A. Physical Chemistry (18%)

1. Fundamental Concepts	(4%)
2. States of Matter	(2%)
3. Atomic Structure	(2%)
4.Chemcial Bonding	(2%)
5. Chemical Energetics	(2%)
6. Electrochemistry	(2%)
7. Chemical Equilibrium	(2%)
8. Reaction Kinetics / Chemical Kinetics	(2%)

- ☐ Learning Outcomes
- ☐ Definitions and Statements
- ☐ Fully Solved Textual Exercise
- ☐ Important MCQs

1. Fundamental Concepts

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

1. FUNDAMENTAL CONCEPTS:

In this topic, student should be able to:

a) Define relative atomic, molecular and formula masses, based on the ^{12}C scale and concept of isotopes.
b) Explain mole in terms of the Avogadro's constant.
c) Apply mass spectrometric technique in determining the relative atomic mass of an element using the mass spectral data provided.
d) Calculate empirical and molecular formulae, using combustion data.
e) Understand stoichiometric calculations using mole concept involving.
   i) Reacting masses
   ii) Volume of gases
   iii) Percentage yield
f) Describe and explain following concentration units of solutions:
   i) Percentage composition
   ii) Molarity
   iii) Mole fraction

Definitions and Statements

1) Atoms, Molecules and Ions: Atoms are the building blocks of matter. Atoms can combine to form molecules. Covalent compounds mostly exist in the form of molecules. Atoms and molecules can either gain or lose electrons, forming charged particles called ions. Metals tend to lose electrons, becoming positively charged ions. Non metals tend to gain electrons forming negatively charged ions. When x-rays or α-particles are passed through molecules in a gaseous state, they are converted into molecular ions.

2) Atomic Mass: The atomic mass of an element is determined with reference to the mass of carbon as a standard element and is expressed in a.m.u. The fractional atomic masses can be calculated from the relative abundance of isotopes. The separation and identification of isotopes can be carried out by mass spectrograph.

3) Chemical Formula: The composition of a substance is given by its chemical formula. A molecular substance can be represented by its empirical or a molecular formula. The empirical or molecular formulas are related through a simple integer.

4) Combustion Analysis: Combustion analysis is one of the techniques to determine the molecular formula of the substance.

5) Mole: A mole of any substance is the Avogadro's number of atoms or molecules or formula units of that substance.

6) Stoichiometry: The study of quantitative relationship between reactants and products in a balanced chemical equation is known as stoichiometry. The mole concept can be used to calculate the relative quantities of reactants and products in a balanced chemical equation.

7) Molar Volume: The concept of molar volume of gases helps to relate solids and liquids with gases in a quantitative manner.

8) Limiting Reactant: A limiting reactant is completely consumed in a reaction and controls the quantity of products formed.

9) Theoretical and Actual yield: The theoretical yield of a reaction is the quantity of the product calculated with the help of a balanced chemical equation. The actual yield of a reaction is always less than the theoretical yield. The efficiency of a chemical reaction can be checked by calculating its percentage yield.

Fully Solved Textual Exercise

Each question has four options. Encircle the correct answer.

1. Isotopes differ in:
(a) properties which depend upon mass.
(b) arrangement of electrons in orbitals.
(c) chemical properties.

(d) the extent to which they may be affected in electrical field.

2. **Which of the following statement is not true?**
   (a) Isotopes with even atomic masses are comparatively abundant.
   (b) Isotopes with odd atomic masses are comparatively abundant.
   (c) Isotopes with even atomic masses and even atomic numbers are comparatively abundant.
   (d) Isotopes with even atomic masses and odd atomic numbers are comparatively abundant.

3. **Many elements have fractional atomic masses. This is because:**
   (a) the mass of atom is itself fractional.
   (b) atomic masses are average masses of isobars.
   (c) atomic masses are masses of isotopes.
   (d) atomic masses are average masses of isotopes proportional to their relative abundance.

4. **The mass of one mole of electrons is:**
   (a) 1.008 mg (b) 0.55 mg
   (c) 0.184 mg (d) 1.673 mg

5. **27g of Al will react completely with how much mass of O_2 to produce Al_2O_3?**
   (a) 8g of oxygen
   (b) 16g of oxygen
   (c) 32g of oxygen
   (d) 24g of oxygen

6. **The number of moles of CO_2 which contain 8.0g of oxygen:**
   (a) 0.25 (b) 0.50
   (c) 1.0 (d) 1.50

7. **The largest number of molecules are present in:**
   (a) 3.6g of H_2O
   (b) 4.8g of C_2H_5OH
   (c) 2.8g of CO
   (d) 5.4g of N_2O_5

8. **One mole of SO_2 contains:**
   (a) 6.02×10^{23} atoms of oxygen
   (b) 18.1×10^{23} molecules of SO_2
   (c) 6.02×10^{23} atoms of sulphur
   (d) 4 gram atoms of SO_2

9. **The volume occupied by 1.4g of N_2 at STP is:**
   (a) 2.24 dm^3
   (b) 22.4 dm^3
   (c) 1.12 dm^3
   (d) 112 dm^3

10. **A limiting reactant is the one which:**
   (a) is taken in lesser quantity in grams as compared to other reactants.
   (b) is taken in lesser quantity in volume as compared to the other reactants.
   (c) gives the maximum amount of the product which is required.
   (d) gives the minimum amount of the product under consideration.

Answers

No	Ans	No	Ans	No	Ans	No	Ans	No	Ans
i	a	ii	c	iii	d	iv	b	v	d
vi	a	vii	a	viii	c	ix	c	x	d

Important MCQs

INTRODUCTION

1. **The branch of science dealing with structure, composition and changes in matter and laws and principles which govern these changes is called as:**
   a) Chemistry b) Geology
   c) Physics d) Mechanics

2. **Smallest particle of an element which may or may not have independent existence is known as:**
   a) A molecule b) An ion
   c) An atom d) An electron

3. **Matter is defined as anything which occupies space and:**
   a) Molecules b) Mass
   c) Compounds d) Chemicals

4. **The number of atoms present in a molecule determines its:**
   a) Molecularity b) Atomicity
   c) Basicity d) Acidity

5. **When an electron is added to a unipositive ion we get:**
   a) Cation b) Molecule
   c) Neutral atom d) Anion

6. **CO^+ is an example of:**
   a) Stable molecule b) Anionic molecule ion
   c) Cationic molecular ion d) Free radical

7. **The diameter of atoms is of the order:**
   a) 2×10^{-5} m b) 2×10^{-10} m
   c) 2×10^{-2} m d) 2×10^{-3} m

8. Swedish chemist J. Berzelius determined:
a) Atomic density b) Atomic number
c) Atomic mass d) Atomic volume

9. Covalent compounds mostly exist in the form of:
a) Protons b) Atoms
c) Neutrons d) Molecules

10. Atoms and molecules can either gain or lose electrons, forming charged particles called:
a) Positrons b) Photons
c) Ions d) Electrons

11. Metals tend to lose electrons, becoming:
a) Positively charged ions b) Non-metals
c) Negatively charged ions d) All of above

12. Non-metals tend to gain electrons, becoming:
a) Metals b) Positively charged ions
c) Negatively charged ions d) (a) and (c)

13. First atomic theory was put forward by an English school teacher:
a) Maxwell b) Newton
c) Sanger d) John Dalton

14. Determination of atomic masses and invention of system of writing symbols was made by:
a) J. Berzelius b) Democritus
c) Dalton d) none of above

15. Atoms can be evident by the use of electron microscope, field ionization microscope and:
a) x-rays b) Video camera
c) Telescope d) Compound microscope

16. The number of subatomic particles in atoms so far discovered is more than:
a) 110 b) 100
c) 125 d) 90

17. $C_6H_{12}O_6$ and $C_{12}H_{22}O_{11}$ are:
a) Mono-atomic molecules
b) Diatomic molecules
c) Poly-atomic molecules
d) Hetero-atomic molecules

18. Cl_2, N_2 and O_2 are:
a) Diatomic molecules
b) Hetero-atomic molecules
c) Poly-atomic molecules
d) Mono-atomic molecules

19. He, Ar and Ne are:
a) Mono-atomic molecules
b) Hetero-atomic molecules
c) Poly-atomic molecules
d) Diatomic molecules

20. NH_3, HCl, H_2O, HI are:
a) Diatomic molecules
b) Poly-atomic molecules
c) Mono-atomic molecules
d) Hetero-atomic molecules

21. Haemoglobin contains nearly:
a) 10,000 atoms b) 100 atoms
c) 1000 atoms d) 1 atom

22. Haemoglobin is 68000 times heavier than:
a) Oxygen atom b) Nitrogen atom
c) Carbon atom d) Hydrogen atom

23. Molecules of high molecular weight usually greater than 10,000 are called:
a) Macromolecules b) Mega molecules
c) Polymolecules d) Gega molecules

24. In molecules kinetic and potential energies are:
a) Definite b) Moderate
c) Indefinite d) None of above

25. Which statement about an atom is true?
a) The number of neutrons is not equal to the number of electrons.
b) Mass number is less than atomic number.
c) All the elements have only one mass number.
d) Mass number can be equal to the atomic number.

26. Which statement about a molecule is incorrect?
a) Molecules of a substance are similar.
b) Haemoglobin is a homo atomic molecules.
c) Oxygen molecule is a macromolecule.
d) It exists independently.

27. A species having positive or negative charge is called:
a) Electron b) Ion
c) Proton d) Atom

28. An ion bearing positive charge is called:
a) Cation b) Positron
c) Anion d) None of the above

29. An ion having negative charge is called:
a) Anion b) Photon
c) Electron d) Cation

30. Formation of a cation is:
a) Exothermic process b) Non-endothermic process
c) Endothermic d) None of the above

process

31. **Anions are larger than their:**
a) Parent molecules b) Parent atoms
c) Present electrons d) None of above

32. **Any molecular species having positive charge is called:**
a) Molecular ion b) Atomic ion
c) Micro ion d) Macro ion

33. **Molecular ions are formed in an instrument called:**
a) Mass thermometer b) Thermocycler
c) Mass spectrophotometer d) Galvanometer

34. **The mass of a molecular ion can be calculated from its:**
a) c/m ratio b) M/e ratio
c) e/m ratio d) M/c ratio

RELATIVE ATOMIC MASS

35. **The mass of one atom of an element compared with the mass of an atom of carbon taken as 12 is called:**
a) Relative molecular mass
b) Atomic mass
c) Molecular mass
d) Relative atomic mass

36. **Due to stability and abundance of carbon compounds carbon is taken as:**
a) Element b) Superior
c) Standard d) Substance

37. **The masses of the atoms are extremely:**
a) Large b) Comparable
c) Small d) Alike

38. **Relative atomic mass of O is:**
a) 1.00794 a.m.u b) 15.9994 a.m.u
c) 35.453 a.m.u d) 17.674 a.m.u

ISOTOPES

39. **Isotopes are sister atoms of same element with similar chemical properties but different:**
a) Atomic structure b) Atomic volume
c) Atomic mass d) Atomic number

40. **Isotopes of an element are recorded separately in:**
a) Mass spectrometer b) Mass spectrophotometer
c) Calorimeter d) Mass meter

41. **Soddy discovered, first of all, the:**
a) Neutrons b) Protons
c) Electrons d) Isotopes

42. **Isotopes can be separated by:**
a) Geological method b) Chemical method
c) Physical method d) Ordinary method

43. **Formula of heavy water is:**
a) H_3O b) H_2O_2
c) H_2O d) D_2O

44. **Isotopes have same:**
a) Chemical properties b) Biochemical properties
c) Physical properties d) Biological properties

45. **Masses of isotopes of same element are:**
a) Same b) Fluctuating
c) Different d) None of above

46. **Isotopes have same position in:**
a) Frequency Table b) Periodic Table
c) Valency Table d) Geological Table

47. **Mass spectrometer separates different positive isotopic ions on the basis of their:**
a) Charge value b) Mass value
c) m/e value d) e/m value

48. **Sn has:**
a) Ten isotopes b) Eleven isotopes
c) Four isotopes d) Twelve isotopes

49. **The properties of an element correspond to the properties of that isotope which is most:**
a) Unsuitable b) Least
c) Abundant d) Suitable

50. **More abundant isotope of an element is the one with:**
a) Odd mass number b) Odd atomic number
c) Even mass number d) Even atomic number

51. **Large number of isotopes are known for the elements whose masses are multiple of:**
a) Eight b) Six
c) Four d) Two

52. **Fractional atomic mass is due to number of possible isotopes and their natural:**
a) Deterioration b) Disturbance
c) Abundance d) Occurrence

53. **Isotopes due to differences in their masses are called:**
a) Compton effect b) Isotopic effect
c) Photoelectric effect d) All of above

ANALYSIS OF A COMPOUND EMPIRICAL & MOLECULAR FORMULAS

54. Simplest formula that gives us information about the simplest ratio of atoms in compound is called:
a) Empirical formula b) Molecular formula
c) Structural formula d) Molar ratio

55. The formula mass of an ionic compound is called:
a) Gram formula b) Simple formula
c) Empirical formula d) None of above

56. Empirical formula for glucose is:
a) CH b) CH_2O
c) CO_2 d) H_2O

57. Empirical formula for benzene is:
a) CO_2 b) CH_2O
c) CH d) H_2O

58. In combustion analysis, % of hydrogen is calculated from:
a) H_2O b) CO
c) CH d) CH_2O

59. In combustion analysis, % of carbon is calculated from:
a) CH b) H_2O
c) CO_2 d) CH_2O

60. In combustion analysis, % of oxygen is calculated by subtracting other percentages from:
a) 50 b) 100
c) 25 d) 200

61. The formula which represents actual number of atoms of each element in a molecule is called:
a) Molecular formula b) Compound formula
c) Atomic formula d) Empirical formula

62. In case of CCl_4, HCl and NH_3 formulas both empirical and molecular formulas are:
a) Not same b) Same
c) Different d) All of above

63. Molecular formula:
a) N×molecular formula b) n×compound formula
c) N×atomic formula d) n×empirical formula

CONCEPT OF MOLE

64. One mole of SO_2 contains:
a) 4 gram atom of SO_2
b) 6.022×10^{23} atoms of sulphur
c) 1.81×10^{23} molecules of SO_2
d) 6.02×10^{23} atoms of oxygen

65. The mass of one mole of electrons is:
a) 1.008 mg b) 0.184 mg
c) 0.54 mg d) 1.673 mg

66. The volume occupied by 1.4g of N_2 at STP is:
a) 2.24 dm^3 b) 1.12 dm^3
c) 112 cm^3 d) 22.4 dm^3

67. One mole of carbon 12 has mass:
a) 0.012 kg b) 1 kg
c) 0.0224 kg d) 12 kg

68. The mass of one mole of chlorine gas is:
a) 35.5 g b) 23 g
c) 71 g d) 32 g

69. The number of moles of hydrogen atoms in 3.2 g of methane CH_4 (Relative atomic mass of H = 1, C = 12):
a) 0.8 b) 0.2
c) 0.6 d) 0.4

70. What are number of moles of oxygen atoms in 11g of CO_2 gas?
a) 1.0 b) 0.75
c) 0.25 d) 0.50

71. A diamond chain is 6g in weight. What is the number of atoms in it:
a) 3.01×10^{23} b) 1.003×10^{23}
c) 12.04×10^{23} d) 6.02×10^{23}

72. How many atoms are present in one mole of water?
a) $3(6.02 \times 10^{23})$ b) 54
c) 6.02×10^{23} d) 3

73. 6g of hydrogen gas is:
a) 4 mol b) 1 mol
c) 3 mol d) 2 mol

74. Which element cannot be analyzed directly by combustion analysis?
a) Oxygen b) Carbon
c) Sulphur d) Hydrogen

75. In SI units, the prefix "nano" means:
a) 10^{-6} b) 10^{-12}
c) 10^{-15} d) 10^{-9}

76. Which of the following substances is used as CO_2 absorber in combustion analysis?
a) Dilute H_2SO_4 b) 50% KOH
c) Dilute HCl d) $Mg(ClO_4)_2$

77. The number of moles of CO_2 in 11g of gas is:
a) 0.5 mol b) 0.2 mol
c) 0.25 mol d) 0.3 mol

78. One mole of ethane (C_2H_6) and one mole of ethanol (C_2H_5OH) have an equal:
a) Number of b) Number of atoms

molecules
c) Number of electrons d) Masses

79. What is the number of protons in one molecule of SO_3?
a) 64 b) 40
c) 32 d) 24

80. The mass of one mole of iodine:
a) 245g b) 127g
c) 74g d) 53g

81. Which will weigh more?
a) 2 mol CO_2 b) 2 mol O_2
c) 2 mol N_2 d) 1 mol O_3

STOICHIOMETRY

82. The calculations based on stoichiometry are known as:
a) Simple calculations
b) Stoichiometric calculations
c) Complex calculations
d) None of above

83. The branch of chemistry which deals with quantitative relationship between reactants and products in a balanced chemical equation is called:
a) Analytical chemistry b) Inorganic chemistry
c) Biochemistry d) Stoichiometry

84. Chemical equations do not tell about:
a) Reactants b) Rate of reaction
c) Products d) Conditions and rate of reaction

LIMITING REACTANT

85. A limiting reactant is one:
a) Which produces minimum number of moles of product.
b) Which produces maximum number of moles of product.
c) Does not effect the amount of product.
d) Which is present in least amount.

86. Efficiency of a chemical reaction can be checked by calculating:
a) Amount of reactant left unused.
b) Amount of product formed.
c) Amount of reactant in excess.
d) Amount of limiting reactant

YIELD

87. The amount of product obtained in a chemical reaction is called:
a) Yield of a reaction b) Product of a reaction
c) Conclusion of a reaction d) None of above

88. The amount of product obtained or calculated from balanced chemical equation is called:
a) Actual yield b) Theoretical yield
c) Experimental yield d) Balanced yield

89. The amount of product which is really obtained in a chemical reaction is called:
a) Experimental yield b) Theoretical yield
c) Balanced yield d) Actual yield

90. The reasons for less experimental yield than theoretical yield are reversible reaction, side reaction and:
a) Temperature b) Crystallization
c) Pressure d) Maximization

Answers

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

2. States of Matter

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Understand gaseous state with reference to:
   i) Postulates of kinetic molecular theory
   ii) Gas laws: Boyle's law, Charles' law, Avogadro's law and gas equation (PV=nRT) and calculations involving gas laws.
   iii) Deviation of real gases from ideal behaviour at low temperature and high pressure'
   iv) Conditions necessary for gasses to approach ideal behavior.

b) Discuss liquid state with reference to:
   Evaporation, vapour pressure, boiling and hydrogen bonding in water.

c) Explain the lattice structure of a crystalline solid with special emphasis on:
   i) Giant ionic structure, as in sodium chloride.
   ii) Simple molecular, as in iodine.
   iii) Giant molecular, as in diamond; silicon (IV) oxide.
   iv) Hydrogen-bonded, as in ice.

d) Outline the importance of hydrogen bonding to the physical properties of substances, including NH_3, H_2O, C_2H_5OH and ice.

e) Suggest from quoted physical data the type of structure and bonding present in a substance.

Definitions and Statements

1) Behaviour of a gas: The behaviour of a gas is described through four variables i.e., pressure, volume, temperature and its number of moles.

2) Simple Gas Laws: The relationships between gas variables are known as simple gas laws. Boyle's law relates pressure of a gas with its volume, while Charle's law relates gas volume with temperatures. Avogadro's law is concerned with volume and amount of a gas. The important concept of absolute zero of temperature originates from the simple gas laws.

3) Equation for Behaviour of Gases: By combining above mentioned three laws, a more general equation about behaviour of gas is obtained i.e., PV = nRT. This equation can be solved for any one of the variables when values for others are known. This equation can be modified for the determination of molar masses and the density of the gas.

4) Usage of Dalton's Law of Partial Pressure: The law can be used to calculate the partial pressures of gases.

5) Diffusion And Effusion: The process of diffusion and effusion are best understood by Graham's law of diffusion.

6) Kinetic Molcular Theory of Gases: This theory provides a theoretical basis for various gas laws. With the help of this theory a relationship is established between average molecular kinetic energy and Kelvin temperature. The diffusion and effusion of the gases can be related to their molar masses through kinetic molecular theory of gases.

7) Real Gases: The real gases show ideal behaviour under specific conditions. They become non-ideal at high pressure and low temperature. The non-ideal behaviour results chiefly from intermolecular attractions and the finite volume occupied by the gas molecules.

8) Liquefaction of Gases: Gases can be liquefied by applying sufficient pressure but temperature should either be critical one or below it.

9) Vander Waal's Equation: To calculate the pressure or volume of a real gas under the non-ideal conditions, alternative Kinetic equation has been developed. This is known as the van der Waal's equation.

Important MCQs

STATES OF MATTER

1. Which of the following is the simplest form of matter?
   a) Gaseous state b) Liquid state
   c) Solid state d) All of above
2. Which statement about gases is not correct?
   a) They spread throughout the vessel.
   b) Pressure is due to collision.
   c) There are larger spaces between the molecules.
   d) Molecules are arranged regularly.
3. The movement of gas molecules from a region of high pressure to vacuum is called:
   a) Evaporation b) Effusion
   c) Conduction d) Diffusion
4. All gases can be compressed by:
   a) Keeping constant pressure
   b) Decreasing pressure
   c) Increasing pressure
   d) None of the above
5. Gases exert pressure on walls of container because the gas molecules:
   a) Obey gas laws.
   b) Have definite volume.
   c) Collide with the walls of container.
   d) Collide with each other.
6. Gases of air, always remain in random motion and do not settle due to:
   a) Difference in molecular masses of air gases.
   b) Difference in partial pressure of gas molecules.
   c) Unequal number of different gas molecules.
   d) Elastic collision of gas molecules.
7. The rate of diffusion of a gas is:
   a) Inversely proportional to its density
   b) Inversely proportional to square root of its molecular mass
   c) Directly proportional to molecular mass
   d) Directly proportional to its density
8. In gases and liquids, temperature is the measure of:
   a) Average translational kinetic energies of molecules.
   b) Average vibrational kinetic energies of molecules.
   c) Average rotational kinetic energies of molecules.
   d) None of above.
9. In solids, the temperature is the measure of:
   a) Rotational kinetic energies
   b) Translational kinetic energies
   c) Vibrational kinetic energies
   d) None of above
10. Cooling happens under the Joule Thomson Effect due to sudden:
    a) Contraction b) Absorption
    c) Expansion d) All of above
11. Gases show uniform behaviour towards their:
    a) Internal conditions b) External conditions
    c) Internal and external conditions d) None of above
12. Liquids are less common than:
    a) Solids b) Plasmas
    c) Gases d) All of above
13. The Intramolecular forces in gases are:
    a) Weak b) Normal
    c) Very weak d) Strong

GAS LAWS

14. The relationships between volume of a given amount of gas and the prevailing conditions of temperature and pressure are:
    a) Charle's law b) Graham's law
    c) Boyle's law d) Gas laws
15. In Boyle's law which of the following pair remains constant:
    a) Temperature and quality of a gas.
    b) Pressure and quality of a gas.
    c) Temperature and pressure.
    d) Temperature and quantity of a gas.
16. In Boyle's law which of the following pair is variable:
    a) Temperature and quantity of a gas.
    b) Pressure and Volume
    c) Volume and quantity of a gas.
    d) Pressure and quantity of a gas.
17. For a gas obeying Boyle's law if pressure is doubled, the volume becomes:
    a) Remains constant b) Double
    c) One half d) None of above
18. Boyle's law is represented as:
    a) $P \propto 1/T$ b) $V \propto 1/P$
    c) $V \propto P$ d) $P \propto 1/V$
19. According to Boyle's law, which parameters give a straight line parallel to x-axis, when we plot a graph between:

a) V and T b) P and V
c) P and 1/V d) P and PV

20. **Boyle's law does not fail even:**
a) Temperature is extremely high.
b) Pressure is extremely high.
c) Mixture of gases is taken.
d) All of above

21. **A graph between P and 1/V at constant temperature and number of moles of a gas meets the:**
a) y-axis b) x-axis
c) origin d) none of above

22. **A graph between P and PV at constant temperature and number of moles is parallel to:**
a) y-axis b) z-axis
c) x-axis d) pressure axis

23. **The product of pressure and volume remains constant when temperature and quantity of gas is:**
a) Zero b) Variable
c) Kept constant d) None of above

24. **The ratio of volume to temperature on Kelvin scale is constant according to:**
a) Charle's law b) Newton's law
c) Coulomb's law d) Boyle's law

25. **The graph between pressure and volume at constant temperature for a gas is:**
a) Isobaric b) Isothermal
c) Isotherm d) None of above

26. **The density of a gas is directly proportional to pressure, inversely proportional to temperature and directly proportional to:**
a) Viscosity b) Molar mass
c) Momentum d) All of above

27. **If absolute temperature of a gas is doubled and the pressure is reduced to one half, the volume of the gas will be:**
a) Remain unchanged b) Doubled
c) Reduced d) Increased four times

28. **Absolute temperature of a gas is proportional to:**
a) Rotational Kinetic energy
b) Translational Kinetic energy
c) Vibrational Kinetic energy
d) Potential energy

29. **The highest temperature at which a substance can exist as a liquid is called its:**
a) Critical b) Zero temperature
c) Absolute temperature d) None of above

30. **Keeping the temperature constant, if the gas is expanded:**
a) Kinetic energy of molecules will increase.
b) Number of gas molecules increases.
c) Temperature will increase.
d) Pressure will decrease.

31. **At constant temperature when pressure of a gas is plotted against volume, the cure is:**
a) Slanting straight line
b) Parabolic
c) Straight line, parallel to pressure axis
d) Of neither type

32. **A gas is heated in such a way that its volume and absolute temperature both are doubled. The pressure of the gas:**
a) Becomes 4 times b) Becomes half
c) Becomes 2 times d) Remains same

33. **If the number of gas molecules are doubled in a certain volume the pressure is:**
a) Increased to four times
b) Remains unchanged
c) Doubled
d) Decreased to half

34. **At same temperature which substance has high kinetic energy:**
a) Liquid water
b) N_2 gas in a container
c) Solid piece of iron
d) Solution of alcohol and water

GENERAL GAS EQUATION

35. **Which one of the following gases has lowest density at room temperature?**
a) NH_3 b) Ne
c) N_2 d) CO

36. **Which one of the following values of R gas constant is not correct?**
a) 1.987 cal K^{-1} mol^{-1}
b) 8.313 Nm K^{-1} mol^{-1}
c) 62400 dm^3 atm K^{-1} mol^{-1}
d) 0.0821 atm dm^3 K^{-1} $mole^{-1}$

37. **Which of the following equations is for ideal gas?**
a) PV = dRT b) PR = nTP
c) PM = nRT d) PV = nRT

38. **If R, T, M, V and P are gas constant, temperature, molar mass, volume and pressure then density is given by:**

a) M/V b) RT/M
c) PM/RT d) V/M

39. General gas equation can be derived by combining:
a) Maxwell's law, Coulomb's law and Avogadro's law.
b) Boyle's law, coulomb's law and Charles law.
c) Boyle's law, Maxwell's law and Avogadro's law.
d) Boyle's law, Charlie's law and Avogadro's law.

40. The value of general gas constant R is derived from:
a) Newton's Cooling law b) Maxwell's law
c) Avogadro's law d) Charle's law

AVOGADRO'S LAW

41. Equal volumes of ideal gases contain equal number of molecules at:
a) Same temperature b) Same pressure
c) Same environmental conditions d) Both (a) and (b)

42. Oxygen molecule is 16 times heavier than:
a) Helium b) Hydrogen
c) Neon d) Aluminium

43. One molecule of a gas is approximately at a distance _____ times its own diameter from its neighbour at room temperature.
a) 30 b) 3000
c) 3 d) 300

44. 22.414 dm^3 of a gas at 273.15 K and one atm pressure has number of molecules =
a) 60.2×10^{23} b) 6.02×10^{23}
c) 602×10^{23} d) 0.602×10^{23}

DALTON'S LAW OF PARTIAL PRESSURES

45. Which pair of gases do not obey Dalton's law of partial pressures?
a) H_2 and He b) NH_3 and HCl
c) H_2 and O_2 d) N_2 and O_2

46. Total pressure of mixture of two gases is:
a) The ratio of their partial pressures
b) The product of their partial pressures
c) The difference of their partial pressures
d) The sum of their partial pressures

47. Partial pressures of gases in a mixture depend upon:
a) Number of moles b) Number of protons
c) Number of electrons d) Number of neutrons

48. The partial pressure of gas can be calculated if we know the total pressure of the mixture and:
a) Number of protons b) Number of electrons
c) Number of neutrons d) Mole fraction of gases

49. The partial pressure of O_2 in the lungs is $116 gcm^{-2}$ while that in the atmosphere is:
a) $159\ gcm^{-2}$ b) $259\ gcm^{-2}$
c) $359\ gcm^{-2}$ d) $459\ gcm^{-2}$

50. Partial pressure of any gas in a mixture of gases can be calculated if provided with:
a) Mass of that gas
b) Number of moles alongwith the total pressure
c) Total number of moles present in mixture
d) All of the above

51. Dalton's law finds its application during the process of:
a) Digestion b) Respiration
c) Reproduction d) All of above

52. Deep sea divers take oxygen with:
a) A heavy gas b) A lighter gas
c) An inert gas d) All of above

DIFFUSION AND EFFUSION

53. The order of rate of diffusion of gases CO_2, Cl_2, SO_2 and NH_3 is:
a) $Cl_2 > SO_2 > CO_2 > NH_3$
b) $NH_3 > CO_2 > SO_2 > Cl_2$
c) $NH_3 > SO_2 > Cl_2 > CO_2$
d) $CO_2 > Cl_2 > SO_2 > NH_3$

54. Which of the following is an example of diffusion?
a) Spreading of smell of flowers in garden.
b) Steam condensing on a cold window.
c) Bubbles rising in a beaker of boiling water.
d) All of above

55. What can be deduce about two gases which have the same molecular mass?
a) They have same number of atoms in a

molecule.

b) They have same rate of diffusion.
c) They have same boiling points.
d) They have equal solubility in water at room temperature.

56. **Which of the following gases diffuse quickly?**
a) N_2 b) NH_3
c) CO_2 d) Cl_2

57. **According to Graham's law of diffusion, the rate of diffusion of H_2 and O_2 gases has the ratio:**
a) 3 : 32 b) 1 : 4
c) $1:\sqrt{4}$ d) 4 : 1

58. **The ratio of diffusion of equal volume of He and SO_2 is (molecular mass He = 4, SO_2 = 64):**
a) 1 : 4 b) 16 : 1
c) 1 : 16 d) 4 : 1

59. **Which of the following gases have maximum root mean square velocity at 25°C?**
a) SO_2 b) NH_3
c) H_2S d) CO_2

60. **The rate of diffusion of a gas of molar mass 72 as compared to H_2 will be:**
a) Same b) 6 times
c) 1.4 time d) 1/6 times

61. **At the same temperature and pressure two balloons are separately filled with H_2 and O_2. If O_2 escapes at the rate of 60cm per hour, the hydrogen will diffuse at the rate of:**
a) 24 cm per hour b) 240 cm per hour
c) 204 cm per hour d) 2.4 cm per hour

62. **The diffusion of gases at absolute zero will be:**
a) Slightly decreased b) Unchanged
c) Slightly increased d) Zero

63. **NH_3 gas diffuses twice as fast as a gas which is?**
a) C_5H_8 b) C_4H_{10}
c) SO_2 d) Cl_2

64. **The rate of diffusion of a gas is inversely proportion to the square root of:**
a) Density of the gas b) Velocity of the gas
c) Viscosity of the gas d) All of above

65. **Smell of the cooking gas during leakage from gas cylinder is detected because of the property of:**
a) Effusion b) Evaporation
c) Diffusion d) Conduction

KINETIC MOLECULAR THEORY OF GASES

66. **The distribution of energies among the molecules of gases was studied by:**
a) Maxwell b) Coulomb
c) Newton d) Boltzmann

67. **The distribution of velocities among molecules of gases was studied by:**
a) Coulomb b) Boltzman
c) Newton d) Maxwell

68. **Kinetic theory of gas was put forward by:**
a) Maxwell b) Bernoulli
c) Coulomb d) Newton

69. **At same temperature, the kinetic energy of one mole of each H_2 and O_2 separately is:**
a) Zero b) Same
c) Different d) None of above

70. **If absolute temperature of a gas is doubled and pressure is reduced to one half, the volume of the gas will:**
a) be doubled b) remain unchanged
c) increase four times d) reduce to 1/4

71. **Which of the following assumptions is not belonging to kinetic molecular theory of gases?**
a) Collisions between molecules is inelastic.
b) The size of molecules is negligible.
c) Molecules move randomly.
d) There is no force of attraction between molecules.

72. **According to kinetic molecular theory of gases, molecules increase in the kinetic energy when they are:**
a) Melted from a solid to liquid state.
b) Condensed into a liquid.
c) Frozen into a solid.
d) Mixed with other molecules at low temperature.

73. **Eight grams each of O_2 and H_2 at 27°C will have total K.E. in the ratio:**

a) 8 : 1 b) 1 : 1
c) 1 : 16 d) 16 : 1

74. The total K.E. of one mole of an ideal gas is given by:
a) 1/2 RT b) 3/2 KT
c) 1/2 KT d) 3/2 RT

75. The kinetic energy of three moles of gas is:
a) 3/2 RT b) 3 RT
c) 1/2 RT d) 2 RT

LIQUEFACTION OF GASES

76. Lind's method for liquefaction of gases is based on the principle of:
a) Graham's law of diffusion
b) Joule Thomson effect
c) Avogadro's hypothesis
d) Dalton's law of partial pressure

77. Which of the following gases cannot be liquefied by Lind's method?
a) Nitrogen and Helium b) Ammonia and Hydrogen
c) Hydrogen and Helium d) Water vapours

78. An ideal gas cannot be liquefied because:
a) It solidify before becoming a liquid.
b) Its critical temperature is always above 0°C.
c) Its molecules are relatively smaller in size.
d) Forces operative between its molecules are negligible.

79. The value of critical temperature of a gas depends upon its:
a) Size
b) Intermolecular forces in it
c) Shape
d) All of above

80. The non-polar gases of low polarizability have a very:
a) Low critical temperature
b) Stable critical temperature
c) High critical temperature

81. During sudden expansion of a gas energy is needed to overcome the intermolecular:
a) Vibrations b) Attractions
c) Repulsions d) All of above

82. When a compressed gas is allowed to expand into a region of low pressure, it produces:
a) Vapours b) Cooling effect
c) Heating effect d) Non of above

83. The critical temperature of NH_3 is greater than CO_2 due to its:
a) Greater polarity b) Stable polarity
c) Lesser polarity d) None of above

NON-IDEAL BEHAVIOUR OF GASES

84. The deviation of a gas from ideal behaviour is maximum at:
a) 0°C and 2.0 atm b) −10°C and 5.0 atm
c) 100°C and 2.0 atm d) −10°C and 2.0 atm

85. Under what conditions of temperature and pressure will a real gas behave most likely as an ideal gas:
a) Low temperature and high pressure.
b) Low temperature and low pressure.
c) High temperature and high pressure.
d) High temperature and low pressure.

86. Absolute zero is equal to:
a) −273.15K b) −273.15°C
c) −237.15K d) −273°C

87. Which gas deviates greater from ideal behaviour at high pressure?
a) NH_3 b) Ar
c) He d) H_2

88. The gas which obey's the gas laws at all conditions of temperature and pressure is called:
a) Perfect gas b) Super gas
c) Ideal gas d) Real gas

89. Gas molecules show more deviation from ideal behaviour at high pressure because:
a) Force of attraction between molecules increases.
b) Force of collision per unit area increases.
c) Velocity of molecules decreases.
d) Velocity of molecules increases.

90. Gases deviate from ideal behaviour because molecules:
a) Repel each other b) Contain covalent bond
c) Attract each other d) None of above

91. At 100 atm, CH_4 develops:
a) Ideal attitude b) Non-ideal attitude
c) Serious attitude d) Laughing attitude

PLASMA STATE

92. The basic distinction between solids, liquids and gases lies in difference between:
a) Strength of the bonds
b) Size of molecules
c) Space which the molecules occupy
d) All of above

93. Plasma consists of:
a) Neutral particles
b) Negative electrons
c) Positive ions
d) Mixture of all above

94. Most of the universe consists of the matter in:
a) Gaseous state
b) Liquid state
c) Plasma state
d) Solid state

95. Inside every fluorescent lamp there is present a:
a) Gas
b) Plasma
c) Liquid
d) Solid

Answers

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

3. Atomic Structure

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Identify and describe the proton, neutron and electron in terms of their relative charges and relative masses.
b) Discuss the behaviour of beams of protons, neutrons and electrons in electric fields.
c) Calculate the distribution of mass and charges within an atom from the given data.
d) Deduce the number of protons, neutrons and electrons present in both atoms and ions for a given proton and nucleon numbers/charge.
e)
   i) Describe the contribution of protons and neutrons to atomic nuclei in terms of proton number and nucleon number.
   ii) Distinguish between isotopes on the basis of different numbers of neutrons present.
f) Describe the number and relative energies of the s, p and d orbitals for the principal quantum numbers 1, 2 and 3 and also the 4s and 4p orbitals.
g) Describe the shapes of s, p and d-orbitals.
h) State the electronic configuration of atoms and ions given, the proton number/charge for period 1, 2, 3 and 4 (hydrogen to Krypton).
i) Explain:
   i) Ionization energy.
   ii) The factors influencing the ionization energies of elements.
   iii) The trends in ionization energies across a Period and down a Group of the Periodic Table.
j) Explain and use the term Electron Affinity.

Definitions and Statements

1) Atoms: Matter is made up of extremely small particles called atoms.

2) Cathode Rays and Positive Rays: Cathode rays and positive rays were discovered during discharge tube experiments. The properties of cathode rays showed them to be negatively charged particles called electrons, whereas, the positive rays were found to contain positively charged particles called protons.

3) Fundamental Particles of an Atom: Electrons, protons and neutrons are regarded as the fundamental particles of an atom. Neutron was discovered through artificial radioactivity.

4) Role of Rutherford: Rutherford discovered the nucleus and unsuccessfully explained the presence of moving electrons around the nucleus.

5) Role of Planck: In 1905, Planck put forward his famous Planck's quantum theory.

6) Role of Neil Bohr: Neil Bohr explained the structure of hydrogen atom by using Plank's quantum theory. He also calculated the radius and energy of electron in the nth shell of hydrogen atom.

7) Bohr's Atomic Model: Bohr's atomic model successfully explained the origin of line spectrum and the lines present in the spectrum of hydrogen atom in the visible and invisible regions.

8) X-rays: X-rays are produced when rapidly moving electrons collide with heavy metal anode in the discharge tube.

9) Role of Mosley: Mosley discovered a simple relationship between the frequency of X-rays and the atomic number of the target element.

10) Role of de-Broglie: de-Broglie discovered wave-particle duality of material particles. According to him all material particles in motion have a dual character. Davission and Germer experimentally verified the wave concept of an electron.

11) Role of Heisenberg: Heisenberg pointed out that it is not possible for us to measure the exact position and the exact momentum of electron simultaneously.

12) Role of Schrodinger: After the failure of Bohr's atomic model, Schrodinger developed the wave mechanical model of hydrogen atom. According to him, although the position of an electron cannot be found exactly, the probability of finding an electron at a certain position at any time can be calculated.

13) Quantum Numbers: An electron in an atom is completely described by its four quantum numbers, three out of these four quantum numbers have been derived from Schrodinger wave equation when it is solved for hydrogen atom.

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

(i) The nature of positive rays depend on:
- (a) The nature of electrode
- (b) The nature of discharge tube
- (c) The nature of residual gas
- (d) All of the above

(ii) The velocity of photon is:
- (a) Independent of its wavelength
- (b) Depends on its wavelength
- (c) Equal to square of its amplitude
- (d) Depends on its source.

(iii) The wave number of the light emitted by a certain source is 2×10^6 m^{-1}. The wavelength of this light will be:
- (a) 500 nm
- (b) 500 m
- (c) 200 nm
- (d) 5×10^7 m

(iv) Rutherford's model of atom failed because:
- (a) The atom did not have a nucleus and electrons
- (b) It did not account for the attraction between protons and neutrons
- (c) It did not account for the stability of the atom
- (d) There is actually no space between the nucleus and the electrons

(v) Bohr model of atom is contradicted by:
- (a) Planck's quantum theory
- (b) Pauli's exclusion theory
- (c) Heisenberg's uncertainty principle
- (d) All of the above

(vi) Splitting of spectral lines when atoms are subjected to strong electric field is called:
- (a) Zeeman effect
- (b) Stark effect
- (c) Photoelectric effect
- (d) Compton effect

(vii) In the ground state of an atom, the electron is present:
- (a) in the nucleus
- (b) in the second shell
- (c) nearest to the nucleus
- (d) farthest from the nucleus

(viii) Quantum number value for 2p orbitals are:

(a) n = 2, l = 1
(b) n = 1, l = 2
(c) n = 1, l = 0
(d) n = 2, l = 0

(ix) Orbital having same energy is called:
(a) hybrid orbital
(b) valence orbital
(c) degenerate orbital
(d) d-orbital

(x) When 6d orbital is complete, the entering electron goes into:
(a) 7f
(b) 7s
(c) 7p
(d) 7d

Answers

No	Ans	No	Ans	No	Ans	No	Ans	No	Ans
i	(c)	ii	(a)	iii	(a)	iv	(c)	v	(c)
vi	(b)	vii	(c)	viii	(a)	ix	(c)	x	(c)

Important MCQs

SUB ATOMIC PARTICLES OF ATOM

1. Neutron was discovered by:
a) Chadwick b) Bohr
c) Rutherford d) Plank

2. The e/m value for positive rays is maximum for:
a) Oxygen b) Nitrogen
c) Helium d) Hydrogen

3. The nature of positive rays depend on:
a) Nature of discharge tube
b) Nature of resident gas
c) Nature of electrode
d) All of the above

4. Which of the following was discovered first:
a) Charge to mass ratio of electrons
b) Mass of electron
c) Charge of electron
d) All of above at same time

5. Which of the following particles has longest wavelength, if they have same speed:
a) Proton b) Neutron
c) Electron d) Positron

6. Maximum potential energy that an electron can have within the atom is:
a) Equal to zero b) Less than zero
c) Greater than zero d) Infinite

7. Alpha rays consist of:
a) Neutrons b) Helium nucleus
c) Protons d) Hydrogen nucleus

8. Charge to mass ratio of electron was discovered by:
a) Millikan b) Rutherford
c) J. J. Thomson d) Chadwick

9. When an electric current is passed through discharge tube at low pressure, cathode rays are emitted from cathode these rays consist of:
a) Alpha rays b) Negative particles
c) Electromagnetic rays d) Positive particles

10. Charge of an electron is:
a) 1.6×10^{-19} C b) 9.1×10^{-34} C
c) 1.7588×10^{11} C d) 6.62×10^{-34} C

11. Mass of simple electron is:
a) 9.1×10^{31} kg b) 9.1×10^{-30} kg
c) 1.66×10^{-31} kg d) 9.1×10^{-31} kg

12. The charge over mass ratio of electron is:
a) 1.6×10^{-1} C Kg^{-1} b) 9.1×10^{-31} C
c) 1.7588×10^{11} C Kg d) 6.62×10^{-34} C Kg^{-1}

13. Charge on electron was discovered by:
a) Millikan b) Crook
c) Neil Bohr d) Rutherford

14. Proton was discovered by:
a) Chadwick b) J. J. Thomson
c) Millikan d) Goldstein

15. Which one of the following particles has a mass 1/1836 time, that of hydrogen?
a) Neutron b) Proton
c) Electron d) Positron

16. Negatively charged particle nature of cathode rays was first demonstrated in 1895 by:
a) Millikan b) J. Perrin
c) Hittrof d) J. J. Thomson

17. With the reference of e/m ratio of anode rays, the e/m ratio of cathode rays is:
a) Greater b) Same
c) Smaller d) Not fixed

18. Which one of the following statements is true about discovery of neutrons?
a) These particles were formed by the bombardment of α-particles on Beryllium.
b) These particles are formed by the splitting of α-particles.
c) These particles were discovered by natural radioactivity.

d) None of above

19. Anode is the surface on which probability of finding electron is:

a) 50% b) Less than 10%
c) More than 95% d) Zero

RUTHERFORD'S MODEL OF ATOM—DISCOVERY OF NUCLEUS

20. The experimental evidences for the existence of atomic nucleus comes from:

a) Line spectrum of hydrogen.
b) Magnetic bonding of cathode rays.
c) Millikan oil drop experiment.
d) Scattering of alpha particles by thin metal foil.

21. When alpha particles are bombarded over Be $^{9}_{4}$ atoms, neutrons are released along with:

a) $_{8}O^{17}$ b) $_{13}Al^{27}$
c) $_{6}C^{12}$ d) $_{15}P^{30}$

22. The Rutherford experiment of using a stream of alpha particles on a piece of gold foil proved that:

a) Atom had neutrons.
b) Atom had electrons.
c) Atom had a great empty space in it.
d) Atom was a solid sphere.

23. Which of the following observations was seen by Rutherford when alpha particles were bombarded over gold foil?

a) Alpha particles were deflected over the angle of 90°.
b) Alpha particles were captured by the gold atoms.
c) Majority of alpha particles were deflected slightly from their path.
d) Majority of alpha particles passed through foil without deflection.

24. The mass of alpha particle is equal to:

a) That of one electron.
b) That of one proton.
c) That of one hydrogen.
d) Four times the mass of one proton.

25. Rutherford's model of atoms failed because:

a) It did not account for stability of the atom.
b) The atom did not have a nucleus and electrons.
c) It did not account for attraction between protons and neutrons.
d) There is actually no space between nucleus and the electrons.

PLANCK'S QUANTUM THEORY

26. Max Planck proposed quantum theory in:

a) 1800 b) 1900
c) 2000 d) 1860

27. Quantum theory explained:

a) Emission of radiations
b) Absorption of radiations
c) Both emission and absorption of radiations
d) None of above

28. According to Planck energy travels in a discontinuous manner and it is composed of large number of tiny discrete units called:

a) Photons b) Planta
c) Quanta d) Particles

29. The value of Planck's constant 'h' is:

a) 6.62×10^{-23} Joule second
b) 6.022×10^{-23} Joule second
c) 6.625×10^{-34} Joule second
d) 6.625×10^{-34} Joule

30. According to Planck, in case of light, the quantum of energy is often called:

a) Quantum b) Deutron
c) Photon d) Proton

31. Wavelength is the distance between two adjacent crests or troughs and expressed in:

a) A° b) A° or nm
c) Nm d) μm

32. Greater the wavelength associated with the photon:

a) Greater is its energy.
b) Smaller is its energy.
c) Its energy will be variable.
d) Its energy will remain constant.

33. Energy of a photon is related to:

a) Wave number b) Wavelength
c) Frequency d) All of above

34. Greater the wave number of photons:

a) Greater is the energy associated with them.
b) Smaller is the energy associated with them.
c) Its energy will be variable.
d) Its energy will remain constant.

BOHR'S MODEL OF ATOM

35. Splitting of spectral lines when atoms are subjected to strong electric field is called:

a) Photoelectric effect b) Stark's effect
c) Compton's effect d) Zeeman's effects

36. The velocity of photon is:

a) Dependent on its source.

b) Equal to square of its amplitude.
c) Dependent on its wavelength.
d) Independent of its wavelength.

