{CG}$ is 0.8.

If the number of adenine in a sample is 25000. What is the number of guanine

1) 50,000

2) 31,250

3) 40, 000

4) 62,500

43. Which of the following statement is incorrect?

1) Every individual has unique finger prints and it occur at the tips of fingers

2) A sequence of bases on DNA is also unique for a person and information regarding this is called DNA finger printing

3) Finger prints and DNA fingerprinting cannot be altered by any known treatment

4) DNA finger printing is used to identify radical groups to rewrite biological evolution

44. Which of the following statements is correct?

i) DNA molecule consists of alternating units of phosphate and the sugar deoxyribose. Each unit has a pair of pentose/hexose bases

ii) Protein found in a biological system with a unique three-dimensional structure and biological activity is called a native protein

iii) To replenish the loss of energy we can use glucose as an instant source of energy

iv) D and L can be written as d and l, as it is only use for the identification of the compounds

1) i and iii
2) iii and iv
3) i, ii and iii
4) ii and iii

45. Which of the following is not a hormone

1) Insulin
2) Endorphine
3) Norepinphrine
4) Thymine

ANSWER KEY

1.	4	24.	2	47.	1	70.	4	93.	2
2.	1	25.	1	48.	4	71.	1	94.	3
3.	4	26.	4	49.	3	72.	1	95.	2
4.	3	27.	4	50.	1	73.	4	96.	3
5.	2	28.	2	51.	1	74.	3	97.	3
6.	1	29.	1	52.	3	75.	3	98.	2
7.	3	30.	1	53.	2	76.	1	99.	4
8.	1	31.	4	54.	2	77.	4	100.	2
9.	1	32.	4	55.	1	78.	2	101.	2
10.	2	33.	3	56.	1	79.	1	102.	4
11.	3	34.	3	57.	1	80.	3	103.	1
12.	4	35.	4	58.	3	81.	4	104.	2
13.	2	36.	1	59.	2	82.	2	105.	3
14.	3	37.	2	60.	3	83.	4	106.	2
15.	1	38.	2	61.	1	84.	3	107.	2
16.	1	39.	2	62.	4	85.	2	108.	1
17.	1	40.	1	63.	3	86.	4	109.	2
18.	4	41.	2	64.	2	87.	3	110.	3
19.	3	42.	1	65.	2	88.	4	111.	1
20.	3	43.	3	66.	4	89.	1	112.	2
21.	1	44.	2	67.	1	90.	2	113.	4
22.	4	45.	2	68.	3	91.	2		
23.	1	46.	4	69.	2	92.	1		

SAMPLE QUESTIONS

1.	2	10.	1	19.	2	28.	4	37.	1
2.	2	11.	1	20.	1	29.	1	38.	2
3.	4	12.	3	21.	2	30.	4	39.	3
4.	1	13.	3	22.	4	31.	1	40.	4
5.	1	14.	1	23.	1	32.	1	41.	1
6.	2	15.	2	24.	1	33.	4	42.	2
7.	4	16.	4	25.	4	34.	1	43.	3
8.	2	17.	4	26.	2	35.	4	44.	4
9.	4	18.	2	27.	4	36.	2	45.	4