37. **Bohr's model of atom explains spectrum of:**
a) H like species only
b) H atom only
c) H and H like species
d) None of above

38. **Transition from various energy levels to the lowest energy level gives:**
a) P-fund series b) Lyman series
c) Balmer series d) Paschen series

39. **P-fund, Bracket and Paschen series lie in:**
a) Infrared region b) Ultra violet region
c) Visible region d) Microwave region

40. **Balmer series lie in:**
a) Radio-wave region b) Visible region
c) Ultraviolet region d) Infrared region

41. **Lyman series lie in:**
a) Visible region b) Radio-wave region
c) Infrared region d) Ultraviolet region

42. **Which of the following series of lines in the atomic emission spectrum of hydrogen is in the visible region:**
a) Paschen b) Bracket series
c) Balmer series d) Lyman series

43. **The sunlight shows the type of a:**
a) Line absorption spectrum
b) Line emission spectrum
c) Continuous spectrum
d) Band spectrum

44. **When spectrum of hydrogen is taken in magnetic field some new lines are created called:**
a) Field effect b) Bohr effect
c) Zeeman effect d) Thomson effect

45. **The spectrum of radiation from which particular radiation has been absorbed after passing through absorbing substance is called:**
a) Line absorption spectrum
b) Band spectrum
c) Continuous spectrum
d) Line emission spectrum

46. **Angular momentum of hydrogen electron is:**
a) $\frac{2n}{2p}$ b) $\frac{nh}{2p}$
c) $\frac{nh}{p}$ d) $\frac{hc}{2p}$

X-RAYS AND ATOMIC NUMBER

47. **X-rays have same nature as:**
a) Cathode rays b) Gamma rays
c) Beta rays d) Alpha rays

48. **X-rays are attracted towards:**
a) Cathode b) Any Electrode
c) Anode d) None of electrode

49. **X-rays were discovered by:**
a) Bohr b) Roentgen
c) Schrodinger d) Rutherford

50. **In 1913, Mosley used the x-rays to determine:**
a) Relative atomic mass b) Avogadro's number
c) Atomic number d) Mass number

WAVE-PARTICLE NATURE OF MATTER

51. **All particles of matter have a dual character, wave and material particle, this was proposed by:**
a) de-Broglie b) Bohr
c) Schrodinger d) Rutherford

52. **Wave nature of moving electron was verified by:**
a) Davission and Rutherford
b) Germer and Planck
c) de-Broglie and Planck
d) Davission and Germer

53. **Davission and Germer proved that accelerated electrons undergo diffraction, like waves, when they fall on:**
a) Cobalt crystals b) Nickel crystals
c) Liquid crystals d) Ice crystals

HEISENBERG'S UNCERTAINTY PRINCIPLE

54. **Uncertainty principle was stated by:**
a) Petersberg b) Heisenberg
c) Johanesberg d) None of above

55. **It is impossible to specify, simultaneously and precisely, the momentum and position of electron. It is called:**
a) Hund's rule

b) Schrodinger atomic model
c) Planck's quantum theory
d) Heisenberg uncertainty principle

56. Quantum number values of 2p orbitals are:
a) $n = 1, \ell = 2$ b) $n = 2, \ell = 1$
c) $n = 2, \ell = 0$ d) $n = 1, \ell = 0$

57. When 6d orbital is complete, entering electron goes into:
a) 7d b) 7f
c) 7s d) 7p

58. Orbitals having same energy are called:
a) Degenerate orbitals b) d-orbitals
c) Hybrid orbitals d) Valence orbitals

59. The values of quantum number for 3p orbitals are:
a) $n = 3, \ell = 1$ b) $n = 2, \ell = 3$
c) $n = 2, \ell = 1$ d) $n = 0, \ell = 3$

60. Which of the following orbitals is not possible?
a) 1s b) 2d
c) 4s d) 3p

61. Total number of d-electrons in an atom of atomic number 26 is:
a) 7 b) 4
c) 6 d) 5

62. Spin quantum number was given by:
a) Sommerfeld b) Goudsmit and Yhlenbech
c) Bohr d) Goldsmith

63. Bohr's model of atom was contradicted by:
a) Heisenberg's uncertainty principle
b) Pauli's exclusion principle
c) Planck's quantum theory
d) All of above

64. Which of the following orbitals will be filled first?
a) 5d b) 4s
c) 4f d) 3d

65. An orbital can accommodate maximum of:
a) 18 electrons b) 12 electrons
c) 8 electrons d) 2 electrons

66. Spherically symmetrical orbital is:
a) s b) f
c) p d) d

67. A region in space, around the nucleus in an atom, where the probability of finding an electron is maximum is called:
a) An orbital b) An orbit
c) A shell d) A wave

68. As the quantum number n increases, the energy difference between adjacent energy level:
a) Decreases b) Increases
c) Remains fluctuating d) Remains same

69. Two electrons in the atom:
a) Occupy different sub shells of same shell
b) Occupy different sub shells of different shells
c) Occupy different shells
d) Have different spin quantum number

70. The shape of an orbital is determined by:
a) Magnetic quantum number
b) Azimuthal quantum number
c) Spin quantum number
d) Principle quantum number

71. If value of Azimuthal quantum number is '1' the atomic orbital is:
a) f b) s
c) p d) d

72. Which one of the following orbitals has high energy?
a) 4d b) 3s
c) 4s d) 2s

73. Which atomic orbital has lowest energy?
a) 7s b) 6p
c) 5d d) 4f

74. If uncertainty in position of electron is zero, the uncertainty in its momentum would be:
a) Also zero b) 50%
c) Less than zero d) Infinite

75. What is the value of $n + \ell$ (principle and Azimuthal quantum numbers) for 3rd orbital?
a) 6 b) 3
c) 4 d) 5

76. An orbital like s_1, p_x, p_y, p_z and d_{xy} can have at the most:
   a) Four electrons
   b) 1, 2, 3, 4 and 5 electrons respectively
   c) 2, 3, 4, 5 and 6 electrons respectively
   d) Two electrons

77. Maximum number of electrons that can be accommodated in a shell is given by:
   a) Avogadro's number b) $2n^2$ formula
   c) Empirical formula d) Molecular formula

78. The electronic configuration of H^- is:
   a) $1s^2 2s^1$ b) $1s^2$
   c) $1s^0$ d) $2s^2$

79. Which one of the following has the same number of electrons as an alpha particle?
   a) H^+ b) He
   c) Li^+ d) H

80. An atom has an electronic configuration $1s^2$, $2s^2$, $2p^3$. The number of unpaired electrons in this atom is:
   a) 5 b) 3
   c) 0 d) 1

81. According to Hund's rule the electronic configuration of carbon is:
   a) ↑↓ ↑↓ ↑↓ ↑ ↑
      1s 2s 2px 2py 2pz
   b) ↑↓ ↑↓ ↑ ↑
      1s 2s 2px 2py 2pz
   c) ↑↓ ↑↓ ↑↓
      1s 2s 2px 2py2pz
   d) ↑↓ ↑↓ ↑ ↑
      1s 2s 2px 2py 2pz

82. Pauli exclusion principle states that no two electrons in a given orbital have:
   a) Same four quantum number
   b) Same principle quantum number
   c) Same Azimuthal quantum number
   d) (b) and (c) are correct.

83. Hund's rule states that when electrons enter to the same sub-levels they are:
   a) Singly occupied with different spins.
   b) Doubly occupied with different spins.
   c) Singly occupied with same spins.
   d) Doubly occupied with same spins.

84. According to the Aufbau principle the electrons are added first to the orbital:
   a) In sub-levels of zero energy
   b) In sub-levels of highest energy
   c) In sub-levels of lowest energy
   d) of no shell

Answers

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

4. Chemical Bonding

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

Characterize electrovalent (ionic) bond as in sodium chloride and calcium oxide.

a) Use the 'dot-and-cross' diagrams to explain:
   i) Covalent bonding, as in hydrogen(H2); oxygen(O2); chlorine(Cl2); hydrogen chloride; carbon dioxide; methane and ethane.
   ii) Co-ordinate (dative covalent) bonding, as in the formation of the ammonium ion in $H3N^{+}$– $BF3$ and $H3O^{+}$.

b) Describe the shapes and bond angles in molecules by using the qualitative model of Valence Shell Electron-Pair Repulsion (VSEPR) theory up to 4 pairs of electron including bonded electron pair and lone pair around central atom.

c) Describe covalent bonding in terms of orbital overlap, giving ▯ and ▯ bonds.

d) Explain the shape of and bond angles in ethane, ethene and benzene molecules in terms of ▯ and ▯ bonds.

e) Describe hydrogen bonding, using ammonia and water as simple examples of molecules containing N-H and O-H groups.

f) Explain the terms bond energy, bond length and bond polarity (electronegativity difference) and use them to compare the nature of covalent bonds i.e. polar and non-polar.

g) Describe intermolecular forces (Van der Waal's forces), based on permanent and induced dipoles, as in HCl, CHCl3, Halogens and in liquid noble gases.

h) Describe metallic bonding in terms of positive ions surrounded by mobile electrons (sea of electrons).

i) Describe, interpret and/or predict the effect of different types of bonding (ionic bonding; covalent bonding; hydrogen bonding; Van der Waal's forces and metallic bonding) on the physical properties of substances.

j) Deduce the type of bonding present in a substance from the given information.

Definitions and Statements

1) Inherent Tendency of Atoms: Atoms combine together due to their inherent tendency to attain the nearest noble gas electronic configurations.

2) The formation of a chemical bond always results in a decrease of energy.

3) The size of an Atom: The size of an atom is expressed in terms of atomic radius, ionic radius and covalent radius, etc.

4) Ionization Energy: The minimum amount of energy required to remove an electron from an atom (in gaseous state) is called ionization energy. It depends upon the atomic size, nuclear charge and shielding effect of electrons.

5) Electron Affinity: The electron affinity of an atom is the energy given out when an electron is added to a gaseous atom.

6) Electronegativity: The tendency of an atom to attract a shared pair of electrons to itself is called electronegativity. Fluorine is the most electronegative atom and it has arbitrarily been given a value of 4.0.

7) Ionic, Covalent and Coordinate Bonds: Ionic bonds are formed by transfer of electron from one atom to another. Covalent bonds are formed by mutual sharing of electrons between combining atoms. After the formation of a coordinate bond, there is no distinction between a covalent bond and a coordinate bond.

8) Polar Covalent Bond: A polar covalent bond is formed when atoms having different electronegativity values mutually share their electrons. Due to polarity, bonds become shorter and stronger and dipole moment may develop.

9) Valence Bond Theory: According to valence bond theory, the atomic orbitals overlap to form bonds but the individual character of the atomic orbitals is retained. The greater the overlap, the stronger will be the bond formed.

10) Geometrical Shapes and Bond Angles: The geometrical shapes and bond angles are better explained by different hybridization schemes where different atomic orbitals are mixed to form hybrid orbitals.

11) VSEPR Theory: The VSEPR theory gives information about general shapes and bond angles of molecules. It is based upon repulsion between bonding and lone pairs of electrons which tend to remain at maximum distance apart so that interaction between them is minimum. The concept provides an alternate way to explain various geometrical shapes of molecules.

12) Molecular Orbital Theory: According to this theory, atomic orbitals overlap to form molecular orbitals. 'n' atomic orbitals combine to form 'n' molecular orbitals. Half of them are bonding molecular orbitals and half antibonding molecular orbitals. In this combination the individual atomic orbital character is lost in order to form an entirely new orbital that belongs to the whole molecule. The theory successfully explains bond order and paramagnetic property of O_2.

13) Bond Energy: The bond energy is defined as the average amount of energy required to break all bonds of a particular type in one mole of the substance. It is a measure of the strength of the bond. Stronger the dipole of a bond, greater will be the bond energy.

14) Bond Length: The distance between the nuclei of two atoms forming a covalent bond is called bond length. In general, it is the sum of the covalent radii of the combined atoms.

15) Dipole Moment: It is defined as the product of electric charge (q) and the distance (r) between the two oppositely charged centres. It is a vector quantity as it has magnitude and direction. It plays a major role in determining the %age ionic character of a covalent bond and the shapes of molecules.

16) Properties of Substances: Properties of substances are characterized by the type of bonds present in them.

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

(i) An Ionic compound A^+B^- is most likely to be formed when

(a) the ionization energy of A is high and electron affinity of B is low.
(b) the ionization energy of A is low and electron affinity of B is high.
(c) both the ionization energy of A and electron affinity of B are high.
(d) both the ionization energy of A and electron affinity of B are low.

(ii) The number of bonds in nitrogen molecule is

(a) one σ and one π
(b) one σ and two π
(c) three sigma only
(d) two σ and one π

(iii) Which of the following statements is not correct regarding bonding molecular orbitals?

(a) Bonding molecular orbitals possess less energy than atomic orbitals from which they are formed.
(b) Bonding molecular orbitals have low electron density between the two nuclei.
(c) Every electron in the bonding molecular orbitals contributes to the attraction between atoms.
(d) Bonding molecular orbitals are formed when the electron waves undergo constructive interference.

(iv) Which of the following molecules has zero dipole moment?

(a) NH_3 (b) $CHCl_3$
(c) H_2O (d) BF_3

(v) Which of the hydrogen halides has the highest percentage of ionic character?

(a) HCl (b) HBr
(c) HF (d) HI

(vi) Which of the following species has unpaired electrons in anti-bonding molecular orbitals?

(a) O_2^{+2} (b) N_2^{-2}
(c) B_2 (d) F_2

Answers

i	B	ii	b	iii	b	iv	d	v	a	v	b

Important MCQs

CAUSE OF CHEMICAL COMBINATION

1. The force which holds together two or more atoms or ions to form a large variety of compounds is called:

a) A chemical bond b) An ionic bond
c) A covalent bond d) A coordinate bond

2. The theory of chemical bonding has been a major problem of:

a) Modern Physics b) Modern Chemistry

c) Modern Biology d) Mechanics

3. Chemical reactivity of elements depends upon their characteristic:
a) Shape b) Colour
c) Electronic configurations d) Sizes

4. Which of the following elements is not stable:
a) Xe b) Ar
c) Kr d) Li

5. Elements combine together due to inherent tendency to stabilize themselves by:
a) Losing electron b) Sharing electrons
c) Gaining electrons d) All of above

6. Which of the following is a noble gas:
a) Ne b) Cl_2
c) H_2 d) N_2

7. The tendency of atoms to attain a maximum of eight electrons in the valence shell is known as:
a) Duplet rule b) Triad rule
c) Octet rule d) Tetrad rule

8. In the chemical combination of sodium and hydrogen to form NaH:
a) Hydrogen atom gains an electron
b) Sodium atom gains an electron
c) Both the atoms share the electron
d) None of above

9. In the chemical combination of hydrogen and fluorine to form HF:
a) Sodium atom donates major share of its electrons
b) Hydrogen atom donates the major share of its electrons.
c) Both the atoms share the electrons equally.
d) None of above

10. Which of the following compound is not formed according to octet rule:
a) KrF_2 b) XeF_2
c) XeO_3 d) SF_6

ENERGETICS OF BOND FORMATION

11. According to modern theory of chemical bonding, atoms form bonds as it leads to a:
a) Increase in energy b) No energy change
c) Decrease in energy d) First decrease then increase in energy

12. When two hydrogen atoms approach each other:
a) Forces of attraction operate
b) Forces of repulsion operate
c) Forces of attraction and repulsion operate simultaneously
d) Nothing happens

13. The bond length between atoms of hydrogen in the hydrogen molecules is:
a) 7.54 nm b) 0.0754 nm
c) 0.754 nm d) 0.00754 nm

ATOMIC SIZE

ATOMIC RADII, COVALENT RADII AND IONIC RADII

14. Which of the following has smaller size:
a) Fe^{+3} b) Fe^{+2}
c) Fe^{+1} d) Fe

15. In a group of periodic table, atomic radii:
a) Remains some
b) Increases
c) First decreases then increases
d) Decreases

16. In a period of periodic table, atomic radii:
a) Decreases b) Increases
c) Remains same d) First decreases then increases

17. Which statement is true for Na and Na^+:
a) Size of Na is smaller than Na^+
b) Size of Na is greater than Na^+
c) Both have same properties
d) Both have equal size

18. As the nuclear charge increases, the pull on the electrons is increased and size of an atom:
a) Decreases b) Remains same
c) Increases d) Is negligible

19. The radius of the ion while considering it to be spherical in shape is called:
a) Covalent radii b) Atomic radii
c) Ionic radii d) Both (a) and (c)

20. The decrease in radius is larger for:
a) Monovalent ions b) Trivalent ions
c) Divalent ions d) Atoms

21. The increase in size of the anion is due to:
a) Increase in electron-electron repulsion
b) Increase in valence shell electrons
c) Decrease in valence shell electrons
d) Both (a) and (b)

22. The covalent radius of Cl atom is:
a) 99.4 pm b) 176.7 pm
c) 38 pm d) 76 pm

IONIZATION ENERGY, ELECTRON AFFINITY AND ELECTRONEGATIVITY

23. CsF is an ionic compound because:
a) High I.P of Cs and high EA of F
b) High I.P of Cs and low EA of F
c) Low I.P of Cs and high EA of F
d) Low I.P of Cs and low EA of F

24. Molecular orbitals are filled with the available electrons according to:
a) Hund's rule
b) Pauli's exclusion principle
c) Aufbau principle
d) All of above

25. An ionic compound will dissolve in water only if:
a) Hydration energy is low and lattice energy is low.
b) Hydration energy is high and lattice energy is very high.
c) Hydration energy is high and lattice energy is low.
d) Hydration energy is low and lattice energy is high.

26. A chemical bond between two atoms having the difference of electronegativity 1.7 then which statement is correct:
a) Zero ionic character
b) Bond is 50% ionic and 50% covalent.
c) Bond is 100% ionic.
d) Bond is 50% covalent.

27. Which of the following compound has ionic bond in it:
a) NH_3
b) H_2O
c) HCl
d) NaF

28. Which of the following is most electronegative element:
a) Cl
b) N
c) O
d) F

29. The energy that is required to remove an electron from an atom is called:
a) Heat of vaporization
b) Ionization potential
c) Electronegativity
d) Electron affinity

30. The tendency of bonded atom in a molecule to attract shared pair of electrons is called:
a) Lattice energy
b) Ionization potential
c) Electronegativity
d) Electron affinity

31. Which of the following element has highest Ionization potential:
a) Rb
b) K
c) Li
d) Na

32. In what area of periodic table, would you expect the most electronegative element:
a) Lower left
b) Middle
c) Upper left
d) Upper right

33. In a group of periodic table, ionization energy:
a) Increases
b) Decreases
c) Remains same
d) First increases then decreases

TYPES OF BONDS

34. The strongest bond is:
a) C = C
b) C – C
c) C ≡ C
d) All are equally strong

35. Which of the following is not correct:
a) Triple bond has greater bond energy than double bond.
b) Polar bond is greater than non-polar bond.
c) Sigma bond is stronger than pi bond.
d) Single bond is shorter than double bond.

36. In which of the following pairs, do the elements form a compound by sharing electrons:
a) Potassium and bromine
b) Neon and oxygen
c) Lithium and iodine
d) Carbon and chlorine

37. Molecular orbital theory explains well:
a) Bond order of molecules
b) Stability of molecules
c) Paramagnetic nature of molecules
d) All of above

38. The expected geometrical shape of molecules which have sp^3 hybridization is:
a) Tetrahedral
b) Pyramidal
c) Trigonal plannar
d) Linear

39. Which of the following compounds have ionic, covalent and coordinate bond in it:
a) H_2O
b) KBr
c) NH_4Cl
d) NH_3

40. Which of the following species has highest bond order:
a) O_2^-
b) O_2
c) O_2^{-2}
d) O_2^+

41. In which molecule central atom is sp hybridized:
a) $BeCl_2$
b) BF_3

c) C_2H_4 d) None of above

42. Which of the following molecules have linear structure and sp-hybridization with angle of 180°:

a) $CH \equiv CH$ b) CH_4
c) $CH_2 = CH_2$ d) $CH_3 - CH_3$

43. Paramagnetic behaviour of O_2 is due to:

a) Two molecular orbitals are partially filled
b) Overlapping of only two partially filled orbitals
c) Greater strength of π bond than sigma bond
d) All molecular orbitals are completely filled

44. According to valence bond theory, O_2 and N_2 molecules:

a) O_2 is diamagnetic and N_2 is paramagnetic
b) Both are paramagnetic
c) Both are diamagnetic
d) O_2 is paramagnetic and N_2 is diamagnetic

45. According to VSEPR Theory:

a) Shape of molecules is not explained well
b) Lone pairs do not attract or repel to each other
c) Molecular orbitals have low energy than atomic orbitals
d) Electron pairs stay at maximum distance with minimum repulsion

46. Valence bond theory is unable to explain:

a) Double and triple bond
b) Stability of covalent molecules
c) Paramagnetism in O_2 molecule
d) Shape of H_2O molecule

47. Mostly ionic compounds are soluble in:

a) n-hexane b) Water
c) Alcohol d) Benzene

48. NaCl has ionic bond in it. From this information alone we can deduce that:

a) It is water soluble.
b) Its aqueous solution is conductor of electricity.
c) It has high melting and boiling points.
d) It is hard.

49. In which bond the electron density is maximum between nuclei of two bonded atoms?

a) Sigma b) Polar
c) P_i d) Covalent bond with parallel overlapping

50. Which of the following bonds explain the nature of HCl?

a) Ionic bond
b) Non-polar covalent bond
c) Polar covalent bond
d) Covalent bond

51. VSEPR Theory explains well:

a) Stability of bonds
b) Shape of molecules
c) Paramagnetic nature of oxygen
d) All of above

52. What type of bonding is present in NH_4Cl:

a) Coordinate covalent bond
b) Ionic Bond
c) Covalent bond
d) All of above

53. When sodium and chlorine interact energy is:

a) Released and covalent bond is formed.
b) Absorbed and ionic bond is formed.
c) Absorbed and covalent bond is formed.
d) Released and ionic bond is formed.

54. Hydrogen atoms are held together in hydrogen molecule by:

a) Electrostatic attraction b) Covalent bond
c) Hydrogen bonding d) Ionic bond

55. In formation of NH_4^+ from NH_3 and H^+, which species is donor:

a) NH_3 b) Both are donor
c) H^+ d) None of above

56. Three sp^2 hybrid orbitals lie in the same plane making with each other an angle of:

a) 90° b) 180°
c) 120° d) 109.5°

57. Which one of the following molecules has bond order two:

a) He b) O_2
c) N_2 d) H_2

58. Which of the following molecule has double covalent bond?

a) N_2 b) O_2
c) H_2 d) CH_4

59. Coordinate covalent bond is present in:

a) CH_4 b) NH_4^+
c) H_2O d) NH_3

60. In NH_3 molecule, the central atom N has:

a) Four bond pairs
b) One bond pair and three lone pairs
c) Three bond pairs and one lone pair

d) Two lone pairs and two bond pairs

61. **Which one of the following molecules has an angle of 104.5°:**
a) NH_3 b) H_2O
c) BF_3 d) $BeCl_2$

62. **Paramagnetism is exhibited by molecules:**
a) Carrying a positive charge
b) Containing unpaired electron
c) Containing only paired electrons
d) Not attracted into the magnetic field

63. **As compared to pure atomic orbitals the hybrid orbitals have:**
a) High energy b) Low energy
c) Same energy d) Variable energy

64. **Which of the following molecule has an angle of 120?**
a) NH_3 b) $BeCl_3$
c) BF_3 d) CH_4

65. **Repulsion is greater in:**
a) Lone pair-lone pair electrons
b) Bond pair-bond pair electrons
c) Bond pair-lone pair electrons
d) All have same repulsion.

66. **Which of the following molecules has an angle of 109.5°:**
a) NH_3 b) CH_4
c) BF_3 d) $BeCl_2$

67. **The shape of BF_3 molecule is:**
a) Trigonal planar b) Pyramidal
c) Linear d) Tetrahedral

68. **The carbon atom is C_2H_4 (ethylene) is hybridized:**
a) sp^2 b) sp
c) sp^3 d) Both sp and sp^2

69. **Pi-bond is found in structure of:**
a) O_2 b) CH_4
c) H_2O d) NH_3

70. **The shape of H_2O molecule is:**
a) Angular b) Pyramidal
c) Tetrahedral d) Linear

71. **A crystal of NaCl is held through:**
a) Attraction of oppositely charged ions
b) Covalent bond
c) Positive ions in a sea of electrons
d) Coordinate covalent bond

72. **Which of the following molecules is paramagnetic:**
a) He b) H_2
c) N_2 d) O_2

73. **The shape of $BeCl_2$ molecule is:**
a) Trigonal plannar b) Pyramidal
c) Tetrahedral d) Linear

74. **What is the number of unpaired electrons present in NH_3 molecules:**
a) 3 b) 2
c) 1 d) 0

75. **The nitrogen atom in ammonia is hybridized:**
a) sp^2 b) sp
c) sp^3 d) Both sp^2 and

76. **Which of the following compounds has an ionic bond:**
a) H_2O b) CsF
c) CCl_4 d) HCl

77. **In CH_4 carbon is hybridized:**
a) dsp^2 b) sp^3
c) sp^2 d) sp

78. **The bond in which overlapping of partially filled orbitals takes place above and below the bond axis is:**
a) Hydrogen bond b) Sigma bond
c) Pi bond d) Coordinate covalent bond

79. **Which of the following molecules is linear:**
a) H_2O b) CH_4
c) NH_3 d) CO_2

80. **Ionic compounds do not show the phenomenon:**
a) Non-directional and non-rigid
b) Non-directional and rigid
c) Directional and non-rigid
d) Directional and rigid

81. **Which of the following statements is incorrect about ionic compounds:**
a) They are gases at room temperature.
b) They have regular arrangement of ions.
c) They conduct electricity in molten state.
d) They have high melting point.

82. **Which of the following has greater ionic characters in it:**

a) H_2 b) H_2O
c) HCl d) HF

83. The geometrical shape of CH_4 is:
a) Pyramidal b) Triangular
c) Tetrahedral d) Cubic

84. Which of the following is a polar molecule:
a) CO_2 b) BF_3
c) HCl d) CCl_4

85. Some covalent compounds are soluble in water because of:
a) Hydrolysis b) Hydrogen bonding
c) Hydration d) All of above

86. Which of the following shape is exhibited by NH_3 molecule:
a) Square plannar b) Angular
c) Pyramidal d) Tetrahedral

87. Which of the following solids does not contain covalent bond:
a) Graphite b) Diamond
c) Ice d) Copper

88. Which of the following hydrogen halides has the highest percentage of ionic character:
a) HI b) HCl
c) HBr d) HF

BOND ENERGY, BOND LENGTH AND DIPOLE MOMENT

89. Which of the following molecules has zero dipole moment:
a) BF_3 b) H_2O
c) $CHCl_3$ d) NH_3

90. Which of the following molecules will have dipole moment:
a) NF_3 b) CF_4
c) BF_3 d) None of above

91. Which of the following molecules has zero dipole moment:
a) HF b) H_2S
c) H_2O d) CO_2

92. One Debye is equal to:
a) 3.336×10^{-30} cm
b) 9.1×10^{-31} cm
c) 1.66×10^{-24} cm
d) 6.06×10^{-23} cm

93. The triatomic molecule with zero dipole moment has shape:
a) Trigonal plannar b) Tetrahedral
c) Linear d) Angular

94. Dipole moment is defined as:
a) Charge × Displacement
b) Bond energy × Charge
c) Charge × Distance
d) Charge × Debye

95. The dipole moment of water is:
a) 1.84 D b) 1.94 D
c) 1.08 D d) 8.0 D

96. The amount of energy required to break one mole of a bond to separate atoms is called:
a) Ionization potential b) Bond energy
c) Electron affinity d) Electronegativity

97. The unit of dipole moment is:
a) Calorie b) Debye
c) Nm^{-1} d) Poise

98. Measure of the degree of polarity is known as:
a) Dipole moment
b) Ionic character of ionic bond
c) Ionization energy
d) Electron affinity

99. Which one of the following molecules has zero dipole moment:
a) CCl_4 b) $CHCl_3$
c) CH_2Cl_2 d) CH_3Cl

100. Benzene has zero dipole moment as it is:
a) Non-symmetrical plannar hexagonal molecule
b) Symmetrical plannar hexagonal molecule
c) Symmetrical Angular hexagonal molecule
d) Non-symmetrical angular hexagonal molecule

101. The dipole moment of orthochlorobenzene is:
a) 1.70 D b) 2.70 D
c) 2.5 D d) 1.5 D

THE EFFECT OF BONDING ON THE PROPERTIES OF COMPOUNDS

102. Mostly ionic compounds are:
a) Soluble in water but insoluble in non-aqueous

solvents.

b) Insoluble in water but soluble in non-aqueous solvents.

c) Soluble both in water and in non-aqueous solvents.

d) Insoluble in both water and in non-aqueous solvents.

103. **Which of the following is incorrect about ionic bonds:**

a) Electrostatic lines of forces between oppositely charged ions exist.

b) Bonds are non-rigid.

c) Bonds are non-directional.

d) Bonds are directional.

Answers

1.	a	2.	b	3.	c	4.	d
5.	d	6.	a	7.	c	8.	a
9.	b	10.	d	11.	c	12.	c
13.	b	14.	a	15.	b	16.	a
17.	b	18.	a	19.	c	20.	b
21.	d	22.	a	23.	c	24.	d
25.	c	26.	b	27.	d	28.	d
29.	b	30.	c	31.	c	32.	d
33.	b	34.	c	35.	d	36.	d
37.	d	38.	a	39.	c	40.	d
41.	a	42.	a	43.	a	44.	d
45.	d	46.	c	47.	b	48.	b
49.	a	50.	c	51.	b	52.	d
53.	d	54.	b	55.	a	56.	c
57.	b	58.	b	59.	b	60.	c
61.	b	62.	b	63.	b	64.	c
65.	a	66.	b	67.	a	68.	a
69.	a	70.	a	71.	a	72.	d
73.	d	74.	d	75.	c	76.	b
77.	d	78.	c	79.	d	80.	b
81.	a	82.	d	83.	c	84.	c
85.	b	86.	c	87.	d	88.	d
89.	a	90.	a	91.	d	92.	a
93.	a	94.	c	95.	a	96.	b
97.	b	98.	a	99.	a	100.	b
101.	c	102.	a	103.			

5. Chemical Energetics

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Understand concept of energy changes during chemical reactions with examples of exothermic and endothermic reactions.

b) Explain and use the terms:
   i) Enthalpy change of reaction and standard conditions, with particular reference to: formation; combustion; solution; neutralization and atomization.
   ii) Bond energy (ΔH positive, i.e. bond breaking).
   iii) Lattice energy (ΔH negative, i.e. gaseous ions to solid lattice).

c) Find heat of reactions/neutralization from experimental results using mathematical relationship i.e. $\Delta H = mc\Delta T$

d) Explain, in qualitative terms, the effect of ionic charge and of ionic radius on the numerical magnitude of lattice energy.

e) Apply Hess's Law to construct simple energy cycles, and carry out calculations involving such cycles and relevant energy terms, with particular reference to:
   i) Determining enthalpy changes that cannot be found by direct experiment, e.g. an enthalpy change of formation from enthalpy change of combustion.
   ii) Born-Haber cycle of NaCl (including ionization energy and electron affinity).

Important MCQs

1. Thermochemistry is the study of relationship between heat, energy and:
   a) Kinetic energy b) Chemical energy
   c) Energy of activation d) Ionization energy

2. What do you call the apparatus generally used for measuring heat changes?
   a) Voltmeter b) Calorimeter
   c) Voltameter d) Coulometer

3. What is the value of internal of an element of 25°C at atmospheric pressure?
   a) 0 cal/mole b) 10 cal/mole
   c) 50 cal/mole d) 273 cal/mole

4. A process is said to be ___ if the temperature remains constant throughout.
   a) Adiabetic b) Isothermal
   c) Endothermic d) Exothermic

5. A reaction in which heat transfer between the reaction vessel and large quantity of water can take place, will be exothermic if:
   a) Heat is transferred from water to the contents of reaction vessel b) Heat contents of reactants are more than the heat contents of products
   c) Products have more heat than reactants d) None of the above

6. Which is an example of endothermic change?
   a) $6CO_2(g)+6H_2O(l) \rightarrow C_6H_{12}O_6(g)+CO_2(g)$
   b) $H_2O(g) \rightarrow H_2O(l) + \Delta H$
   c) $C_3+O_g \rightarrow CO_2(g) + \Delta H$
   d) None of the above

7. Evaporation of water is a:
   a) An endothermic change b) An exothermic change
   c) No heat change occurs d) Chemical energy is produced

8. In exothermic reactions, ΔH is:
   a) Negative b) Positive
   c) More than products d) Given in surroundings

9. The SI unit of heat + energy is:
   a) Joule b) BTU
   c) Calorie d) None of the above

10. A joule is equal to:
    a) $1kg^2/S^2$ b) $1Kg/S^2$
    c) $1Kgm^2/S^2$ d) None of the above

11. There are how many joules in 1 kilocalorie?
    a) 4.184×10^3J b) 8.184×10^3J
    c) 12.184×10^3J d) 16.184×10^3J

12. There are how many joules in 1 KWh:
    a) 3.6×10^3J b) 6.6×10^3J
    c) 9.6×10^3J d) 12.6×10^3J

13. A substance or a mixture undergoing a physical change is called:
    a) System b) Surrounding
    c) Compound d) None of the above

14. Any property which depends upon the state of system is called:
    a) Enthalpy b) State function
    c) Free energy d) Internal energy

15. What is not a state function?
    a) Temperature b) Enthalpy
    c) Entropy d) Internal energy

16. A complete of gas changes from P_1 and V_1 & T_1 to P_2V_2 & T_2 by one path and then back to P_1V_1 and T_1. ΔE for the process is:
    a) Infinite b) > 0
    c) < 0 d) = 0

17. Since the enthalpy of elements in their natural state is taken as zero, the heat of formation of Hf is:
    a) Always negative b) Positive
    c) Depending on conditions d) Is zero

18. Which is most stable form of C at 25°C?
    a) Diamond b) Graphite
    c) Coal d) None of the above

19. All the naturally processes proceed with the:
    a) Increase of energy b) Decrease of energy
    c) None of the above d) All of the above

20. A state function represents:

a) Physical state b) Chemical state
c) Thermodynamic state d) None of the above

21. The heat contents of a system is called:
a) Internal energy b) Enthalpy
c) Combustion energy d) Heat energy

22. According to Hess' Law:
a) $Kp=Kc(RT)^a$ b) ΔH= Positive
c) ΔH is same whither process takes place in one step or more than one step d) None of the above

23. Hess' Law deals with:
a) Changes in heat of reaction b) Rate of reaction
c) Equilibrium constant d) Influence of pressure on volume of gas

24. The energy which is sum of all the energies of all the atoms, molecules, or ions with in a system is called:
a) Internal energy b) Bond energy
c) Potential energy d) Chemical energy

25. The heat content of all elements in their standard states is taken as:
a) 0 b) Maximum
c) Minimum d) Unity

26. The enthalpy change does not depend upon:
a) Conditions under which reaction is carried out b) Number of intermediate steps involved
c) State of reaction and products d) Initial and final energies and enthalpies of reaction and products

27. Entropy of universe tends towards:
a) Maximum b) Minimum
c) Zero d) Remains constant

28. Which of the following is not accompanied by an increase of entropy:
a) Dissolution of NH_4Cl in water b) Burning of rocket fuel
c) Solution of dry ice d) Condensing steam

29. When solid is converted to liquid, entropy is:
a) Increased b) Decreased
c) Zero d) Remains constant

30. Entropy is a measure of _____ system.
a) Disorder b) Internal energy
c) Input d) Efficiency

31. A spontaneous change is one in which a system suffers:
a) Increase in internal energy b) Lowering in free energy
c) Lowering of entropy d) No energy change

Answers

1.	B	2.	B	3.	A	4.	B
5.	B	6.	C	7.	A	8.	B
9.	A	10.	C	11.	A	12.	A
13.	A	14.	B	15.	A	16.	B
17.	A	18.	B	19.	B	20.	C
21.	A	22.	C	23.	A	24.	A
25.	A	26.	B	27.	D	28.	
29.	A	30.	A	31.	B		

6. Electrochemistry

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Describe and explain redox processes in terms of electron transfer and/or of changes in oxidation number.

b) Define the terms:
Standard electrode (redox) potential and
Standard cell potential.

c) Describe the standard hydrogen electrode as reference electrode.

d) Describe methods used to measure the standard electrode potentials of metals or non-metals in contact with their ions in aqueous solution.

e) Calculate a standard cell potential by combining two standard electrode potentials.

f) Use standard cell potentials to:
i) Explain/deduce the direction of electron flow in the external circuit.
ii) Predict the feasibility of a reaction.

g) Construct redox equations using the relevant half-equations.

h) State the possible advantages of developing the H2/O2 fuel cell.

i) Predict and to identify the substance liberated during electrolysis from the state of electrolyte (molten or aqueous), position in the redox series (electrode potential) and concentration e.g. H2SO4(aq) and Na2SO4(aq).

Definitions and Statements

1) Electrolytic Conduction: Electrolytic conduction is carried out by the ions produced when an ionic compound is infused or dissolved in water.

2) Electrolysis: It is the process in which a chemical reaction takes place at the expense of electrical energy.

3) Uses of Electrolysis: Electrolysis is used for the extraction of elements and for the commercial preparation of several compounds. It is also used for electroplating.

4) Galvanic Cell: A galvanic cell or a voltaic cell produces electrical energy at the expense of chemical energy.

5) Electrode Potential: Electrode potential is developed when a metal is dipped into a solution of its own ions.

6) Standard Hydrogen Electrode Potential: Standard hydrogen electrode potential is arbitrarily fixed as 0.00 volts. Electrode potential of an element is measured when it is coupled with standard hydrogen electrode.

7) Electrochemical Series: When elements are arranged in order of their standard electrode potentials on the hydrogen scale, the resulting list is known as electrochemical series. This series is used to predict the feasibility of a redox chemical reaction.

8) Modern Batteries and Fuel Cells: Modern batteries and fuel cells include lead accumulator, alkaline battery, silver oxide battery, nickel cadmium cell and hydrogen oxygen fuel cell.

9) Redox Chemical Equations Balancing: Redox chemical equations can be balanced using oxidation number method and ion electron method.

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

(1) The cathodic reaction in the electrolysis of dil. H_2SO_4 with Pt electrodes is:
(a) Reduction
(b) Oxidation
(c) Both oxidation and reduction
(d) Neither oxidation or reduction

(2) Which of the following statements is correct about galvanic cell?
(a) Anode is negatively charged
(b) Reduction occurs at anode

(d) Reduction occurs at cathode

(3) Stronger the oxidizing agent, greater is the:
(a) oxidation potential
(b) reduction potential
(c) redox potential
(d) E.M.F. of cell

(4) If the salt bridge is not used between two half cells, then the voltage:
(a) Decrease rapidly
(b) Decrease slowly
(c) Does not change
(d) Drops to zero

(5) If a strip of Cu metal is placed in a solution of $FeSO_4$:
(a) Cu will be precipitated out
(b) Fe is precipitated out
(c) Cu and Fe both dissolve
(d) No reaction take place

Answers

No	Ans	No	Ans	No	Ans	No	Ans	No	Ans
i	a	ii	d	iii	b	iv	d	v	b

Important MCQs

INTRODUCTION

1. Electrochemistry is concerned with the conversion of electrical energy into chemical energy in:
a) Galvanic cell b) Electrolytic cell
c) Voltaic cell d) Both (a) and (c)

2. The conversion of chemical energy into electrical energy requires:
a) Electrolytic cell b) Galvanic cell
c) Voltaic cell d) Both (b) and (c)

ELECTROLYTIC CONDUCTION

3. Most metals are conductors of electricity because of the:
a) Light weight
b) Immobility of the electrons
c) Lustrous surfaces
d) Relatively free movement of their electrons

4. Metallic conduction is also called as:
a) Ionic conduction b) Protonic conduction
c) Electronic conduction d) Super conduction

5. Electrolytes in the form of solution or in the fused state have the ability to conduct:
a) Light b) Electricity
c) Ions d) Electrons

6. Ionization is the process in which ionic compounds when fused or dissolved in water split up into charged particles called:
a) Atoms b) Electrons
c) Protons d) Ions

ELECTROCHEMICAL CELLS AND ELECTROLYSIS

7. Electrolysis is used for:
a) Manufacture of caustic soda
b) Refining of copper
c) Electroplating
d) All of above

8. In an electrolytic cell, the electrons flow from:
a) Cathode to anode or opposite
b) Cathode to anode
c) Anode to cathode
d) Radom flow

9. When aqueous NaCl is electrolyzed, which of the following ions get discharged at anode:
a) H^+ b) Na^+
c) OH^- d) Cl^-

10. In electrolytic cells, the chemical changes may be:
a) Either spontaneous or non-spontaneous
b) Always spontaneous
c) Always non-spontaneous
d) More spontaneous and less non-spontaneous

11. Which of the following cannot conduct electricity:
a) NaCl fused b) $NaCl_{(aq)}$
c) $NaCl_{(solid)}$ d) Both (b) and (c)

12. During electrolysis, the reaction that takes place at cathode is:
a) Reduction b) Both (a) and (c)
c) Oxidation d) No reaction occurs

13. During electrolysis, electrons are:
a) Lost by anions and gained by cations
b) Gained by anions and lost by cations
c) Gained only
d) Lost only

14. The function of salt bridge is:
a) To increase movement of ions
b) To increase the emf of cell
c) To decrease the temperature
d) To maintain electrical neutrality.

15. **Which of the following yield both hydrogen and chlorine on electrolysis:**
a) Electrolysis of acidified water
b) Electrolysis of molten NaCl
c) Electrolysis of aqueous NaCl
d) Electrolysis of saline water

16. **Which of the following correctly describes the process occurring at the electrodes when molten NaCl is electrolyzed:**
a) No reaction at anode, reduction at cathode.
b) No reaction at cathode, oxidation at anode.
c) Oxidation at anode, reduction at cathode.
d) Oxidation at cathode, reduction at anode.

17. **What are the products of electrolysis of aqueous sodium chloride at two electrodes:**
a) Chlorine at anode and oxygen at cathode.
b) Hydrogen at anode and chlorine at cathode.
c) Chlorine at anode and hydrogen at cathode.
d) Chlorine at anode and sodium at cathode.

18. **Sodium can be obtained by:**
a) Electrolysis of acidified water.
b) By heating NaCl and water at 100°.
c) Electrolysis of molten sodium chloride.
d) Electrolysis of aqueous sodium chloride.

19. **A cell in which electric current is produced as a result of spontaneous redox reaction is called:**
a) Dry cell b) Electrolytic cell
c) Galvanic cell d) Half cell reaction

20. **A cell which produces electrical current by an oxidation reduction reaction is known as:**
a) Electrolytic cell b) Voltaic cell
c) Reversible cell d) Standard cell

21. **The cell in which a non-spontaneous redox reaction takes place as a result of electricity is known as:**
a) Electrolytic cell b) Voltaic cell
c) Daniel cell d) Dry cell

22. **When fused $PbBr_2$ is electrolyzed:**
a) Lead appears at anode
b) Lead appears at cathode
c) Bromine appears at cathode
d) Lead appears at both electrodes

23. **When aluminium electrode is coupled with copper electrode in a galvanic cell:**
a) Reduction takes place at aluminium electrode.
b) Oxidation takes place at copper electrode.
c) Reduction takes place at copper electrode.
d) Both (a) and (b)

24. **K, Ca and Li metals may be arranged in decreasing order of their reduction potential as:**
a) Li, K, Ca b) Ca, K, Li
c) Li, Ca, K d) K, Ca, Li

25. **The best electrode used in salt bridge is KCl. Which other electrolyte can also be used for the purpose:**
a) NaCl b) NH_4NO_3
c) KNO_3 d) $NaNO_3$

26. **Cell potential depends upon:**
a) Concentration of ions b) Nature of electrolyte
c) Temperature d) All of above

27. **Reduction or oxidation potential of standard hydrogen electrode is:**
a) 0.0 volt b) 1.0 volt
c) 0.8 volt d) 1.8 volt

28. **A half reaction can be defined as:**
a) It always occurs at cathode.
b) Involves only half of a mole of electrolyte.
c) Occurs at one of the electrode.
d) Goes only half way to completion.

29. **Which of the following statement is incorrect about SHE (standard hydrogen electrode):**
a) Reduction potential of Cu^{+2} is smaller than H^+ ions when it is coupled with copper electrode.
b) H_2 gas is passed in it at 1 atm pressure.
c) Its oxidation potential and reduction potential is zero.
d) It is made of a platinum wire dipped in HCl solution.

30. **The difference of potential of two electrodes when concentration of solution is 1M each at 25°C and 1 atm is called:**
a) Cell reaction b) Electrode potential
c) Cell voltage d) Standard cell potential

31. **Standard hydrogen electrode has an arbitrarily fixed potential:**
a) 1.0 volt b) 0.34 volt
c) 0.0 volt d) 0.84 volt

32. **The overall positive value for the reaction potential predicts that process is energetically:**
a) Impossible b) Not feasible
c) Feasible d) Both (a) and (b)

THE ELECTROCHEMICAL SERIES

33. Value of standard reduction potential for strong reducing agents is:
a) Large negative value
b) Zero
c) Large positive value
d) Negligibly small

34. The standard reduction potential of Zn is 0.76V. The standard oxidation potential of Zn will be:
a) > 0.76
b) 0.76
c) + 0.76
d) < 0.76

35. The standard reduction potential of silver is about 0.8V. This value gives information that:
a) Ag^+ has tendency to be oxidized
b) Ag has tendency to be oxidized to Ag^+ ion
c) Ag^+ ions have tendency to be converted to Ag metal atom
d) Both (b) and (c)

36. A reaction will be spontaneous if its calculated emf is:
a) Positive or negative
b) Negative
c) Zero
d) Positive

37. emf of the cell is:
a) Sum or difference of two electrode potentials.
b) Sum of two electrode potentials.
c) Difference of two electrode potentials.
d) Always zero.

MODERN BATTERIES AND FUEL CELLS

38. A single cell voltage in lead storage battery is:
a) 2.5 volt
b) 1.3 volt
c) 2.0 volt
d) 2.3 volt

39. In Daniel cell, if salt bridge is removed between two half cells, the voltage:
a) Increases rapidly
b) Increases gradually
c) Does not change
d) Drops to zero

40. Fuel cells are mostly used in space aircrafts as the source of:
a) Fuel and drinking water
b) Drinking water only
c) Power only
d) Drinking water and power

41. The most common fuel used in fuel cells are:
a) O_2 and C_2H_6
b) H_2 and CH_4
c) CH_4 and O_2
d) H_2 and O_2

42. In recharging of the lead storage battery:
a) Pb is converted to PbO_2.
b) $PbSO_4$ is converted to Pb.
c) Pb is converted to $PbSO_4$.
d) Both (a) and (b)

43. Which statement is incorrect for fuel cells?
a) H_2 and O_2 are used as fuels.
b) Aqueous KOH is used as electrolyte in fuel cell.
c) Water is produced in the cells.
d) They operate at very low temperature.

44. Lead storage battery is recharged by:
a) Adding concentrated H_2SO_4
b) Adding more water
c) Passing more current
d) Reversing the direction of current

45. Which one of the following is a correct statement about battery and cell:
a) A cell has more than one batteries.
b) Battery is another name for cell.
c) A battery is chargeable whereas cell is not.
d) A battery has more than one cells.

46. In lead accumulator (storage battery) cathode is made of:
a) Mixture of Pb and PbO_2
b) Pb
c) Pb coated with PbO_2
d) $PbSO_4$

47. Fuel cells are the means by which chemical energy may be converted into:
a) Sound energy
b) Potential energy
c) Electric energy
d) Heat energy

Answers

1.	b	2.	d	3.	d	4.	c
5.	b	6.	d	7.	d	8.	c
9.	d	10.	c	11.	c	12.	a
13.	a	14.	d	15.	c	16.	c
17.	c	18.	c	19.	c	20.	b
21.	a	22.	b	23.	c	24.	d
25.	b	26.	d	27.	a	28.	c
29.	a	30.	d	31.	c	32.	c
33.	a	34.	c	35.	c	36.	d
37.	b	38.	c	39.	d	40.	d
41.	d	42.	b	43.	d	44.	d
45.	d	46.	c	47.	c		

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7. Chemical Equilibrium

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Explain, in terms of rates of the forward and reverse reactions, what is meant by a reversible reaction and dynamic equilibrium.
b) State Le Chatelier's Principle and apply it to deduce qualitatively the effects of changes in temperature, concentration or pressure, on a system at equilibrium.
c) Deduce whether changes in concentration, pressure or temperature or the presence of a catalyst affect the value of the equilibrium constant for a reaction.
d) Deduce expressions for equilibrium constants in terms of concentrations; Kc, and partial pressures; Kp
e) Calculate the values of equilibrium constants in terms of concentrations or partial pressures from appropriate data.
f) Calculate the quantities present at equilibrium, given appropriate data.
g) Describe and explain the conditions used in the Haber process
h) Understand and use the Bronsted-Lowry theory of acids and bases.
i) Explain qualitatively the differences in behaviour between strong and weak acids and bases and the pH values of their aqueous solutions in terms of the extent of dissociation.
j) Explain the terms pH; Ka; pKa; Kw and use them in calculations.
k) Calculate $[H^+(aq)]$ and pH values for strong and weak acids and strong bases.
l) Explain how buffer solutions control pH.
m) Calculate the pH of buffer solutions from the given appropriate data.
n) Show understanding of, and use, the concept of solubility product, Ksp.
o) Calculate Ksp from concentrations and vice versa.
p) Show understanding of the common ion effect.

Definitions and Statements

1) Chemical Equilibrium Concentrations and Equilibrium Mixture: The reversible chemical reactions can achieve a state in which the forward and the reverse processes are occurring at the same rate. This state is called state of chemical equilibrium. The concentrations of reactants and products are called equilibrium concentrations and the mixture is called equilibrium mixture.

2) Law of Mass Action: Law of mass action provides the relationship between concentrations of reactants and products of a system at equilibrium stage.

3) Equilibrium constant: The ratio of concentration of the products to the concentrations of reactants is called equilibrium constant. The equilibrium constants are expressed as K_c, K_p, K_n and K_x.

4) Value of Equilibrium Constant: The value of equilibrium constant can predict the direction and extent of a chemical reaction.

5) Le-Chatelier's Principle: The effect of change of concentration, temperature, pressure or catalyst in a reaction can be studied with the help of Le-Chatelier's principle. Increasing concentrations of reactants or decreasing concentrations of products or heating of the endothermic reactions shifts the reaction to the forward direction. The change of temperature disturbs the equilibrium position and the equilibrium constant of reaction.

6) Catalyst: A catalyst decreases the time to reach the equilibrium and does not alter the equilibrium position and equilibrium constant under the given conditions.

7) Water-A Very Weak Electrolyte: Water is a very weak electrolyte and ionizes to a slight degree. The extent of this auto-ionization is expressed by ionic product of water called K_w having a value 10^{014} at 25°C. The addition of an acid or a base changes the $[H^+]$ and $[OH^-]$, but the ionic product remains the same at 25°C.

8) pH and pOH: The concentration of H^+ is expressed in terms of pH and that of $[OH^-]$ in terms of pOH. Neutral water has a pH = 7. The value of pK_w is 14 at 25°C.

9) Lowry-Bronsted Concept: According to this concept of an acid and a base the conjugate base of a strong acid is always weak. So $pK_a + pK_b = pK_w$.

Where pK_a and pK_b are the parameters to measure the strengths of acids and bases.

10) Buffer Solutions: Those solutions which resist the change in pH are called buffer solutions. Buffer solutions of pH below 7 are prepared by mixing a weak acid and salt of it with a strong base while basic buffers can be prepared by combining a weak base and salt of it with a strong acid.