WORK BOOK

Chapter 24

PRINCIPLES RELATED TO PRACTICAL CHEMISTRY

QUESTIONS

PRACTICAL ORGANIC CHEMISTRY

1. Lassaigne's test is used in the qualitative analysis to detect.

1) Nitrogen 2) Sulphur

3) Chlorine 4) All of these

2. Nitrogen containing organic compound when fused with sodium metal forms

1) $NaNO_2$ 2) NaCN

3) $NaNH_2$ 4) Na_2CO_3

3. A positive carbylamine test is given by

1) N, N-dimethylaniline

2) 2,4-dimethylaniline

3) N-methyl-o-methylaniline

4) N-methylaniline

4. The Hinsberg's method is used for

1) Preparation of primary amines

2) Preparation of secondary amines

3) Preparation of tertiary amines

4) Separation of amine mixtures

5. The reaction used to distinguish between primary, secondary and tertiary alcohols is

1) Tollen's test

2) Lucas Test

3) Phthalein dye test

4) Schiff's test

6. In the Lassaigne's test, one of the organic compounds gave red colour with $FeCl_3$. Compound can be

1) Na_2S 2) NH_2CSNH_2

3) C_6H_5Cl 4) NaCN

7. In conversion of 2-butanone to propanoic acid, which reagent is used?

1) DIBAL-H/H_2O

2) Fehling's reagent

3) $NaOH, I_2 / H^{\oplus}$

4) Tollens' reagent

8. The compound that does not give a blue colour in Lassaigne's test is

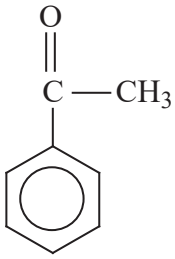
1) $C_6H_5–NH_2$

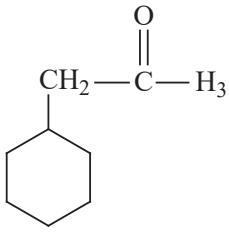
2) CH_3CONH_2

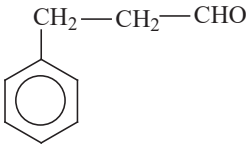
3) $NH_2–NH_2$

4) $C_6H_5–NO_2$

9. Which of the following compounds will not react with I_2/OH^-?

1) 

2) 

3) 

4) CH_3–CHO

10. The sodium fusion extract of an organic compound on acidification with acetic acid and addition of lead acetate solution gives a black precipitate. The organic compound contains.

1) Nitrogen

2) Halogen

3) Sulphur

4) Phosphorus

11. Which of the following reagents may be used to distinguish between phenol and benzoic acid?

1) Aqueous NaOH

2) Tollens' reagent

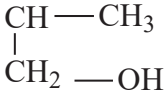
3) Hinsberg's reagent

4) Neutral $FeCl_3$

12. Among the following, the one that gives positive iodoform test upon reaction with I_2 and NaOH is

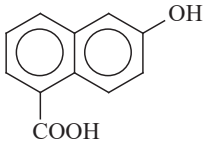
1) $CH_3CH_2CH(OH)\ CH_2CH_3$

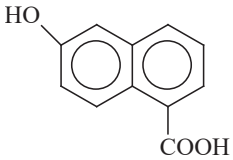
2) $C_6H_5CH_2CH_2OH$

3) 

4) $PhCH(OH)CH_3$

13. The following two compounds I and II can be distinguished by using reagent.

I) 

II) 

a) aq.$NaHCO_3$

b) Neutral $FeCl_3$

c) Blue litmus solution

d) $HCl/ZnCl_2$ anhydrous

1) a or c 2) b or d

3) d or a 4) c or d

14. Silver mirror test is given by which of the following compounds?

1) Acetaldehyde

2) Acetone

3) 2-Butanone

4) Benzophenone

15. Iodoform can be prepared from all except

1) Ethyl methyl ketone

2) Isopropyl alcohol

3) 3- Methyl-2-butanone

4) Isobutyl alcohol

16. In the preparation of p-nitroacetanilide from nitration of acetanilide, the electrophile which attacks the benzene ring is

1) NO_3^+

2) NO^+

3) NO_2^+

4) NO^{2+}

17. Match the columns

Column-I (Functional group)		Column-II (Test for detection)	
a)	Carboxyl group	i)	Lucas test
b)	Alcoholic group	ii)	Neutal $FeCl_3$ test
c)	Phenolic group	iii)	Carbylamine test
d)	Amino group	iv)	Sodium bicarbonate test

1) a→iv, b→i; c→ii; d→iii

2) a→i, b→iv; c→ii; d→iii

3) a→iv, b→ii; c→i; d→iii

4) a→i, b→ii; c→iv; d→iii

18. A compound $C_5H_{10}O$ gives a positive test of carbonyl group gives a negative test with Fehling solution but gives positive haloform test and on reduction it gives normal pentane. Identify the compound.