11) Henderson's Equation: Henderson's equation guides us quantitatively to have the buffer solutions of good buffer capacity and to select the pair of compounds for this purpose.

12) Solubility Product Data: The solubility of sparingly soluble substances are calculated from the solubility product data. This data provides us the information about the selective precipitation and fractional precipitation.

13) Common Ion Effect:

Common ion effect operates best in buffers solutions, and purification of certain substances. It is one of the best applications of Le-Chatelier's principle.

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

(1) For which system does the equilibrium constant, K_c has units of (concentration)$^{-1}$?

(c) $N_2 + 3H_2 \rightleftharpoons 2NH_3$

(d) $H_2 + I_2 \rightleftharpoons 2HI$

(e) $2NO_2 \rightleftharpoons N_2O_4$

(f) $2HF \rightleftharpoons H_2 + F_2$

(2) Which statement about the following equilibrium is correct?

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ $\Delta H = -188.3$ kJ mol^{-1}

(e) The value of K_p falls with a rise in temperature

(f) The value of K_p falls with increasing pressure

(g) Adding V_2O_5 catalyst increase the equilibrium yield of sulphur trioxide

(h) The value of K_p is equal to K_c

(3) The pH of 10^{-3} mol dm^{-3} of an aqueous solution of H_2SO_4 is:

(a) 3.0 (b) 2.7

(c) 2.0 (d) 1.5

(4) The solubility product of AgCl is 2.0×10^{-10} mol^2 dm^{-6}. The maximum concentration of Ag^+ ions in the solution is:

(c) 2.0×10^{-10} mol dm^{-3}

(d) 1.41×10^{-5} mol dm^{-3}

(e) 1.0×10^{-10} mol dm^{-3}

(f) 4.0×10^{-20} mol dm^{-3}

(5) An excess of aqueous silver nitrate is added to aqueous barium chloride and precipitate is removed by filtration. What are the main ions in filtrate?

(c) Ag^+ and NO_3^- only

(d) Ag^+ and Ba^{2+} and NO_3^-

(e) Ba^{2+} and NO_3^- only

(f) Ba^{2+} and NO_3^- and Cl^-

Answers

i	c	Ii	a	iii	b	iv	b	v	b

Important MCQs

REVERSIBLE REACTION

1. A reaction is reversible because:

a) Products are stable.

b) Reactants are reactive.

c) Products are reactive.

d) Reactants are stable.

2. What happens when a reaction is at equilibrium and more reactant is added:

a) Forward reaction rate is increased.

b) Forward reaction rate is decreased.

c) Backward reaction rate is increased.

d) Equilibrium remains unchanged.

3. The rate of a chemical reaction is directly proportional to product of molar concentration of reacting substance. It is called:

a) Law of conservation of energy

b) Law of mass action

c) Rate law

d) Active mass rule

4. A chemical reaction A $\longrightarrow$ B is said to be in equilibrium when:

a) Rate of transformation of A to B is equal to B to A.

b) 50% reactant has been changed to B.

c) Conversion of A to B is 50% complete.

d) Complete conversion of A to B has taken

place.

5. The rat of reaction:
   a) Remains same as reaction proceeds
   b) May decrease or increase as reaction proceeds
   c) Increases as reaction proceeds
   d) Decreases as reaction proceeds

6. Law of mass action was given by:
   a) Guldberg and Waage
   b) Berkeley and Hartly
   c) Ramsay and Reyleigh
   d) Berthelot

7. In a chemical reaction equilibrium is said to have been established when:
   a) Rate of opposing reactions are equal.
   b) Rate constants of opposing reactions are equal.
   c) Opposing reactions stop.
   d) Concentration of reactants and products are equal.

8. $H_2 + I_2 \rightleftharpoons 2HI$

   In the above equilibrium system, if the concentration of reactants at 25°C is increased, the value of K_c will:
   a) Remains constant b) Increases
   c) Decreases
   d) Depends upon nature of reactants

9. $N_2 + 3H_2 \rightleftharpoons 2NH_3$

   For the above reaction the relationship between K_C and K_P will be:
   a) $K_P = K_CRT$ b) $K_P = K_C(RT)^{01}$
   c) $K_P = K_C(RT)^{02}$ d) $K_C = K_P$

0. The correct relation between K_C and K_P is:

   a) $K_P = K_C\left[\frac{P}{N}\right]^{\Delta n}$ b) $K_C = K_P(RT)^{0n}$

   c) $K_P = K_C(RT)^{0n}$ d) $K_P = K_C(RT)^{0n}$

1. $N_2O_4 \rightleftharpoons 2NO_2$

   1 mol of N_2O_4 was decomposed according to given equation in $1dm^3$ container. At equilibrium x mole of N_2O_4 have dissociated. What is the value of K_C:

   a) $\frac{2x}{(1-x)^2}$ b) $\frac{4x^2}{(1-x)}$

   c) $\frac{4x}{(1-x)}$ d) $\frac{2x}{(1-x)}$

2. $N_2 + O_2 \rightleftharpoons 2NO$

   The unit of K_C for this reaction will be:
   a) No unit b) $mol^{02}\ dm^{03}$
   c) $mol^{01}\ dm^{03}$ d) $mol^{02}\ dm^{-3}$

13. $N_2 + 3H_2 \rightleftharpoons 2NH_3$

    The unit of K_C for this reaction will be:
    a) $mol^2\ dm^{06}$ b) $mol^{02}\ dm^{06}$
    c) $mol\ dm^{03}$ d) $mol^{01}\ dm^{-3}$

14. For what value of K_C almost forward reaction is complete:
    a) $K_C = 10^{30}$ b) $K_C = 10^{030}$
    c) $K_C = 0$ d) $K_C = 1$

15. In a particular reaction for the value $K_C = 1 \times 10^{025}$ which statement is correct:
    a) Almost forward reaction is complete.
    b) Amount of reactant is negligible as compared to product.
    c) Amount of product is negligible as compared to reactant.
    d) Amount of product is equal to amount of reactant.

16. Almost forward reaction is complete when value of K_C is:
    a) Neither larger nor very small
    b) Very small
    c) Very large
    d) Negligible

17. If K_C of a reaction is very large, it indicates that equilibrium occurs:
    a) With the help of a catalyst.
    b) With no forward reaction.
    c) At a low product concentration.
    d) At a high product concentration.

18. $N_2O_4 \rightleftharpoons 2NO_2$

    For the above reaction, which of the following expression of K_C is correct:

    a) $K_C = \frac{[N_2O_4]}{[NO_2]^2}$ b) $K_C = \frac{[N_2O_4]}{[NO_2]}$

    c) $K_C = \frac{[N_2O]^2}{[N_2O_4]}$ d) $K_C = \frac{[N_2][O_4]}{[NO_2]}$

19. In an exothermic reversible reaction increase in temperature shift the equilibrium to:
    a) Remains unchanged b) Product side
    c) Reactant side d) None of above

20. A large value of K_C means that at equilibrium:
    a) Less reactants and more products
    b) Reactants and products in same amounts
    c) More reactants and less products
    d) None of above

21. Which statement about following equilibrium

is correct:

$2SO_2 + O_2 \rightleftharpoons 2SO_3$ ΔH = 188KJ mole^{-1}

a) The value of K_P falls with a rise in temperature.
b) The value of K_P is equal to K_C.
c) The value of K_P falls with increasing pressure.
d) Adding V_2O_5 catalyst increase the equilibrium yield of sulphur trioxide.

APPLICATIONS OF EQUILIBRIUM CONSTANT

22. Extent to $H_2 + I_2 \longrightarrow 2HI$ can be increased by:
a) Increasing temperature
b) Increasing product
c) Increasing pressure
d) Adding a catalyst

23. $N_2 + 3H_2 \rightleftharpoons 2NH_3$
Which of the following change will favour the formation of more NH_3 at equilibrium in above reaction:
a) By adding NH_3 b) By removing H_2
c) By decreasing pressure d) By increasing pressure

24. The substance which increases rate of reaction but remains unchanged at the end of reaction is called:
a) Catalyst b) Indicator
c) Promoter d) Activator

25. $N_2 + 3H_2 \rightleftharpoons 2NH_3$ + Heat For above equation, the maximum product will be obtained at:
a) Low temperature and high pressure
b) High temperature and low pressure
c) High temperature and high pressure
d) Low temperature and low pressure

26. $H_2 + I_2 \rightleftharpoons 2HI$
For above equation which of the following change will favour formation of more HI:
a) By adding more HI at equilibrium.
b) By decreasing pressure.
c) By increasing pressure.
d) By adding more H_2 and I_2 at equilibrium.

27. $2SO_2 + O_2 \rightleftharpoons 2SO_3$ + Heat
For above equation which of the following change will favour the formation of more SO_3 at equilibrium:
a) By decreasing pressure
b) By increasing temperature
c) By adding SO_3 at equilibrium
d) By decreasing temperature.

28. $N_2 + O_2$ + Heat $\rightleftharpoons 2NO$
For the above equilibrium system, the equilibrium constant decreases by:
a) Adding a catalyst b) Adding NO
c) Adding N_2 d) Decreasing temperature

29. Ice $\rightleftharpoons$ Water
When pressure is applied to above equilibrium, which of the following will happen:
a) Equilibrium will not be disturbed.
b) Water will evaporate.
c) More water will be formed.
d) More ice will be formed.

30. Which of the following can affect the magnitude of equilibrium constant K_P of a reversible gaseous reaction:
a) Temperature b) Catalyst
c) Pressure d) All of above

31. $N_2 + 3H_2 \rightleftharpoons 2NH_3$
For the above reaction the value of K_C would depend upon:
a) Temperature b) Pressure
c) Initial concentration of reactants
d) All of above

IONIC PRODUCT OF WATER

32. Unit of K_W is:
a) mole^2 dm^{-3} b) mole dm^{-3}
c) mole^2 dm^{-6} d) mole dm^{-6}

33. The pH of 10^{-3} mole dm^{-3} of an aqueous solution of H_2SO_4 is:
a) 1.5 b) 1.9
c) 3.7 d) 2.7

34. The pH value of 0.001M HCl solution in water is:
a) Exactly 7 b) < 7
c) > 7 d) Nearly 7

35. pH of pure water is:
a) 0 b) 9
c) 14 d) 7

36. Human blood has a pH of:
a) 8.35 b) 9.35
c) 7.35 d) 6.35

37. The sum of pH and pOH is:
a) 10 b) 14
c) 18 d) 7

38. H_2SO_4 is a dibasic acid which dissociates

completely in water. What will be molarity of this acid which has a pH 1:

a) 0.5M b) 0.005M
c) 0.05M d) 1M

39. Which one of the following aqueous solutions has highest pH:

a) 0.1M HNO_3 b) 0.1M HCl
c) 0.2MH_2SO_4 d) 0.1M NaOH

40. The pH of 0.001M NaOH aqueous solution is:

a) 13 b) 11
c) 9 d) 8

41. Which of the following pH is considered as acidic?

a) 9 b) 11
c) 8 d) 1

42. Which one of the following aqueous solutions has lowest pH:

a) 0.1M $Ba(OH)_2$ b) 0.1M NaOH
c) 0.1M KOH d) 0.1M HCl

43. Which one of the following has highest pH:

a) Distilled water
b) Water saturated with chlorine gas.
c) 1M NH_4OH
d) 1M NaOH

44. The OH^- concentration of a solution having pH value 3 will be:

a) 1×10^{06} b) 1×10^{04}
c) 1×10^{011} d) 1×10^{09}

45. The pH of a solution having H^+ ions concentration of 1×10^{07} will be:

a) Zero b) Acidic
c) Neutral d) Basic

46. The pH of a solution is zero, it will be:

a) Highly basic b) Neutral
c) Highly acidic d) Moderately acidic

47. pH of water slowly changes from 7 to 6 as a sample of air was bubbled into pure water. Which gas in the sample caused this change:

a) CO_2 b) Ar
c) N_2 d) O_2

48. At 25°C the pH of water is 7. What will be the effect on pH of water at 100°C.

a) pH decreases
b) pH increases
c) pH will remain same
d) pH first increases then decreases

49. Which of the following solutions have zero pH:

a) 0.5M H_2SO_4 b) 0.1M HNO_3
c) 0.5M CH_3COOH d) 0.5M HCl

50. The pH of soft drink is:

a) Greater than 7 b) Zero
c) Less than 7 d) 7

51. The pH of fresh saliva is:

a) 7.5 ▯ 8.5 b) 6.5 ▯ 6.5
c) 6.5 ▯ 6.9 d) 5.5 ▯ 6.5

52. The pH of bananas is:

a) 3.6 b) 5.5
c) 6.2 d) 4.6

IONIZATION CONSTANTS OF ACIDS (K_a) AND BASES (K_b)

53. The strength of an acid can be determined by:

a) pK_w b) pK_b
c) pK_a d) p[OH].

54. Ionization of weak acid is expressed in term of following constant:

a) K_b b) K_a
c) K_w d) K_n

55. Ionization constant K_a for CH_3COOH at 25°C is:

a) 1.85×10^{015} b) 1.85×10^{011}
c) 1.85×10^{05} d) 1.85×10^{09}

56. When HCl is added to H_2S aqueous solution its ionization:

a) Increases b) Remains constant
c) Decreases d) First decreases then increases

57. The dissociation constant for water at 25°C is:

a) 1×10^{014} b) 1×10^{010}
c) 1×10^{07} d) 1×10^{012}

58. The pK_b value for aqueous ammonia at 25°C is 4.8. What is the correct pK_a value for ammonium ions at this temperature:

a) 7.2 b) 4.8
c) 9.2 d) ▯4.8

59. A conjugate acid base pair is produced, whenever:

a) A weak acid and weak base is dissolved in water.
b) A weak acid and strong base is dissolved in water.
c) A strong acid and weak base is dissolved in water.
d) A strong acid and a strong base is dissolved in water.

60. **Conjugate base of a very weak acid is:**
a) Relatively strong base
b) Relatively weak base
c) Relatively very strong base
d) Relatively very weak base

61. **Acids and bases when dissolved in water:**
a) May not be completely dissociated.
b) May be completely dissociated.
c) May or may not be completely dissociated.
d) None of above.

COMMON ION EFFECT

62. **The process in which ionization of an electrolyte is suppressed by the addition of another strong electrolyte containing one same ion is called:**
a) Electrolysis b) Hydrolysis
c) Common ion effect d) Pyrolysis

63. **When HCl gas is passed through the solution of NaCl, sodium chloride is precipitated out, due to:**
a) Increasing solubility of NaCl
b) Decreasing solubility of NaCl
c) Increasing ionization of NaCl
d) Formation of a complex

64. **Common ion effect finds extensive applications in the:**
a) Qualitative analysis b) Quantitative analysis
c) Preparation of buffers d) Both (a) and (c)

BUFFER SOLUTIONS

65. **Buffer solutions are mostly prepared by mixing:**
a) Three substances b) Four substances
c) Two substances d) Five substances

66. **Mixtures of NH_4OH and NH_4Cl is one of the best examples of:**
a) Acidic buffers b) Natural buffers
c) Basic buffers d) Acid base buffers

67. **A basic buffer solution can be prepared by mixing:**
a) Strong acid and its salt with weak base.
b) Weak base and its salt with strong acid.
c) Strong base and its salt with weak acid.
d) Weak acid and its salt with strong base.

68. **Buffer action can be explained by:**
a) Le-Chatelier's principle
b) Law of mass action
c) Common ion effect
d) All of above

69. **A buffer solution can be prepared by mixing:**
a) NaCl and HCl
b) H_2SO_4 and Na_2SO_4
c) Na_2SO_4 and NaOH
d) CH_3COONa and CH_3COOH

70. **Buffer capacity is maximum when both components have:**
a) High concentration
b) Equal concentration
c) Low concentration
d) High and equal concentration

SOLUBILITY PRODUCT

71. **The precipitation occurs if the ionic concentration is:**
a) Equal to K_{sp} b) More than K_{sp}
c) Less than K_{sp} d) Is present in any amount

72. **If K_{sp} value is large, the salt in water is:**
a) More soluble b) Less soluble
c) Moderately soluble d) No concentration

73. **The solubility of $PbBr_2$ is 23×10^{02}M at 25°C. What is K_{sp} of $PbBr_2$:**
a) 4.8×10^{05} b) 4.8×10^{05}
c) 1.2×10^{05} d) 5.3×10^{04}

74. **The solubility product expression for BaF_2 can be written as:**
a) $[Ba^{+2}][2F^{0}]$ b) $[Ba^{+2}][F^{0}]^2$
c) $[Ba^{+}] + [F^{0}]^2$ d) $[Ba^{+2}]\,[F^{0}]$

75. **The molar solubility of $Ca(OH)_2$ in water in term of its K_{sp} can be written as:**

a) $S = \left(\frac{K_{sp}}{6}\right)^{1/3}$ b) $S = (K_{sp})^{1/2}$

c) $S = (\quad)^{1/3}$ d) $S = \left(\frac{K_{sp}}{4}\right)^{1/3}$

Answers

1.	c	2.	a	3.	b	4.	a
5.	d	6.	a	7.	a	8.	a
9.	c	10.	c	11.	b	12.	a
13.	b	14.	a	15.	c	16.	c
17.	d	18.	c	19.	c	20.	a
21.	a	22.	a	23.	d	24.	a
25.	a	26.	d	27.	d	28.	d
29.	c	30.	a	31.	a	32.	c
33.	d	34.	b	35.	d	36.	c
37.	b	38.	c	39.	d	40.	b
41.	d	42.	d	43.	d	44.	c
45.	c	46.	c	47.	a	48.	a
49.	a	50.	c	51.	c	52.	d
53.	c	54.	b	55.	c	56.	c
57.	a	58.	c	59.	a	60.	c
61.	c	62.	c	63.	b	64.	d
65.	c	66.	c	67.	b	68.	d
69.	d	70.	d	71.	b	72.	a
73.	a	74.	b	75.	d		

8. Reaction Kinetics

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Explain and use the terms: rate of reaction; activation energy; catalysis; rate equation; order of reaction; rate constant; half-life of a reaction; rate-determining step.

b) Explain qualitatively, in terms of collisions, the effect of concentration changes on the rate of a reaction.

c) Explain that, in the presence of a catalyst, a reaction has a different mechanism, i.e. one of lower activation energy.

d) Describe enzymes as biological catalysts which may have specific activity.

e) Construct and use rate equations of the form Rate = $k[A]^m[B]^n$ with special emphasis on:

i) Zero order reaction
ii) 1st order reaction
iii) 2nd order reaction

f) Show understanding that the half-life of a first-order reaction is independent of initial concentration and use the half-life to calculate order of reaction.

g) Calculate the rate constant from the given data.

h) Name a suitable method for studying the rate of a reaction, from given information.

Definitions and Statements

1) Kinetics of Chemical Reactions: Many reactions in aqueous solutions are so rapid that they seem to occur instantaneously. While there are certain reactions, which proceed at a moderate rate.

2) Reaction Kinetics or Chemical Kinetics: The studies concerned with rates of chemical reactions and

factors that affect the rates of chemical reactions constitute the subject matter of reaction kinetics or chemical kinetics.

3) Rate of a Reaction: The rate of a reaction is the change in the concentration of a reactant or a product divided by the time taken for the reaction.

4) Average Rate of Reaction: The rate of reaction between two specific time intervals is called the average rate of reaction.

5) Instantaneous Rate of a Reaction: Rate of a reaction at any one instant during the interval is called the instantaneous rate.

6) Rate Constant of a Chemical Reaction: Rate constant of a chemical reaction is rate of reaction when the concentration of reactants are unity.

7) Order of Reaction: Order of reaction is the sum of exponents of the concentration terms in the rate expression of a chemical reaction. The exponents in the expression may or may not be different from the coefficients of the chemical equation. Order of a reaction may be zero, whole number or fractional.

8) Zero Order Reaction: A reaction is said to be zero order, if its rate is entirely independent of the concentrations of reactant molecules.

9) Half Life Period of a Reaction: It is the time required to convert 50% of the reactants into products. Half life period of any reaction is inversely proportional to the initial concentration raised to the power one less than the order of that reaction.

10) Rate Determining Step of a Reaction: The step which limits how fast the overall reaction can proceed is known as the rate determining step of a reaction

11) Determination of Rate of Chemical Reaction: Determination of the rate of a chemical reaction involves the measurement of the concentration of reactants or products at regular time intervals during the progress of reaction. The change in concentration of reactants and products can be determined by both physical and chemical methods.

12) Energy of Activation: The effective collisions between the colliding species will take place only when the reactant molecules processes minimum amount of energy, which is called energy of activation.

13) Factors Affecting Rate of Chemical Reaction: All those factors, which change the number of effective collisions per second, affect the rate of chemical reaction. Some of the important factors are, nature and concentration of reactants, surface area, light and temperature.

14) Catalyst and Catalysis: A catalyst is a substance, which alters the rate of a chemical reaction, but itself remains chemically unchanged at the end of reaction. This process is called catalysis.

15) Homogenous Catalysis: The process when the catalyst and the reactants are in same phase is said to be a homogenous catalysis.

16) Heterogeneous Catalysis: In case of heterogeneous catalysis, the catalyst and the reactants are in different phases. Mostly the catalyst is in the solid phase, while the reactants are in gaseous phase or liquid phase.

17) Promoter or Activator: A substance, which promotes the activity of a catalyst, is called promoter or activator.

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

(1) In zero order reaction, the rate is independent of:
- a) Temperature of reaction
- b) Concentration of reactants
- c) Concentration of products
- d) None of these

(2) If the rate equation of a reaction 2A + B ⟶ Products is, Rate = k[A]² [B], and A is present in large excess, then order of reaction is:
- (a) 1 (b) 2
- (c) 3
- (d) None of these

(b) The rate of reaction:
- (a) increases as the reaction proceeds.
- (b) decreases as the reaction proceeds.
- (c) remains the same as the reaction proceeds.
- (d) may decrease or increase as the reaction proceeds.

(c) With increases of 10°C temperature the rate of reaction doubles. This increase in rate of reaction is due to:
- (a) decrease in activation energy of reaction.
- (b) decrease in the number of collisions between reactant molecules.
- (c) increase in activation energy

of reactants.

(d) increase in number of effective collisions.

(d) The unit of the rate constant is the same as that of the rate of reaction in:

(a) first order reaction.
(b) second order reaction.
(c) zero order reaction.
(d) third order reaction.

Answers

i	b	ii	a	iii	b	iv	d	v	c

Important MCQs

INTRODUCTION

1. A white precipitate of silver chloride immediately formed on addition of:

a) Silver nitrate solution to sodium chloride solution.
b) Silver chloride solution to sodium nitrate solution.
c) Silver nitrate solution to potassium chloride solution.
d) Silver nitrate solution to hydrogen chloride solution.

2. Which of the following reactions occur at moderate rate:

a) Rusting of iron
b) Chemical weathering of stone work of buildings by acidic gases in atmosphere.
c) Hydrolysis of an ester
d) Fermentation of sugars

3. All reactions occur in:

a) A single step b) A series of steps
c) Two steps d) Both (a) and (b)

4. The rate determining step is the:

a) Slowest step b) Fastest step
c) Moderate step d) Both (a) and (b)

5. Which of the following will affect the rate:

a) First step of reaction
b) Last step of reaction
c) Rate determining step
d) Fastest step

6. It is common observation that rates of chemical reactions differ:

a) Greatly b) A little bit
c) Moderately d) Do not differ

RATE OF REACTION

7. Which of the following may affect the rate constant (K) for a reaction:

a) Change in concentration
b) Change in pressure
c) Change in pH
d) Change in temperature

8. The change in concentration of reactant or product per unit time is called:

a) Rate constant b) Rate of reaction
c) Rate equation d) Rate law

9. Rate of a chemical reaction depends upon:

a) The number of total collisions per second.
b) Number of molecules taking part in a chemical reaction.
c) Number of fruitful collisions per second.
d) Number of fruitless collisions per second.

10. Which statement is true about order of reaction:

a) Order of reaction can only be determined by an experiment.
b) Order of reaction can be determined from a balance equation only.
c) Order of reaction increases by increasing temperature.
d) Order of reaction must be in whole number and not in fraction.

11. The unit of rate constant K is $mole^{n1}\ dm^3\ s^{n1}$ for a chemical reaction, the order of reaction is:

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

12. Hydrolysis of ethyl-acetate (ester) has order of reaction:

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

13. If rate law of an equation is written as $\frac{-dx}{dt} = K[A][B]$?

a) Reaction is independent of the concentration of A and B.
b) Product is decreasing with passage of time.
c) Reactant is decreasing with passage of time.

d) Reactant is increasing with passage of time.

14. The example of a photochemical reaction is photosynthesis has order of reaction:
a) 1 b) 2
c) 0 d) 3

15. Rate law of an equation is obtained:
a) From a balanced equation
b) Can be calculated theoretically as well as determined experimentally.
c) It is only calculated theoretically.
d) Experimentally

16. A pseudo uni-molecular reaction has order of reaction:
a) 3 b) 2
c) 1 d) 0

17. A zero order reaction is one in which:
a) Rate is not affected by changing concentration of reactants.
b) Concentration of reactant do not change with passage of time.
c) Reactants do not react.
d) One reactant s in large excess.

18. The rate equation for a reaction is Rate = K[A]. What are units of K?
a) $mol^{-1}\ dm^3\ s^{-1}$ b) $mol\ dm^{-3}\ s^{-1}$
c) $mol\ dm^{-3}$ d) s^{-1}

19. The unit of the rate constant is the same as that of rate of reaction in:
a) Third order reaction
b) Second order reaction
c) First order reaction
d) Zero order reaction

20. Half life period of a first order reaction is independent of:
a) Presence of catalyst b) Conditions of temperature
c) Initial concentration of the compound
d) All of above

21. If the rate of decay of radioactive isotope decreases from 200 cpm to 25 cpm after 24 hours, what is its half life:
a) 8 hours b) 6 hours
c) 4 hours d) 3 hours

22. The rate of reaction between two specific time intervals is called:
a) Instantaneous rate of reaction.
b) Average rate of reaction.
c) Rate of a reaction.
d) Minimum rate of a reaction.

23. Dilatometer method is useful for the reaction that involve:
a) Small volume changes in solutions
b) Change in refractive indices
c) Where reactants absorb U.V, visible or infrared radiation
d) Ionic species

24. The rate of reaction:
a) Decreases as the reaction proceeds
b) Increases as the reaction proceeds
c) May decrease or increase as the reaction proceeds
d) Remains same as the reaction proceeds

25. Which technique is used to determin the absorption of radiations:
a) Dilatometer method b) Optical rotation method
c) Spectrometry d) Refractometric method

26. Which property of a liquid is measured by polarimeter:
a) Change in volume b) Optical activity
c) Refractive index d) Conductance

ENERGY OF ACTIVATION

27. For a given reaction system, the minimum amount of energy which molecules must have to form an activated complex is called:
a) Heat energy of reaction
b) Mechanical energy
c) Activation energy
d) Ionization energy

28. Generally by increasing temperature, rate of chemical reaction increases. It is due to:
a) Greater number of molecules having activation energy.
b) Greater number of collisions.
c) Greater velocity of molecules.
d) Lesser number of molecules having activation energy

29. Rate of a chemical reaction generally increases rapidly, even for small increase in

temperature because of rapid increase in:

a) Fraction of molecules with energies more than activation energy
b) Collision energy
c) Average kinetic energy of molecules
d) Activation energy

30. The activation energy of a reaction is usually:

a) Zero for exothermic reactions
b) Different for forward and backward reaction
c) Unaffected by the presence of a catalyst
d) Low for reaction that takes place slowly

31. The energy of activation of forward reaction is less than that of backward reaction in:

a) Exothermic reactions
b) Isothermic reactions
c) Endothermic reactions
d) All reactions

FINDING THE ORDER OF REACTION

32. The order of a reaction can be determined by:

a) Half life method
b) Graphical method
c) Method of large excess
d) All of above

33. In large excess method one of the reactants is taken:

a) In large amounts as composed to rest of the reactants.
b) In small amounts as compared to rest of the reactants.
c) All reactants are taken in large amounts.
d) A standard volume

34. The active masses of substances in large excess method:

a) Remain constant throughout
b) Remain in large amounts
c) Remain in small amounts
d) Remain fluctuating

FACTORS AFFECTING RATE OF REACTION

35. Generally by increasing temperature, rate of reaction increases. It is due to:

a) Greater number of collisions of molecules
b) Greater number of collisions having fruitful collisions
c) Greater velocity of molecules

36. A reaction has equal activation energy for forward and backward reaction which statement is correct:

a) Enthalpy change is zero.
b) Reaction is of zero order.
c) Product has less energy than reactants.
d) No catalyst has been used.

37. Collision theory explains:

a) Molecularity of reaction
b) Order of reaction
c) Rate of reaction
d) All of above

38. In zero order reaction, the rate is independent of:

a) Concentration of products
b) Concentration of reactants
c) Pressure of reaction
d) Temperature of reaction

39. When NaOH solution reacts with aluminium in different physical states most rapid reaction occurs:

a) Aluminium foil
b) Aluminium powder
c) Alloy of aluminium
d) Cubes of aluminium

40. Combustion occurs slowly in air but more rapidly in pure oxygen at same pressure:

a) Concentration of oxygen has risen.
b) Pure oxygen exerts more pressure.
c) Reactivity of pure oxygen is more than oxygen of air.
d) All of above

CATALYSIS

41. The substance that alters the rate of a chemical reaction but recovered unchanged at the end is called a:

a) Catalyst
b) Reactant
c) Product
d) Promoter

42. A catalyst:

a) Increases the rate of forward reaction.
b) Increases the rate of both forward and reverse reactions.
c) Changes equilibrium position.
d) Increases the rate of forward reaction and

decreases the rate of reverse reaction.

43. **Poisoning of a catalyst may be temporary or permanent. In permanent poisoning:**
   a) Catalyst reacts with poison.
   b) Physical state of catalyst changes.
   c) Catalyst reacts with product.
   d) Catalyst reacts with reactant.

44. **When rate of reaction is restarted by adding a substance, it is said to be:**
   a) Positive catalyst b) Auto catalyst
   c) Catalyst d) Negative catalyst

45. **Indicate the enzyme which catalyses the following reaction:**

$$(NH_2)_2CO + H_2O \longrightarrow 2NH_3 + CO_2$$

   a) Urease b) Diastase
   c) Invertase d) Zymase

46. **Which statement about the effect of catalyst on a reversible reaction is correct?**
   a) It increases the rate constant for forward reaction.
   b) It increases rate constant for forward and reverse reaction.
   c) It increases the yield of product in an equilibrium.
   d) It increases equilibrium constant for forward reaction.

47. **The decolourization of $KMnO_4$ by acid is catalysed by Mn^{+2} ions. This is an example of:**
   a) Poisoning of catalysis b) Inhibitor
   c) Chemo-catalysis d) Auto-catalysis

48. **A catalyst accelerates the reaction by:**
   a) Increasing activation energy
   b) Lowering enthalpy change
   c) Lowering activation energy
   d) Lowering kinetic energy

49. **Which statement about catalyst is incorrect:**
   a) It is regenerated at the end of chemical reaction.
   b) It lowers the activation energy.
   c) It increases the reaction rate.
   d) It decreases the enthalpy of a reaction.

50. **Catalyst changes:**
   a) Enthalpy of reactants
   b) Enthalpy of products
   c) Enthalpy of reaction
   d) Enthalpy of none.

Answers

1.	a	2.	c	3.	d	4.	a
5.	c	6.	a	7.	d	8.	b
9.	c	10.	a	11.	d	12.	c
13.	c	14.	c	15.	d	16.	c
17.	a	18.	d	19.	d	20.	c
21.	a	22.	b	23.	a	24.	a
25.	c	26.	b	27.	c	28.	a
29.	a	30.	b	31.	a	32.	d
33.	b	34.	a	35.	b	36.	a
37.	c	38.	b	39.	b	40.	a
41.	a	42.	b	43.	a	44.	d
45.	a	46.	b	47.	c	48.	c
49.	d	50.	d	51.	b	52.	c
53.	b	54.	b	55.	c	56.	C
57.	d	58.	b				

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B. Inorganic Chemistry

1. Periods	(2%)
2. Groups	(2%)
3. Transition elements	(2%)
4. Elements of biological importance	(4%)

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

1. Periods

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:
Discuss the variation in the physical properties of elements belonging to period 2 and 3 and to describe and explain the periodicity in the following physical properties of elements.

a) Atomic radius.
b) Ionic radius.
c) Melting point.
d) Boiling point.
e) Electrical conductivity.
f) Ionization energy.

Definitions and Statements

1. **Define Periodic Table:** A table which provides a basic framework to study the periodic behaviour of physical and chemical properties of elements as well as their compounds is called Periodic Table."
2. **Define Law of Triad (1829):** According to this law "a triad contains three elements with similar properties and each middle element in triad has atomic mass an average of first and third element when arranged in increasing order of atomic masses. These three elements were called triad.
3. **Define Law of Octaves (1864):** When elements are arranged in increasing order of their atomic

each eighth element repeats the properties of the first element. These group of eight elements are called octaves.

Define Modern Periodic Law: The periodic function of properties of elements is their atomic number, when elements are arranged in their increasing order of atomic numbers.

Define Mendeleev's Periodic Law: The periodic function of properties of elements is their *atomic masses*, when they are arranged in increasing order of their atomic masses."

Define Mosley's Law (1913): When elements are arranged in increasing order of their *atomic number*, the periodic function of properties of elements is their atomic numbers.

Define Groups: The vertical columns in periodic table are called groups.

Define Sub-group-A: It include typical or normal elements.

Define Sub-group-B: It includes less typical elements called transition elements. They are present in the centre of the periodic table.

Define Periods: The horizontal rows in periodic table are called periods."

Define Short Periods: Period 2 and period 3 are called short periods which contain eight elements.

Define Long Periods: Period 4 and 5 are called long periods.

Define Period-6 (Lanthanides): The period starting after Lanthanum $_{59}La$ is called Lanthanides.

Period-7 (Actinides): The inner transition elements of period 07 starting from actinium are called Actinides." Actinides are elements starting after Actinium ($_{89}Ac$).

Define Alkali Metals Family: Elements of group I-A are called alkali metals.

Define Alkaline Earth Metals Family: Elements of group II-A are called alkaline earth metals.

Halogens Family (Means salt forming): Group VII-A elements are called halogens.

Define Noble Gases: Elements of group VIII-A are called noble gases, inert gases, inert gases, rare gases or zero group elements.

Define s-block elements: Elements in which "s"-orbital is in the process of completion are called s-block elements." Group I-A and II-A sub group are called s-block elements.

Define p-block elements: Elements in which "p"-orbital is in the process of completion are called p-block elements."

Define d-block elements: Elements in which d-orbital is in the process of completion are called d-block elements.

22. **Define f-block elements:** Elements in which f-orbital is in the process of completion are called "f"-block elements."

23. **Define Metals:** Elements having tendency to release electrons are called metals *i.e.*, metals are always electropositives.

24. **Define Non-Metals:** Elements which gain electron to complete their valence shell are called non-metals."

25. **Define Semi-metals or metalloids:** Elements having some properties of metals and some of non metals are called metalloids or semi-metals."

26. **Define Atomic Radii:** Half of the distance between the centers of two adjacent atoms of an element is called atomic radii."

27. **Define Ionic Radii:** It is the distance between outermost shell electrons to the nucleus of the ion.

28. **Define Lanthanide Contraction:** Gradual decrease in the size of the atoms of the lanthanides due to the involvement of "d" and "f" orbitals is called lanthanide contraction."

29. **Define Iso electronic specie:** These ions which have same number of electrons in their valence shell are called isoelectronic specie." **Examples:**

Li^{+1}, Be^{+2}, B^{+3}, N^{-3}, O^{-2}, F^{-1} etc.

30. **Define Ionization Energy (I.E) or Ionization Potential (I.P)** The minimum amount of energy, which is required to remove an electron from the outer most shell of isolated, gaseous atom in its ground state is called ionization energy of that element."

31. **Define Electron Affinity:** The amount of energy released when an electron is added up in the valence shell of a gaseous atom is called electron affinity."

32. **Define Metal:** These are the elements which release electron to complete their valence shells are called metals.

33. **Define Non-Metal:** The tendency of gaining electrons is called non-metallic characters of the elements.

34. **Define Oxidation State:** The oxidation state of an atom in a compound is defined as the charge (with sign) which it would carry in the compound."

35. **Define Oxidation State of Ionic Compounds:** The number of electrons gained or lost (valency) by the atom is called its oxidation state."

36. **Define Electrical Conductance:** The ability of metals to conduct (allow to pass) electrons

(electricity) through them are called electrical conductance."

37. **Define Hydration Energy:** Amount of heat change when one mole of gaseous ions dissolve in water to give an infinitely dilute solution is called heat of hydration or hydration energy.

38. **Define Halides:** The binary compounds of halogens are called halides."

39. **Define Ionic halides:** The halides having ionic bonding in them are called ionic halides."

40. **Define Covalent halides:** The halides having covalent bonding in them are called covalent halides."

41. **Define Polymeric halides:** Halides having partially ionic bonding with layered structure or chain lattice are called polymeric halides."

42. **Define Hydrides:** Binary compounds of hydrogen are called hydrides."

43. **Define Covalent Hydrides:** The hydrides formed due to mutual sharing of electrons (covalent bonding) are called covalent hydrides."

44. **Define Intermediate Hydrides:** The hydrides of beryllium and magnesium represent the class of compounds called intermediate hydrides."

45. **Define Oxides:** The binary compound oxygen are called oxides."

46. **Define Basic Oxides:** The oxides of metals except Be are called basic oxides."

47. **Define Acidic Oxides:** Oxides of non-metals (C, N, P and S) are called acidic oxides."

Example: $S + O_2 \longrightarrow SO_2$

48. **Define Amphoteric Oxides:**
The oxides having properties of both acids and bases are called amphoteric oxides."

Example: $2Zn + O_2 \longrightarrow 2ZnO$

Fully Solved Textual Exercise

1. ***Keeping in view the size of atoms, which order is the correct one?***
(a) Mg > Sr (b) Ba > Mg
(c) Lu > Ce (d) Cl > I

2. ***Mark the correct statement:***
(a) Na^+ is smaller than Na atom.
(b) Na^+ is larger than Na atom.
(c) Cl^{-1} is smaller than Cl atom.
(d) Cl^- (ion) and Cl (atom) are equal in size.

3. ***Mark the correct statement:***
(a) All lanthanides are present in the same group.
(b) All halogens are present in the same period.
(c) All the alkali metals are present in the same group.
(d) All the noble gases are present in the same period.

4. ***Which statement is incorrect?***
(a) All the metals are good conductor of electricity.
(b) All the metals are good conductor of heat.
(c) All the metals form positive ions.
(d) All the metals form acidic oxides.

5. ***Which statement is correct?***
(a) Hydrogen resembles in properties with I-A, IV-A and VII-A elements.
(b) Hydrogen resembles in properties with II-A, IV-A and V-A elements.
(c) Hydrogen resembles in properties with II-A, IV-A and VI-A elements.
(d) Hydrogen resembles in properties with II-A, III-A and VII-A elements.

6. ***Mark the correct statement:***
(a) The ionization energy of calcium is lower than that of barium.
(b) The ionization energy of calcium is lower than that of magnesium.
(c) The ionization energy of calcium is higher than that of beryllium.
(d) The ionization energy of calcium is lower than that of strontium.

7. ***Mark the correct statement:***
(a) Electron affinity is a measure of energy required to remove the electron.
(b) Ionization energy is a measure of energy asked by removing an electron.
(c) Electron affinity is a measure of energy required to excite an electron.
(d) Electron affinity is measure of energy released by removing an electron.

8. ***Mark the incorrect statement:***
(a) Metallic character increases down the group.
(b) Metallic character increases along a period.
(c) Metallic character decreases along a period.
(d) Metallic character remains the same down the group.

9. ***Mark the correct statement:***
(a) Melting points of halogens decreases down the group.
(b) Melting points of halogens increase down

the group.

(c) Melting points of halogens remain the same throughout the group.

(d) Melting points of halogens first increase and then decrease down the group.

10. ***Mark the correct statement:***

(a) Covalent character of metal halides increases from left to right in a period.

(b) Boiling points of Group IV-A hydrides decrease down the group.

(c) Ionic character of hydrides increases from left to right in a period.

(d) The basicity of group II-A oxides decreases on descending the group.

Important MCQs

11. ***Modern Periodic Table is based upon periodic function:***

(a) Atomic mass (b) Mass number
(c) Nuclide number (d) Atomic number

12. ***Newland's gave law:***

(a) Triad's law (b) Octaves law
(c) Periodic law (d) Modern periodic

13. ***The element not known till Mendleev tabulated his periodic table:***

(a) Carbon (b) Hydrogen
(c) Aluminium (d) Germanium

14. ***Which one was the problem associated with Mendleev periodic table?***

(a) Systematic study
(b) Grouping of alkali metals with coinage
(c) Prediction of unknown
(d) Introduction of elements groups & periods

15. ***Element with higher oxidation state form oxides:***

(a) Acidic (b) Basic
(c) Amphoteric (d) Peroxides

16. ***Period Number 6 contains elements in it:***

(a) 2 (b) 8
(c) 18 (d) 32

17. ***Sodium belongs to block of periodic table:***

(a) s-block (b) p-block
(c) d-block (d) f-block

18. ***Properties of metals are:***

(a) Malleable and ductile
(b) Form basic oxides
(c) Tarnish in air
(d) All are true

19. ***Atomic radius changes from top to bottom in a group:***

(a) Increases (b) Decreases
(c) Remains same (d) Sometimes increases & decreases

20. ***Ionization energy of sodium is (KJ/mol):***

(a) 503 (b) 513
(c) 523 (d) 524

21. ***Electron affinity value from higher to heavier element:***

(a) Increases (b) Decreases
(c) Remains same (d) No effect

22. ***Which group elements are the least metallic in nature?***

(a) IV-A (b) V-A
(c) VI-A (d) VII-A

23. ***Oxidation state of an element in free state is:***

(a) Its number of electrons lost
(b) Its number of electrons gained
(c) Zero
(d) Its number of electrons shared

24. ***Oxidation state of boron, aluminium and gallium is:***

(a) +1 (b) +2
(c) +3 (d) +5

25. ***Hydration energy depends upon:***

(a) Charge of ion (b) Size of ion
(c) Charge to size ratio (d) Heat change

26. ***Binary compounds of hydrogen are called:***

(a) Halides (b) Hydrides
(c) Oxides (d) Nitrides

27. ***Hydrides are:***

(a) Ionic (b) Covalent
(c) Intermediate (d) All above

28. ***oxidation state of Sn in $SnCl_4$ is:***

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

29. ***Alkali and alkaline earth metals are basic oxides except:***

(a) Li (b) Be
(c) Fr (d) Ba

30. ***E.N. value of fluorine is:***

(a) 2.1 (b) 2.5
(c) 3.5 (d) 4.0

31. ***All facts of chemistry must be in simple logical patterns because chemistry is a subject:***

a) Simple b) Complex
c) Un-understandable d) Easy

32. ***Periodic table provides a basic framework to study the periodic behaviour of:***

a) Physical properties of elements
b) Chemical properties of elements
c) Physical properties of compounds
d) Periodic table provides basic information about properties

HISTORICAL BACKGROUND

33. Scientist(s) made contributions in the field of designing a periodic table:
a) Newland b) Dobriener
c) Mendeleev & Mosley d) All of these

34. Dobriener gave his law in the year:
a) 1829 b) 1864
c) 1871 d) 1913

35. Newland gave his law in the year:
a) 1829 b) 1864
c) 1871 d) 1913

36. Mendeleev gave his periodic law in the year:
a) 1829 b) 1864
c) 1871 d) 1913

37. Mosley gave his periodic law in the year:
a) 1829 b) 1864
c) 1871 d) 1913

38. Law of triads was given by:
a) Al-Razi b) Dobriener
c) Newland d) Mendeleev

39. Law of octaves was given by:
a) Al-Razi b) Dobriener
c) Newland d) Mendeleev

40. Periodic law was given by:
a) Al-Razi b) Dobriener
c) Newland d) Mendeleev

41. Mendeleev was a scientist:
a) Russian b) German
c) English d) French

42. Newland's was a scientist:
a) Russian b) German
c) English d) French

43. Dobriener's was a scientist:
a) Russian b) German
c) English d) French

44. Dobriener's arranged elements in a group of:
a) Duplets b) Triads
c) Pentaves d) Hexaves

45. Newland's arranged elements in a group of:
a) Duplets b) Triads
c) Pentaves d) Octaves

46. Newland said, every eight element repeats properties of element:
a) 1st b) 2nd
c) 3rd d) 4th

47. The periodic function of properties of elements is their atomic mass
a) Al-Razi b) Dobriener
c) Newland d) Mendeleev

48. The periodic function of properties of elements is their atomic number
a) Al-Razi b) Mosley
c) Newland d) Mendeleev

49. First of all, idea of groups and periods was introduced by:
a) Al-Razi b) Dobriener
c) Newland d) Mendeleev

50. There were seven groups in periodic table proposed by:
a) Al-Razi b) Dobriener
c) Newland d) Mendeleev

51. Mendeleev periodic table was arranged in the order of atomic masses:
a) decreasing b) increasing
c) Decreasing d) descending

52. The improvement(s) in Mendeleev table is/are:
a) periodic function was taken atomic weight
b) periodic function was taken as atomic number
c) idea of groups and periods was introduced
d) unknown elements places were left blank

53. The improvement(s) made in Mendeleev periodic table is/are:
a) place of isotopes
b) electronic configuration
c) correction of wrong pairs (Ar & K)
d) All of these

54. An extra group of noble gases (VIII-A) was added in table of:
a) Al-Razi b) Mendleev
c) Newlands d) Mosley

THE ESSENTIAL FEATURES OF MODERN PERIODIC TABLE

55. Essential features of modern periodic table are:
a) Groups and periods b) Block in periodic table
c) Families. d) All of these

GROUPS & PERIODS

56. Vertical columns in periodic table are called:
a) Groups b) Periods
c) Blocks d) Lanthanides

57. Horizontal rows are called in periodic table:
a) Groups b) Periods
c) Blocks d) Lanthanides

58. Modern periodic table has:
a) Eight groups and seven periods.
b) Seven groups and seven periods.
c) Eight groups and eight periods.
d) Seven groups and seven periods.

59. Mendeleev periodic table has groups:
a) 6 b) 7
c) 8 d) 9

60. Sub-group -A in periodic table consists of

elements:

a) halogens b) alkali metals
c) Non-typical elements d) typical or normal

61. **Sub-group- B in periodic table consists of elements:**

a) halogens b) alkali metals
c) transition elements d) typical or normal

62. **Short periods contain elements:**

a) 2 b) 8
c) 18 d) 32

63. **Period 1 has elements:**

a) 2 b) 8
c) 18 d) 32

64. **Period 4 & 5 has elements:**

a) 2 b) 8
c) 18 d) 32

65. **Period 6 has elements:**

a) 2 b) 8
c) 18 d) 32

66. **Period 4 and 5 has elements:**

a) Eight are typical and ten are non-typical elements.
b) Ten are typical and eight are non-typical elements.
c) Twelve are typical and six are non-typical elements.
d) Six are typical and twelve are non-typical elements.

67. **Period 6 has elements belonging to:**

a) typical (8), non-typical, (10), lanthanides (14)
b) typical (10), non-typical, (8), lanthanides (14)
c) typical (10), non-typical (14), lanthanides (8)
d) typical (14), non-typical (10), lanthanides (8)

68. **Francium and Radium are present in period:**

a) 1 b) 2, 3
c) 4, 5 d) 7

69. **Rare earth metals are present in period of periodic table:**

a) 1 b) 2, 3
c) 4, 5 d) 7

70. **Actinides are present in period of periodic table:**

a) 1 b) 2, 3
c) 4, 5 d) 7

71. **Lanthanides are present in period of periodic table:**

a) 1 b) 2, 3
c) 4, 5 d) 6

SOME MORE FAMILIES IN THE PERIODIC TABLE

72. **Modern period table has families:**

a) Lanthanide family b) Halogens family
c) Alkali metals family d) All of these

73. **Modern periodic table has families:**

a) Halogens (Group VII-A)
b) Chalcogens (Group VI-A)
c) Noble gases (Group VIII-A)
d) All above are families in periodic table.

BLOCKS IN PERIODIC TABLE

74. **Groups I-A & II-A belongs to block of elements:**

a) "s" b) "p"
c) "d" d) "f"

75. **Groups III-A, IV-A, V-A, VI-A, VII-A and VIII-A except He belong to block of elements:**

a) "s" b) "p"
c) "d" d) "f"

76. **Transition elements belong to block of elements:**

a) "s" b) "p"
c) "d" d) "f"

77. **Lanthanides and Actinides belong to block of elements:**

a) "s" b) "p"
c) "d" d) "f"

78. **Blocks of elements give informations about the:**

a) Chemistry of elements
b) Behaviour towards physical properties
c) Atomic mass d) Mass number

METALS, NON-METALS AND METALLOIDS

79. **Elements having tendency to release electrons are:**

a) metals b) non-metals
c) kept in "s" & "p" block d) always kept in "f" block

80. **Elements having tendency to gani electrons are:**

a) metals b) non-metals
c) kept in "s" & "p" block d) always kept in "f" block

81. **Elements having properties in between metals and non-metals are called:**

a) Halogens b) Alkali metals
c) Alkaline earth metals d) Metalloids

THE POSITION OF HYDROGEN

82. **Hydrogen is placed at the top of group:**

a) I-A b) II-A
c) IV-A d) VI-A

83. **Which property of hydrogen is not in resemblance with IA group?**

a) same valence configuration
b) same block
c) same physical state
d) same trend of I.E

84. Which property of hydrogen is not in resemblance with IV-A?
a) Half filled valence shell
b) Ionic characters of both
c) Covalents characters of both
d) Reducing agent

85. Which property of hydrogen is NOT in resemblance of group VII-A?
a) Both have oxidation states (-1)
b) Both complete valence shell by releasing electrons
c) Both are diatomic gases
d) Both have same electronic configuration

86. Oxidation states (+1) of hydrogen is a property in resemblance to the group:
a) I-A b) II-A
c) IV-A d) V-A

87. Electronic configuration of the hydrogen is in agreement to the group of periodic table:
a) I-A b) II-A
c) IV-A d) V-A

88. Hydrogen is diatomic gas, a property in accordance of group of periodic table:
a) I-A b) II-A
c) IV-A d) VII-A

PERIODIC TRENDS IN PHYSICAL & CHEMICAL PROPERTIES ATOMIC SIZE

89. The half distance between centres of two nuclei of two atoms in an element is called:
a) Atomic radii b) Covalent radii
c) Ionic radii d) Cationic radii

90. The radius of a positive ion is called:
a) Atomic radii b) Covalent radii
c) Ionic radii d) Cationic radii

91. The radius of a negative ion is called:
a) Atomic radii b) Covalent radii
c) Anionic radii d) Cationic radii

92. A radius smaller than parent atom is called:
a) Atomic radii b) Covalent radii
c) Ionic radii d) Cationic radii

93. A radius greater than its parent atom is called:
a) Atomic radii b) Covalent radii
c) Anionic radii d) Cationic radii

94. Size of an atom is measured:
a) directly b) indirectly
c) may be direct ly d) may be directly or Indirectly

95. Trend of atomic is:
a) increases down the group
b) increases down the group and decreases along the period
c) increases down the group and decreases along the period
d) increases along the period

96. Atomic radius is affected by:
a) proton numbers b) shielding effect
c) nuclear change d) all above

97. Atomic radius increases in a group because of increase in:
a) atomic number b) nuclear charge
c) shielding effect number d) shielding effect and proton

98. Atomic radius decreases in a period because of:
a) increases in nuclear charge
b) no effect of shielding
c) increase in nuclear group
d) a, b, c all are factors

99. The smaller size of cations is greater prominent in orbitals:
a) "s" b) "p"
c) "d" d) d and f

100. The smaller size of cations in Lanthanides is called:
a) Lanthanide contraction
b) Lanthanides oxidation state
c) Lanthanides expansion
d) Lanthanides valency

101. An atom loses electrons to become:
a) ion b) radical
c) positive ion d) negative ion

102. An atom gains electrons to become:
a) ion b) radical
c) positive ion d) complex ion

103. The size of atom in positive ion decreases because:
a) outermost shell loses b) imbalance no. protons
c) a & b d) shielding effect increases

104. The radius of Na-atom is (in pm):
a) 157 b) 136
c) 95 d) 72

105. The radius of Na^+ ion is (in pm):
a) 157 b) 136
c) 95 d) 72

106. The radius of Fluorine atom is (in pm):
a) 157 b) 136
c) 95 d) 72

107. The radius of Fluoride ion is (in pm):

a) 157 b) 136
c) 95 d) 72

108. *Iso- electronic specie are substances having electrons:*

a) same b) different
c) eight electrons in valence shell of F^{-1}, O^{-2}, N^{-3}, C^{-4} d) a &c

IONIZATION ENERGY

109. *The amount of energy released an addition of an electron into valence shell of a gaseous isolated atom is called:*
a) Ionization energy b) Electron Affinity
c) Electron negativity d) Electropositivity

110. *The tendency to attract shared pair of electrons towards itself:*
a) Ionization energy b) Electron Affinity
c) Electron negativity d) Electropositivity

111. *The minimum amount of energy required to dissociate a crystal lattice into its ions is called:*
a) Ionization energy b) Electron Affinity
c) Electron negativity d) Lattice energy

112. *Ionization energy and electron affinity is measured in:*
a) e.v b) KJ mol^{-1}
c) KCal d) All of the above

113. *Trend of Ionization energy in a group from top to bottom is:*
a) increases b) decreases
c) remains same d) Increases, decreases

114. *Trend of ionization energy in a period from left to right is:*
a) increases b) decreases
c) remains same d) Increases, decreases

115. *Ionization energy of sodium is (KJ/mol):*
a) 513 b) 738
c) 1451 d) 1480

116. *Ionization energy of $Mg^{+1} \longrightarrow Mg^{+1} + 1e^-$ is (in KJ/mol):*
a) 513 b) 738
c) 1451 d) 1480

117. *Ionization energy for: $Mg^{+1} \longrightarrow Mg^{+2} + 1e^-$ (in KJ/mol)*
a) 513 b) 738
c) 1451 d) 1480

118. *Second Ionization energy is than first ionization energy:*
a) less b) least
c) same d) greater

119. *Inert gases have the Ionization value maximum became of:*
a) complete valence shell b) inertness
c) nobleness d) difficult removal of electron

ELECTRON AFFINITY

120. *The value of E.A in KJ mol^{-1} for $F + 1e^- \longrightarrow F^{-1}$ is:*
a) –337 b) –141
c) –780 d) –870

121. *The value of E.A in KJ/mol for $O + e^- \longrightarrow O^{-1}$ is:*
a) –337 b) –141
c) –780 d) –870

122. *The value of E.A in KJ/mol for $O^{-1} + 1e^- \longrightarrow O^{-2}$ is:*
a) –337 b) –141
c) –780 d) –870

123. *Electron affinity value is expressed in figures:*
a) positive b) negative
c) sometimes positive d) sometimes negative

124. *Ionization energy value is expressed in figures:*
a) positive b) negative
c) sometimes positive d) sometimes negative

125. *Trend of electron affinity is:*
a) increases in period and groups
b) decreases in period and groups
c) Firstly increases and then decreases in a group
d) Always increases in a group and

METALLIC CHARACTER

126. *Periodic table has elements of nature:*
a) metals b) non-metals
c) metalloids d) a, b, all

127. *Metals are present generally in periodic table:*
a) Left hand side b) in the centre and bottom
c) a & b d) right hand top

128. *Non-metals are present in periodic table:*
a) Left hand side b) in the centre and at the bottom
c) a & b d) right hand top

129. *Metalloids are present in periodic table:*

a) Left hand side b) In the centre and at the bottom
c) along the stepped line d) right hand top

130. Which one is non-metal?
a) Na b) Pb
c) S d) Po

131. Properties of metals is/are:
a) loose electrons b) good conductor
c) basic oxides and hydroxides d) all above

132. Characteristics of non-metals are:
a) form acidic oxides
b) high ionization energy and law electron affinity
c) smaller atomic size and greater nuclear charge
d) all above

133. Which metal is in liquid state at room temperature?
a) Na b) Mg
c) Hg d) Au

134. Which is the only non-metal is liquid state?
a) Chlorine b) Iodine
c) Bromine d) Silicon

135. Which is true for metallic characters?
a) It is the tendency of gaining electrons.
b) It is the tendency of releasing electrons.
c) It is the tendency of absorbing electrons.
d) None is true in case of metallic characters.

136. Trend of metallic characters is:
a) Increases in a period and decreases in a group.
b) Increases in a group and decreases in a period.
c) Increases in a group and period.
d) Decreases in a group and a period.

137. Trend of non-metallic characters is:
a) Increases in a period and decreases in a group.
b) Increases in a group and decreases in a period.
c) Increases in a group and period.
d) Decreases in a group and a period.

MELTING & BOILING POINTS

138. Melting and boiling points tells us:
a) physical state at room temperature
b) strength between atoms
c) strength between molecules
d) all of the above

139. The relation of binding electrons with m.p & b.p is:
a) greater the bending electrons, greater will be the m.p & b.p
b) it is inversely proportional
c) no link between them
d) lesser the binding electrons, greater will be the m.p & b.p

140. Carbon has high m.p in:
a) Diamond b) Graphite
c) Charcoal d) Coke

141. Allotropic form of carbon having giant tetrahedral structure:
a) Diamond b) Graphite
c) Charcoal d) Coke

142. Allotropic form of carbon having low m.p layered structure with π-bond and hexagonal structure:
a) Diamond b) Graphite
c) Charcoal d) Coke

143. A diatomic molecule with individual existence, no three dimensional lattice and weak intermolecular forces have m.p & b.p:
a) higher b) high
c) medium d) low

OXIDATION STATE

144. The charge, an atom carry in a molecule is called:
a) valency b) oxidation state
c) reduction state d) electron affinity

145. Oxidation state of Cl in NaCl is:
a) –1 b) +1
c) –2 d) +4

146. oxidation state of Na is NaCl is:
a) –1 b) +1
c) –2 d) +4

147. The oxidation state of "Sn" in $SnCl_4$ is:
a) –1 b) +1
c) –2 d) +4

148. The oxidation state of "S" in H_2S is:
a) –1 b) +1
c) –2 d) +4

149. The oxidation state of "s" in H_2SO_4 is:
a) –1 b) +1
c) –2 d) +6

150. Oxidation state of an element is represented by its:
a) group number in periodic table
b) valence electrons
c) no of vacancies in valence electrons
d) all above are correct

151. Which one has zero oxidation state?
a) Alkali metals b) Alkaline earth metals
c) Noble gases d) Lanthanides

152. Zinc shows oxidation number:
a) II b) V
c) VI d) VII

153. Vanadium shows oxidation number:
a) II b) V
c) VI d) VII

154. Chromium shows oxidation number:
a) II b) V
c) VI d) VII

155. Manganese shows oxidation number:
a) II b) V
c) VI d) VII

ELECTRICAL CONDUCTANCE

156. Trend of electric conductance for group I–A & II–A in a group is:
a) decreases b) increases
c) Increases, decreases d) may Increases or decreased

157. Coinage metals have conductance:
a) low b) maximum
c) least d) medium

HYDRATION ENERGY

158. Heat change (evolved or absorbed) when one mole of gaseous ions dissolves in water to give an infinitely dilute solution is called:
a) Ionization energy b) Lattice energy
c) Hydration energy d) Binding energy

159. $H^+_{(g)} + Water \longrightarrow H^+_{(aq)}$ the value of ΔH_b in KJ/mol is:
a) –1075 b) 1075
c) 1175 d) –1175

160. Hydration energy of ions depend upon:
a) mass of ion b) charge to size ratio of ion
c) P.E. of ion d) charge of ion

161. Trend of charge to size ratio and hydration energy in a period is:
a) increases b) decreases
c) remains same d) varies continuously

(1.5.A) HALIDES

162. The binary compounds of hydrogen are called:
a) hydrides b) halides
c) oxides d) nitrides

163. The binary compounds of halogens are called:
a) hydrides b) halides
c) oxides d) nitrides

164. The binary compounds of oxygen are called:
a) hydrides b) halides
c) oxides d) nitrides

165. The binary compounds of nitrogen are called:
a) hydrides b) halides
c) oxides d) nitrides

166. The binary compound in which one element, is fluorine is called:
a) Hydride b) Chloride
c) Bromide d) Fluoride

167. The binary compound in which one element is chlorine is called:
a) Hydride b) Chloride
c) Bromide d) Fluoride

168. The binary compound in which are element is bromine is called:
a) Hydride b) Chloride
c) Bromide d) Fluoride

169. $SiCl_4$, PCl_3 and S_2Cl_2 are examples of halides of:
a) ionic b) covalent
c) polymeric d) a, b & c

170. Halides with ionic bond is called:
a) ionic b) covalent
c) only a & b d) none

171. Halides in which halogen element makes a bridge between two other atoms are called:
a) ionic b) covalent
c) polymeric d) a, b & c

172. I-A & II-A groups halides are examples o halides:
a) ionic b) covalent
c) polymeric d) a, b & c

173. Halides of Be, Al and Ga form type of halides:
a) ionic b) covalent
c) polymeric d) a, b & c

174. Halides with the dimensional lattice are:
a) ionic b) covalent
c) polymeric d) a, b & c

175. Ionic halides have property:
a) high m.p & b.p b) high lattice energy
c) high m.p & b.p as well as lattice energy d) non conductor in aqueous state

176. Physical properties of covalent halides a affected by:
a) size of halogen atom b) polarize ability halogen atom
c) polarity of halide bond d) all a & b & c

177. Order of decreasing of ionic character for metal is:
a) F > Cl > Br > I b) I > Br > Cl > F

c) F > I > Cl > Br d) F > Br > I > Cl

178. AlF_3 is a purely ionic halide having melting point (in °C):
a) 1270 b) 1280
c) 1290 d) 1300

179. AlI_3 is predominantly a polar covalent with melting point (in °C):
a) 168 b) 178
c) 188 d) 198

180. AlF_3 is:
a) conductor b) non-conductor
c) semi-conductor d) may be conductor

181. AlI_3 is a:
a) conductor b) non-conductor
c) semi-conductor d) may be conductor

182. $PbCl_2$ is mainly:
a) ionic b) covalent
c) polymeric d) polar covalent

183. PCl_4 is fairly:
a) conductor b) non-conductor
c) semi-conductor d) may be conductor

HYDRIDES

184. Hydrides are classified based upon:
a) bonding b) physical states
c) m.p d) nature

185. Reaction of hydrogen with group I.A and II-A give hydrides:
a) ionic b) covalent
c) intermediate d) complex

186. Hydrides of Be, Mg, Zn & Cd are in nature:
a) ionic b) covalent
c) intermediate d) complex

187. Reaction of hydrogen with groups IV to VII-A give hydrides:
a) ionic b) covalent
c) intermediate d) complex

188. Reaction of hydrides of group I-A & III-A give type of hydrides:
a) ionic b) covalent
c) intermediate d) complex

189. Adsorption of hydrogen in transition elements give hydrides:
a) ionic b) interstitial
c) intermediate d) complex

190. Hydrides used as catalysts generally are:
a) ionic b) covalent
c) intermediate d) complex

191. Tendency of hydrides to be covalent in a period from left to right:
a) decreases b) remains same
c) increases d) all

192. The non-conductor, usually gaseous and volatile hydrides are:
a) ionic b) covalent
c) intermediate d) complex

193. Stability of hydrides in a period from left to right:
a) decreases b) remains same
c) increases d) may increases or decreases

194. Stability of hydrides in group from top to bottom:
a) decreases b) remains same
c) increases d) may increases or decreases

195. Most stable hydrides is of:
a) Fluorine b) Bismuth
c) Thallium d) Lead

196. Hydrides form hydrogen bonding:
a) H_2O b) NH_3
c) HF d) All of the above

197. Boiling point of hydride is the greatest:
a) H_2O b) H_2S
c) H_2Se d) CH_4

198. Hydrides formed between elements with E.N difference greater than 1.8 is:
a) ionic b) covalent
c) complex d) intermediate

OXIDES

199. Oxygen forms its oxides with other elements:
a) almost all b) some one
c) very rare d) with few

200. Types of oxides is/are:
a) Normal b) Super
c) Sub and Per d) All of the above

201. Al_2O_3 and ZnO are oxides:
a) acidic b) basic
c) amphoteric d) superoxides

202. Na_2O, K_2O, MgO and CaO are oxides:
a) acidic b) basic
c) amphoteric d) superoxides

203. Oxides of metals are:
a) acidic oxides b) basic oxides
c) amphoteric oxides d) super oxides

204. Oxides of non-metals are:
a) acidic oxides b) basic oxides
c) amphoteric oxides d) super oxides

205. Oxides of semi-metals are:
a) acidic oxides b) basic oxides
c) amphoteric oxides d) super oxides

Answers

No	Ans	No	Ans	No	Ans	No	Ans	No	Ans
1	b	2	a	3	c	4	d	5	a
6	b	7	b	8	c	9	b	10	a
11	d	12	b	13	d	14	b	15	a
16	d	17	a	18	d	19	a	20	b
21	a	22	d	23	c	24	c	25	c
26	b	27	d	27	d	29	b	30	d
31	b	32	d	33	d	34	a	35	b
36	c	37	d	38	b	39	c	40	d
41	a	42	c	43	b	44	d	45	a
46	d	47	d	48	b	49	d	50	d
51	b	52	b	53	d	54	d	55	d
56	a	57	b	58	a	59	b	60	d
61	c	62	b	63	a	64	c	65	d
66	a	67	a	68	d	69	d	70	d
71	d	72	d	73	d	74	a	75	b
76	c	77	d	78	a	79	a	80	b
81	d	82	a	83	c	84	b	85	d
86	a	87	a	88	d	89	a	90	d
91	c	92	d	93	c	94	b	95	c
96	d	97	d	98	d	99	d	100	a
101	c	102	d	103	c	104	a	105	c
106	d	107	b	108	d	109	b	110	c
111	d	112	d	113	b	114	a	115	a
116	b	117	c	118	d	119	a	120	a
121	b	122	c	123	b	124	a	125	d
126	d	127	c	128	d	129	c	130	c
131	d	132	d	133	c	134	c	135	b
136	b	137	a	138	d	139	a	140	a
141	a	142	B	143	d	144	b	145	a
146	b	147	D	148	c	149	d	150	d
151	c	152	a	153	b	154	c	155	d
156	a	157	b	158	c	159	a	160	b
161	a	162	a	163	b	164	c	165	d
166	d	167	b	168	c	169	b	170	c
171	c	172	a	173	c	174	a	175	c
176	d	177	a	178	c	179	d	180	a
181	b	182	a	183	b	184	a	185	a
186	c	187	b	188	d	189	b	190	d
191	c	192	b	193	b	194	a	195	a
196	d	197	a	198	b	199	a	200	d
201	c	202	b	203	b	204	a	205	c

2. Groups

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:
Describe and explain the variation in the properties of group II and VII elements from top to bottom with special emphasis on:

a) Reactions of group-II elements with oxygen and water.
b) Properties of halogens and uses of chlorine in water purification and as bleaching agent.
c) Reaction of chlorine with sodium hydroxide (disproportionation reactions of chlorine).
d) Uses of Nobel gases (group VIII).

Definitions and Statements

1. **Define Borax:** The sodium salt of tetraboric acid is called borax. Borax has formula $Na_2B_4O_7$
2. **Define Tincal** Borax is also obtained from reservoirs of borax as tincal. Tincal is dissolved in water and then borax is crystallized out through crystallization.
3. **Define Orthoboric Acid** Orthoboric acid (H_3BO_3) is simply called boric acid.
4. **Define Silica** Silicon dioxide is called silica."
5. **Define Silicates** Compounds of silicic acids (H_2SiO_3) are called silicates.

Derivatives of silicic acids are called silicates.

1. **Define Sodium Silicate** A sodium salt of metasilicic acid (H_2SiO_3) is called Sodium silicate (Na_2SiO_3).

6. Sodium silicate is also called water glass or

soluble glass.

7. Define Aluminium Silicate Silicate of Aluminium metal is called Aluminium silicate

Fully Solved Textual Exercise

Q.1. Circle the best suitable choice among the givens.

1. **Which metal is used in the thermit process because of its activity?**
   a) Iron b) Copper
   c) Aluminium d) Zinc
2. **Aluminium oxide is:**
   a) Acidic oxide b) Basic oxide
   c) Amphoteric oxide
   d) None of these
3. **Chemical composition of colemnite is.**
   a) $Ca_2B_6O_{11}.5H_2O$
   b) $CaB_4O_7.4H_2O$
   c) $Na_2B_4O_7.4H_2O$
   d) $CaNaB_5O_9.8H_2O$
4. **Which element forms an ion with charge 3+?**
   a) Beryllium b) Aluminium
   c) Carbon d) Silicon
5. **Which electronic configuration corresponds to an element of Group III-A of the periodic table?**
   a) $1s^2,2s^2,2p^6,3s^2,3p^1$
   b) $1s,2s^2,2p^6,3s^2,3p^6,4s^2$
   c) $1s^2,2s^2,2p^6$
   d) $1s^2,2s^2,2p^6,3s^2,3p^3$
6. **Which element among the following belongs to Group IV-A of the periodic table?**
   a) Barium b) Iodine
   c) Lead d) Oxygen
7. **Boric acid cannot be used:**
   a) as antiseptic in medicine
   b) for washing eyes
   c) in soda bottles
   d) for enamels and glazes
8. **Which of the following elements is not present abundantly in earth's crust?**
   a) Silicon
   b) Aluminium
   c) Sodium
   d) Oxygen
9. **Tincal is a mineral of:**
   a) Al b) B
   c) Si d) C
10. **Chief ore of aluminium is:**
    a) Na_3AlF_6 b) $Al_2O_3.2H_2O$
    c) Al_2O_3 d) $Al_2O_3.H_2O$

Important MCQs

11. **What is the formula of asbestos?**
    (a) $CaMg_3(SiO_3)_4$ (b) $CaSiO_3$
    (c) Na_2SiO_3 (d) $Mg_3H_2(SiO_3)_4$
12. **What is going to replace the petroleum?**
    (a) Silica (b) Silicates
    (c) Silicones (d) Silicon
13. **Which is litharge or massicot?**
    (a) PbO (b) Pb_2O
    (c) Pb_3O_4 (d) PbO_2
14. **What is chrome yellow?**
    (a) PbO (b) Pb_2O
    (c) $PbCrO_4$ (d) Pb_3O_4
15. **Borax is hydrated:**
    (a) Penta (b) deca
    (c) Hepta (d) octa
16. **Silicon atom is hybridized:**
    (a) sp (b) sp^2
    (c) sp^3 (d) dsp^2
17. **Which is not the form of silica?**
    (a) Amethyst quartz (b) Rose quartz
    (c) Smoky (d) None of these
18. **Pb has inert pair of electrons:**
    (a) One (b) two
    (c) Three (d) four
19. **Which is used in navigational equipments?**
    (a) B (b) Be
    (c) Mg (d) Al
20. **Which is used to remove air bubbles from metals?**
    (a) B (b) Be
    (c) Mg (d) Al
21. **Copper oxide is detected by borax bead test with colour:**
    (a) blue (b) red
    (c) yellow (d) black
22. **Which has soapy touch?**
    (a) $Na_2B_4O_7$ (b) H_3BO_3
    (c) $Ca_2B_6O_{11}$ (d) HBO_2
23. **Density of aluminium is ($g\ cm^{-3}$):**
    (a) B (b) Al

(c) Si (d) Ge

24. **Al is the most element in earth crust:**
(a) O (b) Si
(c) Al (d) Pb

25. **Which property is not present in Al?**
(a) reacts with acids (b) reacts with bases
(c) changes litmus paper (d) changes methyl orange colour

26. **Corrundam is ore of:**
(a) Li (b) Be
(c) B (d) Al

27. **A compound used as eye wash:**
(a) borax (b) boric acid
(c) metaboric acid (d) pyroboric acid

28. **Dipole moment of CO molecule is:**
(a) 0.0 (b) 1.112 D
(c) 0.112 D (d) 2.112 D

29. **Hybridization in carbon is:**
(a) sp (b) sp^2
(c) sp^3 (d) d^2sp

30. **Hybridization in oxygen is:**
(a) sp (b) sp^2
(c) sp^3 (d) dsp^3

GROUP III-A ELEMENTS

31. Boon Aluminum, Gallium, indium, and thallium belong to group.
(a) I-A (b) II-A
(c) III-A (d) IV-A

32. **Which element does not belong to III-A group?**
(a) Al (b) Ge
(c) Ga (d) Th

33. **Which element is non metallic in nature?**
(a) Al (b) Ge
(c) Ga (d) B

34. **Which element isa semi-metal?**
(a) Al (b) Ge
(c) Ca (d) B

35. **Pair of element belonging to group III-A?**
(a) Al & Ca (b) B & Be
(c) Ga & Ge (d) In & Te

36. **The metallic characters increase from, in group III-A**
(a) B to Th (b) Ti to B
(c) Ga to B (d) In to Al

OCCURRENCE (BORON AND ALUMINUM)

37. **Element necessary for proper plant growth in small amounts.**
(a) B (b) Al
(c) Ga (d) In

38. **Elements not present in free state.**
(a) B (b) Th
(c) Ga (d) In

39. **The 3rd most abundant element in the earth crust after oxygen and silicon**
(a) Si (b) Al
(c) O (d) H

40. **Borax or Tincal formula is**
(a) $Na_2B_4O_7.10H_2O$
(b) $Ca_2B_6O_{11}.5H_2O$
(c) $Al_2O_3.2H_2O$
(d) Al_2O_3

41. **Formula of colemanite is**
(a) $Na_2B_4O_7.10H_2O$
(b) $Ca_2B_6O_{11}.5H_2O$
(c) $Al_2O_3.2H_2O$
(d) Al_2O_3

42. **Formula of bauxite is**
(a) $Na_2B_4O_7.10H_2O$
(b) $Ca_2B_6O_{11}.5H_2O$
(c) $Al_2O_3.2H_2O$
(d) Al_2O_3

43. **Formula of corundum is**
(a) $Na_2B_4O_7.10H_2O$
(b) $Ca_2B_6O_{11}.5H_2O$
(c) $Al_2O_3.2H_2O$
(d) Al_2O_3

44. **Formula of cryolite is**
(a) $Na_2B_4O_7.10H_2O$
(b) $Ca_2B_6O_{11}.5H_2O$
(c) $Al_2O_3.2H_2O$
(d) Na_3AlF_6

PECULIAR BEHAVIOR OF BORON

45. **A difference in Boron and rest of elements of group III-A.**
(a) three valence electrons
(b) ns^2p^1configuration
(c) molecular addition compound
(d) electron deficient

46. **Difference of boron from rest of elements of group III-A is due to**
(a) Boron shows +3and-3 oxidation
(b) Boron is non-metallic
(c) Boron forms molecular addition compounds
(d) All above

47. **Which ionic compound of boron does exist?**
(a) BCl_3 (b) $B(NO_3)_3$
(c). $B_2(SO_4)_3$ (d) $B(OH)_3$

COMPOUNDS OF BORON

48. **Borax is a salt of tetraboric acid of metal**
(a) K (b) Na

(c) Mg (d) Ca

49. *Borax occurs as natural deposits as*
(a). Tincal
(b). Feldspar
(c). Aluminite
(d). Borite

50. *Borax in water is*
(a) Soluble (b) insoluble
(c) Immiscible (d) Sparingly soluble

51. *Borax is*
(a) White
(b) Crystalline
(c) Sparingly soluble
(d) All above

52. *100 grams of water dissolves borax in it at 10°C*
(a) 1gm (b) 2gm
(c) 3gm (d) 98.3gm

53. *100 grams of water dissolves borax in it at 100°C*
(a) 1gm (b) 2gm
(c) 3gm (d) 99.3gm

54. *Octahedral crystals of pentahydrated borax are obtained above.*
(a) Room temperature
(b) 0°C
(c) 28°C
(d) 62°C

55. *Deca hyedrated crystals of borax are obtained above*
(a) Room temperature
(b) 0°C
(c) 28°C
(d) 62°C

56. *Hydrolysis of borax yields solution.*
(a) Acidic (b) basic
(c) amphoteric (d) Neutral

57. *Hydrolysis of borax can be prevented in the presence of*
(a) Alcohol (b) KCl
(c) NaCl (d) Glycerin

58. $Na_2B_4O_7 + 2HCl + 5H_2O \longrightarrow 2NaCl + ---?$
(a) H_3BO_3 (b) HBO_2
(c) $H_2B_4O_7$ (d) $H_6B_4O_9$

59. $Na_2B_4O_7 + H_2SO_4 + 5H_2O \longrightarrow Na_2SO_4 + ?$
(a) H_3BO_3 (b) HBO_2
(c) $H_2B_4O_7$ (d) $H_6B_4O_9$

60. *Metal used in borax bead test is*
(a) Al (b) Na
(c) Co (d) Pt

61. *Glassy bead formed in borax bead test is*
(a) $NaBO_2$ (b) B_2O_3
(c) $Na_2B_4O_7$
(d) $Na_2B_9O_7.2NaBO_2$

62. *Colour of bead of Cu metal in oxidizing flame is*
(a) Green(hot) blue (cold)
(b) colourless (cold)
(c) Brown(hot)yellow(cold)
(d) Bottle green hot & cold

63. *Borax is used*
(a) borate glasses (b) in water softening
(c) As flux (d) All above

BORIC ACIDS

64. *The most important boric acid is*
(a). Orthoboric acid (H_3BO_3)
(b). Metaboric acid
(c). Tetraboric acid
(d). Pyroboric acid

65. *H_3BO_3 is an acid*
(a). Orthoboric acid (H_3BO_3)
(b). Metaboric acid
(c). Tetraboric acid
(d). Pyroboric acid

66. *HBO_2 is an acid*
(a). Orthoboric acid (H_3BO_3)
(b). Metaboric acid
(c). Tetraboric acid
(d). Pyroboric acid

67. *$H_2B_9O_7$ is*
(a). Orthoboric acid (H_3BO_3)
(b). Metaboric acid
(c). Tetraboric acid
(d). Pyroboric acid

68. *$2B_2O_3 . H_2O$ is*
(a). Orthoboric acid (H_3BO_3)
(b). Metaboric acid
(c). Tetraboric acid
(d). Pyroboric acid

69. *$H_6B_4O_9$ is*
(a). Orthoboric acid (H_3BO_3)
(b). Metaboric acid
(c). Tetraboric acid
(d). Pyroboric acid

70. *Orthoboric acid has crystalline solid*
(a). Tetrahedral (b). Orthogonal
(c). Cubic (d). Triclinic

71. *Solubility of orthoboric acid in water at 40°C is*
(a). 2.6% (b). 3.6%
(c). 4.6% (d). 5.6%

72. *Solubility of orthoboric acid in water at 107°C is*
(a). 17% (b). 27%

(c). 37% (d). 47%

73. **Boric acid is**
(a). Crystalline
(b). soft soapy touch
(c). Volatile in steam
(d). All above

74. **Orthoboric acid turns blue litmus to red but to methyl orange it has**
(a). No effect
(b). changes its colour
(c). Changes red to yellow
(d). Changes yellow to red

75. **Orthoboric acid can be titrated against strong alkali in the presence of**
(a). Glycerin (b). ethanol
(c). Acetone (d). Xylene

76. **Which is used as antiseptic medicine?**
(a). Boric acid (b). borax
(c). Sodium meta borate
(d). Metaboric acid

77. **Boric acid is used as**
(a). Dusting powder (b). boric ointment
(c). Eye wash (d). All above

REACTIONS OF ALUMINUM

78. **Oxide layer over aluminum metal is enhanced by a process called**
(a). Fermentation (b). rusting
(c). Anodizing (d). Electroplating

79. **Aluminum reacts with hydrogen forming**
(a). AiH (b). AlH_2
(c). AlH_3 (d). AlH_4

80. **Aluminum burns in oxygen at temperature**
(a). highest (b). room
(c). 0°C (d). Over 20°C

81. **Intense white high splash produces on the reaction of aluminum with**
(a). Hydrogen (b). oxygen
(c). Nitrogen (d). Halogens

82. **Colour of aluminum nitride precipitate is**
(a). White (b). blue
(c). Intense green (d). Yellow

83. **Air bubbles are removed from molten metals by using metal**
(a). Li (b). Cu
(c). Co (d). Al

84. **Which metal does corrode badly in salt solution?**
(a). Li (b). Cu
(c). Co (d). Al

85. **Which metal or its alloys are not useful for marine use?**
(a). Li (b). Cu
(c). Co (d). Al

86. **Aluminum reacts easily with most of mineral acids but is passive towards**
(a). HCl (b). H_2SO_4
(c). HNO_3 (d). H_3PO_4

87. **Dilute acids react with Al- producing gas**
(a). H_2 (b). Cl_2
(c). SO_2 (d). NO_2

88. **Concentrated hot sulfuric acid reacts with aluminum producing gas**
(a). H_2 (b). Cl_2
(c). SO_2 (d). NO_2

GROUP IV-A ELEMENTS

89. **Element of group IV-A**
(a). C (b). In
(c). Th (d). Al

90. **The element(s) non metals are:**
(a). C and Sn (b). C and Si
(c). Si and Sn (d). Sn and Pb

91. **Which pair of elements form long chains?**
(a). C and Sn (b). C and Si
(c). Si and Sn (d). Sn and Pb

92. **Silicon forms long chains alternating with element.**
(a). Carbon (b). Nitrogen
(d). Oxygen (d). Hydrogen

93. **Which pair of elements forms acidic oxides?**
(a). C and Si (b). Si and Ge
(c). Sn and Pb (d). Ge and Sn

94. **Which pair of elements form amphoteric oxides?**
(a). C and Si (b). Si and Ge
(c). Sn and Pb (d). Zn and Al

95. **Which pair of elements form only covalent compounds?**
(a). C and Si (b). Si and Ge
(c). Sn and Pb (d). Ge and Sn

96. **Which pair of elements can use its four or two electrons from four?**
(a). C and Si (b). Si and Ge
(c). Sn and Pb (d). Ge and Sn

97. **What oxidation state may be of carbon?**
(a). +4 (b). –4
(c). +4 and -4 (d). +2 and +4

98. **What is oxidation state of tin?**
(a). +4 (b). –4
(c). +4 and -4 (d). +2 and +4

99. **What is oxidation state of lead?**
(a). +4 (b). –4
(c). +4 and -4 (d). +2 and +4

100. *Common property of group IV-A elements*
(a). Valency four
(b). form hydrides
(c). Form chlorides
(d). All above

OCCURRENCE OF CARBON

101. *Formula of lime stone is*
(a). $CaCO_3$ (b). $MgCO_3.CaCO_3$
(c). $MgCO_3$ (d). $CaMg_3(SiO_3)_4$

102. *Formula of dolomite is*
(a). $CaCO_3$ (b). $MgCO_3.CaCO_3$
(c). $MgCO_3$ (d). $CaMg_3(SiO_3)_4$

103. *Formula of magnesite is*
(a). $CaCO_3$ (b). $MgCO_3.CaCO_3$
(c). $MgCO_3$ (d). $CaMg_3(SiO_3)_4$

104. *Formula of asbestos is*
(a). $CaCO_3$ (b). $MgCO_3.CaCO_3$
(c). $MgCO_3$ (d). $CaMg_3(SiO_3)_4$

105. *Formula of talc or soapstone is*
(a). $CaCO_3$ (b). $MgCO_3.CaCO_3$
(c). $H_2Mg_3(SiO_3)_4$ (d). $MgCO_3$

106. *About 25% of eath crust mass is made up of element*
(a). Carbon (b). Silicon
(c). Germanium (d). Tin

107. *Silicon exists as quartz in the form of its*
(a). Oxides (b). Hydrides
(c). Halides (d). Hydroxide

108. *Sand is infect:*
(a). Silica (b). Opal
(c). Smoky quartz (d). Rose quartz

109. *Hydrated variety of quartz is called*
(a). Silica (b). Opal
(c). Smoky quartz (d). Rose quartz

PECULIAR BEHAVIOR OF CARBON

110. *Which element cansitute basic of organic chemistry*
(a). C (b). Si
(c). Ge (d). Sn

COMPOUNDS OF CARBON AND SILICON

111. *Known oxide of carbon is*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

112. *The least important oxide of carbon is*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

113. *Which molecule is diatomic in nature?*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

114. *The molecule has triple bond in it*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

115. *The slightly polar oxide of carbon is*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

116. *Molecule with dipole moment = 0.112D is*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

117. *Which molecule exists as linear molecule?*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

118. *Which has dipole moment zero?*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

119. *A molecule in solid state having face-centred cusic structure is :*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

120. *The bond distance is 115 pm in molecule*
(a). CO (b). CO_2
(c). C_3O_2 (d). CO and CO_2

Answers

1	c	2	c	3	a	4	b	5	a
6	c	7	c	8	c	9	b	10	b
11	a	12	c	13	a	14	c	15	b
16	c	17	d	18	b	19	d	20	d
21	a	22	b	23	b	24	c	25	d
26	d	27	b	28	c	29	a	30	b
31	c	32	b	33	d	34	b	35	d
36	a	37	a	38	a	39	b	40	a
41	B	42	c	43	d	44	d	45	c
46	d	47	a	48	b	49	a	50	d
51	d	52	c	53	d	54	d	55	d
56	b	57	d	58	a	59	a	60	d
61	a	62	a	63	d	64	a	65	a
66	b	67	c	68	d	69	d	70	d
71	a	72	c	73	d	74	a	75	a
76	a	77	d	78	c	79	c	80	a
81	b	82	a	83	d	84	d	85	d
86	c	87	a	88	c	89	a	90	b
91	b	92	d	93	a	94	d	95	a
96	c	97	b	98	d	99	d	100	d
101	a	102	b	103	c	104	d	105	c
106	b	107	a	108	a	109	b	110	a
111	d	112	c	113	a	114	a	115	a
116	a	117	b	118	b	119	b	120	a

****

3. Transition Elements

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:
Discuss the chemistry of transition elements of 3-d series with special emphasis on:

a) Electronic configuration.
b) Variable oxidation states.
c) Use as a catalyst.
d) Formation of complexes.
e) Colour of transition metal complexes.

Definitions and Statements

1. **3d–Series:** The elements present in **fourth period** of periodic table are called 3d-series. It starts from $_{21}Sc$ to $_{30}Zn$.
2. **4d–Series:** The elements present in **fifth period** of periodic table are called 4d-series. It starts from $_{39}Y$ to $_{48}Cd$
3. **5d–Series:** The elements present in **6th period** of periodic table are called 5d-series. It starts from $_{57}La$, $_{42}Hf$ – $_{80}Hg$. It has ten elements.
4. **6d–Series:** Elements present in **seventh period** of periodic table are called 6d-series. It has seven elements from atomic number (104–110).
5. **Typical Transition Elements: Transition elements except group II-B and III-B are called typical transition elements."**
6. Non Typical Transition Elements: Transition elements of group II-B and III-B are called non-typical transition elements. These elements show exceptional behavior than the typical transition elements."
7. **Inner Transition Elements:**

The transition elements in which valence shell electrons are present in f-orbital are called inner transition elements.
Elements of f-block in periodic table are called inner transition elements.
Examples: Lanthanides and Actinides.

8. **Outer Transition Elements**

The transition elements in which valence electron is present in d-orbital are called outer transition elements.
Elements of d-block in periodic table are called outer transition elements.

9. **Magnetic Characters**

The effect of the magnetic field on the rotation of electrons is called magnetic character.

10. **Diamagnetic Substances**

The substances which are weakly **repelled** by a strong magnetic field are called diamagnetic substances.

11. **Paramagnetic Substances**

The substances which are weakly **attracted** by a strong magnetic field are called paramagnetic substances.

12. **Oxidation State**

All transition elements show important property of variable oxidation state.

13. **Interstices**

Transition metals have empty spaces in their structure. These empty spaces are called interstices.

14. **Interstitial Compounds**

Non-metals like H, B, C, N are adsorbed in interstices of transition metals giving them characteristics feature. These transition compounds are called interstitial compounds.

15. **Alloy Formation**

"Replacement of atoms of one element (metal) with the atoms of the other element (metal) in the metallic lattice due to similar in size are called alloys formation or substitutional alloys."

16. **Complex Compounds**

The compounds containing complex molecules or ions and capable of independent existence are called coordination compounds or coordination complexes or complex compounds."

17. **Central Metal Ion**

A metal atom or ion (usually a transition element) surrounded by a number of ligands is called a central metal atom or ion."

Example: $K_4[Fe(CN)_6]$, $[Ag(NH_3)_2]Cl$

18. **Ligand**

The atoms or ions or neutral molecules which surround the central metal ion and donate electron pairs are called ligands." They may be anions or neutral molecules

Example: $K_4[Fe(CN)_6]$, $[Ag(NH_3)_2]Cl$

19. Bidentate Ligands

"Ligands having two donor atoms are called bidentate ligands."

20. Coordination number

The number of lone pair of electrons provided by the ligands to the central metal atom or ion is called the coordination number of the central metal atom or ion."

21. Coordination Sphere

"The central metal atom or ion along with ligands is called the coordination sphere."

22. Charge on the Coordination Sphere

It is the algebraic sum of the charges present on the central metal ion and the total charge on the ligands."

23. Chelates

When all the donor atoms of a polydentate ligand get coordinated with the same metal ion, a complex compound is formed which contains one or more rings in its structure is called a Chelate."

24. Puddling: It is a special type of furnace called reverberatory furnace.

Fully Solved Textual Exercise

Q.1. Encircle the suitable choice.

1. Which of the following is non-typical transition element?

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

2. Which of the following is a typical transition metal?

(a) Sc (b) Y
(c) Ra (d) Co

3. f-block elements are also called:

(a) Non-typical transition elements.
(b) Outer transition elements.
(c) Normal transition elements.

4. The strength of binding energy of transition elements depends upon:

(a) Number of electron pairs.
(b) Number of unpaired electrons.
(c) Number of Neutrons.
(d) Number of protons.

5. Group VI-B of transition elements contains:

(a) Zn, Cd, Hg
(b) Fe, Ru, Os
(c) Cr, Mo, W
(d) Mn, Te, Re

6. Which is the formula of tetra-ammine chloronitro platinum (IV) sulphate?

(a) $[Pt(NH_3)_4(NO_2)]SO_4$
(b) $[PtNO_2Cl(NH_3)_4]SO_4$
(c) $[PtCl(NO_2)(NH_3)_4]SO_4$
(d) $[Pt(NH_3)_4(NO_2)Cl]SO_4$

7. The percentage of carbon in different types of iron products is in the order of:

(a) Cast iron > wrought iron > steel
(b) Wrought iron > steel > cast iron
(c) Cast iron > steel > wrought iron
(d) Cast iron = steel > wrought iron

8. The colour of transition metal complexes is due to:

(a) d-d transitions of electrons.
(b) Paramagnetic nature of transition elements.
(c) Ionization.
(d) Loss of s-electrons.

9. Coordination number of Pt in $[PtCl(NO_2)(NH_3)_4]^{2-}$ is:

(a) 2^- (b) 4
(c) 1 (d) 6

10. The total number of transition elements is:

(a) 10 (b) 14
(c) 40 (d) 50

Answers

No.	Ans.	No.	Ans.
1.	c	2.	d
3.	c	4.	b
5.	c	6.	c
7.	a	8.	a
9.	b	10.	d

Important MCQs

1. *3-d-series elements are present in:*

a) first period *b)* second period
c) third period *d)* 4th period

2. *Which period starts from $_{11}Sc$ to $_{30}Zn$?*

a) first period *b)* second period
c) third period *d)* 4th period

3. *Series starting from $_{39}Y$ to $_{48}Cd$ is in period:*

a) 4th *b)* 5th
c) 6th *d)* 7th

4. *4-d-series is in the period:*

a) 4th *b)* 5th
c) 6th *d)* 7th

5. *5d-series is in the period:*

a) 4th *b)* 5th
c) 6th *d)* 7th

6. *Series starting from $_{57}La$, $_{42}Hf$–$_{80}Hg$ is in the period:*

a) 4th *b)* 5th

c) 6th d) 7th

7. **6d-series is in the period:**
a) 4th b) 5th
c) 6th d) 7th

8. **d-block elements are also called:**
a) alkali metal b) alkaline earth metals
c) transition elements d) electron deficient elements

9. **f-block elements are called:**
a) alkali metal b) alkaline earth metals
c) transition elements d) electron deficient elements

10. **Transition elements are called so because:**
a) form interstitial compounds
b) have high m.p
c) in between 's' and 'p' block elements
d) All of these

11. **Which element pair is although transition elements, yet have half filled s-orbitals?**
a) Cu and Co b) Co and Cr
c) Cu and Cr d) Zn and Cr

12. **Why Cr and Cu has half filled s-orbitals?**
a) they belong to s-block elements
b) they are alkali metals
c) this gives stability to d-orbitals
d) they are alkaline earth metals

TYPICAL AND NON-TYPICAL TRANSITION ELEMENTS

13. **Typical transition elements are transition elements except the groups:**
a) I–A and II–A b) II–A and II–B
c) II–B and III–B d) III–B and III–A

14. **Non-typical elements belong to the series:**
a) I–A and II–A b) II–A and II–B
c) II–B and III–B d) III–B and III–A

15. **Zn, Cd and Hz belong to the series:**
a) I–B b) II–B
c) III–B d) IV–B

16. **Sr, Y and La belong to the series:**
a) I–B b) II–B
c) III–B d) IV–B

17. **A property which includes the II–B series, in transition elements:**
a) they make complexes
b) they are pure metals
c) they have partially filled d-orbital
d) they show transition properties in compound state

18. **Group III–B series elements have electrons in d-orbitals:**
a) one b) two
c) three d) nil

19. **Group II–B series elements have electrons in d-orbital:**
a) one b) two
c) three d) nil

20. **A typical transition element is:**
a) Sc b) Y
c) Zr d) Zn

21. **A non-typical transition element is:**
a) Cu b) Y
c) Cr d) Zr

22. **Coinage metals are:**
a) Cu b) Ag
c) Au d) All of these

23. **Coinage metal is:**
a) Co b) Ag
c) Pt d) Ni

24. **Valency of gold is:**
a) +1 b) +2
c) +3 d) +4

25. **Valence electronic configuration of Cu^{+2} is:**
a) $3d^9$ b) $4d^9$
c) Sd^9 d) $6d^9$

26. **Valence electronic configuration of Ag^{+1} is:**
a) $3d^9$ b) $4d^9$
c) Sd^9 d) $6d^9$

27. **Valence electronic configuration of Au^{+3} is:**
a) $3d^9$ b) $4d^9$
c) Sd^9 d) $6d^9$

28. **d-block elements are called:**
a) outer transition elements
b) inner transition elements
c) transition elements
d) chalcogens

29. **f-block elements are called:**
a) outer transition elements
b) inner transition elements
c) transition elements
d) chalcogens

30. **d- and f-block elements are called:**
a) outer transition elements
b) inner transition elements
c) transition elements
d) chalcogens

31. **Elements having d-orbital in process of completion are called:**
a) outer transition elements
b) inner transition elements
c) transition elements
d) chalcogens

32. **Elements having f-orbital in process of**

completion are:

a) outer transition elements
b) inner transition elements
c) transition elements
d) chalcogens

GENERAL CHARACTERISTICS OF TRANSITION ELEMENTS

33. Transition elements have property(ies):
a) pure metals b) complex formation
c) alloys formation d) All of these

34. A property NOT in transition elements:
a) complexes formation b) diamagnetic
c) alloys formation d) interstitial compounds

BINDING ENERGIES, MELTING POINT, BOILING POINT

35. Transition elements have binding energies:
a) low b) high
c) no effect d) All of these

36. Melting point, boiling point and binding energies of transition elements is high because of:
a) electrons are present in d-orbitals only
b) all are metals and form alloys
c) all show variable oxidation state
d) electrons in 's' and 'd'-orbitals involve in bonding

37. Binding energies of group II-B is
a) maximum b) minimum
c) zero d) medium

38. V–B and VI–B have binding energy:
a) maximum b) minimum
c) zero d) medium

39. Which element has maximum binding energy?
a) Zn b) Co
c) V d) W

40. Which element has zero binding energy?
a) Zn b) Co
c) V d) W

41. Which element has highest melting point?
a) Zn b) Co
c) V d) W

42. Which has least melting point among the given?
a) Zn b) Co
c) V d) W

PARAMAGNETISM

43. An atom or molecule with all completely filled orbitals show:
a) magnetism b) paramagnetism
c) diamagnetism d) None of them

44. An atom or molecule having partially filled orbitals show:
a) magnetism b) paramagnetism
c) diamagnetism d) None of them

45. Transition elements show:
a) magnetism b) paramagnetism
c) diamagnetism d) None of them

46. Elements showing no net effect of applied magnetic field are called:
a) magnetism b) paramagnetism
c) diamagnetism d) None of them

47. Elements showing net effect of applied magnetic field are called:
a) magnetism b) paramagnetism
c) diamagnetism d) None of them

48. Maximum paramagnetism are present in:
a) Fe^{+3} b) Mn^{+2}
c) Fe^{+3} and Cu^{+2} d) Fe^{+3} and Sc^{+3}

49. Greater the number of unpaired electrons, stronger will be the:
a) binding energies b) melting and boiling points
c) paramagnetism d) All of these

50. Oxidation states of iron are:
a) +1, +2 b) +2, +3
c) +1, +3 d) +2, +4

51. Oxidation state of copper is:
a) +1, +2 b) +2, +3
c) +1, +3 d) +2, +4

52. Oxidation states of lead is:
a) +1, +2 b) +2, +3
c) +1, +3 d) +2, +4

53. Oxidation state of tin is:
a) +1, +2 b) +2, +3
c) +1, +3 d) +2, +4

54. Oxidation state of antimony is:
a) +1, +2 b) +2, +3
c) +1, +3 d) +2, +4

COLOUR AND INTERSTITIAL COMPOUNDS

55. Transition of electrons from 'd' to 'd' orbitals gives property to the transition elements:
a) paramagnetism b) variable oxidation state
c) colour d) interstitial compounds

56. Transition of electrons from 's' or 'd' to 'd'-orbitals gives properties:
a) paramagnetism b) variable oxidation

c) colour d) state interstitial compounds

57. $[Ti(H_2O)_6]^{+3}$ absorbs light of wavelength:
a) yellow b) red
c) blue d) Both (a) and (b)

58. $[Ti(H_2O)_6]^{+3}$ transmit light of wavelength:
a) yellow b) red
c) blue d) Both (a) and (b)

59. A property(ies) which differentiate the interstitial compounds from true compounds is(are):
a) Non-stoichiometric ratio
b) No true bond
c) No whole number ratio
d) All of these

60. Elements which can adsorb in interstics of transition elements:
a) Hydrogen b) Carbon
c) Boron and Nitrogen d) All of these

COMPLEX COMPOUNDS

61. Which is a complex ion?
a) Fe^{+2} b) CN^{-11}
c) K^+ d) $[Fe(CN)_6]^{4-}$

62. Which is a central metal ion in $K_4[Fe(CN)_6]$?
a) Fe^{+2} b) CN^{-11}
c) K^+ d) $[Fe(CN)_6]^{4-}$

63. Which is ligand in $K_4[Fe(CN)_6]$?
a) Fe^{+2} b) CN^{-11}
c) K^+ d) $[Fe(CN)_6]^{4-}$

64. What is coordination number in $K_4[Fe(CN)_6]$?
a) 1 b) 3
c) 4 d) 6

65. Coordination number of Cu in $[Cu(NH_3)_4]SO_4$ is:
a) 2 b) 4
c) 6 d) 8

66. What type of a coordination sphere may be:
a) anionic b) cationic
c) neutral d) All of these

67. Which is neutral sphere?
a) $[Fe(CN)_6]^{4-}$ b) $[Cu(NH_3)_4]^{2+-}$
c) $[Ni(CO)_4]^0$ d) All of these

68. The charge on the coordination sphere in $[Fe(CN)_6]$ is:
a) −1 b) −2
c) −3 d) −4

69. If all the donar atoms coordinate with central metal atom making one or more rings in the structure is called:
a) zwitter ion b) chelates
c) dipolar ion d) molecular ion

70. $[MnCl_4]^{2-}$ has hybridization in it:
a) sp^3d^2 b) dsp^3
c) dsp^2 d) sp^3

71. PCl_5 has hybridization in it:
a) sp^3d^2 b) dsp^3
c) dsp^2 d) sp^3

IRON

72. Formula of magnetite is:
a) Fe_2O_3 b) Fe_3O_4
c) $Fe_2O_3.3H_2O$ d) FeS_2

73. Formula of haematite is:
a) Fe_2O_3 b) Fe_3O_4
c) $Fe_2O_3.3H_2O$ d) FeS_2

74. Formula of limonite is:
a) Fe_2O_3 b) Fe_3O_4
c) $Fe_2O_3.3H_2O$ d) FeS_2

75. Formula of iron pyrite is:
a) Fe_2O_3 b) Fe_3O_4
c) $Fe_2O_3.3H_2O$ d) FeS_2

76. In Quran, al-hadeed means:
a) copper b) iron
c) gold d) silver

77. Iron is known to Egypt since:
a) pre-historic times b) 1500 BC
c) 2500 BC d) 600 BC

78. Iron is known to the Chinese since:
a) pre-historic times b) 1500 BC
c) 2500 BC d) 600 BC

79. Iron was produced in Sub-continent since:
a) pre-historic times b) 1500 BC
c) 2500 BC d) 600 BC

80. Pig iron or cast iron has carbon contents:
a) 2.5–4.5% b) 0.12%–0.25%
c) 0.25–2.5% d) 0.1–0.2%

81. Wrought iron has carbon in it:
a) 2.5–4.5% b) 0.12%–0.25%
c) 0.25–2.5% d) 0.1–0.2%

82. *Steel has carbon in it:*
a) 2.5–4.5% b) 0.12%–0.25%
c) 0.25–2.5% d) 0.1–0.2%

83. *Mild steel has carbon contents in it:*
a) 2.5–4.5% b) 0.12%–0.25%
c) 0.25–2.5% d) 0.1–0.2%

84. *Wrought iron is prepared from pig iron by the process:*
a) Bessemer's atom b) blast furnace
c) puddling d) open hearth process

85. *Reverberatory furnace is lined with:*
a) steel b) carbon
c) graphite d) haematite

86. *Medium steel has carbon contents:*
a) 0.1–0.2% b) 0.2–0.7%
c) 0.7–1.5% d) 0.2–1.5%

87. *Hard steel contains carbon in it:*
a) 0.1–0.2% b) 0.2–0.7%
c) 0.7–1.5% d) 0.2–1.5%

88. *A furnace used for steel lined with silica:*
a) acidic lined furnace b) basic lined furnace
c) open hearth process d) puddling

89. *Furnace lined with oxides of manganese and calcium is:*
a) acidic lined furnace b) basic lined furnace
c) open hearth process d) puddling

CORROSION

90. *Process of chemical decay due to atmospheric effect is called:*
a) corrosion b) anodization
c) puddling d) oxidation

91. *Annually, amount of iron get corroded is of its production:*
a) 1/2 b) 1/4
c) 3/4 d) 1/10

92. *In a galvanic cell of zinc with iron, zinc destroys, it is called:*
a) corrosion b) sacrificial corrosion
c) galvanizing d) cathode coating

93. *Plating of iron with zinc is called:*
a) corrosion b) sacrificial corrosion
c) galvanizing d) cathode coating

CHROMATES AND DICHROMATES

94. *Salts of chromic acids are called:*
a) chromates b) dichromates
c) silicates d) silicones

95. *Salts of dichromic acids are:*
a) chromates b) dichromates
c) silicates d) silicones

Answers

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

4. Elements of Biological Importance

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

topic, student should be able to:

a) Describe the inertness of Nitrogen.
b) Manufacture of Ammonia by Haber's process.
c) Discuss the uses of nitrogenous fertilizers.
d) Describe the presence of Sulphur dioxide in the atmosphere which causes acid rain.
e) Describe only manufacturing of Sulphuric acid by contact method.