1) 3-pentanone 2) 2- pentanone

3) 1,5-pentanediol 4) 2- Butanone

19. An organic compound contains C, H, N, S and Cl. For the detection of chlorine, the sodium extract of the compound is first heated with a few drops of concentrated HNO_3 and then $AgNO_3$ is added to get a white precipitate of AgCl. The digestion with HNO_3 before the addition of $AgNO_3$ is to

1) Prevent the formation of NO_2

2) Create a common ion effect

3) Convert CN^- and S^{2-} to volatite HCN and H_2S, or else they will interfere with the test forming precipitate of AgCN or Ag_2S

4) Prevent the hydrolysis of NaCN and Na_2S

20. Which of the following tests are correctly matched?

1) Phenol - Phthalein test

2) Benzyl amine - Azo dye test

3) Phthalic acid - Fluorescence test

4) CH_3CONH_2 - Carbylamine test

PRACTICAL PHYSICAL CHEMISTY

21. Specific heat capacity of pure water is nearly

1) 4.18 $Jg^{-1}K^{-1}$ 2) 2.08 $Jg^{-1}K^{-1}$

3) 1 J g^{-1} K^{-1} 4) 8.36 J $g^{-1}K^{-1}$

22. What is the purpose of varying the concentration of iodide ions in its reaction with hydrogen peroxide at room temperature?

1) To investigate the effect of temperature of iodide ions in its reaction with hydrogen peroxide at room temperature?+

1) To investigate the effect of temperature on the reaction rate.

2) To observe the effect of pH on the reaction rate

3) To measure the volume of oxygen produced.

4) To study the effect of concentration on the reaction rate.

23. Which ions are completely consumed before the appearance of intense blue colour in the reaction between iodide ion and hydrogen peroxide?

1) Hydroxide ions

2) Starch ions

3) Thiosulphate ions

4) Hydrogen ions

24. Which of the following is not a method to prepare colloids?

1) Chemical methods

2) Distillation

3) Peptization

4) Electrical disintegration

25. Select the incorrect statement about lyophilic sol.

1) Egg albumin sol is a lyophilic sol.

2) Stability of lyophilic sols is primarily due to the solvation of colloidal particles by the solvent

3) The lyophilic sols cannot be directly formed by mixing and shaking the substance with a suitable liquid.

4) Ferric hydroxide is not a lyophilic sol

26. The enthalpy of solution of hydrated copper (II) sulphate can be determind by measuring the temperature changes when a known amount of copper (II) sulphate is added to a fixed volume of water in a calorimeter. What assumption is not made when calculating the enthalpy change?

1) There is negligible heat losses in the calorimeter.

2) The specific heat capacity of the solution is the same as water.

3)The density of solution is the same as water.

4) The specific heat capacity of solution is different from water.

27. The formula mass of Mohr's salt is 392 g. The iron present in it is oxidized by $KMnO_4$ in acidic medium. The equivalent mass of Mohr's salt is

1) 392 2) 31.6

3) 278 4) 156

28. How many moles of acidified $FeSO_4$ can be completely oxidized by one mole of $KMnO_4$?

1) 10 2) 5

3) 6 4) 2

29. A sample of $Na_2CO_3 . H_2O$ weighing 0.62 g is added to 100 mL of 0.1 N sulphuric acid. The resulting solution be (At. mass H=1, C=12, O=16, Na=23, s= 32)

1) Weakly acidic 2) Basic

3) Neutral 4) Strongly acidic

30. How many grams of $NaHCO_3$ are required to neutralize 1 mL of 0.0902 N of an acid?

1) 8.4×10^{-2}g 2) 1.5×10^{-3}g

3) 7.58×10^{-3}g 4) 1.07×10^{-3} g

31. How many moles of MnO_4^- ions will react with 1 mole of ferrous oxalate in acidic medium?

1) $\frac{1}{5}$ 2) $\frac{2}{5}$

3) $\frac{3}{5}$ 4) $\frac{5}{3}$

32. $KMnO_4$ reacts with oxalic acid according to the equation,

$$2MnO_4^- + 3C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

Here, 20 mL of 0.1 M $KMnO_4$ is equivalent to

1) 120 mL of 0.25 M $H_2C_2O_4$

2) 150 mL of 0.1 M $H_2C_2O_4$

3) 50 mL of 0.1 M $H_2C_2O_4$

4) 50 mL of 0.2 M $H_2C_2O_4$

33. 50 mL of a solution containing 2 g of NaOH in 500 mL will require for complete neutralization