Fully Solved Textual Exercise

1. *Out of all the elements of group V-A, the highest ionization energy is possessed by:*
(a) N (b) P
(c) Sb (d) Bi

2. *Among group V-A elements, the most electronegative element is:*
(a) Sb (b) N
(c) P (d) As

3. *Oxidation of NO in air produces:*
(a) N_2O (b) N_2O_3
(c) N_2O_4 (d) N_2O_5

4. *The brown gas formed when metal reduces HNO_3 is:*
(a) N_2O_5 (b) N_2O_3
(c) NO_2 (d) NO

5. *Laughing gas is chemically:*
(a) NO (b) N_2O
(c) NO_2 (d) N_2O_4

6. *Out of all the elements of group VI-A the highest melting and boiling points is shown by the element:*
(a) Te (b) Se
(c) S (d) Pb

7. *SO_3 is not absorbed in water directly to or H_2SO_4 because:*
(a) the reaction does not go to completion.
(b) the reaction is quite slow.
(c) the reaction is exothermic.
(d) SO_3 is insoluble in water.

8. *Which catalyst is used in contact process?*
(a) Fe_2O_3 (b) V_2O_5
(c) SO_3 (d) Ag_2O

9. *Which of the following species has the maximum number of unpaired electrons?*
(a) O_2 (b) O_2^+
(c) O_2^- (d) O_2^{-2}

Important MCQs

10. *Which has garlic like odour?*
(a) N_2O (b) NO
(c) NO_2 (d) P_2O_5

11. *Reaction of HNO_3 with very dilute Zinc and at low temperature gives:*
(a) H_2 (b) NO
(c) NO_2 (d) NH_4

12. *Tungsten and uranium are turned to an reaction with HNO_3:*
(a) Oxides (b) Chlorides
(c) Nitrides (d) Nitrates

13. *NO_2 forms acidic solution:*
(a) Red (b) Blue
(c) Green (d) Brown

14. *Aqua Regia has ratio of conc. HCl and HNO_3:*
(a) 1 : 2 (b) 1 : 3
(c) 1 : 4 (d) 2 : 3

15. *Which phosphorus is the most poisonous?*
(a) White (b) Red
(c) Black (d) All

16. *Nitrogen is present in atmosphere by weight:*
(a) 75% (b) 76%
(c) 77% (d) 78%

17. *Which are metalloid?*

(a) Nitrogen and phosphorous (b) Arsenic and antimony
(c) Phosphorous and arsenic (d) Antimony and bismuth

18. Calcium carbonate contains oxygen in it:
(a) 48% (b) 50%
(c) 53% (d) 60%

19. Sulphuric acid is used:
(a) As fertilizers (b) As dehydrating agent
(c) As oxidizing agent (d) All above

20. Which is aqua regia?
(a) HCl : NO (b) HCl : HNO_3
(c) HCl : H_2SO_4 (d) H_2SO_4 : HNO_3

21. Which is laughing gas?
(a) NO (b) N_2O
(c) NO_2 (d) NO_3

22. Which gas produces here? $2P + 4SOCl_2 \longrightarrow$ Products
(a) CO_2 (b) P_2O_5
(c) PCl_3 (d) SO_2

23. Which are the possible products? $6HI + 2HNO_{3(conc.)} \longrightarrow$
(a) NO (b) H_2O
(c) I_2 (d) A, b, c

24. Which can be prepared from HNO_3?
(a) T.N.T (b) Fertilizers
(c) Picric acid (d) All of these

25. Formation of NO from N_2 and O_2 requires temp:
(a) 30°C (b) 300°C
(c) 3000°C (d) 30000°C

26. Which is nitrous acid?
(a) HNO_3 (b) HNO
(c) HNO_2 (d) H_2NO_3

27. Which has sweetish taste?
(a) N_2O (b) NH_3
(c) Cl_2 (d) CO_2

28. Which gas is heavier than air?
(a) CO_2 (b) NH_3
(c) NO_4 and SO_2 (d) All of these

29. Which element belongs to group V-A?
(a) Cs (b) Ba
(c) Sr (d) Bi

30. What are non-metals?
a) Sb & Bi b) P & Bi
c) N & P d) As & N

31. Which property is not present in non-metals.
a) Predominantly covalent
b) Poor conductor
c) Hig E.N. value
d) High electropositivity

32. Which element of group IV-A does not use d. orbital?
a) N b) P
c) As d) Sb

33. Nitrogen is present in atmosphere.
a) 21 % b) 36 %
c) 78 % d) 89 %

34. Which is an inert gas?
a) Nitrogen b) Oxygen
c) Hydrogen d) CO

35. Which gas will produce in the reaction of zinc with dil HNO_3?
a) NO b) NO_2
c) N_2O d) N_2O_3

36. Which is explosive compound?
a) $NaNO_3$ b) NH_4NO_3
c) $AgNO_3$ d) $Ca(NO_3)_2$

37. Which gas has pleasant smell and sweetish taste?
a) NO b) NO_2
c) N_2O d) N_2O_3

38. Which is called a laughing gas?
a) NO b) NO_2
c) N_2O d) N_2O_3

39. A gas, itself not combustible but rekindle a glowing splinter?
a) NO b) NO_2
c) N_2O d) N_2O_3

40. Reaction of copper with nitrous oxide gives a gas,
a) N_2 b) NO
c) NO_2 d) O_2

41. Reaction of copper with dil HNO_3 gives.
a) NO b) NO_2
c) N_2O d) N_2

42. *Reaction of copper with conc HNO_3 gives a gas*
a) NO b) NO_2
c) N_2O d) N_2

43. *A reddish brown gas is*
a) NO b) NO_2
c) N_2O d) N_2

44. *Ring test is given by ions.*
a) Nitrides b) Nitrates
c) Cyanates d) Nitriles

45. *Decomposition of lead nitrate gives*
a) N_2 & O_2 b) N_2O & O_2
c) NO_2 & O_2 d) NO & O_2

46. *Colour of N_2O_4 is*
a) reddish brown b) Yellow
c) Colourless d) green

47. *KI is to iodine during reaction with $FeSO_4$*
a) Oxidized b) Reduced
c) Decomposed d) Disproportionate

48. *Temperature required to connect N_2 & O_2 into NO is*
a) 1000°C b) 2000°C
c) 30000°C d) 4000°C

49. *Specific gravity of HNO_3 is*
a) 1.35 b) 1.53
c) 1.39 d) 1.93

50. *Carbonates and bicarbonates react with acids to release*
a) CO b) CO_2
c) NO d) NO_2

51. *Which pair of metals don't react with HNO_3?*
a) Au & Pt b) Fe & CO
c) W & U d) Mg & Ca

52. *Reaction of metals with acids produce gas.*
a) CO_2 b) N_2O
c) H_2 d) NO

53. *Silver, mercury, copper produce gas on reaction with conc HNO_3.*
a) NO b) N_2O
c) NO_2 d) N_2

54. *Aqua regia is a solution*
a) HNO_3: 3HCl b) HCl: $3HNO_3$
c) HCl: HNO3 d) HCl: 2HNO3

55. *Which metals dissolve in aqua regia only?*
a) Au & Cu b) Au & Pt c) Au & Ni d) Cu & Pt

56. *T.N.T is an explosive, it is prepared by the acid*
a) H_2SO_4 b) HCl
c) HNO_3 d) H_3PO_4

57. *Phosphorus belongs to a group*
a) III-A b) IV-A
c) V-A d) VI-A

58. *Formula of apatite is*
a) $Ca_3(PO_4)_2$ b) $Ca_5F(PO4)_3$
c) KCl d) $NaNO_3$

59. *Bone ash contains calcium phosphate*
a) 70 % b) 80%
c) 90 % d) 100 %

60. *Allotropic forms of phosphorus are*
a) three b) four
c) five d) six

61. *Structure of P_4 is*
a) Trigonal b) tetragonal
c) hexagonal d) monoclinic

62. *Which is the most reactive?*
a) White phosphorus
b) red phosphorous
c) graphite
d) Plastic sulphur

63. *The most stable phosphorus allotrope is*
a) White b) Red
c) Black d) All

64. *Colour of PCl_5 is*
a) Red b) Yellowish White
c) Grey d) Colourless

65. *PCl_5 at 100°C*
a) melts b) boils
c) sublimes d) evaporates

66. *Which compound fumes is air?*
a) P_2O_5 b) NaOH
c) PCl_5 d) P_4O_{10}

67. *A highly poisonous compound is*
a) NaOH b) P_2O_3
c) P_2O_5 d) HNO_3

68. *A compound with garlic ordour is.*
a) NaOH b) P_2O_3
c) P_2O_5 d) HNO_3

69. *P_2O_5 sublimes at*
a) 350°C b) 360°C
c) 370°C d) 380°C

70. *Group VI-A elements are called*

a) Halogens
b) Electron deficient
c) Alkaline earth metals
d) chalcogens

All elements of group VI-A non-metals except

a) Te b) S
c) Se d) Po

Allotropic forms of oxygen ,Te, Se are

a) Two b) Three
c) Four d) five

Allotropic forms of sulphur are

a) Two b) Three
c) Four d) five

Which element comprises about 50% of earth crust?

a) Oxygen b) Silicon
c) Aluminum d) Hydrogen

Oxygen is present in atmosphere about

a) $\frac{1}{2}$ b) $\frac{1}{4}$
c) $\frac{3}{4}$ d) not exactly so,

Calcium carbonate contains oxygen.

a) 48% b) 50%
c) 53% d) 89%

Water contains oxygen about

a) 48% b) 50%
c) 53% d) 89%

Silica contains oxygen by weight.

a) 48% b) 50%
c) 53% d) 89%

79. Which property of oxygen resembles with sulphur?

a) O- has not but S- has isotopes
b) Ionic bond formation
c) No poly atomic molecules
d) Typical non-metals

80. The outer most electronic configuration of group VI – A is

a) $ns^2.np^2$ b) $ns^2.np^3$
c) $ns^2.np^4$. d) $ns^2.np^5$

Answers

1	a	2	b	3	c	4	c	5	b
6	a	7	b	8	b	9	a	10	d
11	d	12	a	13	b	14	b	15	a
16	d	17	b	18	a	19	d	20	b
21	b	22	d	23	d	24	d	25	c
26	c	27	a	27	d	29	d	30	C
31	D	32	A	33	C	34	A	35	C
36	B	37	C	38	C	39	C	40	A
41	A	42	B	43	C	44	B	45	C
46	B	47	A	48	C	49	B	50	B
51	A	52	C	53	C	54	A	55	B
56	C	57	C	58	B	59	B	60	D
61	B	62	A	63	C	64	B	65	C
66	C	67	B	68	B	69	B	70	D
71	D	72	A	73	B	74	A	75	B
76	A	77	D	78	C	79	D	80	C

C. Organic Chemistry

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

1. Fundamental Principles

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes

Students should be able to

1. FUNDAMENTAL PRINCIPLES:

In this topic, student should be able to:

a) Classify the organic compounds.
b) Explain the types of bond cleavage, homolytic and heterolytic.
c) Suggest how cracking can be used to obtain more useful alkanes and alkenes of lower masses.
d) Discuss the types of reagents; nucleophile, electrophile and free radicals.
e) Explain isomerism; structural and cis-trans.
f) Discuss the functional group and nomenclature of organic compounds with reference to IUPAC names of Alkanes, Alkenes, Alcohols, Haloalkanes and Carboxylic acids.

Definitions and Statements

- The study of compounds of carbon and hydrogen (hydrocarbons) and their derivatives is called organic chemistry."
- Organic Compounds: The hydrocarbons and their derivatives are called organic compounds."
- The compounds containing fundamentally carbon, essentially hydrogen and may be oxygen, halogens, nitrogen etc., in them are called organic compounds."
- Carbon has unique property to combine with other carbon atoms making long chains. Thus self-linkage is called catenation.
- Petroleum:"Refined mineral oil is called Petroleum."
- Crude oil: "A liquid of blackish colour extracted from rocks is known as crude oil."
- Fraction Distillation
- The process in which a liquid (Mixture of many substances) is heated at different temperature ranges and each fraction is condensed from its vapours into liquid state at a temperature range is called fractional distillation."
- Breaking of higher hydrocarbons of high boiling point into smaller hydrocarbons of low boiling point in the absence of air is called cracking or pyrolysis."
- Breaking down of large hydrocarbons into smaller one under high temperature and pressure is called thermal cracking."
- Cracking in the presence of a catalyst at a lower temperature (500°C) and pressure is called catalytic cracking."
- Break down of higher hydrocarbons in the vapour state mixed with steam is called steam cracking."
- A sharp metallic sound produced in engines during internal combustion is called knocking."
- Conversion of straight chain hydrocarbons into branched chain hydrocarbons in the presence of a catalyst and in the absence of oxygen is called reforming."
- Octane Number: It is a ratio between a hydrocarbon to the iso-octane is called octane number."
- Open chain or Acyclic compounds or Aliphatic compounds
- Hydrocarbons in which open chain of carbon–carbon atoms are present is called open chain hydrocarbons.
- Closed Chain Compounds or Cyclic Compounds
- Hydrocarbons containing one or more rings in it are called closed chain or cyclic compounds."
- Homocyclic or Carbocyclic compounds
- When rings of compounds have all carbon atoms in it, they are called homocyclic compounds."
- Alicyclic compounds:The homocyclic compounds containing three or more than three carbon atoms in the ring and resemble with aliphatic compounds are called alicyclic compounds."
- The cyclic compounds containing at least one benzene ring in it are called aromatic compounds."
- Monocyclic Aromatic Compounds
- Aromatic compounds containing one benzene ring are called monocyclic aromatic compounds."

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

1. The state of hybridization of carbon atom in methane is:
(a) sp^3 (b) sp^2
(c) sp (d) dsp^2

2. In t-butyl alcohol, the tertiary carbon is bonded to:
(a) Two hydrogen atoms (b) Three hydrogen atoms
(c) One hydrogen atom (d) No hydrogen atom

3. Which set of hybrid orbitals has planar triangle shape?
(a) sp^3 (b) sp
(c) sp^2 (d) dsp^2

4. The chemist who synthesized urea from ammonium cyanate was:
(a) Berzelius (b) Kolbe
(c) Wohler (d) Lavoisier

5. Linear shape is associated with which set of hybrid orbitals?
(a) sp (b) sp^2
(c) sp^3 (d) dsp^2

6. A double bond consists of:
(a) Two sigma bonds
(b) One sigma and one pi bonds
(c) One sigma and two pi bonds
(d) Two pi bonds

7. Ethers show the phenomenon of:
(a) Position isomerism
(b) Functional group isomerism
(c) Metamerism
(d) Cis-trans isomerism

8. Select from the following which one is alcohol?
(a) $CH_3–CH_2–OH$
(b) $CH_3–O–CH_3$
(c) CH_3COOH
(d) $CH_2–CH_2–Br$

Important MCQs

9. Fossil fuels consist of:
(a) Coal (b) Natural gas
(c) Petroleum (d) All of these

10. Geological survey of Pakistan estimates about billion tons of coal in Pakistan:
(a) 182 (b) 183
(c) 184 (d) 185

11. Major component of natural gas is:
(a) Ethane (b) Ethene
(c) Propane (d) Methane

12. At present oil refineries in Pakistan are:
(a) One (b) Two
(c) Three (d) Four

13. Cracking products are:
(a) Only alkanes (b) Only alkenes
(c) Alkanes and alkenes (d) Alkynes

14. Types of cracking are:
(a) Thermal (b) Catalytic
(c) Steam (d) All a, b, c

15. Tetraethyl lead causes disease:
(a) Typhoid (b) Respiratory
(c) Stomach (d) Muscular

16. The general formula of saturated allcyclic hydrocarbons is:
(a) C_nH_n (b) C_nH_{2n}
(c) C_nH_{2n+2} (d) C_nH_{2n-1}

17. Diversity of organic compounds in millions is:
(a) Four (b) Five
(c) Six (d) Seven

18. General formula of carboxylic acids is:
(a) RCOH (b) RCOR
(c) RCOOR (d) R-OH

19. Linear geometry is present in:
(a) Sp^3 (b) Sp^2
(c) Sp (d) d^2sp^3

20. Angle 120° is observed in molecules:
(a) CH_4 (b) CH_3-CH_3
(c) $CH\equiv CH$ (d) $CH_2=CH_2$

21. Functional group of ketones is:
(a) —CHO (b) —CO—
(c) —C≡N (d) —COOH

22. Products of coal is:
(a) Peat (b) Lignite
(c) Bituminous coal (d) All above

23. Which gasoline is better?
(a) of low boiling point (b) of low molecular mass
(c) of high octane (d) All of these

24. Type of isomerism in BrCH=CHBr is:
(a) Structural isomerism (b) Conformational isomerism
(c) Geometrical isomerism (d) Position isomerism

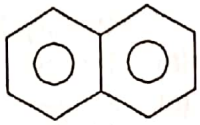
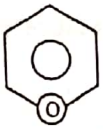
25. Type of hybridization in CH≡CH is:
(a) sp (b) sp^2
(c) sp^3 (d) dsp^2

26. Formula of thiophene is:

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

27. Number of isomers of butane are:
(a) One (b) Two
(c) Three (d) Four

28. Formula of furan is:

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

29. Source of organic compounds primarily is:
(a) plants (b) animals
(c) minerals (d) a & b

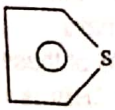
30. Wohler synthesized first of all the organic compound:
(a) carbohydrates (b) urea
(c) aniline (d) toluene

31. Self linkage of carbon to produce long chains is:
(a) isomerism (b) polymorphism
(c) polymerization (d) catenation

32. In the presence of high temperature and pressure peat is converted to:
(a) Lignite (b) Bituminous coal
(c) Anthracite (d) Coal

33. Coal is used to bake bricks in lime kiln:
(a) 40% (b) 60%
(c) 80% (d) None of these

34. Isooctanes burns smoothly having arbitrarily value of octane number:
(a) 0 (b) 25
(c) 50 (d) 100

35.  is formula of:
(a) pyridine (b) furan
(c) thiophene (d) pyrrole

36 —COOH is functional group of:
(a) Carboxyl (b) Carboxylic acid
(c) Formyl (d) Acid halide

37. CH_3-O-CH_3 and CH_3CH_2OH is example of isomerism:
(a) chain isomerism (b) position isomerism
(c) functional group isomerism (d) metamerism

38. Which has sp hybridization?
(a) CH_3-CH_3 (b) CH_2=CH_2
(c) CH≡CH (d) CH_3Cl

INTRODUCTION

39. Organic compounds are derived from sources:
a) plants b) animals
c) living d) minerals

40. Inorganic compounds are derived from sources:
a) plants b) animals
c) living d) minerals

41. Vital force theory is:
a) organic compounds can be prepared themselves.
b) organic compounds can be prepared from inorganic compounds.
c) organic compounds cannot be prepared in laboratory from inorganic compounds.
d) Organic compounds can be prepared from inorganic compounds.

42. Vital force theory was rejected by the work of scientist:
a) F. Wohler b) Gibbs
c) Henderson d) Avogadro's

43. F. Wohler prepared compound from ammonium cyanate:
a) protein b) lipids
c) carbohydrates d) urea

44. An element essential for organic compounds:
a) hydrogen b) carbon
c) nitrogen d) halogen

45. Element commonly present in organic compounds is:
a) hydrogen b) carbon
c) nitrogen d) halogen

46. Organic compounds are:
a) compounds of carbon
b) compounds of carbon and their derivatives
c) compounds of carbon and halogens
d) compounds of carbon and nitrogen

SOME FEATURES OF ORGANIC COMPOUNDS

47. Self linkage in carbon is called:
a) polymerization b) catenation
c) polymorphism d) allotropy

48. Organic compounds are in nature:
a) ionic b) coordinate
c) covalent d) polar covalent

49. General formula of starch is:
a) $(CH_2O)_n$ b) $(C_6H_{12}O_5)_n$
c) $(C_3H_6O_2)_n$ d) $(C_4H_6O_2)_n$

50. A property in which a compound have same molecular formula but different structural formula:
a) polymerization b) polymorphism
c) isomerism d) metamerism

51. Most organic compounds are soluble in:
a) non-polar solvents b) benzene
c) petroleum ether d) polar solvents

IMPORTANCE OF ORGANIC CHEMISTRY

52. Which is not an organic compound?
a) glucose b) plastics
c) medicines d) water

SOURCES OF ORGANIC COMPOUNDS

53. Fossil fuels are:
a) petroleum b) coal
c) natural gas d) All of these

54. Fossil fuels form under ground due to:
a) itself from minerals
b) decomposition of organisms under the action of bacteria
c) decomposition of living bodies without the presence of microorganisms
d) High temperature and pressure

55. Peat is converted into, due to bacteria and chemical reactions:
a) coal b) coal tar
c) anthracite d) lignite

56. Wood under the bacterial and chemical reactions get converted in to:
a) coal b) peat
c) lignite d) anthracite

57. Heating of coal in the absence of air at 500-1000°C, converts it into:
a) coke b) coal gas
c) coal tar d) All of these

58. Fractional distillation of which separates many compounds?
a) coke b) coal gas
c) coal tar d) All of these

59. Total coal resources in Pakistan are estimated by the geological survey of Pakistan is (in billion tones):
a) 180 b) 181
c) 183 d) 184

60. About 80% of coal is used in:
a) agriculture b) industry
c) domestic purpose (d) to bake bricks in lime kilns

61. A mixture of low boiling hydrocarbons is:
a) coke b) petroleum
c) coal tar d) natural gas

62. Natural gas mainly contains:
a) methane b) ethane
c) ethene d) propane

63. Mineral oil is called:
a) petroleum b) natural gas
c) coal d) diesel oil

64. Petroleum obtained from rocks as blackish colour is:
a) crude mixture b) coke
c) crude oil d) coal tar

65. Attock Oil Refinery has capacity (in million tones):
a) 1.20 b) 1.25
c) 2.13 d) 2.20

66. Capacity of Pakistan oil Refinery and National Oil Refinery at Karachi is (in million tones):
a) 1.20 b) 1.25
c) 2.13 d) 2.20

67. Attock Oil Refinery is located at:
a) Morgah (Rawalpindi) b) Mahmud Kot, (Multan)
c) Karachi d) Lahore

68. Pak Arab Refinery is located at:
a) Morgah (Rawalpindi) b) Mahmud Kot, (Multan)
c) Karachi d) Lahore

CRACKING AND REFORMING

69. Fractional distillation of petroleum yields of gasoline:
a) 10% b) 20%
c) 30% d) 40%

70. Converting of petroleum fractions like kerosene oil and gas oil into gasoline is called:
a) reforming b) destructive distillation
c) cracking d) distillation

71. Hexadecane ($C_{16}H_{34}$) splits up into compounds:
a) heptane b) ethane
c) propene d) All of these

72. Unsaturated hydrocarbon can be prepared by:
a) cracking b) thermal cracking
c) catalytic cracking d) steam cracking

73. Better quality gasoline with high octane numbers are prepared from the method:
a) cracking b) thermal cracking
c) catalytic cracking d) steam cracking

74. Lower unsaturated hydrocarbons are prepared preferably by:
a) cracking b) thermal cracking
c) catalytic cracking d) steam cracking

75. Catalyst used in catalytic cracking is:
a) Silica (SiO_2) b) Al_2O_3 Alumina
c) Fe_2O_3 d) SiO_2 & Al_2O_3

76. A problem of combustion initiation before the spark plug fires is called:
a) reforming b) cracking
c) knocking d) octane number

77. Cracking problem can be overcome by:
a) reforming b) improving octane number
c) adding TEL d) All of these

78. Highest octane number is of:
a) Isooctane b) 2,2,4-trimethyl petane
c) a & b d) n-octane

79. An octane number of 100 is given to:
a) iso-octane b) n-heptane
c) n-octane d) iso-heptane

80. Which is an efficient antiknock agent?
a) n-octane b) iso-octane
c) TEL d) iso-heptane

CLASSIFICATION OF ORGANIC COMPOUNDS

81. n-butane is a type of compound:
a) straight chain aliphatic compound
b) branched chain aliphatic compound
c) homocyclic compound
d) alicyclic compound

82. Benzene belongs to the group:
a) straight chain aliphatic compound
b) branched chain aliphatic compound
c) homocyclic compound
d) aromatic compound

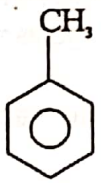
83. Phenol belongs to the group:
a) straight chain aliphatic compound
b) branched chain aliphatic compound
c) homocyclic compound
d) aromatic compound

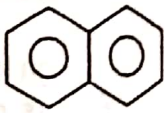
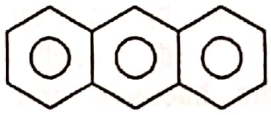
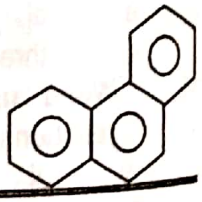
84. Naphthalene, anthracene, toluene, benzaldehyde belong to the group:
a) straight chain aliphatic compound
b) branched chain aliphatic compound
c) homocyclic compound
d) aromatic compound

85. Pyridine, furan, pyrole, thiophene belong to the group:
a) aromatic compounds b) heterocyclic compounds
c) alicyclic compounds d) homocyclic compounds

86. The saturated alicyclic hydrocarbons have the general formula:
a) C_nH_{2n+2} b) C_nH_{2n+1}
c) C_nH_{2n} d) C_nH_{2n-1}

87. Compounds containing one or more atoms in the ring of heterocyclic compounds are called:
a) aromatic compounds b) heterocyclic compounds
c) carbocyclic compounds d) aliphatic compounds

88. Formula of anthracene is:
a) 

b) 
c) 
d) 

FUNCTIONAL GROUPS

89. A functional group consists of:
a) atom b) group of atoms
c) double bond d) all

90. A group of atoms or atom which I mparts characteristics properties to the class of compounds is called:
a) isomerism b) polymorphism
c) functional group d) polymerism

91. Functional group of imino group is:
a) —NH_2 b) $C = NH$

c) —C(=O)—NH₂ d) —C≡N

92. Functional group of acid amide is:

a) —NH₂ b) >C = NH

c) —C(=O)—NH₂ d) —C≡N

93. Functional group of nitriles is:

a) —NH₂ b) >C = NH

c) —C(=O)—NH₂ d) —C≡N

94. Functional group of acid halide is:

a) —NH₂ b) >C = NH

c) —C(=O)—NH₂ d) —C(=O)—X

HYBRIDIZATION

95. Electronic configuration of carbon is ground state is:
a) $1s^2.2s^2.2p^2$ b) $1s^2.1s^1.2p^3$
c) $1s^2.2s^2.2p^13s^1$ d) $1s^2.2s^1.2p.2p,2p$

96. The electronic configuration of carbon in excited state (hybridized) is:
a) $1s^2.2s^2.2p^2$ b) $1s^2.1s^1.2p^3$
c) $1s^2.2s^2.2p^13s^1$ d) $1s^2.2s^1.2p.2p,2p$

97. Orbital hybridization explains the concept of valency:
a) monovalency b) divalency
c) trivalency d) tetravalency

98. The mode of hybridization in CH_4 is:
a) tetrahedral b) trigonal
c) trigonal pyramid d) v-shaped

99. The geometry in ethane is:
a) tetrahedral b) trigonal
c) trigonal pyramid d) v-shaped

100. The geometry in ethene is:
a) tetrahedral b) trigonal
c) trigonal pyramid d) v-shaped

101. The geometry is acetylene is:
a) tetrahedral b) pyramidal triangular
c) triangular d) linear

102. The hybridization in CH_4 and $CH_3–CH_3$ is:
a) sp^3 b) sp^2
c) sp d) dsp^2

103. The hybridization in $CH_2{=}{=}CH_2$ is:
a) sp^3 b) sp^2
c) sp d) dsp^2

104. The hybridization in CH≡CH is:
a) sp^3 b) sp^2
c) sp d) dsp^2

105. The angle in CH_4 and $CH_3–CH_3$ is:
a) 109.5° b) 107.2°
c) 120° d) 180°

106. The angle in $CH_2{=}{=}CH_2$ is:
a) 109.5° b) 107.2°
c) 104.5° d) 120°

107. The angle in CH≡CH is:
a) 109.5° b) 107.2°
c) 104.5° d) 120°

108. The %age character of 's' and 'p' in sp^3 is respectively:
a) 25% & 75% b) 33% & 66%
c) 50% & 50% d) 30% & 70%

109. Orbitals have same energy, symmetry and shape:
a) 1s & 2s b) 2s and 2p
c) Hybrid d) 3s and 3d

ISOMERISM

110. Isomers of butane are:
a) 2 b) 5
c) 8 d) 10

111. Which compound does not show isomerism?
a) propane b) butane
c) pentane d) hexane

112. Isomers have same properties:
a) physical b) chemical
c) physical & chemical d) nuclear

113. Isomers are written for a compound, if it has carbon atoms at least:
a) one b) two
c) three d) four

114. Structural isomerism is given by:
a) hydrocarbons only
b) hydrocarbons and their derivatives
c) derivatives of hydrocarbons
d) only carbohydrates

115. Pentane has isomers:
a) one b) two
c) three d) four

Answers

1	a	2	d	3	c	4	c	5	a
6	b	7	c	8	a	9	d	10	c
11	d	12	d	13	c	14	d	15	b
16	b	17	c	18	d	19	c	20	d
21	b	22	d	23	d	24	c	25	a
26	a	27	b	27	d	29	d	30	b
31	d	32	a	33	c	34	d	35	c
36	b	37	c	38	c	39	c	40	d
41	c	42	a	43	d	44	b	45	a
46	b	47	b	48	c	49	b	50	c
51	a	52	d	53	d	54	c	55	a
56	b	57	d	58	c	59	d	60	d
61	d	62	a	63	a	64	c	65	b
66	c	67	a	68	b	69	b	70	c
71	d	72	b	73	c	74	d	75	d
76	c	77	d	78	c	79	a	80	c
81	a	82	d	83	d	84	d	85	b
86	c	87	b	88	c	89	d	90	c
91	b	92	c	93	d	94	d	95	a
96	d	97	d	98	a	99	b	100	a
101	d	102	a	103	b	104	c	105	a
106	d	107	d	108	b	109	c	110	a
111	a	112	b	113	d	114	b	115	c

2. Hydrocarbon

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:
Describe the chemistry of Alkanes with emphasis on:
a) Combustion.
b) The mechanism of free radical substitution reaction of methane with particular reference to the initiation, propagation and termination.

Discuss the chemistry of Alkenes with emphasis on:
a) Preparation of alkenes by elimination reactions:
   i) Dehydration of alcohols.
   ii) Dehydrohalogenation of Alkyl halide.
b) Reaction of Alkenes such as:
   i) Catalytic hydrogenation.
   ii) Halogenation (Br2 addition to be used as a test of an alkene).
   iii) Hydration of alkenes.
   iv) Reaction with HBr with special reference to Markownikoff's rule.
   v) Oxidation of alkenes using cold alkaline or acidic KMnO4 (Bayer's reagent) and using hot concentrated acidic or alkaline KMnO4 for cleavage of double bond in 2-butene.
   vi) Polymerization of ethene.

Discuss chemistry of Benzene with examples
a) Structure of benzene showing the delocalized

orbital which causes stability of benzene.

b) Electrophilic substitution reactions of benzene including mechanism of:
   i) Nitration
   ii) Halogenation (chlorination and bromination)
   iii) Friedel Craft's reaction (Alkylation and acylation)

c) Hydrogenation of benzene ring to form cyclohexane ring.

d) Side chain oxidation of methyl benzene (toluene) and ethyl benzene.

e) Directive influence of substituents on the benzene ring by 2,4 directing and 3,5 directing groups (orientation in Electrophilic Substitution reactions of Benzene).

Definitions and Statements

1. Aromatic Hydrocarbons:
The compounds of carbon and hydrogen including benzene and its derivatives are called aromatic hydrocarbons."
Arenes and their derivatives are also called aromatic hydrocarbons.
The benzene and its derivatives are called aromatic hydrocarbons."

2. Monocyclic Aromatic Hydrocarbons:
Aromatic hydrocarbons containing only one benzene ring are called monocyclic aromatic hydrocarbon."

3. Poly cyclic Aromatic Hydrocarbons:
Aromatic hydrocarbons containing two or more benzene rings in them are called poly cyclic aromatic hydrocarbons."

4. Condensed Aromatic Hydrocarbons:
Aromatic poly cyclic hydrocarbons in which two or more benzene rings are fused together at ortho "o" positions is called condensed aromatic hydrocarbons."

5. Phenyl & Aryl Group ($-C_6H_5$)
When a hydrogen is removed from benzene ring then it is called phenyl group. It is symbolized as –Ph when a phenyl group is substituted then it is called Aryl Group."
It is represented as Ar–Group.

6. Resonance: The possibility of different pairing schemes of valence electrons of atoms is called resonance and different structures are called resonating structures or canonical forms."

7. Benzene: Six carbon containing ring with unsaturation in this compound which is an important and basic structural unit of all aromatic hydrocarbons is called benzene."

8. Halogenation: Substitution of a hydrogen with halogen group (–X) in benzene ring is called halogenation.

9. Nitration ("Nitro" means $-NO_2^+$ and "ation" means "addition"): Replacement of a hydrogen of benzene by a NO_2^+ group in the presence of H_2SO_4 is called nitration."

10. Friedel Craft Akylation: Substitution of Alkyl (R) group with a hydrogen atom of benzene ring in the presence of a catalyst is called Friedel Craft Alkylation."

11. Friedel Craft Acylation: Substitution of an acyl group ($R-\overset{O}{\overset{\|}{C}}-$) with a hydrogen atom of benzene ring in the presence of a catalyst is called Friedel Craft Acylation."

12. Halogenation:
Addition of halogen in the presence of sunlight is called halogenation".

13. Orientation:
The location of position or placement of a group in a monosubstituted benzene is called orientation."

14. Aromatic:
The benzene and its derivatives are called aromatics or aromatic hydrocarbons."

15. Oxidation:
Following are the definitions:

a) Addition of O_2 is called oxidation.
b) Addition of electronegative element is called oxidation.
c) Removal of hydrogen is called oxidation.
d) Removal of electrons is called oxidation.
e) Removal of electropositive elements is called oxidation.
f) Increase of oxidation number is called oxidation

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

1. The benzene molecule contains.
(a) Three double bond
(b) Two double bond
(c) One double bond
(d) Delocalized π electron charge

2. Aromatic hydrocarbons are the derivativ of:

(a) normal series of paraffins
(b) alkene
(c) benzene
(d) cyclohexane

Which of the following acid can be used as a catalyst in Friedel Craft's reactions?

(a) $AlCl_3$
(b) HNO_3
(c) $BeCl_2$
(d) NaCl

Benzene cannot undergo:

(a) substitution reactions
(b) addition reactions
(c) oxidation reactions
(d) elimination reactions

Amongst the following, the compound that can be most readily sulphonated is:

(a) toluene (b) benzene
(c) nitrobenzene
(d) chlorobenzene

During nitration of benzene, the active nitrating agent is:

(a) NO_3^{-1} (b) NO_2^+
(c) NO_2^{-1} (d) HNO_3

Acylation of benzene to produce aliphatic aromatic ketones is known as:

(a) Friedel Craft's reaction
(b) benzene condensation
(c) hydroformylation
(d) Clemmensen reduction

Benzene reacts with Cl_2 in sunlight to give the end product:

(a) $C_6H_6Cl_6$ (b) C_6H_6Cl
(c) $O - C_6H_4Cl_2$ (d) $P\text{-}C_6H_4Cl_2$

Which of the following is explosive?

(a) Trinitrophenol
(b) Nitrophenol
(c) Nitromethane
(d) Nitrobenzene

Which compound is the most reactive one?

(a) benzene (b) ethene
(c) ethane (d) ethyne

Important MCQs

Among the following, poly cyclic compound is:

(a) styrene (b) cumene
(c) naphthalene (d) xylene

Benzene can be obtained from

(a) $H_3C \equiv CH_3$
(b) chlorobenzene
(c) $CH_2 = CH_2$ and butadiene
(d) all of above

The electrophil n aromatic sulphonation is:

(a) H_2SO_4 (b) HSO_4^-
(c) SO_3 (d) SO_3^+

Aromatic compounds burn with sooty flame cause:

(a) They have high percentage of hydrogen.
(b) They have a ring structure.
(c) They have high percentage of carbon.
(d) They resist reaction with air.

The conversion of n-hexane into benzene by heating in the presence of Cr_2O_3 is called:

(a) Isomerization
(b) Aromatization
(c) Dealkylation
(d) Rearrangement

Simplest aromatic compound is:

(a) bezene (b) toluene
(c) aniline (d) phenol

Ratio of carbon to hydrogen in aromatic compounds is:

(a) Low than alkanes (b) High than alkanes
(c) Low than alkenes not high than alkanes (d) High than alkenes

Kekule structures contributed towards actual structure of benzene:

(a) 60% (b) 70%
(c) 80% (d) 90%

Resonance energy of benzene is (in KJ mol^{-1}):

(a) 120 (b) 150
(c) 170 (d) 180

Benzene gives reactions generally:

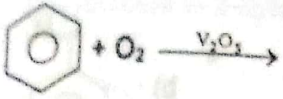
(a) electrophilic substitution (b) addition
(c) synthesis (d) addition and electrophilic substitution

Monosubstituted benzene can have disubstitution at position:

(a) ortho (b) meta
(c) para (d) a, b, c

Oxidation of benzene occurs in the presence of catalyst:

(a) V_2O_5 (b) Ni
(c) Al_2O_3 (d) $FeCl_3$

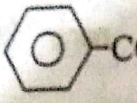


23. (a) CO_2 (b) H_2O
(c) ozonide (d) glyoxal

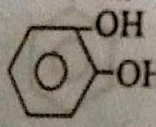
24. **Ozonolysis of benzene gives:**
(a) nitration (b) sulphonation
(c) ozonide (d) glyoxal

25. **Benzoic acid can be prepared from the oxidation of:**
(a) benzene (b) ethyl benzene
(c) benzoic acid (d) toluene

26. **Bond angle in benzene is:**
(a) 109.5° (b) 180°
(c) 120° (d) 107.2°

27.  **is formula of:**
(a) aniline (b) toluene
(c) benzaldehyde (d) benzoic acid

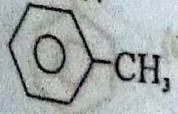
28. **Which is correct priority series?**
(a) –COOH, –CN, –CHO, $–COCH_3$, –OH
(b) –CN, –CHO, $–COCH_3$, –OH, COOH
(c) –CHO, $–COCH_3$, –OH, –COOH, –CN
(d) $–COCH_3$, –OH, –COOH, –CN, –CHO

29.  **is**
(a) hydroquinane (b) catechol
(c) resorsinol (d) T.N.T

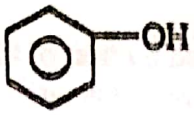
30. **Empirical formula mass of benzene is times lesser than molecular formula mass:**
(a) four (b) five
(c) six (d) seven

31. **Which is the property of benzene?**
(a) decolourizes $KMnO_4$ (b) straight chain structure
(c) only double bond is present (d) triple and double bond

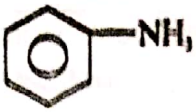
32. **Bond length in benzene between C—C is:**
(a) 1.54°A (b) 1.34°A
(c) 1.44°A (d) 1.39°A

33.  **is formula of:**
(a) aniline (b) catechol
(c) toluene (d) benzyl alcohol

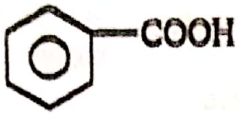
34. **The hybridization in benzene is:**
(a) sp^3 (b) sp^2
(c) sp^2 (d) dsp^2

46.  is called:

a) Benzene b) Toluene
c) Phenol d) Aniline

47.  is called:

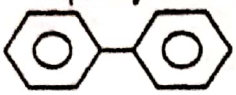
a) Benzene b) Toluene
c) Phenol d) Aniline

48.  is called:

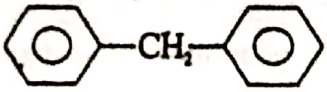
a) Benzene b) Toluene
c) Phenol d) Benzoic acid

49.  is called:

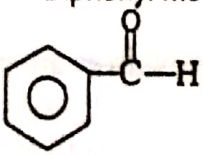
a) Naphthalene b) Biphenyl
c) Diphenyl methane d) Benzaldehyde

50.  is called:

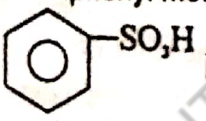
a) Naphthalene b) Biphenyl
c) Diphenyl methane d) Benzaldehyde

51.  is called:

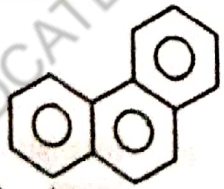
a) Naphthalene b) Biphenyl
c) Diphenyl methane d) Benzaldehyde

52.  is called:

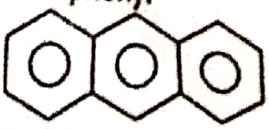
a) Naphthalene b) Biphenyl
c) Diphenyl methane d) Benzaldehyde

53.  is called:

a) Naphthalene b) Biphenyl
c) Diphenyl methane d) Benzene sulphonic acid

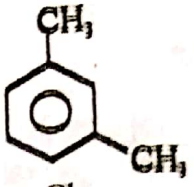
54.  is called:

a) benzene b) toluene
c) biphenyl d) phenanthrene

55.  is called:

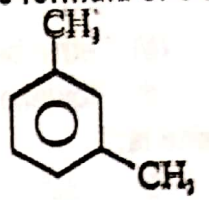
a) benzene b) toluene
c) biphenyl d) anthracene

56. The formula of ethyl benzene is:

a)  b) 

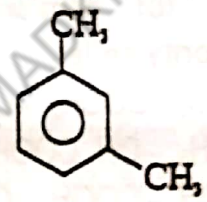
c)  d) 

57. The formula of o-xylene is:

a)  b) 

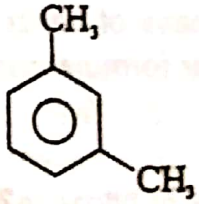
c)  d) none

58. The formula of m-xylene is:

a)  b) 

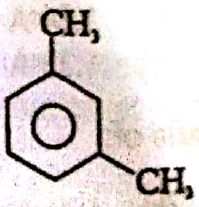
c)  d) 

59. The formula of chlorobenzene is:

a)  b) 

c)  d) 

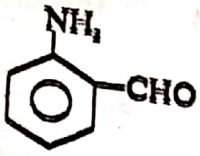
60. The formula of nitrobenzene is:

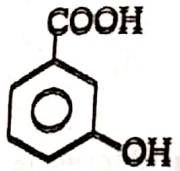
a)  b) 

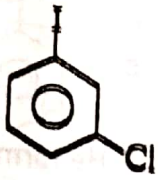
c)  d) 

61. The formula of p-xylene is:

a) 

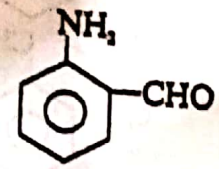
b) 

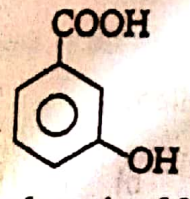
c) 

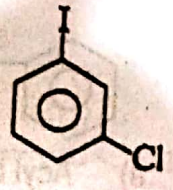
d) 

62. The formula of 2-amino benzaldehyde is:

a) 

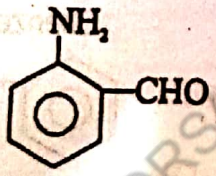
b) 

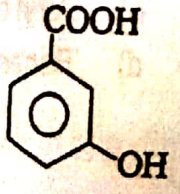
c) 

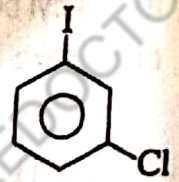
d) 

63. The formula of 3-hydroxybenzoic acid is:

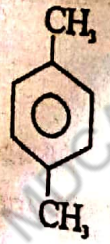
a) 

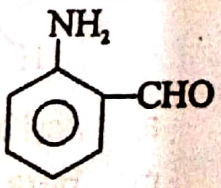
b) 

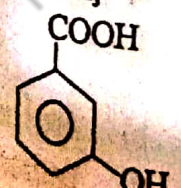
c) 

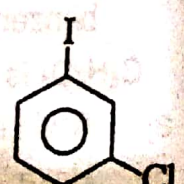
d) 

64. The formula of 3-chloroiodo benzene is:

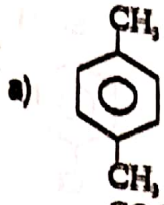
a) 

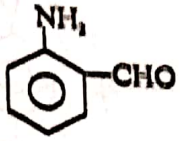
b) 

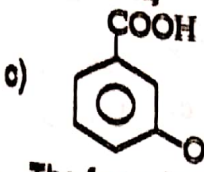
c) 

d) 

65. The formula of 2-bromo nitrobenzene is:

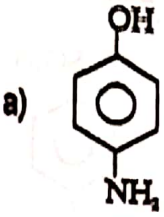
a) 

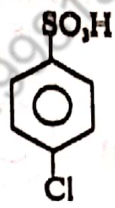
b) 

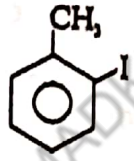
c) 

d) none

66. The formula of 4-amino phenol is:

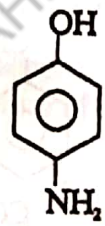
a) 

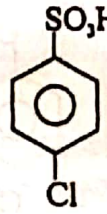
b) 

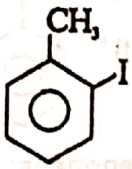
c) 

d) 

67. The formula of benzene hexachloride is:

a) 

b) 

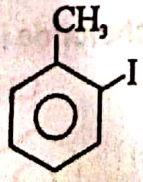
c) 

d) 

68. The formula of cyclohexane is:

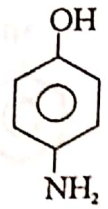
a) 

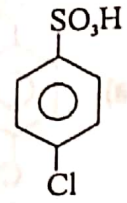
b) 

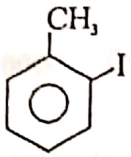
c) 

d) 

69. The formula of 2-iodotoluene is:

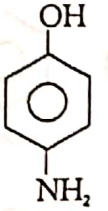
a) 

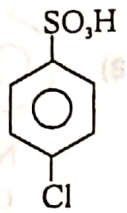
b) 

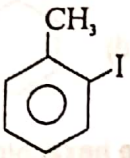
c) 

d) 

70. The formula of 4, chloro benzene sulphonic acid is:

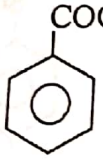
a) 

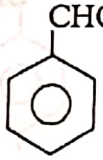
b) 

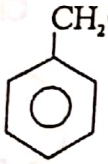
c) 

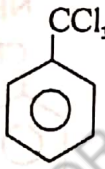
d) 

71. The formula of sodium benzoate is:

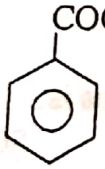
a) 

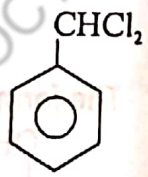
b) 

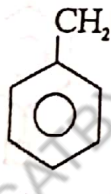
c) 

d) 

72. The formula of acetophenone is:

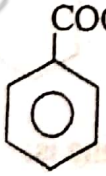
a) 

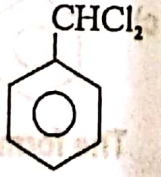
b) 

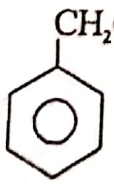
c) 

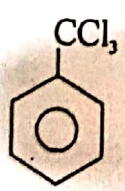
d) None

73. The formula of benzotricholoride is:

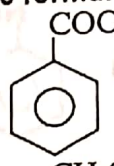
a) 

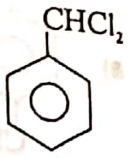
b) 

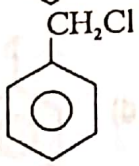
c) 

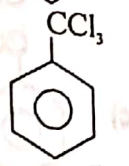
d) 

74. The formula of benzyl chloride is:

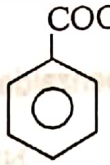
a) 

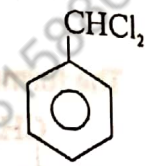
b) 

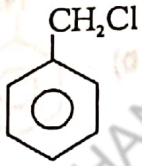
c) 

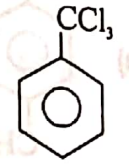
d) 

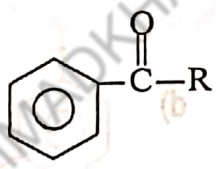
75. He formula of benzal chloride is:

a) 

b) 

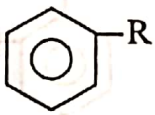
c) 

d) 

76. 

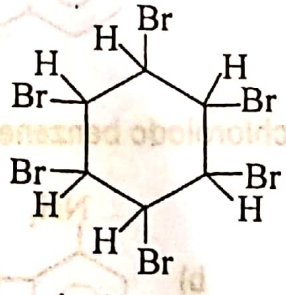
is called:

a) Acyl benzene b) Alkyl benzene
c) Hexa bromo benzene d) Benzene trizonide

77. 

is formula of:

a) Acyl benzene b) Alkyl benzene
c) Hexa bromo benzene d) Benzene trizonide

78. 

is formula of:

a) Acyl benzene b) Alkyl benzene
c) Hexa bromo benzene d) Benzene trizonide

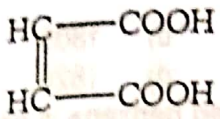
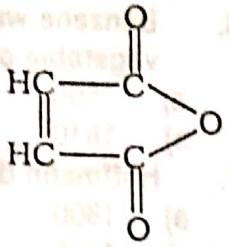
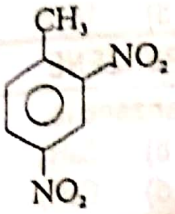
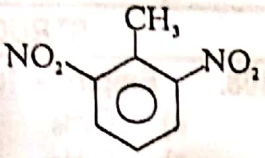
79. $C_6H_6O_9$ is formula:

a) Acyl benzene b) Alkyl benzene
c) Hexa bromo benzene d) Benzene trizonide

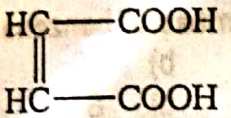
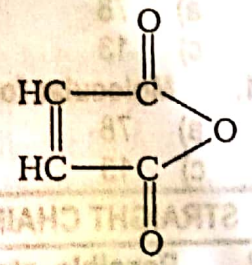
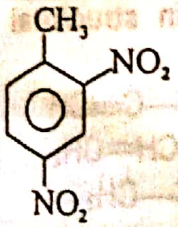
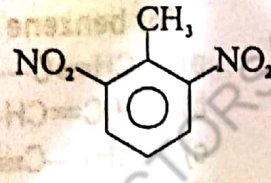
80. CHO is formula of:
|
CHO

a) Acyl benzene b) Alkyl benzene
c) Hexa bromo benzene d) glyoxal

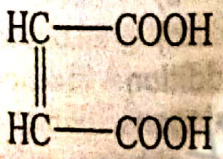
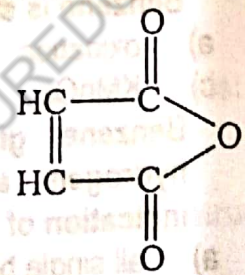
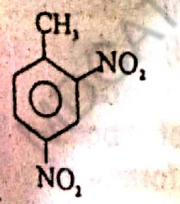
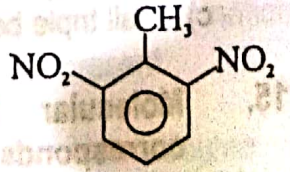
Formula of maleic acid is:

a) 
b) 
c) 
d) 

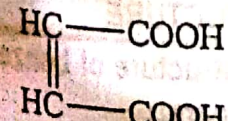
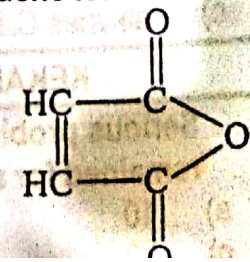
Formula of maleic anhydride is:

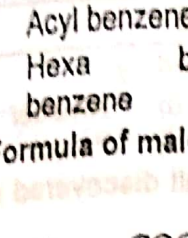
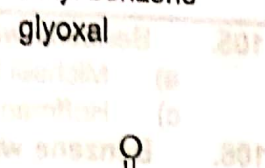
a) 
b) 
c) 
d) 

Formula of o, p-dinitro toluene is:

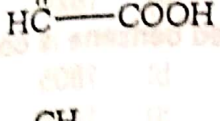
a) 
b) 
c) 
d) 

Formula of o,o-dinitro toluene is:

a) 
b) 

c) 
d) 

85. Formula of T.N.T. is:

a) 
b)
c)
d) none

CLASSIFICATION OF HYDROCARBONS

86. Study of aromatic hydrocarbons starts with study of:
a) Benzene b) Toluene
c) Aniline d) Phenol

87. Structure of benzene is:
a) planar b) regular coplanar
c) hexagonal d) planar hexagonal

88. Monocyclic aromatic hydrocarbons are benzene rings:
a) one b) two
c) two condensed rings d) two isolated rings

89. Polycyclic aromatic hydrocarbons have benzene rings:
a) one b) two
c) two condensed rings d) More than one rings

90. Biphenyl has benzene rings:
a) one b) two
c) two condensed rings d) two isolated rings

91. Naphthalene has benzene rings:
a) one b) two
c) two condensed rings d) two isolated rings

92. Diphenyl methane has benzene rings:
a) one b) two
c) two condensed rings d) two isolated rings

93. Benzene rings are fused at position:
a) ortho b) meta
c) para d) meta & para

NOMENCLATURE (MONOCYCLIC AROMATIC HYDROCARBONS)

94. The nomenclature of aromatic hydrocarbons is then aliphatic hydrocarbons:
a) simple b) easy
c) complex d) simplest

95. System of naming benzene and its derivatives depends upon substituents:
a) position b) number
c) direction d) position and number

96. Mono-substituted benzene derivatives are named by writing benzene as:
a) prefix b) suffix
c) main item d) both prefix and suffix

97. Branch in mono-substituted benzenes are named by writing benzene as:
a) prefix b) suffix
c) main item d) both prefix and suffix

98. Phenyl group is symbolized as:
a) Ph b) C_6H_5
c) Ar d) R

99. When phenyl group itself is substituted it is called group:
a) Ph b) C_6H_5
c) Ar d) a and b

100. Second substituent in benzene gives isomeric products:
a) one b) two
c) three d) four

101. Different substituents are named based upon:
a) high priority group b) low priority group
c) intermediate priority group
d) no priority group is preferred

102. Which is the most priority group among follows?
a) —COOH b) —CN
c) —CHO d) $—COCH_3$

103. Which group has least priority?
a) —COOH b) —CN
c) $—NH_2$ d) —R

104. Substituents not in priority order is named:
a) alphabetically
b) from high atomic number
c) from least atomic number
d) from high molecular mass

BENZENE

105. Benzene was discovered by:
a) Michael Faraday b) Lavoiser
c) Hoffmann d) Proust

106. Benzene was first of all discovered in gas of vegetable oil in:
a) 1800 b) 1805
c) 1810 d) 1825

107. Hoffmann discovered benzene is coal tar in:
a) 1800 b) 1805
c) 1810 d) 1825

STRUCTURE OF BENZENE

108. Empirical formula of benzene is:
a) C_6H_6 b) C_4H_4
c) C_3H_3 d) C_2H_2

109. Molecular formula of benzene is:
a) C_6H_6 b) C_4H_4
c) C_3H_3 d) C_2H_2

110. Empirical formula mass of benzene is:
a) 78 b) 70
c) 13 d) 6

111. Molecular formula mass of benzene is:
a) 78 b) 70
c) 13 d) 6

STRAIGHT CHAIN STRUCTURES RULED OUT

112. Possible straight chain structural formulas for benzene is:
a) $CH{\equiv}C—CH_2—CH_2—C{\equiv}CH$
b) $H_2C{=}CH—C{\equiv}C—CH{=}CH_2$
c) $CH_3—C{\equiv}C—C{\equiv}C—CH_3$
d) a and b

113. Benzene is stable to:
a) oxidation b)
c) $KMnO_4$ d)

114. Benzene gives addition hydrogen and halogens indication of presence of
a) all single bonds b)
c) all triple bonds d)

115. Molecular formula of corresponds to general form
a) alkanes C_nH_{2n+2} b)
c) alkynes C_nH_{2n-2} d)

KEKALE STRUCTURE

116. Serious problem of structure of benzene was remained for about years:
a) 10 b) 20
c) 30 d) 40

117. Chemist gave structure of benzene:
a) Kekule b) Dewar
c) Thomson d) Wholer

118. German chemist Kekule solved the problem of benzene structure in:
a) 1855 b) 1865
c) 1875 d) 1885

119. Characteristics of benzene:
a) have three double and single bonds alternating with each other
b) gives mono substituted only one product
c) give three types of disubstituted products
d) a planner hexagonal structure adding three hydrogen or halogens molecules

120. x-ray studies of benzene confirm its structure as:
a) cubic b) triangular
c) regular planner d) octahedral

121. All angles in benzene molecule < CCC or CHC are:
a) 90° b) 60°
c) 30° d) 120°

122. Al the C—C bond length in benzene is:
a) 1.20 Å b) 1.34 Å
c) 1.397 Å d) 1.54 Å

123. All C—H bond length in benzene molecule is:
a) 1.20 Å b) 1.34 Å
c) 1.397 Å d) 1.54 Å

124. Bond length between C—C in alkane is:
a) 1.20 Å b) 1.34 Å
c) 1.397 Å d) 1.54 Å

125. Bond length between C=C in alkene is:
a) 1.20 Å b) 1.34 Å
c) 1.397 Å d) 1.54 Å

126. Bond length between C≡C in alkyne is:
a) 1.20 Å b) 1.34 Å
c) 1.397 Å d) 1.54 Å

127. The objection on benzene structure proposed by Kekule is:
a) It has double and single bonds in alternation.
b) delocalization of π bond is present
c) no pure double bond
d) benzene should have high degree of unsaturation while benzene

128. Which reactions are given by benzene more readily?
a) addition reactions b) substitution reactions
c) oxidation reactions d) decomposition reactions

MODERN CONCEPTS ABOUT THE STRUCTURE OF BENZENE

129. In benzene molecule each carbon is hybridized:
a) sp b) sp^2
c) sp^3 d) d sp^3

130. sp^2-hybridization yields maximum sigma bonds:
a) one b) two
c) three d) four

131. The $2p_z$ orbital of each carbon in benzene structure are present as:
a) coplanner b) planner
c) perpendicular d) right angle

132. The $2p_z$ orbitals of each carbon in benzene ring form electron cloud of nature:
a) a continuous sheath b) delocalized
c) diffused d) All of these

THE STABILITY OF BENZENE

133. The most stable molecule is:
a) benzene b) ethene
c) ethyne d) ethane

134. The heat of hydrogenation of cyclohexene is (in KJ/mole):
a) –119.5 b) –231.5
c) –358.5 d) –208

135. The heat of hydrogenation of 1,3-cyclohexadiene is (KJ/mol):
a) –119.5 b) –231.5
c) –358.5 d) –208

136. The calculated chart of hydrogenation of 1,3,5-hexatriene is (KJ/mol):
a) –119.5 b) –231.5
c) –358.5 d) –208

137. The heat of hydrogenation of benzene is (KJ/mol):
a) –119.5 b) –231.5
c) –358.5 d) –208

138. The difference of energy showing high stability is (KJ/mol):
a) –119.5 b) –231.5
c) –358.5 d) –208

THE RESONANCE METHOD

139. The possibility of different pairing schemes of valence electrons of atoms is called:
a) hyperconjugation b) tautomerism
c) resonance d) molecular orbital

140. The three alternating double and single

bonds in benzene are in fact:

a) pure single bonds b) resonating bonds
c) conjugate bonds d) b and c

141. The C—C bond length of benzene is, than of alkane and alkenes:

a) greater b) lesser
c) intermediate d) None of these

142.  is structure of benzene:

a) Hybrid b) Dewar
c) Kekule d) Kekule & Dewar

PREPARATION OF BENZENE

143. Large source of preparation of benzenes and their derivatives are:

a) coal and petroleum b) Dow's process
c) chlorobenzene
d) dehydrogenation of cyclohexanes

144. Catalyst used for the hydrogenation of unsaturated compounds is:

a) Pd, Pt, Ni at elevated temperature
b) $AlCl_3$, $AlBr_3$, BBr_3, BCl_3, $FeCl_3$
c) $Cr_2O_3 + Al_2O_3 + SiO_2$ at 500°C
d) CaO

145. Catalysts used in Friedel Craft reaction are:

a) Pd, Pt, Ni at elevated temperature
b) $AlCl_3$, $AlBr_3$, BBr_3, BCl_3, $FeCl_3$
c) $Cr_2O_3 + Al_2O_3 + SiO_2$ at 500°C
d) CaO

146. Catalysts used in dehydrogenation of alkanes to benzene are:

a) Pd, Pt, Ni at elevated temperature
b) $AlCl_3$, $AlBr_3$, BBr_3, BCl_3, $FeCl_3$
c) $Cr_2O_3 + Al_2O_3 + SiO_2$ at 500°C
d) CaO

147. Catalyst used in preparation of benzene from sodium benzoate is:

a) Pd, Pt, Ni at elevated temperature
b) $AlCl_3$, $AlBr_3$, BBr_3, BCl_3, $FeCl_3$
c) $Cr_2O_3 + Al_2O_3 + SiO_2$ at 500°C
d) CaO

148. Catalyst used in catalytic oxidation of benzene is:

a) Pd, Pt, Ni at elevated temperature
b) $AlCl_3$, $AlBr_3$, BBr_3, BCl_3, $FeCl_3$
c) $Cr_2O_3 + Al_2O_3 + SiO_2$ at 500°C
d) V_2O_5 at 450°C

149. Benzene can be prepared from the method:

a) From polymerization of acetylene
b) From chlorobenzene
c) From dehydrogenation of alkenes
d) All of these

150. $3CH{\equiv}CH \xrightarrow[70^\circ C]{\text{Organo nickel catalyst}}$

a) benzene b) chlorobenzene
c) nitrobenzene d) aniline

151. n-heptane $\xrightarrow[500^\circ C]{Cr_2O_3+Al_2O_3+SiO_2}$

a) benzene b) chlorobenzene
c) nitrobenzene d) toluene

152. Phenol + zinc $\longrightarrow$

a) benzene b) chlorobenzene
c) nitrobenzene d) aniline

153. Hydrolysis of benzene sulphonic acid ylelds:

a) benzene b) chlorobenzene
c) nitrobenzene d) aniline

154. Reaction of bromobenzene with ethyl bromide in the presence of sodium in an insert medium like ether gives:

a) benzene b) toluene
c) aniline d) ethyl benzene

REACTIONS OF BENZENE

155. Which type of reaction is Friedel Craft reaction?

a) addition b) substitution
c) reduction d) oxidation

156. The introduction of halogen group in the presence of catalyst is called:

a) addition of halogens b) halogenation
c) alkylation d) acylation

157. Which is too fast to control of alkylation?

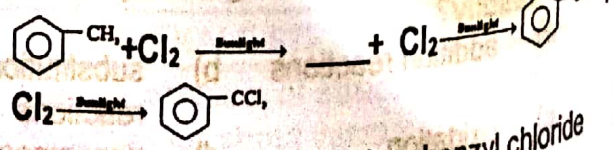
a) fluorination b) chlorination
c) bromination d) chlorination and bromination

158. Which is too show to proceed of alkylation?

a) fluorination b) chlorination
c) bromination d) iodination

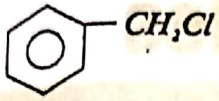
159. Which is normal reaction to occur?

a) fluorination b) chlorination
c) bromination d) chlorination and bromination

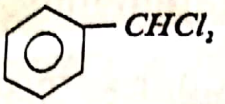
160. 

a) chloro toluene b) benzyl chloride

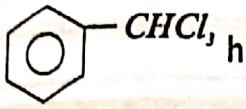
c) benzal chloride d) benzotrichloride

161.  has name:

a) chloro toluene b) benzyl chloride
c) benzal chloride d) benzotrichloride

162.  has name:

a) chloro toluene b) benzyl chloride
c) benzal chloride d) benzotrichloride

163.  has name:

a) chloro toluene b) benzyl chloride
c) benzal chloride d) benzotrichloride

164. **Sulphonation of benzene yields:**

a) benzene sulphonic acid b) nitrobenzene
c) maleic anhydride d) benzophenone

165. **Alkylation of benzene gives:**

a) benzene sulphonic acid b) nitrobenzene
c) maleic anhydride d) toluene

166. **Reaction of HNO_3 with benzene gives:**

a) benzene sulphonic acid b) nitrobenzene
c) maleic anhydride d) benzophenone

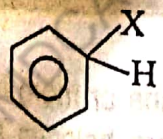
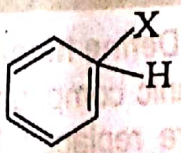
167. **Catalytic oxidation of benzene gives:**

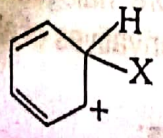
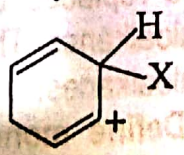
a) benzene sulphonic acid b) nitrobenzene
c) maleic anhydride d) benzophenone

168. **Acylation of benzene gives:**

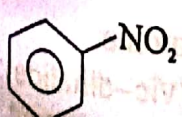
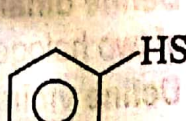
a) benzene sulphonic acid b) nitrobenzene
c) maleic anhydride d) benzophenone

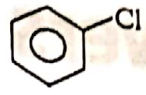
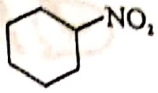
169. **Which is benzenonium ion?**

a)  b) 

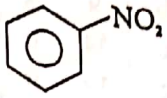
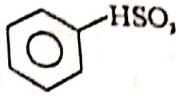
c)  d) 

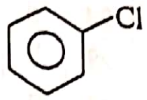
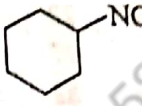
170. **The compound in the result of nitration of benzene is:**

a)  b) 

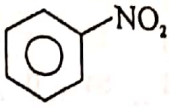
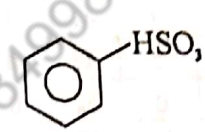
c)  d) 

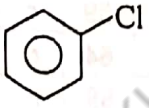
171. **The compound formed in the result of Sulphonation of benzene is:**

a)  b) 

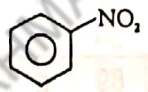
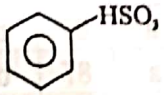
c)  d) 

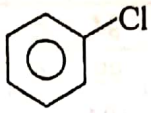
172. **The chlorination of benzene in the presence of a catalyst gives:**

a)  b) 

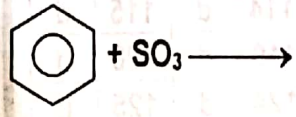
c)  d) none

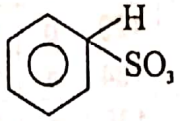
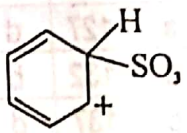
173. **Compound formed due to hydrogenation of benzene is:**

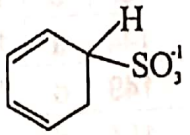
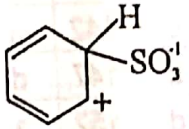
a)  b) 

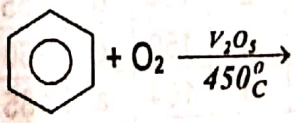
c)  d) 

174. **Which is the correct step product in the following reaction?**



a)  b) 

c)  d) 

175. 

a) aleic acid b) CO_2 and water
c) glyoxal d) benzoic acid

Answers

1	d	2	c	3	a	4	d	5	a
6	b	7	d	8	b	9	a	10	d
11	c	12	b	13	c	14	c	15	b
16	a	17	a	18	c	19	b	20	d
21	d	22	a	23	d	24	d	25	d
26	c	27	d	27	a	29	b	30	c
31	a	32	d	33	c	34	b	35	a
36	c	37	a	38	d	39	a	40	c
41	a	42	a	43	a	44	a	45	b
46	c	47	d	48	d	49	a	50	b
51	c	52	d	53	d	54	d	55	d
56	b	57	d	58	a	59	c	60	d
61	a	62	b	63	c	64	d	65	d
66	a	67	d	68	d	69	c	70	b
71	a	72	d	73	d	74	c	75	b
76	a	77	b	78	c	79	d	80	d
81	a	82	b	83	c	84	d	85	d
86	a	87	d	88	a	89	d	90	d
91	c	92	d	93	a	94	c	95	d
96	a	97	b	98	d	99	c	100	c
101	a	102	a	103	d	104	a	105	a
106	d	107	d	108	d	109	a	110	c
111	a	112	d	113	c	114	d	115	d
116	d	117	a	118	b	119	d	120	d
121	d	122	c	123	d	124	d	125	b
126	a	127	d	128	b	129	b	130	c
131	d	132	b	133	d	134	a	135	b
136	c	137	d	138	d	139	c	140	d
141	c	142	a	143	a	144	a	145	b
146	c	147	d	148	d	149	d	150	a
151	d	152	a	153	a	154	d	155	b
156	b	157	a	158	d	159	d	160	b
161	b	162	c	163	d	164	a	165	d
166	b	167	c	168	d	169	c	170	a
171	b	172	c	173	d	174	d	175	a

****

3. Alkylhalides

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Discuss importance of halogenoalkanes in everyday life with special use of CFCs, halothanes, CCl_4, $CHCl_3$ and Teflon.

b) Reaction of alkyl halides such as:

i) SN-reactions, (Reactions of Alkyl halides with aqueous KOH, Alcoholic / aqueous KCN and Alcoholic / aqueous NH_3).

ii) Describe SN1 and SN2 Mechanisms for tertiary butyl chloride and methyl bromide respectively using aqueous KOH.

iii) Elimination reaction with alcoholic KOH to give alkenes.

Definitions and Statements

1. Define haloalkanes:

The organic compounds in which one or more hydrogen atoms are replaced by one or more halogen atoms is called Haloalkanes. The halogen derivatives of alkanes is called Haloalkanes.

2. Define mono Haloalkanes:

It consists of only one halogen atom.

3. Define dihaloalkane:

It consist of two halogen atoms in alkane.

4. Define vicinal dihalide (Vic–dihalide):

Halides having two halogen atoms at adjacent carbons

are called vicinal dihalide.

5. Define germinal dihalide (Gem–dihlaide):
Halides having both halogen atoms at same carbon are called geminal dihalides."

6. Define trihalo Halides:
Mono haloalkanes are also called alkyl halides. Organic compounds in which only one hydrogen is replaced by a halogen atom is called alkyl halides. General Formula: R—X

7. Define primary Alkyl Halides:
When halogen atom is attached to a carbon which is further attached with one carbon or no carbon atom are called primary alkyl halides.

8. Define secondary Alkyl Halide:
When halogen atom is attached to the secondary carbon i.e., a carbon which is directly attached with two other carbon atoms, it is called secondary alkyl halide.

9. Define tertiary Alkyl Halide:
When halogen atom is attached with tertiary carbon "a carbon which is directly attached to three other carbon atoms" it is called tertiary alkyl halide.

10. Define bond Energies:
Bond energy is the energy required to break the bond.

11. Define Wurtz Reaction:
Alkyl halides react with sodium metal to produce higher alkanes. These alkanes consist of the total number of carbons present in both alkyl halides.

12. Define nucleophilic substitution reactions or SN–reactions:
The type of reactions in which one nucleophile replaces other nucleophile ($—X^{-1}$) already present in alkyl halide.

13. Define elimination reactions or E–reactions:
The types of reactions in which a halogen atom from one carbon atom and hydrogen from adjacent carbon atom is removed making a double bond is called elimination reaction.

14. Define nucleophile ("Nucleo"–"Nucleus" and "Phile" lover):
A specie (containing lone pair or a negative ion) which attacks on an electrophile is called nucleophile."

15. Define electrophile ("Electro" means "Electron" and "phile" means "Lover"):
A specie (cation or electron deficient) which attacks a nucleophile is called electrophile."

16. Define leaving Group:
A nucleophile which is being replaced from a substrate by the attack of another nucleophile is called leaving group."

17. Define substrate Molecule:
An alkyl halide molecule on which a nucleophile attacks is called a substrate molecule."

18. Define nucleophilic Substitution Reactions:
A reaction in which a nucleophile from a substrate (R–X) is replaced by the attack of attaching nucleophile is called nucleophilic substitution reaction."

19. Define unimolecular Nucleophilic Substitution Reactions:
A nucleophilic substitution reaction occurring in two steps is called unimolecular nucleophilic substitution reaction."

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

1. In primary alkyl halides, the halogen atom is attached to a carbon which is attached to how many carbon atoms?
a) Two b) Three
c) One d) Four

2. The reactivity order of alkyl halides for a particular alkyl group is:
a) F> Cl>Br>I (b) Cl>Br>F>I
c) I>Br>Cl>F (d) Br>I>Cl>F

3. When CO_2 is made to react with ethyl magnesium iodide, followed by hydrolysis, the product formed is:
a) Propane (b) Propanoic acid
c) Propanal (d) Propanol

4. Grignard reagent is reactive due to:
a) the presence of halogen atom
b) the presence of Mg atom
c) the polarity of C – Mg bond
d) none of above.

5. SN_2 reactions can be best carried out with:
a) Pri. alkyl halide
b) Sec. Alkyl halide
c) Ter. Alkyl halide
d) All the three

6. Elimination bimolecular reactions involve:
a) First order kinetics
b) Second order kinetics
c) Third order kinetics
d) Zero order kinetics

7. For which mechanisms, the first step involved is the same:
a) E_1 and E_2 b) E_2 and SN_2
c) E_2 and E_1 d) E_1 and SN_1

8. Alkyl halides are considered to be very reactive compounds towards nucleophiles, because:
a) They have an electrophilic carbon
b) They have an electrophilic carbon and good leaving group.

c) They have an electrophilic carbon and a bad leaving group.
d) They have a nucleophilic carbon and a good leaving group.

9. The rate of E_1 reaction depends upon:
a) The concentration of substrate
b) The concentration of nucleophile
c) The concentration of substrate as well as nucleophile
d) None of the above

10. Which one of the following is not a nucleophile?
a) H_2O b) H_2S
c) BF_3 d) NH_3

Important MCQs

11. General formula of alkyl halide is:
(a) R—X (b) R—OH
(c) R—COH (d) R—COOH

12. General formula of alkyl halide is:
(a) $C_nH_{2n+2}X$ (b) $C_nH_{2n+1}X$
(c) $C_nH_{2n}X$ (d) C_nH_nX

13. Best method of preparation of alkyl halide from alcohols is by its reaction with:
(a) HX (b) $SOCl_2$
(c) PX_5 and PX_3 (d) All

14. Alkyl halides are reactive:
(a) high (b) medium
(c) less (d) least

15. SN_2 reaction has order of reaction:
(a) first (b) second
(c) third (d) zero

16. E_2 has molecularity:
(a) one (b) two
(c) three (d) half

17. Metal used in the preparation of Grignard's reagent is:
(a) Ca (b) Na
(c) Mg (d) Zn

18. Reaction of Grignard's reagent with CO_2 gives:
(a) aldehyde (b) pri–alcohol
(c) sec–alcohol (d) carboxylic acid

19. Reaction of which with Grignard's reagent gives primary alcohol:
(a) formaldehyde (b) aldehyde
(c) ketones (d) acetone

20. Primary carbon attaches with other hydrogen atoms directly:
(a) one (b) two
(c) three (d) at least one or more than it

21. Catalyst in the reaction $ROH + SOCl_2 \longrightarrow RCl + SO_2 + HCl$ is:
(a) $ZnCl_2$ (b) Pyridine
(c) H_2SO_4 (d) Ether

22. Electronegativity of fluorine is:
(a) 2.1 (b) 2.5
(c) 2.8 (d) 4.0

23. Reactivity order of alkyl halides is:
(a) RI > RBr > RCl > RF (b) RBr > RCl > RF > RI
(c) RCl > RF > RI > RBr (d) RF > RI > RBr > RII

24. Steps in SN_1 reactions are:
(a) one (b) two
(c) three (d) four

25. Grignard's reagent was prepared in:
(a) 1900 (b) 1910
(c) 1920 (d) 1930

26. Reactivity of alkyl halides with magnesium is of the order:
(a) RI > RBr > RCl > RF (b) RBr > RCl > RF > RI
(c) RCl > RF > RI > RBr (d) RF > RI > RBr > RII

27. The order of reactivity for a given halogen in Grignard's reagent is:
(a) $CH_3X > C_2H_5X > C_3H_4X > C_4H_4X$ (b) $C_2H_5X > C_3H_7X > C_4H_9X > CH_3X$
(c) $C_3H_7X > C_4H_7X > CH_3X > C_2H_5X$ (d) $C_4H_4X > C_3H_7X > C_2H_5X > CH_3X$

28. Organic compounds containing halogen atom are called:
(a) R—OH (b) R—X
(c) $R—NH_2$ (d) R—COH

29. Hydrolysis of Grignard's reagent gives:
(a) alkane (b) alkyl halide
(c) alcohol (d) carboxylic acid

30. Which is a good nucleophile?
(a) F^{-1} (b) Cl^{-1}
(c) Br^{-1} (d) I^{-1}

INTRODUCTION

31. Compounds of hydrocarbons with halogens are called:
a) alkyl halides b) haloalkanes
c) alcohols d) a and b

32. The organic compounds having halogen atom in them are called:
a) alkyl halides b) haloalkanes
c) alcohols d) a and b

33. The alkanes in which hydrogen is replaced

by any halogen atom are called:
a) alkyl halides b) haloalkanes
c) alcohols d) a and b

34. The compounds with general formula R—X are called:
a) alkyl halides b) haloalkanes
c) alcohols d) a and b

CLASSIFICATION OF ALKYL HALIDES

35. Monohaloalkanes are also called:
a) alkyl halides b) haloalkanes
c) alcohols d) ester

36. Haloalkanes are:
a) monohaloalkanes b) dihaloalkanes
c) trihaloalkanes d) all

37. Monohaloalkanes have halogen atoms in it:
a) one b) two
c) three d) four

38. Dehaloalkanes have halogen atoms in it:
a) one b) two
c) three d) four

39. Trihaloalkanes have number of halogen atom(s):
a) one b) two
c) three d) four

40. Tetrahaloalkanes have halogen atoms:
a) one b) two
c) three d) four

41. Poly haloalkanes have halogen atoms:
a) one b) two
c) three d) many

42. Primary alkyl halide have halogen atom attached to carbon atom:
a) primary b) secondary
c) tertiary d) All of these

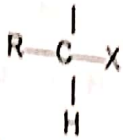
43. Alkyl halides having halogen atom attached to secondary carbon are called:
a) primary b) secondary
c) tertiary d) All of these

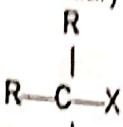
44. Alkyl halides having halogen atom attached to tertiary carbon are called:
a) primary b) secondary
c) tertiary d) All of these

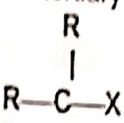
45. A carbon attached with all three hydrogen or a carbon is called a carbon:
a) primary b) secondary
c) tertiary d) All of these

46. A carbon attached at least with two carbon atoms is called a carbon:
a) primary b) secondary
c) tertiary d) All of these

47. A carbon attached at least with three carbon atoms is called a carbon:
a) primary b) secondary
c) tertiary d) All of these

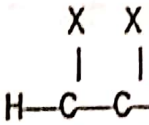
48.  is called alkyl halide:
a) primary b) secondary
c) tertiary d) All of these

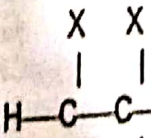
49.  is called alkyl halide:
a) primary b) secondary
c) tertiary d) All of these

50.  is called alkyl halide:
a) primary b) secondary
c) tertiary d) All of these

51. An alkyl halide with two halogen atoms at same carbon is called:
a) vic-dihalide b) gem-dihalide
c) poly haloalkane d) primary alkyl halide

52. An alkyl halide with two halogen atoms at two adjacent carbon atoms is called:
a) vic-dihalide b) gem-dihalide
c) poly haloalkane d) primary alkyl halide

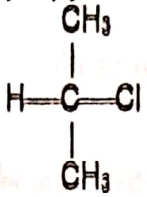
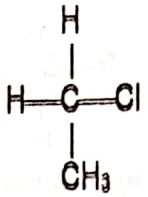
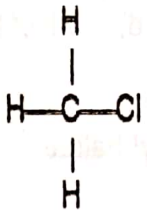
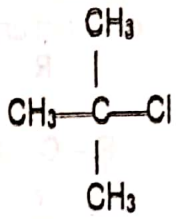
53.  is called:
a) vic-dihalide b) gem-dihalide
c) poly haloalkane d) primary alkyl halide

54.  is called:
a) vic-dihalide b) gem-dihalide
c) poly haloalkane d) primary alkyl

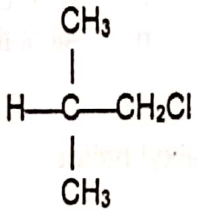
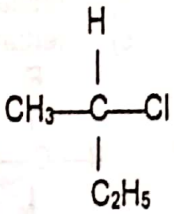
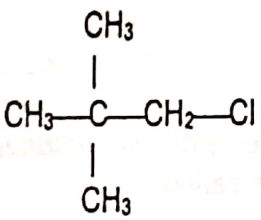
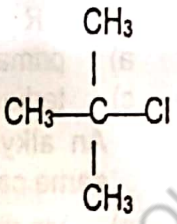
halide

55. **A primary alkyl halide is:**
a) ethyl chloride b) propyl chloride
c) methyl chloride d) 1-chlorobutane

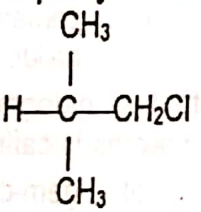
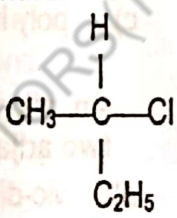
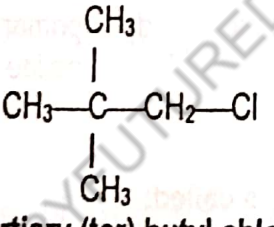
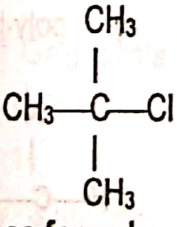
56. **Isopropyl has formula:**

a) 
b) 
c) 
d) 

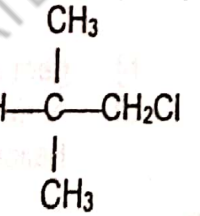
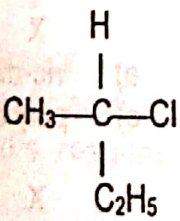
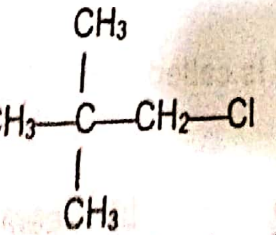
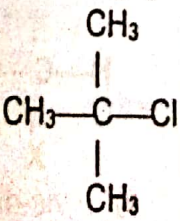
57. **Secondary butyl chloride has formula:**

a) 
b) 
c) 
d) 

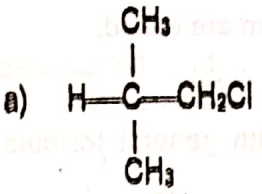
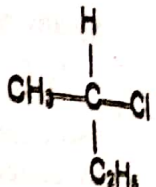
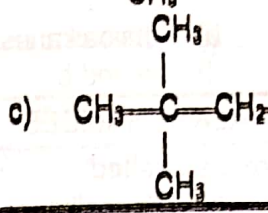
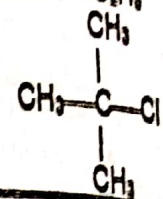
58. **Neo-pentyl chloride has formula:**

a) 
b) 
c) 
d) 

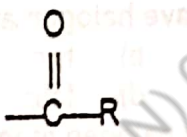
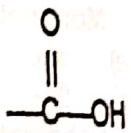
59. **Tertiary (ter) butyl chloride has formula:**

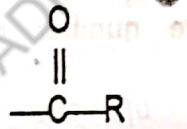
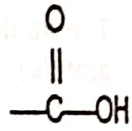
a) 
b) 
c) 
d) 

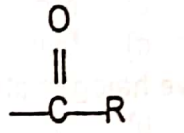
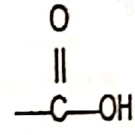
60. **Iso-butyl chloride has formula:**

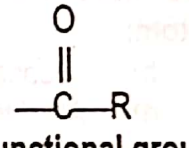
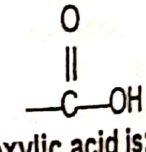
a) 
b) 
c) 
d) 

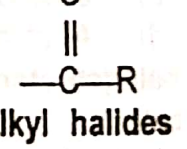
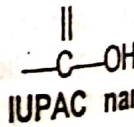
NOMENCLATURE

61. **Functional group of alkyl halides is:**
a) —X b) —OH
c)  d) 

62. **Functional group of alcohols is:**
a) —X b) —OH
c)  d) 

63. **Functional group of aldehydes is:**
a) —X b) —OH
c)  d) 

64. **Functional group of ketones is:**
a) —X b) —OH
c)  d) 

65. **Functional group of carboxylic acid is:**
a) —X b) —OH
c)  d) 

66. **Alkyl halides are given IUPAC names by changing halogen to:**
a) halo b) —ol
c) al— d) —one

67. **Compounds of alcohols are name by replacing "—e" of alkane with:**
a) halo b) —ol
c) al— d) —one

68. **Compounds of aldehydes are named by replacing "—e" of alkanes with:**
a) halo b) —ol

c) al— d) —one

69. Compounds of ketones are given names by replacing "e" of alkane with:

a) halo b) —ol
c) al— d) —one

70. Compounds of carboxylic acid are named by replacing "e" of alkane with:

a) halo b) —ol
c) al— d) —one

71. Formula of methylene chloride is:

a) CH_2Cl_2 b) CH_3Cl
c) $CHCl_3$ d) CCl_4

72. Names of more than are different groups or branches are written:

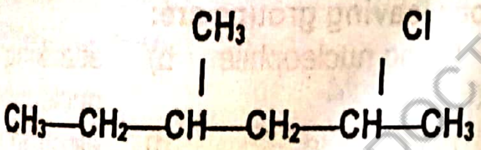
a) as given in the formula
b) in molecule w.r.t. position
c) w.r.t. increasing atomic number
d) alphabetically

73. More than similar branches are written in IUPAC names:

a) using prefix di, tri etc.
b) writing each time name with position
c) using prefix with position
d) using suffix

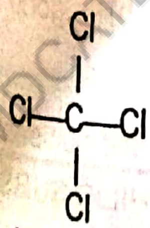
74. A substituent in the compound is given position always:

a) lowest b) first
c) second d) maximum

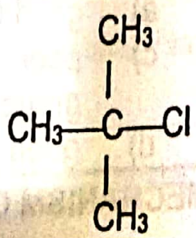
75. 

a) 2-chloro-4-methylhexane
b) 4-chloro-2-methyl hexane
c) 3-methyl-5-chlorohexane
d) 2 chloro 4-methyl hexane

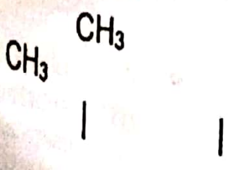
76. Which is correct formula as well as name?