1) 10 mL decinormal HCl

2) 20 mL decinormal HCl

3) 50 mL decinormal HCl

4) 25 mL decinormal HCl

34. Which of the following acids is added in the titration of oxalic acid and potassium permanganate?

1) HNO_3 2) HCl

3) CH_3COOH 4) H_2SO_4

35. An aqueous solution of 6.3 g of oxalic acid dihydrate is made up to 250 mL. The volume of 0.1 N NaOH required to completely neutralize 10 mL of this solution is

1) 40 mL 2) 20 mL

3) 10 mL 4) 4 mL

36. How many mL of a 0.05 M $KMnO_4$ solution are required to oxidize 2.0 g of $FeSO_4$ in a dilute solution (acidic) ?

1) 52.7 mL 2) 33.3 mL

3) 28.6 mL 4) 22.8 mL

37. **Assertion (A)** : In the titration of HCl against NaOH, phenolphthalein is used as a suitable indicator.

Reason(R) : Phenolphthalein is pink coloured in basic medium.

1) Both Assertion and Reason are correct, and Reason is the correct explanation of Assertion.

2) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

3) Assertion is correct, but Reason is incorrect

4) Assertion is incorrect, but Reason is correct.

38. **Assertion (A)**: Equivalent mass of $KMnO_4$ is 1/5 times of its molecular mass when it acts as an oxidizing agent in acidic medium.

Reason (R): Oxidation number of Mn in $KMnO_4$ is +7.

1) Both Assertion and Reason are correct, and Reason is the correct explanation of Assertion.

2) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

3) Assertion is correct, but Reason is incorrect

4) Assertion is incorrect, but Reason is correct.

39. For kinetic study of the reaction of iodide ion with H_2O_2 at room temperature:

A) Always use freshly prepared starch solution

B) Always keep the concentration of sodium thiosulphate solution less than that of KI solution.

C) Record the time immediately after the appearance of blue colour.

D) Record the time immediately before the appearance of blue colour

E) Always keep the concentration of sodium thiosulphate solution more than that of KI solution. Choose the correct answer from the options given below:

1) A, B, C only 2) A, D, E only

3) D, E only 4) A, B, E only

40. Heat evolved during neutralization of 1 mol NaOH with 1 mol HCl will be nearly.

1) 13.7 kcal 2) 27.4 kcal

3) 6.8 kcal 4) 27.1 kcal

41. Which among the following acids will result in maximum evolution of heat on neutralization with KOH?

1) HCl 2) HBr

3) HI 4) HF

42. **Assertion(A)** : Aqueous solution of $CuSO_4$ will have pH less than 7 at 25°C.

Reason (R) : Dissolution of $CuSO_4$ in water results in acidic solution.

1) Both Assertion and Reason are correct, and Reason is the correct explanation of Assertion.

2) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

3) Assertion is correct, but Reason is incorrect

4) Assertion is incorrect, but Reason is correct.

43. The enthalpies of solution for copper sulphate pentahydrate and anhydrous copper sulphate are -11.7 kJ mol^{-1} and -65.5 kJ mol^{-1}, respectively. The hydration enthalpy of anhydrous copper sulphate is

1) -53.8 kJ mol^{-1} 2) +53.8 kJ mol^{-1}

3) –77.2 kJ mol^{-1} 4) +77.2 kJ mol^{-1}

44. Iodine solution is prepared by dissolving iodine in

1) NaOH 2) Na_2SO_3

3) HCl 4) KI

45. In the reaction, $I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$, the equivalent weight of iodine will be equal to

1) 4/6 of its molecular weight

2) ½ of its molecular weight

3) 2/9 of its molecular weight

4) Twice of the molecular weight

46. **Assertion(A)** : Starch is used as an indicator in iodometric and iodimetric titrations.

Reason(R) : Starch forms iodo-starch complex with iodine, which is blue coloured.

1) Both Assertion and Reason are correct, and Reason is the correct explanation of Assertion.

2) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

3) Assertion is correct, but Reason is incorrect

4) Assertion is incorrect, but Reason is correct.