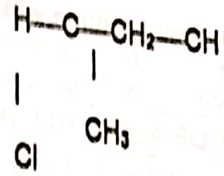
a) 

tetrachloromethane

b) 

2-chloro-2-methylpropane

c) 



2-chloro-4-methylpentane

d) all

PREPARATION OF ALKYL HALIDES

77. Alkyl halides are prepared from:

a) hydrogenation of alkane
b) hydrogenation of alkene
c) hydrogenation of alkyne
d) by halogenation of alkane and HX to alkenes

78. The best method to prepare alkyl halide is from:

a) alcohols b) alkene
c) alkanes d) alkynes

79. Catalyst used in the reaction of alcohols with HX is:

a) $ZnCl_2$ b) NH_4OH & Cu_2Cl_2
c) H_2SO_4 d) $HgSO_4$ & H_2SO_4

80. Catalyst is used in hydrogenation process is:

a) $ZnCl_2$ b) NH_4OH & Cu_2Cl_2
c) H_2SO_4 d) Ni & Pd & Pt

81. Hydrogenation of the alkynes occur in the presence of catalyst:

a) $ZnCl_2$ b) NH_4OH & Cu_2Cl_2
c) H_2SO_4 d) $HgSO_4$ & H_2SO_4

82. Dehydration of alcohols occur in the presence of catalyst:

a) $ZnCl_2$ b) NH_4OH & Cu_2Cl_2
c) H_2SO_4 d) $HgSO_4$ & H_2SO_4

83. Linear polymerization of ethyne occurs in the presence of:

a) $ZnCl_2$ b) NH_4OH & Cu_2Cl_2
c) H_2SO_4 d) $HgSO_4$ & H_2SO_4

84. $CH_3CH_2—OH + HX \xrightarrow{ZnCl_2}$

a) CH_3CH_2X b) CH_3CH_2X & H_2O
c) CH_3CH_2X & H_2 d) $CH_2=CH_2$ & H_2

85. The catalyst in the following reaction is:

$ROH + SOCl_2 \longrightarrow RCl + SO_2 + HCl$

a) pyridine b) alcohol
c) water d) HCl

86. Reaction of PCl_5 with ethanol gives:

a) ethyl chloride b) ethyl chloride & $POCl_3$
c) HCl
d) Ethyl chloride & $POCl_3$ & HCl

87. Simple alkyl iodide is prepared by reaction of

alkyl chloride or alkyl bromide with:
a) sodium iodide b) sodium fluoride
c) sodium bromide d) sodium chloride

10.4 REACTIVITY OF ALKYL HALIDES

88. Factors affecting reactivity of alkyl halides:
a) C—X bond energy b) C—X bond polarity
c) difference in electronegativity between C & X
d) All of these

89. Bond energy of C—F bond in Kj/mol is:
a) 467 b) 413
c) 346 d) 228

90. The strength of R—X bond with iodo compounds is:
a) weak b) weaker
c) the weakest d) strongest

91. The strength of R—F bond is:
a) weak b) weaker
c) the weakest d) strongest

92. The order of decreasing reactivity of alkyl halide is:
a) R—F > R—Cl > R—Br > R—I
b) R—Cl > R—F > R—I > R—Br
c) R—F > R—Br > R—Cl > R—I
d) R—I > R—Br > R—Cl > R—F

93. Electronegativity value of fluorine is:
a) 4.0 b) 3.0
c) 2.8 d) 2.5

94. Electronegativity of chlorine is:
a) 4.0 b) 3.0
c) 2.8 d) 2.5

95. Electronegativity of bromine is:
a) 4.0 b) 3.0
c) 2.8 d) 2.5

96. Electronegativity of iodine is:
a) 4.0 b) 3.0
c) 2.8 d) 2.5

97. Electronegativity of hydrogen is:
a) 4.0 b) 3.0
c) 2.8 d) 2.1

98. The maximum electronegativity difference is between bond:
a) R—F b) R—H
c) R—Cl d) R—Br

99. Reactivity order of halogen atom with a specific alkyl group is:
a) F > Br > Cl > I b) I > Cl > Br > F
c) I > Br > Cl > F d) F > I > Cl > Br

REACTIONS OF ALKYL HALIDES

100. Alkyl halides show reaction types:
a) SN reactions b) E-reactions
c) SN & E-reactions d) Addition reactions

101. When a nucleophile replaces another nucleophile from substrate (alkyl halide) the reaction is called:
a) SN reactions b) E-reactions
c) SN & E-reactions d) Addition reactions

102. A nucleophile is a specie:
a) neutral radical b) positively charged
c) cation
d) both neutral as well as negatively charged

103. Nucleophile is:
a) nucleus loving b) negatively charged
c) neutral d) All of these

104. Electrophile is:
a) electron loving b) positively charged
c) neutral d) All of these

105. A group which attacks on alkyl halide substrate is called:
a) loving nucleophile b) attacking nucleophile
c) nucleophile d) electrophile

106. A group which is being replaced from alkyl halide substrate is called:
a) loving nucleophile b) attacking nucleophile
c) nucleophile d) electrophile

107. Poor leaving groups are:
a) loving nucleophile b) attacking nucleophile
c) nucleophile d) electrophile

108. Good loving groups are:
a) loving nucleophile b) attacking nucleophile
c) nucleophile d) electrophile

109. Iodide ion is:
a) good loving group b) good nucleophile
c) poor leaving groups
d) good leaving group and nucleophile

MECHANISM OF NUCLEOPHILIC SUBSTITUTION REACTIONS

110. Reaction of alkyl halide with a base follow mechanism:
a) substitution b) elimination & substitution
c) free radical d) elimination

111. Which property is not present in SN_1 reactions?
a) unimolecular b) order of reaction two
c) no transition state d) two steps mechanism

112. Which property is not present in SN_2 reactions?
a) bimolecular b) first order reaction
c) transition state occurs d) one step mechanism

113. The hybridization of carbon is alkyl halide changes to in SN_1 reactions is:
a) sp to sp^3 b) sp to sp^2
c) sp^2 to sp^3 d) sp^3 to sp^2

114. Replacement of attacking and leaving nucleophile occurs in alkyl halide gives inverted molecules of types:
a) one b) Two
c) three d) Four

115. Rates of SN_1 reaction depends upon:
a) concentration of alkyl halide
b) attacking nucleophile
c) concentration of alkyl halide and attacking nucleophile
d) None of these

116. The number of molecules taking part in the rate determining steps is called:
a) order b) Molecularity
c) rate d) Mechanism

117. The sum of coefficients of reactants in rate determining step is called:
a) order b) Molecularity
c) rate d) Mechanism

118. The pathway through which reactants are converted to products is called:
a) order b) Molecularity
c) rate d) Mechanism

119. Which step does not occur in SN_1 reactions?
a) inversion b) Ionization
c) attack and removal of nucleophiles in different steps
d) Unimolecular

120. The percentage of retention and inversion configuration in SN_1 is:
a) 50% each b) 40% & 60%
c) 70% & 30% d) 20% & 80%

β-ELIMINATION REACTIONS

121. The reaction in which both halogen atom and β-hydrogen is replaced from alkyl halide is called:
a) addition b) Substitution
c) elimination d) Redox

122. Mechanism of elimination reactions followed are:
a) addition b) Substitution
c) elimination d) Redox

123. E_1 reactions are given by alkyl halide:
a) primary b) Secondary
c) tertiary d) Monohaloalkane

124. E_2-reactions are given by alkyl halides:
a) primary b) Secondary
c) tertiary d) Monohaloalkane

125. SN_1 reactions are given by alkyl halides:
a) primary b) Secondary
c) tertiary d) Monohaloalkane

126. SN_2 reactions are given by alkyl halides:
a) primary b) Secondary
c) tertiary d) Monohaloalkane

127. E_1 reactions follows mechanism of SN reactions:
a) SN_1 b) SN_2
c) E_2 d) free radical

128. E_2-reactions follow mechanism of SN reactions:
a) SN_1 b) SN_2
c) E_2 d) free radical

129. Which is not nucleophile?
a) OR b) NH_3
c) NH_2 d) BH_3

130. Which is not the electrophile?
a) BH_3 b) H_3C^+
c) OR d) H_3O^+

131. Wurtz reaction is used to prepare:
a) Alcohol b) Alkyl halide
c) Ether d) Alkanes

132. Frankland reaction is used to prepare:
a) Alcohol b) Alkyl halide
c) Ether d) Alkanes

133. Reaction of R—X with nascent hydrogen gives:
a) Alcohol b) Alkyl halide
c) Ether d) Alkanes

134. Catalyst used in the reaction R—X + [H] ⟶ R—H + HX is:
a) Zn/HCl b) Sn/HCl
c) C_2h_5OH/Na d) all

135. TEL is abbreviation of:
a) Tetra ethyl liquid b) Tetra ethanol liquid

c) Triethyl lead d) Tetra ethyl lead

136. TML is abbreviation of:
a) Tetra ethyl liquid b) Tetra ethanol liquid
c) Triethyl lead d) Tetramethyl lead

137. TEL is prepared from:
a) Methyl chloride & lead
b) Ethyl chloride & lead
c) Ethyl chloride and $(Na)_4Pb$
d) Ethyl chloride and white lead

GRINARD'S REAGENT

138. Grignard reagent is prepared from reaction of magnesium with:
a) R—X b) R—OH
c) R—C(=O)—H d) R—C(=O)—R

139. Preparation of Grignard's reagent is an application of:
a) R—X b) R—OH
c) R—C(=O)—H d) R—C(=O)—R

140. Solvent used in preparation of Grignard's reagent is:
a) water b) methyl alcohol
c) ether d) anhydrous ether

141. Anhydrous ether (water free) is used in preparation of Grignard's reagent because:
a) alkyl halide can react with water
b) magnesium can react with water which will then not be available for reaction with R—X
c) anhydrous ether may or may not be used
d) All of these

142. Grignard's reagent (RMgX) is a derivative of:
a) alcohols b) alkyl halides
c) ether d) ketones

143. H_3C—CH_2—Mg—X
which bond is more strong? bond between
a) Mg—X b) C—Mg
c) C—H d) C—C

144. Which bond is more polar in H_3C—CH_2—Mg—X?
a) Mg—X b) C—Mg
c) C—H d) C—C

145. Which bond breaks first in H_3C—CH_2—Mg—X
a) Mg—X b) C—Mg
c) C—H d) C—C

146. R—Mg—X reagent was prepared by:
a) Victor Grignard b) Frankland
c) Wurtz d) Kolb

147. The order of reactivity of alkyl halides with magnesium is:
a) R—I > R—Br > R—Cl
b) R—Cl > R—Br > R—I
c) R—Cl > R—I > R—Br
d) R—I > R—Cl > R—Br

148. The order of increasing reactivity of alkyl group with same halogen atom is:
a) $CH_3X > C_2H_5X > C_3H_7X$
b) $C_2H_5X > CH_3X > C_3H_7X$
c) $CH_3X > C_3H_7X > C_2H_7X$
d) $C_3H_7X > CH_3X > C_2H_3X$

149. H_3C—CH_2—Mg—X
increasing reactivity order in this molecule is
a) C—H > C—C > C—Mg > Mg—Cr
b) C—Mg > Mg—Br > C—H > C—C
c) C—C > C—H > C—Mg > Mg—Br
d) Mg—Br > C—Mg > C—C > C—H

150. Alkanes can be prepared an Grignard's reaction with:
a) water b) ammonia
c) R—X d) all

151. Alkanes can be prepared from Grignard's reagent with:
a) water b) HCN
c) NH_3 d) all

152. Alkanes with same number of carbons as in Grignard's reagent can be prepared by its reaction with:
a) water b) HCN
c) NH_3 d) all

153. Reaction of CO_2 with Grignard's reagent gives:
a) ethanal b) ethanol
c) ethanone d) ethanoic acid

154. Reaction of Grignard's reagent with aldehyde gives:
a) primary alcohol b) secondary alcohol
c) tertiary alcohols d) ethanoic acid

155. Reaction of Grignard's reagent with acetaldehyde gives:
a) primary alcohol b) secondary alcohol

c) tertiary alcohols d) ethanoic acid

156. **Reaction of Grignard's reagent with acetone gives:**

a) primary alcohol b) secondary alcohol
c) tertiary alcohols d) ethanoic acid

157. **Reaction of Grignard's reagent with cyanogens chloride gives:**

a) primary alcohol b) secondary alcohol
c) tertiary alcohols d) ethanoic acid

Answers

1	c	2	c	3	b	4	c	5	a
6	b	7	d	8	b	9	a	10	c
11	a	12	b	13	e	14	a	15	a
16	b	17	c	18	e	19	b	20	d
21	b	22	d	23	a	24	b	25	a
26	a	27	a	27	b	29	a	30	d
31	d	32	d	33	d	34	d	35	a
36	d	37	a	38	b	39	c	40	d
41	d	42	a	43	b	44	c	45	a
46	b	47	c	48	a	49	b	50	c
51	b	52	a	53	a	54	b	55	d
56	a	57	b	58	c	59	d	60	a
61	a	62	b	63	c	64	d	65	d
66	a	67	b	68	c	69	d	70	d
71	a	72	d	73	c	74	a	75	a
76	d	77	d	78	a	79	a	80	d
81	d	82	c	83	b	84	b	85	a
86	d	87	a	88	d	89	a	90	d
91	c	92	d	93	a	94	b	95	c
96	d	97	d	98	a	99	c	100	c
101	a	102	d	103	d	104	d	105	b
106	a	107	a	108	b	109	d	110	d
111	b	112	b	113	d	114	b	115	c
116	b	117	a	118	d	119	a	120	a
121	c	122	b	123	c	124	a	125	b
126	a	127	a	128	b	129	d	130	c
131	d	132	d	133	d	134	d	135	d
136	d	137	c	138	a	139	a	140	d
141	b	142	b	143	a	144	a	145	b
146	a	147	a	148	a	149	b	150	d
151	d	152	d	153	d	154	a	155	b
156	c	157	d						

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4. Alcohols & Phenols

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

Discus Alcohols with reference to:

a) Classification of alcohols into primary, secondary and tertiary.

b) Preparation of ethanol by hydration of ethene using conc. H_2SO_4 or conc. H_3PO_4

c) Reaction of alcohol with:
   i) $K_2Cr_2O_7 + H_2SO_4$ (oxidation).
   ii) PCl_5.
   iii) Na-metal.
   iv) Alkaline aqueous Iodine (Iodoform Test).
   v) Carboxylic acid (Esterification).

d) Dehydration of alcohol to give alkene.

Phenols:

a) Discuss reactions of phenol with:
i) Bromine ii) HNO_3 iii) NaOH

b) Explain the relative acidity of water, ethanol and phenol.

Definitions and Statements

1. Define alcohols:

If one hydrogen of water molecule is replaced by an alkyl (R) group. These are called alcohols."

2. Define phenols:

If one hydrogen from water molecule is replaced by an aryl group (Ar), these are called phenols."

3. Define eEthers:

If both hydrogen atoms of water molecule are replaced by two alkyl or aryl groups these are called ethers."

4. Define alcohols:

Organic aliphatic compounds containing hydroxyl group (—OH, hydroxy) in them are called alcohols. **General Formula:** R — O — H.

5. Define monohydric alcohol ("mono" means "one" and "hydric" means "—OH group"):

The alcohols containing are only — OH group are called monohydric alcohol."

Example: CH_3OH (Methyl alcohol) C_2H_5OH Ethyl alcohol

6. Define dihydric alcohols ("Di" means "two", Hydric means "OH—group"):

The alcohols containing two — OH groups are called dihydric alcohols."

7. Define Trihydric alcohols ("Tri" means three and "hydric" means OH—group"):

Alcohols containing three —OH groups are called trihydric alcohols."

8. Define Polyhydric alcohols ("poly" means many and "hydric" means OH group):

Alcohols containing more than one hydroxy group (—OH) are generally termed as polyhydric alcohols."

9. Define Primary Alcohol:

An alcohol in which —OH group is directly attached with primary carbon atom is called primary alcohol."

10. Define Secondary Alcohol:

An alcohol in which —OH group is directly attached with a secondary carbon atoms is called secondary alcohol."

11. Define Tertiary Alcohol:

An alcohol in which — OH group is directly attached with a tertiary carbon atom is called tertiary alcohol."

12. Define Wood Spirit:

Earlier methyl alcohol was prepared from distillation of wood. That is why it is also called wood spirit.

13. Define Distinction between ethanol and methanol:

Ethanol gives Iodoform test while methanol does not.

14. Define Fermentation:

It is a biochemical degradion process which occurs in the presence of certain enzymes secreted by microorganisms such as yeast."

15. Define Absolute alcohol:

100% alcohol (ethanol) s called absolute alcohol. It is obtained by re-distillation of rectified spirit in the presence of CaO.

16. Define Methylated spirit:

Ethanol denatured with 10% methanol or small amount of acetone or pyridine to avoid its use as drinking is called methylated spirit."

17. Define Rectified spirit:

95 % alcohol (ethanol) is called rectified alcohol. It is obtained by distillation of 12% alcohol.

18. Define Denaturing of alcohols:

Ethanol is denatured by addition of 10% methanol to avoid its used for drinking purpose. Such alcohol is called methylated spirit. A small amount of pyridine or acetone also be used for this purpose.

19. Define Phenols:

Aromatic compounds in which one hydrogen of benzene molecule is replaced with hydroxyl group (—OH) are called phenols. **General Formula:** Ar—OH

20. Define Nitration:

Substitution of a hydrogen with NO^+_2 group is benzene ring is called nitration."

21. Define Ethers:

Organic compounds in which both valencies of oxygen are satisfied by alkyl or aryl group are called ethers. **General Formula:** R—O—R'

22. Define Simple Ethers:

Ethers in which two same alkyl or aryl groups are present are called simple or symmetrical ethers."

23. Define Mixed Ethers:

Ethers in which two different alkyl or aryl groups are present are called mixed or unsymmetrical ethers."

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

1. Which compound shows more hydrogen bonding?

(a) C_2H_6 (b) C_2H_5Cl
(c) $CH_3 — O — CH_3$ (d) C_2H_5OH

2. Which compound shows maximum hydrogen bonding with water?

(a) CH_3OH (b) C_2H_5OH
(c) $CH_3 — O — CH_3$ (d) C_6H_5OH

3. Which compound is more soluble in water?

(a) C_2H_5OH (b) C_6H_5OH
(c) CH_3OCH_3 (d) n-Hexanol

4. Which compound will have the maximum repulsion with water?
(a) C_6H_6 (b) C_2H_5OH
(c) $CH_3CH_2CH_2OH$
(d) $CH_3—O—CH_3$

5. Ethanol can be converted into ethanoic acid by:
(a) Hydrogenation (b) Hydration
(c) Oxidation
(d) Fermentation

6. Which enzyme is not involved in the fermentation of starch?
(a) Diastase (b) Zymase
(c) Urease (d) Invertase

7. Which compound is called a universal solvent?
(a) H_2O (b) CH_3OH
(c) C_2H_5OH
(d) $CH_3—O—CH_3$

8. Methyl alcohol is not used:
(a) as a solvent
(b) as an anti-freezing agent
(c) as a substitute for petrol
(d) for denaturing of ethyl alcohol

9. Rectified spirit contains alcohol about:
(a) 80% (b) 85%
(c) 90% (d) 95%

10. According to Lewis concept ethers behave as:
(a) acid (b) base
(c) acid as well as a base (d) None of them

Important MCQs

11. Phenols are derivative of:
(a) alkanes (b) alkenes
(c) alkynes (d) benzene

12. Alcohols are derivatives of:
(a) alkanes (b) alkenes
(c) alkynes (d) benzene

13. Derivative of water is:
(a) alcohols (b) phenols
(c) ether (d) All of these

14. Dow's method is used to prepare:
(a) Methanol (b) Ethanol
(c) Ether (d) Phenol

15. Which is not property in ether:
(a) very weak (b) High b.p
(c) slightly soluble (d) inflammable

16. Methanol is prepared from CO and H_2 using catalyst:
(a) ZnO (b) Cr_2O_3
(c) Pt (d) Ni

17. Taste of lower alcohols is:
(a) sweet (b) bitter
(c) our (d) salty

18. Oxidation of ter–alcohol gives:
(a) aldehyde (b) formaldehyde
(c) ketone (d) alkenes
(e) alkanes

19. Alcohols can be distinguished using test:
(a) Lucas (b) Tollen's
(c) Kolb's (d) William's

20. Ethyl alcohol prepared during fermentation is pure:
(a) 10% (b) 11%
(c) 12% (d) 13%

21. Use of ethanol as:
(a) drink (b) Solvent and fuel
(c) in beverage (d) All of these

22. Ethanol in Pakistan is prepared from fermentation of:
(a) starch (b) sugar
(c) glucose (d) molasses

23. Alcohols are named by replacing 'e' of alkane with:
(a) al (b) ene
(c) ol (d) one

24. General formula of alcohol is:
(a) ROH (b) Ar–OH
(c) R–O–R (d) Ph–OH

25. Which is possible in ethers?
(a) reactivity high (b) oxidation and reduction
(c) reactivity towards bases (d) Towards acids

26. Denaturing of alcohol is done by addin methanol in ethanol:
(a) 10% (b) 20%
(c) 30% (d) 40%

27. Absolute alcohol is obtained by adding rectifie spirit in alcohol:
(a) Water (b) Na_2CO_3
(c) NaOH (d) CaO

28. Concentration of rectified spirit is:
(a) 12% (b) 14%
(c) 90% (d) 95%
(e) 100%

29. Alcohol can be denaturated by adding:
(a) acetone (b) methanol
(c) pyridine (d) all

30. Phenol was discovered by:
(a) Hofmann (b) Runge
(c) Henderson (d) Bakelite

INTRODUCTION

31. The organic compound, alcohols are much closer to, in structure and hence is also called its derivative:
a) water b) oxides of lithium
c) oxides of magnesium d) oxides of aluminium

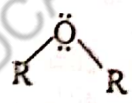
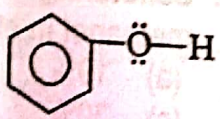
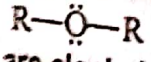
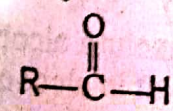
32. Ether, an organic compound has close resemblance in structure and thus a derivative of:
a) water b) oxides of lithium
c) oxides of magnesium d) oxides of aluminium

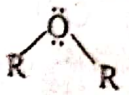
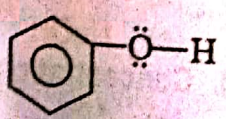
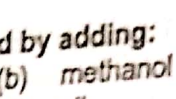
33. Phenol is a derivative and has a resemblance in structure to:
a) water b) oxides of lithium
c) oxides of magnesium d) oxides of aluminium

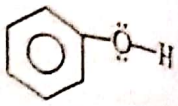
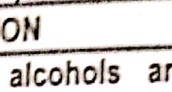
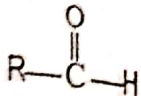
34. The organic compounds which are derivative of hydrocarbons of oxygen are:
a) carbohydrates b) phenols
c) alcohols d) All of these

35. The organic compounds which are derivative of hydrocarbons due to oxygen are:
a) aldehydes b) ketones
c) carboxylic acid d) All of these

36. The organic compounds, not derivative of oxygen is:
a) phenol b) alcohol
c) alkyl halide d) ether

37. Which are phenols?
a) 
b) 
c) 
d) 

38. Which are alcohols?
a) 
b) 
c) 
d) 

39. Which are ethers?
a) 
b) 
c) 
d) 

40. Which are much closer to each other?
a) Alcohols and alkyl halides
b) Alcohols and phenols
c) Phenols and ethers
d) Phenols and alkyl halides

41. Hydroxyl derivative of alkanes is:
a) phenols b) alcohols
c) ethers d) alkenes

42. Hydroxyl derivative of benzene is:
a) phenols b) alcohols
c) ethers d) alkenes

43. In phenol, hydrogen of water is replaced by:
a) alkyl group b) aryl group
c) alkyl or aryl group d) phenyl group

44. In alcohols, hydrogen of water is replaced by:
a) alkyl group b) aryl group
c) alkyl or aryl group d) phenyl group

ALCOHOLS

45. General formula of alcohols is:
a) R—H b) R—X
c) R—COH d) R—CO—R

46. In alcohols, R- represents in general formula:
a) alkyl group b) aryl group
c) phenyl group d) benzyl group

47. Alcohols are classified based upon:
a) number of hydroxyl groups
b) nature of carbon to which —OH group is attached
c) type of hydroxyl group attached
d) number of line pair in —OH group

48. Monohydric alcohols have hydroxyl groups:
a) one b) two
c) three d) four

49. Dihydric alcohols have hydroxyl groups:
a) one b) two
c) three d) four

50. Trihydric alcohols have hydroxyl groups:
a) one b) two
c) three d) four

51. Tetrahydric alcohols have hydroxyl groups:
a) one b) two

52. Alcohol containing more than one hydroxyl groups are called:
a) one b) two
c) three d) many

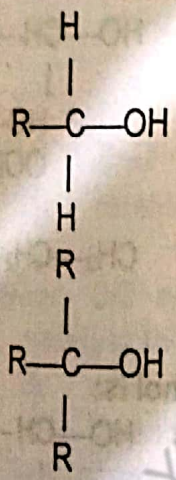
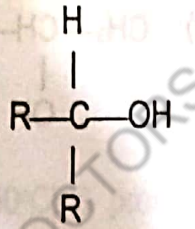
53. In primary alcohol, —OH group is attached to a carbon directly linked with:
a) all three hydrogens
b) only two hydrogens one carbon
c) only one hydrogen and two carbons
d) either all hydrogens or at least two hydrogens

54. In secondary alcohols, —OH group containing carbon is linked directly with:
a) all three hydrogens
b) only two hydrogens one carbon
c) only one hydrogen and two carbons
d) either all hydrogens or at least two hydrogens

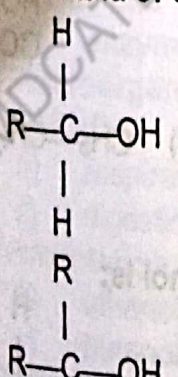
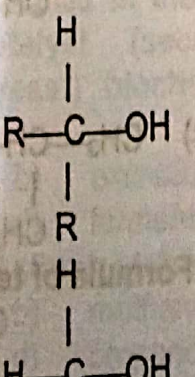
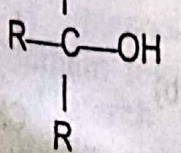
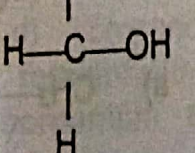
55. In tertiary alcohols, —OH group containing carbon in linked directly with:
a) all three hydrogens
b) only two hydrogens one carbon
c) only one hydrogen and two carbons
d) either all hydrogens or at least two hydrogens

56. Primary, secondary and tertiary alcohols is a classification of type after alcohol:
a) monohydric b) dihydric
c) trihydric d) polyhydric

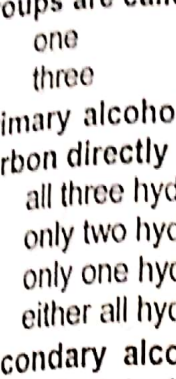
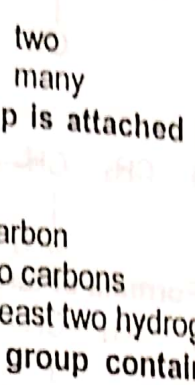
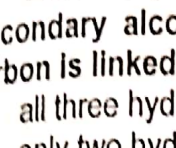
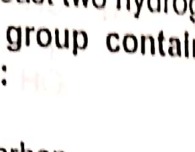
57. General formula of primary alcohols is:

a) 
b) 
c)
d) none

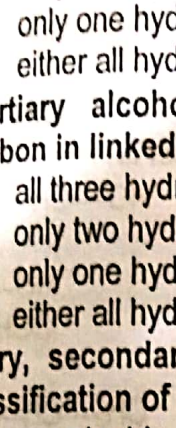
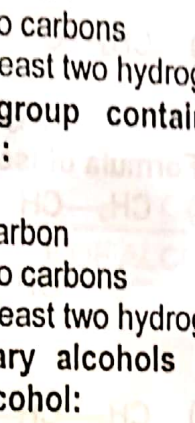
58. General formula of secondary alcohols is:

a) 
b) 
c) 
d) 

59. General formula of tertiary alcohols is:

a) 
b) 
c) 
d) 

60. Simplest example of trihydric alcohols is:

a) 
b) 
c)
d)

61. Simplest example of dihydric alcohols is:

a)
b)
c)
d)

NOMENCLATURE

62. Trivial or common names are given to compounds based upon:
a) Origin
b) man who discovered that
c) place from where obtained
d) All of these

63. Common names are given to alcohols by writing:
a) "al" in alkane in place of "e"
b) adding alcohol at the end after writing alkyl group
c) "ol" in alkane in place of "e"
d) "one" in alkane in place of "e"

64. Formula of benzyl alcohol is:
a) CH_3OH b) C_2H_5OH

c) $C_2H_5CH_2OH$ d) $CH_2(OH)-CH_2(OH)$

65. Formula of methanol (methyl alcohol) is:
a) CH_3OH b) C_2H_5OH
c) $C_2H_5CH_2OH$ d) $CH_2(OH)-CH_2(OH)$

66. Formula of ethyl alcohol (ethanol) is:
a) CH_3OH b) C_2H_5OH
c) $C_2H_5CH_2OH$ d) $CH_2(OH)-CH_2(OH)$

67. Formula of Glycerol is:
a) CH_3OH b) C_2H_5OH
c) $C_2H_5CH_2OH$ d) $CH_2(OH)-CH(OH)-CH_2(OH)$

68. Formula of glycol is:
a) CH_3OH b) C_2H_5OH
c) $C_2H_5CH_2OH$ d) $CH_2(OH)-CH_2(OH)$

69. In IUPAC-system of naming alcohol "e" of alkane is replaced by:
a) "al" b) "ol"
c) oic-acid d) "one"

70. Which is rule to write IUPAC of alcohols?
a) longest carbon chain is selected with OH group
b) longest chain is given name by writing "ol" in place of "e" of alkane
c) longest chain is numbered by giving lowest number to hydroxyl group
d) All of these

71. Which will get preference for numbering in unsaturated alcohols?
a) double bond b) triple bond
c) double or triple bond d) hydroxyl group

72. In aldehydes, ketones, containing also —OH group, the name of compound is given:
a) as alcohol b) as aldehydes & ketones
c) —OH group is given name hydroxyl with position and over molecule is given name as aldehydes or ketone
d) None of them

73. Formula of lactic acid is:
a) $CH_3-CH(OH)-COOH$ b) $HO-CH(HO-CH-C)-COOH$
c) $CH_3-CH(CH_3)-OH$ d) $CH_3-CH(CH_3)-CH_2-OH$

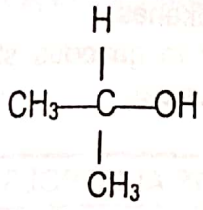
74. Formula of tartaric acid is:
a) $CH_3-CH(OH)-COOH$ b) $HO-CH(HO-CH-C)-COOH$
c) $CH_3-CH(CH_3)-OH$ d) $CH_3-CH(CH_3)-CH_2-OH$

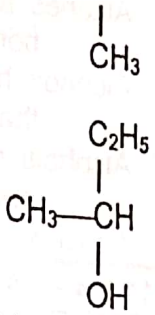
75. Formula of isopropyl alcohol is:
a) $CH_3-CH(OH)-COOH$ b) $HO-CH(HO-CH-C)-COOH$
c) $CH_3-CH(CH_3)-OH$ d) $CH_3-CH(CH_3)-CH_2-OH$

76. Formula of isobutyl alcohol is:
a) $CH_3-CH(OH)-COOH$ b) $HO-CH(HO-CH-C)-COOH$
c) $CH_3-CH(CH_3)-OH$ d) $CH_3-CH_2-CH(CH_3)-OH$

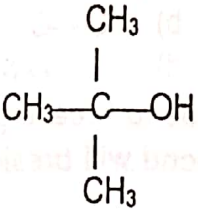
77. Formula of sec-butyl alcohol is:
a) $CH_3-CH(OH)-COOH$ b) $HO-CH(HO-CH-C)-COOH$
c) $CH_3-CH(CH_3)-OH$ d) $CH_3-CH_2-CH(CH_3)-OH$

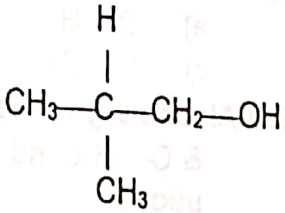
78. Formula of ter-butyl alcohol is:
a) $CH_3-C(CH_3)(CH_3)-OH$ b) $CH_3-C(H)(OH)-C$

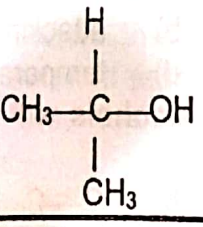
c) 

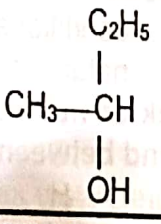
d) 

79. **Formula of neo-pentyl alcohol is:**

a) 

b) 

c) 

d) 

INDUSTRIAL PREPARATION OF ALCOHOLS

80. **Methanol can be prepared:**
   a) from water gas
   b) from distillation of wood
   c) from oxidation of methane
   d) All

81. **In $CO + 2H_2 \longrightarrow CH_3OH$, the conditions are:**
   a) 450°C temperature
   b) 200 atm pressure
   c) $ZnO + Cr_2O_3$
   d) catalyst + temp (450°C) & pressure 200 atm are required

82. **When CO reacts with H_2 in the presence of catalyst to produce:**
   a) ethanol
   b) methanol
   c) butanol
   d) propanol

83. **The process in which large molecules are broken down into simpler molecules in the presence of enzymes as catalyst (secreted by microorganisms like yeast) biochemistry is called:**
   a) respiration
   b) excretion
   c) digestion
   d) fermentation

84. **Fermentation of sugar and starch yields:**
   a) ethanol
   b) methanol
   c) butanol
   d) propanol

85. **Optimum temperature for fermentation process of starch where microorganism activity is maximum is (in °C):**
   a) 25-35
   b) 15-25
   c) 35-45
   d) 5-15

86. **Essential conditions for fermentation process are:**
   a) normal temperature
   b) proper aeration
   c) dilution of solution
   d) All of these

87. **In Pakistan ethanol is prepared by commonly:**
   a) fermentation of molasses, starch grains or fruit juices
   b) by the reaction of alkenes with water
   c) by the oxidation of alkanes
   d) by the reaction of Grignard's reagent with aldehydes

88. **Ethanol is prepared from fermentation of sugar, starch etc. in Pakistan because of it is:**
   a) a dangerous process
   b) very fine product obtains at first step
   c) no hazards
   d) a cheap process because of cheap raw material

89. **The residue obtained after crystallization of sugar from concentrated sugar cane juice is:**
   a) sugar
   b) starch
   c) molasses
   d) carbohydrate

90. **Fermentation of ethanol is done by enzyme:**
   a) invertase
   b) zymase
   c) diastase
   d) maltase

91. **Glucose is converted into ethanol in the presence of enzyme:**
   a) invertase
   b) zymase
   c) diastase
   d) maltase

92. **Starch is converted into sucrose in the presence of enzyme:**
   a) invertase
   b) zymase
   c) diastase
   d) maltase

93. **$C_{12}H_{22}O_{11} + H_2O \longrightarrow 2C_6H_{12}O_6$**
   a) invertase
   b) zymase
   c) diastase
   d) maltase

94. **The purity of alcohol obtained from fermentation is:**
   a) 10–12%
   b) 12–14%
   c) 14–16%
   d) 16–18%

95. **Purification of alcohol above 14% is done by:**
   a) distillation
   b) crystallization
   c) solvent extraction
   d) filtration

96. **Distillation of fermented alcohol to rectified spirit have purity:**
   a) 80%
   b) 85%

c) 90% d) 95%

97. Absolute alcohol is obtained from rectified spirit by:
a) redistillation b) recrystallisation
c) solvent extraction d) chromatography

98. Moisture from absolute alcohol is dried by using:
a) CaO b) Na_2O
c) MgO d) Li_2O

99. Denaturing of alcohol is done by adding methanol in the alcohol:
a) 6% b) 7%
c) 8% d) 10%

100. Methylated spirit is obtained by mixing in alcohol:
a) methyl alcohol b) pyridine
c) acetone d) All of these

11.2.3 PHYSICAL PROPERTIES

101. Alcohols are:
a) sweet in smell b) burning in taste
c) colourless liquids d) All of these

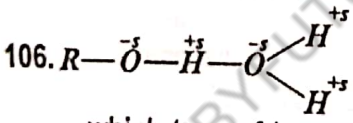
102. Alcohols are colourless:
a) gases b) liquids
c) solids
d) only lower alcohols are liquids

103. Solubility of alcohols in water is in:
a) lower alcohols b) medium alcohols
c) high alcohols d) higher alcohols

104. Higher alcohols are:
a) least soluble b) less soluble
c) best soluble d) normal solubility in

105. Solubility of alcohols in water is due to bonding:
a) comic b) covalent
c) coordinate d) hydrogen

covalent

106. 

which type of bonding in hydrogen of alcohol and oxygen of water exist in above situation?
a) comic b) covalent
c) coordinate d) hydrogen

covalent

107. What is link between m.p & b.p of alcohols with corresponding alcohols?
a) similar b) lower
c) higher d) no regular behaviour

108. Why methanol and ethanol are liquids while methane & ethane with same number of carbons are gases?
a) Alkanes have bond & alcohols have sigma bond.
b) Alcohols have stronger van-dar-waal's forces than above alkanes.
c) Alcohols can't exist in gaseous state while above alkanes can.
d) Above state is false.

11.2.4 REACTIONS OF ALCOHOLS

109. Alcohols give reactions due to bond:
a) C—H b) C—C
c) C—OH d) C—O & O—H

110. Alcohols give reactions due to breaking of C—O & O—H bond. Which bond will break depends upon?
a) conditions b) attacking reagent
c) nature of alcohol d) temperature

111. Attack of nucleophile on alcohols will break the bond between:
a) C—H b) C—C
c) C—O d) O—H

112. Attack of an electrophile will break the bond:
a) C—H b) C—C
c) C—O d) O—H

113. When nucleophile attacks at ethyl alcohol we get:
a) $CH_3{}^+CH_2$ b) $CH_3{}^+CH_2 + OH^-$
c) $CH_3CH_2—O^-$ d) $CH_3CH_2—O^- + H^+$

114. When electrophile attacks at ethyl alcohol we get:
a) $CH_3{}^+CH_2$ b) $CH_3{}^+CH_2 + OH^-$
c) $CH_3CH_2—O^-$ d) $CH_3CH_2—O^- + H^+$

115. The order of reactivity of alcohols on breakage of C—O bond is:
a) ter-alcohol > sec-alcohol > pri-alcohol
b) sec-alcohol > primary-alcohol > ter-alcohol
c) primary alcohol > secondary alcohol > tertiary alcohol
d) ter-alcohol > pri-alcohol > sec-alcohol

116. The order of reactivity of alcohols is when O—H bond breaks:
a) ter-alcohol > sec-alcohol > pri-alcohol
b) sec-alcohol > primary-alcohol > ter-alcohol
c) primary alcohol > secondary alcohol > tertiary alcohol
d) ter-alcohol > pri-alcohol > sec-alcohol

117. $C_2H_5OH + SOCl_2 \xrightarrow{Pyridine} C_2H_5Cl + \_?\_ + HCl$

a) SO_3 b) SO_2
c) H_2O d) O_2

118. The catalyst in the reaction is:
$C_2H_5OH + SOCl_2 \longrightarrow C_2H_5Cl + SO_2 + HCl$
a) Pyridine b) $ZnCl_2$
c) ThO_2 d) H_2SO_4

119. The catalyst in the reaction of alcohols with HCl is:
a) Pyridine b) $ZnCl_2$
c) ThO_2 d) H_2SO_4

120. The catalyst in the reaction of alcohols with ammonia is:
a) Pyridine b) $ZnCl_2$
c) ThO_2 d) H_2SO_4

121. The catalyst in the reaction of alcohols with carboxylic acid esterification process is:
a) Pyridine b) $ZnCl_2$
c) ThO_2 d) H_2SO_4

122. Reaction of ethanol with HCl gives water and:
a) ethyl chloride b) methyl chloride
c) propyl chloride d) iso propyl chloride

123. Reaction of ethyl alcohol with ammonia gives water and:
a) ethyl chloride b) methyl chloride
c) propyl chloride d) ethyl amine

124. $C_2H_5OH + NH_3 \xrightarrow{ThO_2} C_2H_5NH_2 + H_2O$ reaction of ethyl alcohol with acetic acid gives water and:
a) ethane b) methanol
c) diethyl acetate d) ethyl acetate

125. Reactions of ethanol with $SOCl_2$, HCl, NH_3 and CH_3COOH involves bond breakage in alcohol:
a) C—O b) C—C
c) C—H d) O—H

126. Reactions of ethanol with sodium, Grignard's reagent involve bond breakage of:
a) C—O b) C—C
c) C—H d) O—H

127. $2C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa +$ _____
a) O_2 b) H_2O
c) H_2 d) NaH

128. Reaction of Sodium ethoxide with acetyl chloride gives:
a) sodium acetate b) methyl ethyl ketone
c) ethyl acetate d) ethyl alcohol

129. Reaction between ethyl alcohol and Grignard's reagent (CH_3MgI) gives:
a) methane b) ethane
c) propane d) butane

130. The process in which alcohols are converted to aldehydes and ketone is of alcohols:
a) reduction b) oxidation
c) addition d) substitution

131. The best reagent(s) for oxidation of alcohols to aldehydes and ketones is:
a) $K_2Cr_2O_7/H_2SO_4$ b) KMn/H_2SO_4
c) SO_3 d) Both (a) and (b)

132. Oxidation of ethanol gives:
a) formaldehyde b) acetaldehyde
c) acetone d) anyoldehyde or ketone

133. Oxidation of methanol gives:
a) formaldehyde b) acetaldehyde
c) acetone d) anyoldehyde or ketone

134. Oxidation of 2-propanol (secondary alcohol) gives:
a) formaldehyde b) acetaldehyde
c) acetone d) anyoldehyde or ketone

135. Oxidation of tertiary alcohol gives:
a) formaldehyde b) acetaldehyde
c) acetone d) an alkene

136. $(CH_3)_3COH + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7}$ _____ $+ H_2O$

a) $C_2H_5-\overset{\overset{O}{\|}}{C}-C_2H_3$ b) $C_3H_7-\overset{\overset{O}{\|}}{C}-H$

c) $2CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ d) $CH_2=\underset{\underset{CH_3}{|}}{C}-CH_3$

137. Which alcohol is resistant to oxidation?
a) monohydric b) primary
c) secondary d) tertiary

138. Reaction of 2-methyl-2-propanol is infect a type of reaction:
a) oxidation b) reduction
c) substitution d) elimination

139. Dehydration of alcohols in the presence of conc. H_2SO_4 give products:
a) always same b) always different
c) may be same or different d) gives different products

140. $C_2H_5OH \xrightarrow{conc.\ H_2SO_4} CH_2=CH_2 + H_2O$
The temperature for this reaction is in (°C):
a) 180° b) 140°C
c) 100°C d) 85°C

141. Dehydration of ethanol at 180°C at the presence

of conc. H_2SO_4 gives:

a) alkene b) ether
c) $CH_2=CH_2$ d) ethyl acetate

142. Dehydration of ethanol at 140°C in the presence of conc. H_2SO_4 gives:

a) alkene b) ether
c) $CH_2=CH_2$ d) diethyl ether

143. Reaction of C_2H_5OH with PCl_3 gives:

a) ethyl chloride
b) ethyl chloride and H_3PO_3
c) H_3PO_3
d) HCl

144. Reaction of C_2H_5OH with PCl_5 gives:

a) ethyl chloride
b) ethyl chloride and H_3PO_3
c) H_3PO_3
d) ethyl chloride, $POCl_3$ and HCl

DISTINCTION BETWEEN PRIMARY, SECONDARY AND TERTIARY ALCOHOLS

145. Different types of alcohols (pri, sec, ter) are tested by test:

a) Boyer b) Lucas
c) Iodine d) Starch

146. When alcohols react with conc. HCl in anhydrous $ZnCl_2$, a layer forms:

a) oily b) liquid
c) colourless d) coloured

147. Primary alcohols give oily layer with conc. HCl in $ZnCl_2$:

a) on heating
b) standing for 5-10 minutes
c) immediately after mixing
d) after half an hour

148. Secondary alcohol gives only layer with conc. HCl in $ZnCl_2$:

a) on heating
b) standing for 5-10 minutes
c) immediately after mixing
d) after half an hour

149. Tertiary alcohol gives oily layer with conc. HCl in $ZnCl_2$:

a) on heating
b) standing for 5-10 minutes
c) immediately after mixing
d) after half an hour

DISTINCTION BETWEEN METHANOL AND ETHANOL

150. Iodoform test is not given by:

a) methanol b) ethanol
c) ethanol d) ethanone

151. Iodoform crystals are of colour in Iodoform test:

a) orange b) blue
c) green d) yellow

152. $C_2H_5OH + 4I_2 + 6NaOH \rightarrow$ ____ $+ HCOONa + 5NaI + 5H_2O$

a) an oily layer
b) oily layer of alkyl halides
c) oily layer of alkyl halide on heating only
d) iodoform crystals

153. Reaction of iodine with methyl alcohol in the presence of NaOH gives:

a) an oily layer
b) oily layer of alkyl halides
c) oily layer of alkyl halide on heating only
d) no reaction in fact occur

154. Reaction of iodine with ethyl alcohol in the presence of NaOH gives:

a) an oily layer
b) oily layer of alkyl halides
c) oily layer of alkyl halide on heating only
d) iodoform crystals

USES OF ALCOHOLS

155. Methanol is used as solvent for:

a) fats b) varnishes
c) oils d) All of these

156. The compound used an antifreeze in radiators of automobiles:

a) methanol b) formaldehyde
c) acetaldehyde d) phenol

157. Denaturing of alcohol is done with:

a) methanol b) ethanol
c) propanol d) butanol

158. Alcohol used as drink is:

a) methanol b) ethanol
c) propanol d) butanol

159. Alcohol used as fuel in some countries:

a) methanol b) ethanol
c) propanol d) butanol

160. Alcohol used in pharmaceutical preparations and preservative for biological specimens is:

a) methanol b) ethanol
c) propanol d) butanol

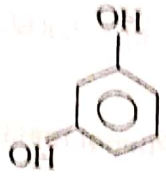
PHENOL

161. Formula of phenol is:

a) 

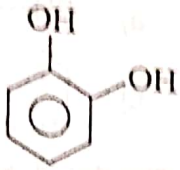
b) 

c) 

d) 

162.Phenols is (are):

a) 

b) 

c) 

d) All of these

163.Organic compounds having one or more —OH groups attached to benzene ring are:

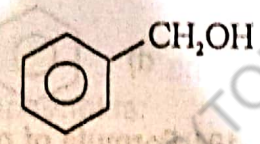
a) alcohols b) carboxylic acids
c) phenol d) carbohydrates

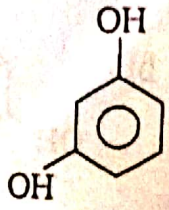
164.The simplest phenol is:

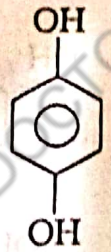
a) carbolic acid b) propanoic acid
c) methanoic acid d) benzyl

165.Carbolic acid is:

a) 

b) 

c) 

d) 

166.Carbolic acid was first of all obtained from coal tar by Runge in:

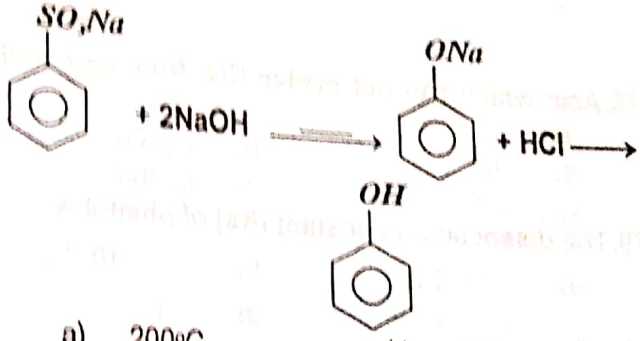
a) 1830 b) 1831
c) 1832 d) 1834

PREPARATION OF PHENOL

167.The preparation of phenol from chlorobenzene and 10% NaOH at 360°C and 200 atmospheric pressure and then with HCl is a process of:

a) Dow's b) Wurtz
c) Frankland d) Kolbe

168.The condition in the reaction of formation of phenol is:



a) 200°C b) 250°C
c) 300°C d) 350°C

169.The phenol is recovered from its mixture with NaCl formed in the reaction of preparation of phenol from sodium salt of benzene sulphonic acid:

a) steam distillation b) crystallization
c) solvent extraction d) sublimation

PHYSICAL PROPERTIES

170.Phenol is:

a) colourless b) crystalline solid
c) deliquescent solid d) All of these

171.Properties of phenol are:

a) m.p 41°C b) b.p 182°C
c) sparingly soluble at room temperature
d) All

172.The poisonous compound is:

a) NaCl b) Ester
c) Phenol d) Ethanol

173.The compound used as disinfectant in hospitals and washrooms:

a) NaCl b) Ester
c) Phenol d) Ethanol

REACTIONS OF PHENOL

174.Phenols are reactive:

a) Less b) medium
c) Most d) both less and more

ACIDIC BEHAVIOUR OF PHENOL

175.Phenol is acidic:

a) much more than alcohols
b) less than carboxylic acids
c) much more than alcohol but less than carboxylic acids
d) stronger than HCl

176.Phenol dissolves alkalies:

a) Slowly b) difficult
c) Hard d) readily

177.Effect of phenol on litmus paper:

a) have effect b) no effect
c) may have effect d) may not have

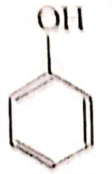
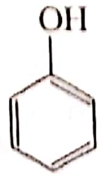
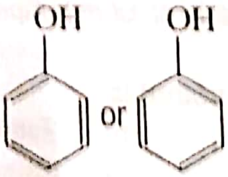
effect

178. Acid which can not evolve CO_2 from carbonates is:
a) HCl b) H_2SO_4
c) CH_3COOH d) phenol

179. The dissociation constant (Ka) of phenol is:
a) 1.0×10^{-10} b) 1.1×10^{-10}
c) 1.2×10^{-10} d) 1.3×10^{-10}

180. Phenol is in water:
a) completely soluble b) miscible in water
c) immiscible in water d) partially soluble

181. The solution of phenol has pH around:
a) 3 or 4 b) 1 or 2
c) 2 or 3 d) 5 or 6

182. The contributing structure of phenol is:
a) 
b) 
c) 
d) 

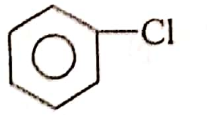
183. The contributing structure of phenolate ion is:
a) 
b) 
c) 
d) All of these

184. The strongest acid among the given is:
a) carboxylic acid b) phenol
c) water d) alcohol

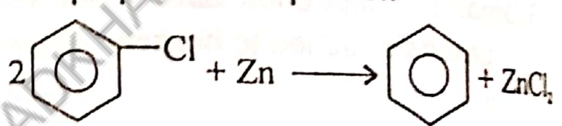
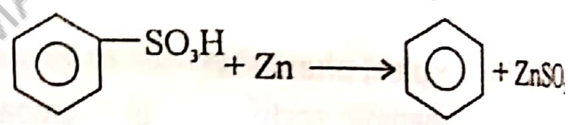
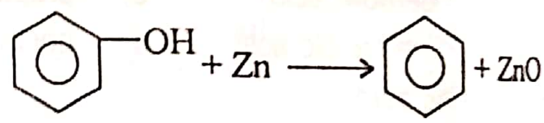
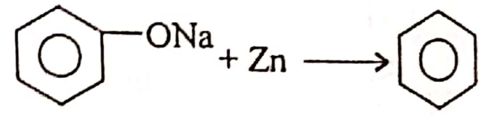
185. The weakest acidic characteristics are of:
a) carboxylic acid b) phenol
c) water d) alcohol

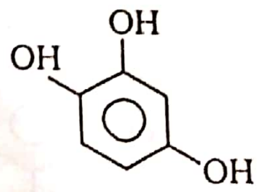
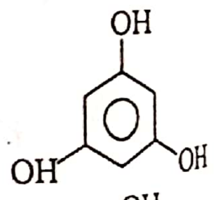
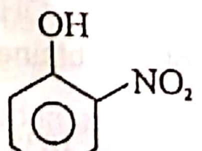
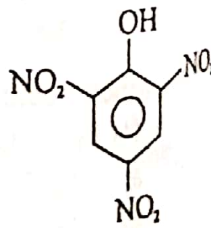
186. Phenol reacts with alkalies forming salts in a type of reaction:
a) oxidation b) reduction
c) sponification d) neutralization

187. Sodium phenoxide is:
a) RO^-Na^+ b) $CH_3O^-Na^+$
c) $C_2H_5O^-Na^+$ d) 

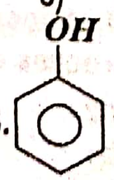
188. Phenol reacts with acetyl chloride forming:
a) $CH_3-\overset{O}{\overset{\|}{C}}-H$ b) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$
c) 
d) None

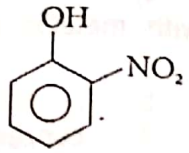
189. The decreasing strength of given acids is:
a) RCOOH > Phenol > Water > Alcohol
b) RCOOH > Water > Phenol > Alcohol
c) RCOOH > Water > Alcohol > Phenol
d) Alcohol > RCOOH > Phenol > Water

190. Benzene is prepared from phenol:
a) 
b) 
c) 
d) 

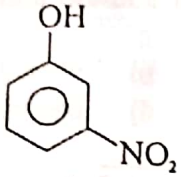
191. Formula of picric acid is:
a) 
b) 
c) 
d) 

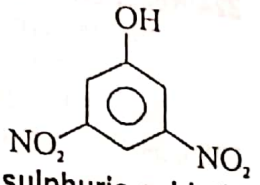
192. 2,4,6-trinitrophenol is also called:
a) stearic acid b) pictric acid
c) tartaric acid d) lactic acid

193.  $+ 3HNO_3 \xrightarrow{\Delta} 3H_2O +$ ______

a) 

b) 

c) 

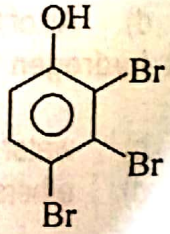
d) 

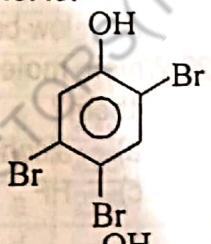
194. In the reaction of phenol and sulphuric acid, the percentage of 0-hydroxybenzene sulphonic acid is:
a) 15% b) 30%
c) 45% d) 60%

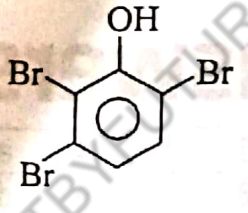
195. In the reaction of phenol with sulphuric acid, the percentage of p-hydroxyl benzene sulphonic acid is:
a) 15% b) 30%
c) 45% d) 85%

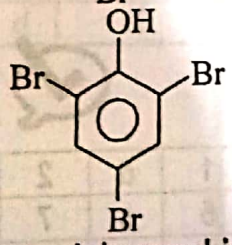
196. Aqueous solution of phenol reacts with bromine water giving white ppt of:
a) 2,4,6 tribromophenol b) bromophenol
c) 2,4 dibromophenol d) 4,6 dibromophenol

197. Correct formula of tribromophenol is:

a) 

b) 

c) 

d) 

198. Hydrogenation of phenol to give cyclohexanol in the presence of Ni occurs at temperature:
a) 50°C b) 100°C
c) 150°C d) 200°C

199. An adduct forms when phenol reacts with:
a) hydrogen b) formaldehyde
c) nitric acid d) sulphuric acid

200. Picric acid forms when phenol reacts with:
a) hydrogen b) formaldehyde
c) nitric acid d) sulphuric acid

201. 2,4,6 tribromophenol forms when phenol directly reacts with:
a) hydrogen b) formaldehyde
c) nitric acid d) Bromine

202. Bakelite forms when phenol reacts with:
a) hydrogen b) formaldehyde
c) nitric acid d) sulphuric acid

203. Bakelite is a:
a) monomer b) simple molecule
c) minor molecules
d) macromolecule or adduct

ETHERS

204. The organic compounds in which both valencies of oxygen are satisfied by two alkyl groups are called:
a) phenol b) Alcohol
c) ether d) Aldehydes

205. R—O—R is a general formula of:
a) phenol b) Alcohol
c) ether d) Aldehydes

206. ROH is a general formula of:
a) phenol b) Alcohol
c) ether d) Aldehydes

207. Ar—OH is a general formula of:
a) phenol b) Alcohol
c) ether d) Aldehydes

208. Ethers are classified into classes:
a) phenol b) Alcohol
c) ether d) Aldehydes

209. Ethers are classified into:
a) simple ethers b) symmetrical ethers
c) unsymmetrical ethers d) All of these

210. CH_3OCH_3 is a type of ether:
a) simple b) symmetrical
c) simple symmetrical or d) Complex

211. $C_2H_5OX_2H_5$ is a type of ether:
a) simple b) symmetrical
c) simple symmetrical or d) Complex

212. $CH_3OC_2H_5$ is a type of ether:
a) simple b) symmetrical
c) simple symmetrical or d) mixed unsymmetrical

213. $C_2H_5—O—C_3H_7$ is a type of ether:
a) simple b) symmetrical
c) simple or symmetrical d) mixed or unsymmetrical

NOMENCLATURE

214. In naming the ether through IUPAC system, the alkyl group taken as parent molecule is:
a) smaller alkyl group b) larger alkyl group
c) no preference
d) smaller group until alkyl group is of two carbon atoms

215. Alkoxy is given name to the alkyl group in ether which is:
a) smaller alkyl group b) larger alkyl group
c) no preference
d) smaller group until alkyl group is of two carbon atoms

216. Usually ethers are known by their names:
a) smaller alkyl group b) larger alkyl group
c) no preference d) common or trivial

217. The difficult way of naming ethers is:
a) smaller alkyl group b) larger alkyl group
c) no preference d) common or trivial

218. Formula of methoxy methane is:
a) CH_3OCH_3 b) $CH_3OC_2H_5$
c) $C_2H_5OC_2H_5$ d) $CH_3OC_6H_5$

219. Formula of methoxy benzene is:
a) CH_3OCH_3 b) $CH_3OC_2H_5$
c) $C_2H_5OC_2H_5$ d) $CH_3OC_6H_5$

220. Formula of ethoxy propane is:
a) CH_3OCH_3 b) $CH_3OC_2H_5$
c) $C_2H_5OC_2H_5$ d) $CH_3OC_6H_5$

221. Methyl phenyl ether is:
a) $CH_3OC_2H_5$ b) $CH_3O—CH(CH_3)_2$
c) $CH_3—O—C_6H_5$ d) $CH_3—O—CH_2—C_6H_5$

11.6.2 PREPARATION OF ETHERS

222. The method to prepare ether is:
a) Dow's b) William son's synthesis
c) Markovnikov's d) Frankland

223. Alcohols are reacted with metallic sodium to form:
a) ether b) phenol
c) alkoxides d) benzene

224. Reaction of alcohols with sodium and then alkyl halide give:
a) ether b) phenol
c) alkoxides d) benzene

225. $C_2H_5ONa + C_2H_5Br \longrightarrow$ _____
a) C_6H_6 b) $C_2H_5—C_2H_5$
c) $C_2H_5—Na$ d) $C_2H_5—O—C_2H_5$

226. Ethers can be prepared from:
a) Reaction of alcohols with sodium & then alkyl halide
b) Reaction of alkyl halide with Al_2O_3
c) Reaction of alcohols in the presence of H_2SO_4 at 140°C
d) None of them can be used to prepare ethers

PHYSICAL PROPERTIES

227. The volatile liquid is:
a) ethers b) phenol
c) water d) alkalies

228. Properties of ethers are:
a) volatile b) highly inflammable
c) low boiling points d) All of these

229. Which molecule has not hydrogen bonding in them?
a) alcohol b) water
c) HF d) ethers

Answers

1	d	2	a	3	b	4	a	5	c
6	c	7	a	8	c	9	d	10	b
11	d	12	a	13	d	14	d	15	d
16	d	17	d	18	c	19	a	20	c
21	d	22	d	23	c	24	a	25	d
26	a	27	d	27	d	29	d	30	b
31	a	32	a	33	a	34	d	35	d
36	c	37	b	38	a	39	c	40	b
41	b	42	a	43	d	44	a	45	a
46	a	47	b	48	a	49	b	50	c
51	d	52	d	53	d	54	c	55	d
56	a	57	a	58	b	59	c	60	a

61	b	62	d	63	b	64	c	65	a
66	b	67	d	68	d	69	b	70	d
71	d	72	c	73	a	74	b	75	c
76	d	77	d	78	a	79	b	80	d
81	d	82	b	83	d	84	a	85	a
86	d	87	a	88	d	89	c	90	b
91	b	92	c	93	d	94	b	95	a
96	d	97	a	98	a	99	d	100	d
101	d	102	d	103	a	104	a	105	d
106	d	107	c	108	d	109	d	110	b
111	c	112	d	113	b	114	d	115	a
116	c	117	b	118	a	119	b	120	c
121	d	122	a	123	d	124	d	125	a
126	d	127	c	128	c	129	a	130	b
131	d	132	b	133	a	134	c	135	d
136	d	137	d	138	d	139	d	140	a
141	c	142	d	143	b	144	d	145	b
146	a	147	a	148	b	149	c	150	a
151	d	152	d	153	d	154	d	155	d
156	a	157	a	158	b	159	b	160	b
161	b	162	d	163	c	164	a	165	a
166	d	167	a	168	b	169	a	170	d
171	d	172	c	173	c	174	a	175	c
176	d	177	b	178	d	179	d	180	d
181	d	182	c	183	d	184	a	185	d
186	d	187	d	188	d	189	a	190	c
191	d	192	b	193	d	194	a	195	d
196	a	197	d	198	c	199	b	200	c
201	d	202	b	203	d	204	c	205	c
206	b	207	a	208	b	209	d	210	c
211	cc	212	d	213	d	214	b	215	a
216	d	217	a	218	a	219	d	220	d
221	c	222	b	223	c	224	a	225	d
226	d	227	a	228	d	229	d		

5. Aldehydes & Ketones

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Describe the structure of aldehyde and ketones.

b) Discuss preparation of aldehydes and ketones by oxidation of alcohols.

c) Discuss following reactions of aldehydes and ketones:

i) Common to both;
- 2,4-DNPH to detect the presence of carbonyl group
- HCN to show mechanism of nucleophilic addition reaction
- Reduction with $NaBH_4$ or $LiAlH_4$

ii) Reactions in which Aldehydes differs from ketones i.e. Oxidation with Tollen's reagent and Fehling's solution.

iii) Reaction which show presence of CH_3CO- group in aldehydes and ketones Triiodomethane test (Iodo form test) using alkaline aqueous iodine.