47. Which mixture of the solutions will lead to the formation of negatively charged colloidal $[AgI]^-$ sol.?

1) 50 mL of 1 M $AgNO_3$+50mL of 1 M KI

2) 50 mL of 1 M $AgNO_3$+ 50 mL of 2M KI

3) 50 mL of 2 M $AgNO_3$+ 50 mL of 1.5 M KI

4) 50 mL of 0.1 M $AgNO_3$+ 50 mL of 0.1 M KI

48. When SO_4 gas is bubbled into H_2S gas

1) Lyophillic sol of sulphur is formed

2) Lyophobic sol of sulphur is formed

3) Suspension of water and sulphur is formed

4) A true solution of sulphur in water is formed.

PRACTICAL INORGANIC CHEMISTRY

49. Chrome alum and Mohr's salt both are the double salts, i.e., show all the properties of their constituents when dissolved in water. The ratio of water of crystallization in alum and Mohr's salt is

1) 1:6 2) 6:1

3) 1:4 4) 4:1

50. A gas is obtained by addition of dil. HCl to a mixture which turns lead acetate paper black. It is

1) SO_2 2) CO_2

3) H_2S 4) NO_2

51. The two colourless gases on mixing formed dense white fumes, these are

1) NH_3 and O_2 2) SO_2 and steam

3) NH_3 and HCl 4) NH_3 and HNO_2

52. Which of the following pairs of acid radicals is decomposed by dil. HCl?

1) NO_2^-, I^- 2) SO_3^{2-}, CO_3^{2-}

3) CO_3^{2-}, Cl^- 4) $Br^- I^-$

53. Which of the following gives smell of rotten eggs with dil. H_2SO_4?

1) CO_3^{2-} 2) SO_3^{2-}

3) S^{2-} 4) NO_2^-

54. When silver nitrate is added to solution of 'A', a yellow ppt. is formed which is partially soluble in excess of NH_4OH solution. Identify the acid radical present in A.

1) Cl^- 2) Br^-

3) I^- 4) F^-

55. Ag^{+}, Hg_2^{2+} and Pb^{2+} are grouped together in first group because they form insoluble

1) Sulphates 2) Chlorides

3) Hydroxides 4) Carbonates

56. In alkaline medium, dimethyl gloxime is used for the test of

1) ZnS 2) CdS

3) Manganese 4) Nickel

57. Which of the following sulphides is yellow?

1) ZnS 2) CdS

3) NiS 4) CoS

58. In borax bead test, which of the following compounds is formed?

1) Metaborate 2) Tetraborate

3) Borazine 4) Ortho borate

59. The brown colour during the test of NO_3^- is due to the formation of complex ion with the formula

1) $[Fe(H_2O)_6]^{2+}$ 2) $[Fe(NO)(CN)_5]^{2+}$

3) $[Fe(H_2O)_5NO]^{2+}$ 4) $[Fe(H_2O)(NO)_5]^{2+}$

60. Fe^{2+} ion can be distinguished from Fe^{3+} ion by

1) NH_4SCN 2) $AgNO_3$

3) $BaCl_2$ 4) NaOH

61. An aqueous solution of an inorganic salt on treatment with HCl gives a white precipitate. This solution contains

1) Hg_2^{2+} 2) Hg^{2+}

3) Zn^{2+} 4) Cd^{2+}

62. In Nessler's reagent for the detection of ammonia, the active species is

1) Hg_2Cl_2 2) $HgCl_2$

3) Hg_2I_2 4) HgI_4^{2-}

63. In the analysis of basic radicals, the group reagent H_2S gas is generally used in

1) I and II groups

2) II and III groups

3) III and V groups

4) II and IV groups

64. Which of the following is not used as a preliminary test to detect ions?

1) Borax bead test

2) Flame test

3) Brown ring test

4) Charcoal cavity test

65. A salt which gives CO_2 with dilute H_2SO_4 and also decolourizes acidified $KMnO_4$ on warming is

1) HCO_3^- 2) CO_3^{2-}

3)Oxalate ion 4) Acetate ion

66. A substance on treatment with dil. H_2SO_4 liberates a colourless gas which produces.

i) Turbidity with baryta water and ii) Turns acidified dichromate solution green

The reaction indicates the presence of

1) $C_2O_3^{2-}$ 2) S^{2-}

3) SO_3^{2-} 4) NO_2^-

67. When $K_2Cr_2O_7$ crystals are heated with concentrated HCl, the gas evolved is

1) O_2 2) Cl_2

3) CrO_2Cl_2 4) HCl

68. When concentrated H_2SO_4 is added to dry KNO_3, brown fumes evolve. These brown fumes are of

1) SO_2 2) SO_3

3) NO 4) NO_2

69. On heating a salt with conc. H_2SO_4, violet vapours with pungent smell is evolved which turns starch paper blue. The test shows the presence of

1) Iodide ion

2) Bromide ion

3) Chloride ion

4) Iodide and bromide ion

70. A mixture is known to contain NO_3^- and NO_2^-.

Before performing ring test for NO_3^-, the aq. solution should be made free of NO_2^-. This is done by heating with

1) NH_4Cl

2) Zn dust

3) Conc. HNO_3

4) Dil. HNO_3

71. $\text{Salt} + AgNO_3 \rightarrow \underset{(A)}{\text{Yellow ppt.}}$

A is almost insoluble in concentrated ammonia solution. Identify the anion in the salt.

1) Cl^- 2) S^{2-}

3) I^- 4) CH_3COO^-

72. $PbCl_2 + KI \rightarrow \underset{\text{Yellow ppt}}{[A]} + KCl$

$\underset{\text{Yellow ppt}}{[A]} + \underset{\text{excess}}{KI} \rightarrow \underset{\text{soluble}}{[B]}$

Compound [A] and [B] are

1) PbI_4 and $K_2[PbI_4]$, respectively

2) $K_2[PbI_4]$ and PbI_4, respectively

3) PbI_2 and $K_2[PbI_4]$, respectively

4) PbI_2 and $K_2[PbI_2]$, respectively

73. Match Column I with Column II and choose the correct combination from the options given

Column-I		Column-II	
A)	Co^{2+} and Ni^{2+}	i)	Group -II
B)	Al^{3+} and Fe^{3+}	ii)	Group - III
C)	Cu^{2+} and Cd^{2+}	iii)	Group -V
D)	Ca^{2+} and Sr^{2+}	iv)	Group- IV

1) A→ii; B→i; C→iii; D→iv

2) A→i; B→iv; C→ii; D→iii

3) A→iv; B→ii; C→i; D→iii

4) A→i; B→ii; C→iv; D→iii

74. Why is dilute sulphuric acid added during the preparation of potash alum?

1) As a catalyst

2) As a solvent

3) To prevent hydrolysis of salt

4) To cause crystallization

75. Which of the following statements is incorrect?

1) Colour of lead sulphide (PbS) precipitate is yellow

2) Colour of lead iodide precipitate is yellow

3) Colour of nickel sulphide (NiS) precipitate is black

4) Colour of lead sulphate ($PbSO_4$) is white

76. Which is the following is the correct statement?

1) Cu^+ can undergo disproportionation in aqueous solution

2) $Cu^{2+}(aq)$ is more stable than $Cu^+(aq)$

3) Hydration energy of Cu^{2+} is more negative than Cu^+

4) All of these

77. An aqueous solution of $FeSO_4Al_2(SO_4)_3$ and chrome alum is heated with excess of Na_2O_2 and filtered. The materials obtained are

1) A colourless filtrate and a green residue

2) A yellow filatrate and a green residue

3) A yellow filtrate and a brown residue

4) A green filtrate and a brown residue

78. Which of the following statements is correct?

1) Fe^{2+} gives brown colour with ammonium thiocyanate

2) Fe^{2+} gives blue precipitate with potassium ferricyanide

3) Fe^{3+} gives brown colour with potassium ferrocyanide

4) Fe^{3+} gives red colour with potassium ferrocyanide

79. The oxidation state of Fe in its brown ring complex is

1) +1 2) +2

3) +3 4) +4

80. The reagent NH_4Cl and aqueous NH_3 precipitates

1) Ca^{2+} 2) Al^{3+}

3) Mg^{2+} 4) Zn^{2+}

81. The colour of the solution in product of the given reaction is

$$CH_3COONa + \underset{\text{(Neutral)}}{FeCl_3} + H_2O \xrightarrow{\Delta}$$

1) Brown red 2) Yellow

3) Black 4) Green

82. Strontium sulphate is mixed with conc. HCl, and flame test is performed. The colour of the flame is

1) Yellow 2) Violet

3) Green 4) Crimson red

83. $Fe^{3+} \xrightarrow{NH_4OH} A \xrightarrow{HCl} B \xrightarrow{K_4[Fe(CN)]_6} C$

$FeCl_3 \xrightarrow{KCNS} D$

Which of the following is incorrect?

1) Compound A is reddish- brown precipitate

2) Compound C is blue in colour

3) Compound D is blood red in colour

4) Compound B is insoluble in water

84. Mark the incorrect statement out of the following.

1) Group I basic radicals precipitate as chlorides

2) Group IV basic radicals precipitate as sulphides

3) Group V basic radicals precipitate as carbonates

4) Group II basic radicals precipitate as hydroxide

85. A white precipitates dissolves in ammonium acetate solution on boiling . A black precipitate appears on passing H_2S gas in its aqueous solution. The black precipitate dissolves in hot HNO_3.This white precipitate is of

1) $BaSO_4$

2) $SrSO_4$

3) $PbSO_4$

4) $CdSO_4$

86. A salt on treatment with dilute HCl gives a pungent smelling gas and a yellow precipitate. The salt gives green flame when tested. The solution gives a yellow precipitate with potassium chromate. The salt is

1) $NiSO_4$ 2) BaS_2O_3

3) PhS_2O_3 4) $CuSO_4$

87. In the qualitative analysis of fifth group radicals $(NH_4)_2CO_3$ is added to precipitate out the carbonates and not Na_2CO_3 because

1) $MgCO_3$ is soluble in Na_2CO_3

2) Na_2CO_3 increases the solubility of fifth group carbonates

3) $MgCO_3$ will also be precipitated out in fifth group

4) Na_2CO_3 will decrease the solubility produce of $MgCO_3$

88. The gas produced in the reaction given below at 25°C is $Na_2C_2O_4 + H_2SO_4 \rightarrow$ (conc.)

1) SO_2 only

2) CO_2 only

3) CO_2 and CO both

4) Na_2SO_4

89. Match the Columns

Column-I (Anion)		Column-II (Gas evolved on reaction with dil. H_2SO_4)	
A)	CO_3^{2-}	i)	Colourless gas which turns lead acetate paper black
B)	S^{2-}	ii)	Colourless gas which turns acidified potassium dichromate solution green
C)	SO_3^{2-}	iii)	Brown fumes which turns acidified KI solution containing starch blue
D)	NO_3^-	iv)	Colourless gas evolved with brisk effervescence, which turns lime water milky.

1) A→iii; B→i; C→ii; D→iv

2) A→ii; B→i; C→iv; D→iii

3) A→iv; B→i; C→iii; D→ii

4) A→iv; B→i; C→ii; D→iii

ANSWER KEY

1.	4	23.	3	45.	2	67.	2
2.	2	24.	2	46.	1	68.	4
3.	2	25.	3	47.	2	69.	1
4.	4	26.	4	48.	2	70.	1
5.	2	27.	1	49.	4	71.	3
6.	2	28.	2	50.	3	72.	3
7.	3	29.	3	51.	3	73.	3
8.	3	30.	3	52.	2	74.	3
9.	3	31.	3	53.	3	75.	1
10.	3	32.	3	54.	4	76.	4
11.	4	33.	3	55.	1	77.	3
12.	4	34.	4	56.	4	78.	2
13.	2	35.	1	57.	2	79.	1
14.	1	36.	1	58.	1	80.	2
15.	4	37.	2	59.	3	81.	1
16.	3	38.	2	60.	1	82.	4
17.	1	39.	1	61.	1	83.	4
18.	2	40.	1	62.	4	84.	4
19.	3	41.	4	63.	4	85.	3
20.	1	42.	1	64.	3	86.	2
21.	1	43.	1	65.	3	87.	3
22.	4	44.	4	66.	3	88.	3
						89.	4