Definitions and Statements

1. Define Carbonyl Group:

— CO — functional group is called carbonyl functional group. In carbonyl group, carbon is bonded with oxygen through a double bond."

2. Define Aldehyde Group:

—CO— H group is called aldehyde functional group."

3. Define Ketone Group:

C —CO— H carbonyl functional group is also called ketone functional group."

4. Define Carbonyl compounds:

Organic compounds containing —CO— functional group are called carbonyl compounds."

5. Define Aldehyde Compounds:

Organic compounds containing — CO— H functional group are called aldehyde compounds."

6. Define Ketone Compounds:

The organic compounds containing carbonyl group bonded with two alkyl groups R —CO —R are called ketone compounds."

7. Define Condensation Reactions:

The process in which two molecules of same or different compounds combine to form a new compound with elimination of a small molecule like H_2O, NH_3, CH_3OH or C_2H_5OH is called condensation reaction."

8. Define Aldol Condensation:

Aldehydes and ketones with α-hydrogen reacts in the presence of dilute alkali to form addition product known as aldols."

9. Define α-hydrogen:

A carbon directly attached to carbonyl carbon is called α-carbon and hydrogen attached to α-carbon is called α–hydrogen."

10. Define Cannizzaro's Reaction:

The condensation of two molecules of aldehydes without α–hydrogen give a molecule of corresponding alcohol and the salt of corresponding acid is called cannizzaro's reaction." It is a self–oxidation reduction (disproportion) reaction.

11. Define Holoform Reaction:

Only acetaldehyde and methyl ketones react with halogens in the presence of sodium hydroxide to give sodium salt of the acid and a compound called holoform. Due to the formation of holoform this reaction is called holoform reaction."

12. Define Haloform:

Haloform term is used because it gives following product with respect to halogen atoms: (yellow ppt)

13. Define Iodoform Test:

A holoform test in which iodine is used with aqueous sodium hydroxide test.

14. Define Addition of hydrogen:

Addition of hydrogen is called hydrogenation or reduction and aldehydes and ketones can be reduced."

15. Define Symmetrical ketones:

In such ketones, only one carbon atom from both carbons is oxidized and a mixture of two carboxylic acids is obtained.

16. Define Unsymmetrical ketones:

In such ketones, the carbon atom joined to the smaller number of hydrogen atoms is preferably oxidized and the carbonyl group remains with the smaller alkyl group.

Fully Solved Textual Exercise

Each question has four options.
Encircle the correct answer.

1. The carbon of a carbonyl group is:
- (a) sp hybridized
- (b) sp^2 hybridized
- (c) sp^3 hybridized
- (d) none of these

2. Formalin is:
- a. 10% solution of formaldehyde in water
- b. 20% solution of formaldehyde in water
- c. 40% solution of formaldehyde in water
- d. 60% solution of formaldehyde in water

3. Which of the following will have the highest boiling point?
- (a) Methanal (b) Ethanal
- (c) Propanal
- (d) 2–Hexanone

4. Ketones are prepared by the oxidation of:
- (a) Primary alcohol
- (b) Secondary alcohol
- (c) Tertiary alcohol
- (d) None of these

5. Acetone reacts with HCN to form a cyanohydrin. It is an example of:
- (a) Electrophilic addition
- (b) Electrophilic substitution
- (c) Nucleophilic addition
- (d) Nucleophilic substitution

6. Which of the following compounds will not give Iodoform test on treatment with I_2/NaOH?
- (a) Acetaldehyde
- (b) Acetone
- (c) Butanone
- (d) 3–Pentanone

7. Which of the following compounds will react

with Tollen's reagent?
(a) $CH_3CO H$
(b) $CH_3CO CH_3$
(c) CH_3COOH
(d) $CH_3CO CH_2CH_3$

8. Cannizzaro's reaction is not given by:
(a) Formaldehyde
(b) Acetaldehyde
(c) Benzaldehyde
(d) Trimethyl acetaldehyde

9. Which of the following reagent will react with both aldehyde and ketones?
(a) Grignard's reagent
(b) Tollen's reagent
(c) Fehling's reagent
(d) Benedict's reagent

Important MCQs

10. Aldehydes are oxidized to give:
(a) Primary alcohol (b) Sec–alcohol
(c) Ter–alcohol (d) Carboxylic acid

11. Carboxyl compounds have functional group:
(a) R–C–X (b) R–CH=O
(c) RCOR (d) all

12. The homologous series of aldehydes and ketones have general formula:
(a) $C_nH_{2n}O$ (b) C_nH_nO
(c) $C_nH_{2n-1}O$ (d) $C_nH_nO_n$

13. Formula of acetone is:
(a) HCHO (b) CH_3CHO
(c) CH_3OCH_3 (d) $CH_3OC_2H_5$

14. Reaction of Grignard's reagent with formaldehyde gives:
(a) pri–alcohol (b) sec–alcohol
(c) ter–alcohol (d) carboxylic

15. Reaction of Grignard's reagent with aldehydes other than formaldehyde gives: Reaction of Grignard's reagent with formaldehyde gives:
(a) pri–alcohol (b) sec–alcohol
(c) ter–alcohol (d) carboxylic

16. Reaction of Grignard's reagent with ketones gives: Reaction of Grignard's reagent with formaldehyde gives:
(a) pri–alcohol (b) sec–alcohol
(c) ter–alcohol (d) carboxylic

17. Iodoform test is given by:
(a) Formaldehyde and (b) Formaldehyde
(c) Acetaldehyde and methyl ketones (d) Acetaldehyde

18. Aldehydes and ketones can be prepared from alcohols by their:
(a) reduction (b) oxidation
(c) decomposition (d) synthesis

19. Common names of aldehydes are given by corresponding:
(a) ketone (b) alcohol
(c) carboxylic acid (d) ester

20. Cannizzaro's reaction is type of reaction:
(a) self oxidation–Reduction reaction (b) disproportion reaction
(c) addition (d) a and b

21. Which reaction is of condensation or addition elimination reaction?
(a) ketol (b) aldol
(c) cannizzaro (d) All of these

22. Hydroxyl amine is a derivative of:
(a) alcohol (b) aldehyde
(c) ammonia (d) ketone

23. Aldehydes are reduced to:
(a) pri–alcohol (b) sec–alcohol
(c) ter–alcohol (d) All of these

24. Which is mild oxidizing agent?
(a) Tollen's reagent (b) $KMnO_4/H_2SO_4$
(c) $K_2Cr_2O_7/H_2SO_4$ (d) dil HNO_3

25. Which is strong oxidizing agent?
(a) $KMnO_4$ in H_2SO_4 (b) $K_2Cr_2O_7$ in H_2SO_4
(c) dil HNO_3 (d) All of these

26. Ketones can be oxidized by:
(a) Tollen's reagent (b) Benedict solution
(c) Fehling solution (d) dil HNO_3

27. Condensation of aldehydes with α–hydrogen gives:
(a) acetal (b) ketal
(c) aldol (d) cannizzaro product

28. Aldehydes give reactions:
(a) Oxidation and reduction (b) base–catalysed nucleophilic
(c) acid catalysed nucleophilic (d) All of these

29. Dehydration of alcohol gives:
(a) alkane (b) alkene
(c) aldehyde (d) ketone

INTRODUCTION

30. Organic compounds having functional group

—C—H are called:

a) aldehydes b) ketones
c) alcohol d) carboxylic acid

31. Organic compounds having functional group —C— are called:

a) aldehydes b) ketones
c) alcohol d) carboxylic acid

32. Organic compounds having functional group —C—OH are called:

a) aldehydes b) ketones
c) alcohol d) carboxylic acid

33. The general formula of aldehydes is:

a) R—C—H b) R—C—R
c) R—C—OH d) R—C—OR

34. The general formula of ketones is:

a) R—C—H b) R—C—R
c) R—C—OH d) R—C—OR

35. The general formula of carboxylic acids is:

a) R—C—H b) R—C—R
c) R—C—OH d) R—C—OR

36. The general formula of esters is:

a) R—C—H b) R—C—R
c) R—C—OH d) R—C—OR

37. The general formula of acid halides is:

a) R—C—H b) R—C—R
c) R—C—OH d) R—C—X

38. The carboxyl group is:

a) —C—H b) —C—
c) —C—OR d) —C—X

39. In carboxyl group the bond between C and oxygen is:

a) sigma bond b) single bond
c) double bond d) triple bond

40. In aldehydes carboxyl group is attached to at least one atom of:

a) hydrogen b) chlorine
c) oxygen d) nitrogen

41. In aldehydes, functional group —C—H exists at the:

a) middle of chain b) end of chain
c) start of chain
d) at any place in the chain

42. In ketones, functional group —C— may be present:

a) middle of chain b) end of chain
c) start of chain
d) at any place in the chain

43. In carboxylic acids, functional group —C—OH is present:

a) middle of chain b) end of chain
c) start of chain
d) at any place in the chain

44. In ketones, functional group containing carboxyl carbon is directly attached with:

a) one hydrogen b) one carbon
c) one hydrogen & one carbon
d) both carbon and hydrogen

45. The homologous member of series of aldehydes & ketones have general formula:

a) $C_nH_{2n}O$ b) C_nH_nO
c) $C_nH_{2n}O$ d) $C_{2n}H_nO_n$

46. Aldehyde group is present in most of:

a) Sugars b) phenols
c) carboxylic acids d) alcohols

47. Principal constituent of many oils used as fragrances and flavours are:
a) aldehydes b) ketones
c) Halides d) nitrides

48. In camphor and menthane, functional group of present:
a) aldehydes b) ketones
c) Halides d) nitrides

NOMENCLATURE (ALDEHYDES)

49. In aldehydes, "e" of alkane is replaced by:
a) Al b) ol
c) Ane d) oxy

50. In ketoses, "e" of alkane is replaced by:
a) Al b) ol
c) Ane d) oxy

51. Common names of aldehydes are obtained from carboxylic acids by replacing with aldehydes:
a) Al b) ol
c) Ane d) oic acid

52. Formula of aldehydes is:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_3H_7CHO

53. Formula of acetaldehyde is:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_3H_7CHO

54. Propionaldehyde has formula:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_3H_7CHO

55. Butyraldehyde has formula of:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_3H_7CHO

56. Pentanoaldehyde has formula of:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_4H_9CHO

57. The positions of other groups on the chain are indicated by letters:
a) Greek b) Latin
c) Arabic d) Romans

58. The aromatic aldehydes are not given names:
a) Greek b) Latin
c) Arabic d) common or trivial

59. Methanol has formula:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_3H_7CHO

60. Ethanal has formula:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_3H_7CHO

61. Ethanal has formula:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_3H_7CHO

62. Propanal has formula:
a) HCHO b) CH_3CHO
c) C_2H_5CHO d) C_6H_5CHO

63. 2-chlorobutanal has formula:

a) $CH_2Cl-CH_2-CH_2-C(=O)-H$

b) $CH_3-CH_2-CH(Cl)-C(=O)-H$

c) $Cl-CH_2-CH(Cl)-CH_2-C(=O)-H$

d) $Cl-CH_2-CH_2-CH(Cl)-C(=O)-H$

64. Which is not isomer of each other?

a) $CH_2(Cl)-CH(Cl)-CH_2-CH_2-C(=O)-H$

b) $CH_2(Cl)-CH_2-CH_2-CH_2(Cl)-C(=O)-H$

c) $CH_2(Cl)-CH_2-CH_2-CH(Cl)-C(=O)-H$

d) $CH_3-CH(Cl)-CH_2-CH_2-CO-H$

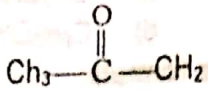
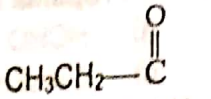
KETONES NOMENCLATURE

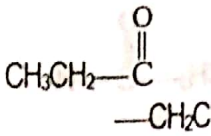
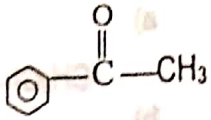
65. Common names of ketones are given:
a) by writing alkane at the end
b) by writing alkyl name
c) by writing alkyl groups and at the end ketone
d) by writing alkyl group at the end of name

66. Aromatic ketones are not given names:

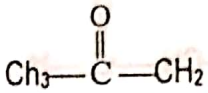
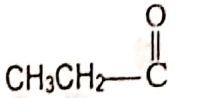
a) IUPAC b) Latin
c) Trivial d) English

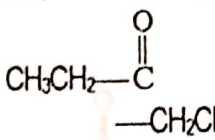
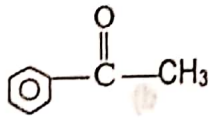
67. Formula of acetone (2-propanone or propanone) is:

a)  b) 

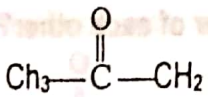
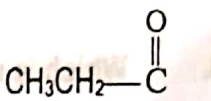
c)  d) 

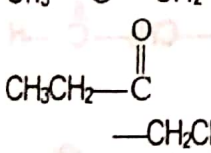
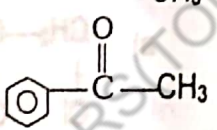
68. Formula of ethyl methyl ketone (2-butanone or butanone) is:

a)  b) 

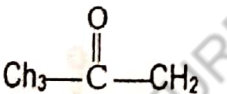
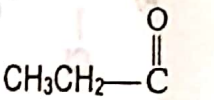
c)  d) 

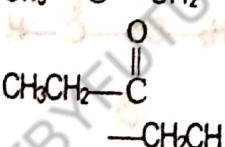
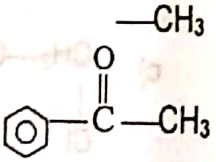
69. Formula of acetophenone is:

a)  b) 

c)  d) 

70. Formula of Benzophenone is:

a)  b) 

c)  d) 

PREPARATION OF ALDEHYDES

71. Aldehydes are prepared from:
a) oxidation of primary alcohols
b) Lucas test
c) Grignard's reagent
d) Frankland reaction

72. Ketones are prepared from:
a) oxidation of primary alcohol
b) oxidation of secondary alcohols
c) oxidation of tertiary alcohol
d) Grignard's reagent

PREPARATION OF ACETALDEHYDE

73. Pure acetaldehyde is obtained by:
a) redistillation b) crystallization
c) evaporation d) sublimation

74. Ethanol oxidized to in the presence of acidified sodium dichromate:
a) methanal b) methanol
c) ethanal d) ethanoic acid

75. Dry distillation of a mixture of calcium salts of formic and acetic acid gives:
a) methanal b) methanol
c) ethanal d) ethanoic acid

76. Dry distillation of formic acid gives:
a) methanal b) methanol
c) ethanal d) ethanoic acid

77. Oxidation of ethylene in the presence of catalyst $PdCl_2$ and promoter $CuCl_2$ gives industrially:
a) methanal b) methanol
c) ethanal d) ethanoic acid

78. $2CH_2{=}CH_2 + O_2 \xrightarrow[H_2O]{PdCl_2+CuCl_2}$
a) methanal b) methanol
c) ethanal d) ethanoic acid

REACTIVITY OF CARBONS GROUP

79. A substance having sigma and pi bond in it gives:
a) addition b) substitution
c) reduction d) neutralization

80. A substance having only sigma bond gives reaction:
a) addition b) substitution
c) reduction d) neutralization

81. A substance having bond in it gives addition type of addition reactions:
a) sigma b) pi
c) two pi d) sigma and pi

82. Approaching of reagent makes the carboxyl group:
a) non polar b) polar
c) ionic d) covalent

83. In carboxyl group, carbon carrying partial positive charge behaves as:
a) electrophile b) nucleophile
c) electrophile & nucleophile
d) substrate

84. In carboxyl group, oxygen carrying petrol negative charge behaves as:
a) electrophile b) nucleophile

c) electrophile & nucleophile
d) substrate

85. Carboxyl group has distribution of electron density:
a) symmetrical b) unsymmetrical
c) partially symmetrical d) equally distributed

86. Whether a reaction will be nucleophilic or electrophilic in origin depends upon:
a) particular reaction b) conditions
c) rate of reaction d) both (a) & (b)

87. The nucleophilic addition reactions of carboxyl group are catalysed by:
a) acids b) bases
c) acids and bases d) salts

88. The product formed during reactions of carboxyl group in aldehydes and ketone is called:
a) product b) yield
c) adduct d) addict

89. The nucleophilic characters of the reagent by a base:
a) increases b) decreases
c) remains same d) None of these

90. The electrophilic character by the attack of an acid:
a) increases b) decreases
c) remains same d) None of these

91. The electrophilic character by the attack of a catalyst is:
a) increases b) decreases
c) remains same d) None of these

REACTIONS OF CARBOXYL COMPOUNDS
NUCLEOPHILIC ADDITION REACTIONS

92. A base catalysed nucleophilic addition reaction will take place with a nucleophilic reagent:
a) weak
b) intermediate of aldehydes
c) weaker
d) strong

93. Which reaction is base catalysed?
a) Addition of HCN
b) Addition of Grignard's reagent
c) Addition of Sodium bisulphate
d) all

94. The reaction of aldehydes which are(is) base catalysed addition:
a) polymerization
b) addition of ammonia
c) addition of hydrogen
d) All

95. Hydrogen cyanide adds to aldehydes and ketones to form:
a) cyanohydrin b) alcohols
c) sodium bisulphate adduct d) aldol

96. Grignard's reagent adds to aldehydes and ketones giving compound:
a) cyanohydrin b) alcohols
c) sodium bisulphate adduct d) aldol

97. Addition of sodium bisulphate to aldehydes and ketones gives:
a) cyanohydrin b) alcohols
c) sodium bisulphate adduct d) aldol

98. Condensation of two aldehydes & ketones having α-hydrogen in the presence of a box gives:
a) cyanohydrin b) alcohols
c) sodium bisulphate adduct d) aldol

99. Condensation of two aldehydes having no-α-hydrogen in the presence of strong base gives:
a) cyanohydrin b) alcohols
c) sodium bisulphate adduct d) alcohol & salt of aldehydes

100. Acetaldehyde and methyl ketones react with halogens in the presence of NaOH gives product:
a) holoform b) metaformaldehyde
c) paraldehyde d) ethanoloxine

101. Formaldehyde polymerizes in the presence of dil H_2SO_4 to give:
a) holoform b) metaformaldehyde
c) paraldehyde d) ethanoloxine

102. Polymerisation of acetaldehyde in the presence of dil.H_2SO_4 to give:
a) holoform b) metaformaldehyde
c) paraldehyde d) ethanoloxine

103. Ethanol reacts with hydroxylamine to give:
a) holoform b) metaformaldehyde
c) paraldehyde d) ethanoloxine

104. Propanone (acetone) reacts with hydroxylamine to give:
a) holoform b) metaformaldehyde
c) paraldehyde d) Propanone oxine

105. Addition of mineral acid slowly to aqueous

solution of sodium cyanide produces:
a) HCN b) KCN
c) NaCN d) HOCN

106. The cyanogroup —C≡N is hydrolysed to the product:
a) aldehyde b) ketones
c) phenol d) carboxylic acids

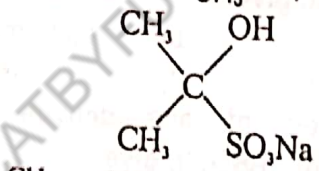
107. Lactic acid can be prepared from reaction of acetaldehyde with:
a) HCN b) NH_2
c) $H_2N—NHOH$ d) $NaHSO_3$

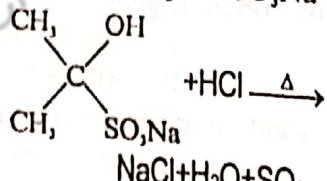
108. The reaction of HCN with aldehydes and ketones having same number of carbon atoms in product is used to produce the product:
a) α–hydroxy acid b) β-hydroxy acid
c) β-hydroxy acid d) adduct

109. Aldehydes and small methyl ketones react with saturated solution aqueous solution of sodium bisulphate to form crystalline precipitate of adduct:
a) coloured b) blue
c) green d) white

110. Bisulphite adducts formed during reaction of aldehyde and small methyl becomes with $NaHSO_3$ on heating mineral acid (HCl, H_2SO_4) generate:
a) aldehydes b) ketones
c) parent aldehydes d) parent aldehydes & ketones

111. The reaction used for separation and purification of carboxyl compounds from non carboxyl compounds like alcohols is done by the reaction:

a) $CH_3—\overset{O}{\overset{\|}{C}}—CH_3 + NaHSO_3 \longrightarrow$ 

b)  $+HCl \xrightarrow{\Delta} CH_3—\overset{O}{\overset{\|}{C}}—H +$ $NaCl+H_2O+SO_2$

c) $H—\overset{O}{\overset{\|}{C}}—H + CH_3MgBr \longrightarrow CH_3—CH_2 +$ $MgBr(OH)$

d) $2H—\overset{O}{\overset{\|}{C}}—H + NaOH \longrightarrow CH_3OH + H—\overset{O}{\overset{\|}{C}}—ONa$

112. Ketones don't react with sodium bisulphate have alkyl groups than methyl:
a) any may be the alkyl group
b) it must be ethyl group
c) it must be aryl group
d) any larger alkyl group than methyl don't give reaction

113. The reaction in which two molecules of the same or different compounds combine to form a new compound with or without elimination of some small molecule is a type of reaction:
a) addition b) co-polymerisation
c) condensation d) substitution

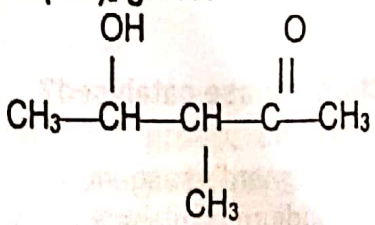
114. The name aldol is given to a product because it contains functional group:
a) aldehyde & alcohol b) aldehyde & ketone
c) aldehyde & carboxylic d) aldehyde and ether

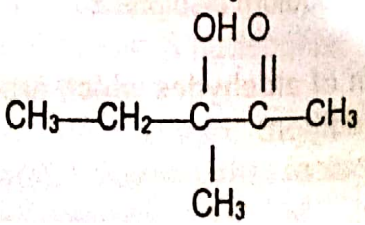
115. Two molecules of the same carboxyl compound condense to form:
a) enol b) aldol
c) cresol d) camphor

116. Condensation of ethanal gives in the presence of dil. NaOH:
a) 3-hydroxy butanal
b) 3-hydroxy butanol
c) 2-hydroxyl-butanal
d) 2-hydroy butanol

117. Condensation of propanal and ethanal in the presence of dil NaOH gives:
a) 3-hydroxy, 3-methyl pentanol
b) 3-hydoxy, 3-pentanol
c) 3-hydroxy-2-methyl pentanal
d) 3-hydroxy-3-methyl pentanal

118. Condensation of propanone in the presence of $Ba(OH)_2$ gives:

a) 

b) 

c) $CH_3-C(OH)(CH_3)-CH_2-C(=O)-CH_3$

d) $CH_2(OH)-CH(CH_3)-CH_2-C(=O)-CH_3$

119. **Aldol compound has a molecule on heating of:**
a) NH_3 b) H_2O
c) C_2H_5OH d) CH_3OH

120. **Heating of 3-hydroxybutanal in the presence of dil. HCl gives:**
a) crotonaldehyde b) aldol
c) enol d) ketol

121. **On heating aldol in the presence of dil. HCl, a bond between α and β-carbon atoms forms:**
a) single b) double
c) triple d) polar

122. **When hydroxide ion acts as a base it removes from aldehyde and ketones, a hydrogen from the carbon:**
a) α-carbon b) β-carbon
c) β-carbon d) $β_n$-carbon

123. **Condensation of two aldehydes having no α-hydrogen undergo reaction:**
a) aldol condensation b) cannizaro reaction
c) $NaHSO_3$ reaction d) HCN reaction

124. **Cannizaro's condensation occurs in the presence of:**
a) weak acid b) weak base
c) strong acid d) strong base

125. **Aldol condensation occurs in the presence of:**
a) weak acid b) weak base
c) strong acid d) strong base

126. $H-C(=O)-H + NaOH \longrightarrow H-C(=O)-ONa +$ ______
a) C_2H_5OH b) CH_3OH
c) $CH_3-C(=O)-CH_3$ d) $CH_3-C(=O)-H$

127. **Condensation of benzyl alcohol in the presence of NaOH give:**
a) ethyl alcohol b) methyl alcohol
c) propyl alcohol d) benzyl alcohol

128. **The formate ion in the presence of alkali give specie of acid called:**
a) anion of acid b) cation of acid
c) salt of acid d) anyone may be

129. **Holoform are given when halogens in the presence of sodium hydroxide react with aldehydes and ketones having only group in them:**
a) methyl b) ethyl
c) propyl d) isopropyl

130. **Holoform includes:**
a) iodoform b) chloroform
c) bromoform d) iodoform, chloroform

131. **CHI_3 is called:**
a) iodoform b) chloroform
c) bromoform d) iodoform, chloroform

132. **$CHCl_3$ is called:**
a) iodoform b) chloroform
c) bromoform d) iodoform, chloroform

133. **CHI_3 is called:**
a) iodoform b) chloroform
c) bromoform d) iodoform, chloroform

134. $R-C(=O)-CH_3 + 4NaOH + 3X_2 \longrightarrow RCOONa + 3NaX + 3H_2O +$ ______
a) $CHBr_3$ b) CHI_3
c) $CHCl_3$ d) CHX_3

135. $CH_3-C(=O)-H + 3I_2 + 4NaOH \longrightarrow HCOONa + 3NaI + 3H_2O +$ ______
a) $CHBr_3$ b) CHI_3
c) $CHCl_3$ d) CHX_3

136. **The yellow colour is precipitates of:**
a) $CHBr_3$ b) CHI_3
c) $CHCl_3$ d) CHX_3

137. **The iodoform test is given by:**
a) secondary alcohols with —OH at second carbon
b) ethanal only primary alcohols give this reaction
c) aldehydes having methyl group

d) All of these

138. A test involving iodine and aqueous sodium hydroxide is called:
a) Iodoform b) Lucas
c) Baeyer d) Acetylide

139. Iodoform is water:
a) immiscible b) insoluble
c) insoluble and immiscible
d) soluble

140. Methyl ketones and aldehydes are distinguished from other aldehydes and ketones with test:
a) immiscible b) insoluble
c) insoluble and immiscible
d) soluble

141. Test used to distinguish between ethanol from methanal and other primary alcohols is:
a) immiscible b) insoluble
c) insoluble and immiscible
d) soluble

142. Test used to distinguish between acetaldehyde and other aldehydes is:
a) immiscible b) insoluble
c) insoluble and immiscible
d) soluble

143. Formaldehydes polymerizes in the presence of dil. H_2SO_4 to:
a) adduct b) backchite
c) puric acid d) metaformaldehyde

144. Acetaldehyde polymerizes in the presence of dil. H_2SO_4 to:
a) adduct b) backchite
c) puric acid d) Paraldehyde

145. Compounds containing general group $\diagdown C$ $= N—G$ are obtained when aldehydes and ketones react with:
a) HCl b) SO_3
c) NH_3 derivatives d) I_2

46. Reaction between aldehydes and ketones with ammonia derivatives is a type of reaction:
a) condensation or addition elimination b) oxidation
c) fermentation d) substitution

147. Which is ammonia derivative group?
a) —NH—OH b) —NH—NH_2
c) —NHC_6H_5 d) All of these

148. Ammonia derivative(s) are (is):
a) hydroxylamine b) hydrazine
c) phenyl hydrazine d) All of these

149. Ethanal reacts with hydroxylamine to form in the presence of acid:
a) oximes b) ethanal oxime
c) propanone oxime d) ethanal phenyl hydrazone

150. Aldehyde and ketones react with hydroxylamine to get:
a) oximes b) ethanal oxime
c) propanone oxime d) ethanal phenyl hydrazone

151. Propanone reacts with hydroxyl amine to get:
a) oximes b) ethanal oxime
c) propanone oxime d) ethanal phenyl hydrazone

152. Ethanal reacts with phenyl hydrazine to get:
a) oximes b) ethanal oxime
c) propanone oxime d) ethanal phenyl hydrazone

153. Propanone reactw ith phenyl hydrazine to give:
a) oximes b) ethanal oxime
c) propanone oxime d) propanone phenyl hydrazone

154. Aldehydes and ketones react with hydrazine to form:
a) oxime b) phenyl hydrozone
c) hydrazine d) hydrazone

155. Crystals of 2-4-dinitrophenyl hydrazone are:
a) yellow b) orange
c) yellow and orange d) red

156. Which can be reduced?
a) alkenes b) alkynes
c) aldehydes d) All of these

157. Which are reduced to primary alcohol?
a) alkenes b) alkynes
c) aldehydes d) All of these

158. Which are reduced to secondary alcohols?
a) alkenes b) alkynes

c) aldehydes d) ketones

159. Reducing agent is:
a) $NaBH_4$ b) Ni
c) Cu d) $KMnO_4/H_2SO_4$

160. Oxidizing agent:
a) $NaBH_4$ b) Ni
c) Cu d) $KMnO_4/H_2SO_4$

161. Hydrating agent is:
a) $NaBH_4$ b) Ni
c) Cu d) $KMnO_4/H_2SO_4$

162. Methanal is reduced in the presence of catalyst into:
a) methane b) alcohol
c) methanol d) ethanol

163. Aldehydes and ketones are reduced to:
a) methane b) alcohol
c) methanol d) ethanol

164. On reduction, carboxyl group is converted to:
a) methane b) alcohol
c) methanol d) ethanol

165. $H-\overset{O}{\overset{\|}{C}}-H \xrightarrow{NaBH_4}$
a) methane b) alcohol
c) methanol d) ethanol

166. Ethanal is reduced to:
a) methane b) alcohol
c) methanol d) ethanol

167. $CH_3CHO \xrightarrow{NaBH_4}$
a) methane b) alcohol
c) methanol d) ethanol

168. Propanone (acetone) is reduced to:
a) acetic acid b) ethone
c) ethane d) 2-propanol

169. Which bond can't be reduced by $NaBH_4$?
a) $C\equiv C$ b) $C=C$
c) $C=O$ d) Both (a) & (b)

170. The alkaxide ion is reacted with water to give:
a) alkene b) alkyne
c) alcohol d) alkanal

171. Catalytic reduction is done on adding hydrogen in the presence of:
a) Ni b) Pt
c) Pd d) Ni, Pt & Pd

172. $H-\overset{O}{\overset{\|}{C}}-H + [H_2] \xrightarrow{Pt, Pd \text{ or } Ni}$
a) CH_3OH b) CH_3CH_2OH
c) CH_3COOH d) HCOOH

173. $H-\overset{O}{\overset{\|}{C}}-H + [H_2] \xrightarrow{Pt, Pd \text{ or } Ni}$
a) CH_3OH b) CH_3CH_2OH
c) CH_3COOH d) HCOOH

174. $H-\overset{O}{\overset{\|}{C}}-H + [H_2] \xrightarrow{Pt, Pd \text{ or } Ni}$
a) CH_3OH b) CH_3CH_2OH
c) $CH_3\underset{\displaystyle OH}{\underset{|}{C}}H-CH_3$ d) HCOOH

175. Aldehydes combine with alcohols in the presence of HCl to form:
a) aldol b) enol
c) ketol d) acetal

176. 1,1-diethoxyethane is also called:
a) aldol b) enol
c) ketol d) acetal

177. Hydrolysis of which regenerates the aldehydes?
a) aldol b) enol
c) ketol d) acetal

178. Which is used to protect the aldehydes group against alkaline oxidizing agents?
a) alcohol b) aldehydes
c) ketone d) carboxylic acids

OXIDATION OF CARBOXYL COMPOUNDS

179. Mild oxidizing agents used for aldehydes are:
a) Tollens reagent b) Fehling solution
c) Benedict solution d) All of these

180. Strong oxidizing agents are:
a) Tollens reagent b) Fehling solution
c) Benedict solution d) $KMnO_4$ or $K_2Cr_2O_7/H_2SO_4$

181. Aldehydes are oxidized to:
a) alcohol b) ketones
c) carboxylic acids d) acetic acid

182. $CH_3-\overset{O}{\overset{\|}{C}}-H + [O] \longrightarrow$
a) alcohol b) ketones
c) carboxylic acids d) acetic acid

183. $C_2H_5-\overset{O}{\overset{\|}{C}}-H + [O] \longrightarrow$
a) alcohol b) ketones
c) carboxylic acids d) propanoic acid

184. The number of carbon atoms in aldehydes and carboxylic acids formed from them are:
a) same b) different
c) unequal d) unsymmetrical

185. Oxidation of ketones is:
a) tough b) impossible
c) easy d) very easy

186. Oxidation of ketones require breaking of bond:
a) C—O b) C—H
c) C—C d) C=C

187. The oxidizing agent(s) used for ketones:
a) $KMnO_4/H_2SO_4$ b) $K_2Cr_2O_7/H_2SO_4$
c) conc. HNO_3 d) All of these

188. Which carbon atom is preferably oxidized in unsymmetrical ketones?
a) having least number of hydrogen atoms
b) maximum number of hydrogen atoms
c) maximum number of alkyl groups
d) a mixture of two carboxylic acids form

189. Oxidation of symmetrical alkenes yield:
a) having least number of hydrogen atoms
b) maximum number of hydrogen atoms
c) maximum number of alkyl groups
d) a mixture of two carboxylic acids form

190. Acetone oxidizes to:
a) acetic acid b) formic acid
c) alcohol d) alkanes

191. Butanone oxidizes to:
a) acetic acid b) formic acid
c) alcohol d) alkanes

192. $CH_3—\overset{\overset{O}{\|}}{C}—CH_3 + [O] \longrightarrow$
a) acetic acid b) formic acid
c) formic acid & acetic acid d) alkanes

193. $CH_3—\overset{\overset{O}{\|}}{C}—CH_2—CH_3 + 3[O] \longrightarrow$
a) acetic acid b) formic acid
c) formic acid & acetic acid d) alkanes

194. Aldehydes & ketones react with 2,4-DNPH forming precipitates of 2,4-dinitro-phenyl hydrione of colour:
a) yellow or red ppt b) white ppt
c) silver mirror d) brick red

195. Aldehydes and methyl ketones react with saturated solution of sodium bisulphate forming precipitate:
a) yellow or red ppt b) white ppt
c) silver mirror d) brick red

196. Aldehydes react with tollen's reagent forming:
a) yellow or red ppt b) white ppt
c) silver mirror d) brick red

197. Aliphatic aldehydes react with Fehling solution and Benedict solution forming precipitate:
a) yellow or red ppt b) white ppt
c) silver mirror d) brick red

198. Ketones react with sodium nitroprusside alkaline giving precipitate:
a) yellow or red ppt b) white ppt
c) silver mirror d) wine red or orange red

199. $Ag(NH_3)_2NO_3$ is changed to Ag in Tollen's test giving ppt:
a) yellow or red ppt b) white ppt
c) silver mirror d) brick red

200. Ketones is given test with:
a) Fehling Solution b) Tollen's reagent
c) Benedict solution d) Sod. Nitroprus side test

201. Aldehydes give tests with:
a) Fehling solution
b) Benedict solution & Tollen's test
c) Tollen's test
d) All of these

202. Which test is given by both aldehydes and ketones:
a) 2,4-DNPH b) Fehling solution
c) Tollen's reagent d) Benedict solution

USES OF FORMALDEHYDES AND ACETALDEHYDE

203. Resins like urea, formaldehyde, bakelite are prepared from:
a) formaldehyde b) ether
c) acetic acid d) ethanol

204. Indigo and para-rosaniline dyes are prepared from:
a) formaldehyde b) ether
c) acetic acid d) ethanol

205. The decolourising agent in rat dyeing used is:
a) formaldehyde b) ether
c) acetic acid d) ethanol

Answers

1	b	2	c	3	d	4	b	5	c
6	d	7	d	8	b	9	a	10	d
11	d	12	a	13	c	14	a	15	b
16	c	17	c	18	b	19	c	20	d

21	d	22	c	23	a	24	a	25	d
26	d	27	d	27	c	29	d	30	a
31	b	32	d	33	a	34	b	35	c
36	d	37	d	38	b	39	c	40	a
41	b	42	d	43	b	44	d	45	a
46	a	47	a	48	b	49	a	50	c
51	d	52	a	53	b	54	c	55	d
56	d	57	a	58	d	59	a	60	b
61	c	62	d	63	b	64	d	65	c
66	a	67	a	68	b	69	d	70	d
71	a	72	b	73	a	74	c	75	c
76	a	77	c	78	c	79	a	80	b
81	d	82	b	83	b	84	b	85	b
86	d	87	c	88	c	89	a	90	a
91	b	92	d	93	d	94	d	95	a
96	b	97	c	98	d	99	d	100	a
101	b	102	c	103	d	104	d	105	a
106	d	107	a	108	a	109	d	110	d
111	b	112	d	113	c	114	a	115	b
116	a	117	b	118	c	119	b	120	a
121	b	122	a	123	b	124	d	125	b
126	b	127	d	128	c	129	a	130	d
131	a	132	b	133	c	134	d	135	b
136	b	137	d	138	a	139	c	140	a
141	a	142	a	143	d	144	d	145	c
146	a	147	d	148	d	149	b	150	a
151	c	152	d	153	d	154	d	155	c
156	d	157	c	158	d	159	a	160	d
161	c	162	c	163	b	164	b	165	c
166	d	167	d	168	d	169	d	170	c
171	d	172	a	173	b	174	c	175	d
176	d	177	d	178	a	179	d	180	d
181	c	182	d	183	d	184	a	185	a
186	c	187	d	188	a	189	d	190	c
191	a	192	c	193	a	194	a	195	b
196	c	197	d	198	d	199	c	200	d
201	d	202	a	203	a	204	a	205	a

6. Carboxylic Acid & Amino Acid

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes

Students should be able to

In this topic, student should be able to:

a) Show preparation of ethanoic acid by oxidation of ethanol or by acidic hydrolysis of Ethane nitrile (CH3CN).

b) Discuss the reactions of ethanoic acid with emphasis on:

   i) Salt formation.

   ii) Esterification.

   iii) Acid chloride formation (acyl chloride).

   iv) Amide formation.

c) Describe the strength of organic acids relative t chloro substituted acids.

d) Explain the relative acidic strength of carboxy acids, phenols and alcohols.

7. AMINO ACIDS:

In this topic, student should be able to:

a) Describe the general structure of α-amino aci found in proteins.

b) Classify the amino acids on the basis of natu of R-group.

c) Describe Acid base properties of amino ac and formation of Zwitter ions.

d) Understand peptide bond formation.

Definitions and Statements

1. Define Aliphatic Carboxylic acids

A carboxylic acid in which carboxyl group is attached with alkyl group is called aliphatic carboxylic acid."

2. Define Aromatic carboxylic acids

A carboxylic acid in which carboxyl group is attached with an aryl group (—Ar), is called aromatic carboxylic acid."

3. Define Monocarboxylic acids

A carboxylic acid having only one carboxyl group in it is called monocarboxylic acid." Examples: CH_3COOH Acetic acid

4. Define Dicarboxylic acids

A carboxylic acid having two carboxyl groups in it is called dicarboxylic acid."

5. Define Polycarboxylic acids

Carboxylic acid having more than one carboxyl groups in it is called poly carboxylic acids."

6. Define Fatty acids

The aliphatic monocarboxylic acids are commonly called as fatty acids."

Examples: Palmitic acid —— $C_{15}H_{31}COOH$ Stearic acid —— $C_{17}H_{35}COOH$ etc.

7. Define Nitriles:

Compounds having cyanide (—C≡N) group are called nitriles."

8. Define Esterification

Carboxylic acids react with alcohols in the presence of concentrated H_2SO_4 to form esters. This process is called esterification."

$$CH_3COOH + C_2H_5OH \rightleftharpoons \underset{\text{ester}}{CH_3COOC_2H_5} + H_2O$$

9. Define Glacial Acetic Acid

Pure acetic acid which freezes to an ice like solid at 17°C is called glacial acetic acid."

10. Vinegar

The dilute acetic acid (about 4–5%) is called vinegar."

11. Define Amino Acids

These are the organic compounds containing both amino groups and carboxyl groups are called amino acids."

12. Define Acidic Amino Acids

The amino acids having two carboxyl groups in them are called acidic amino acids.

Example: Glutamic acid, aspartic acid etc.

13. Define Basic amino acids

The amino acids having two amino groups in them are called basic amino acids."

Example: Lysine, histidine etc.

14. Define Neutral Amino Acids

The amino acids having one carboxyl group and one amino group are called neutral amino acids." Example: Glycine, alanine etc.

15. Define Non-essential amino acids

Amino acids synthesized by the human body itself are called non-essential amino acids."

16. Define Essential amino acids

Amino acids which are not being synthesized by human body itself are called essential amino acids."

17. Define Zwitter ion

A molecule with positive and negative charged ions on it is called dipolar ion or Zwitter ion."

18. Define Peptide

When two and more than two similar or different α–amino acids condense with each other with elimination of water molecule, the resulting compounds formed is called peptide."

19. Define Peptide Bond or Peptide linkage

The linkage between two amino acids is called peptide bond."

20. Define Protein or Polypeptide

A macromolecule formed by the condensation of several hundred thousand amino acids is called protein."

21. Define Tripeptide

When three amino acids combine, the molecule is called tripeptide.

22. Define Tetrapeptide

When four amino acids condense, the molecule is called tetrapeptide."

23. Define α–amino acids

The amino acids having amino group "NH_2" at α–carbon is called α–amino acids."

Fully Solved Textual Exercise

1) Acetic acid is manufactured by:

(a) distillation (b) fermentation
(c) ozonolysis
(d) esterification

2) A carboxylic acid contains:

(a) a hydroxyl group
(b) a carboxyl group
(c) a hydroxyl and carboxly group
(d) a carboxyl and aldehyde group

3) Which acid is used in the manufacture of synthetic fibre?

(a) Formic acid (b) Oxalic acid
(c) Carbonic acid (d) Acetic acid

4) Which following derivative cannot be prepared directly from acetic acid?

(a) Acetamide
(b) Acetyl chloride
(c) Acetic anhdride
(d) Ethyl acetate

5) Which reagent is used to reduce a carboxylic group to an alcohol?
(a) H_2/Ni (b) H_2/Pt
(c) $NaBH_4$ (d) $LiAlH_4$

6) The solution of which acid is used for seasoning of food?
(a) Formic acid (b) Acetic acid
(c) Benzoic acid (d) Butanoic acid

7) Organic compouunds X and Y react together to form organic compound Z. What types of compounds can X, Y and Z be?

	X	Y	Z
(a)	Alcohol	Ester	Acid
(b)	Acid	Ester	Alcohol
(c)	Ester	Alcohol	Acid
(d)	Alcohol	Acid	Ester

8) An aqueous solution of an organic compound reacts with sodium carbonate to produce carbon dioxide gas. Which one of the following could be the organic compound?
(a) $CH_2=CH-CH_3$
(b) CH_3-CHO
(c) $CH_3COOC_2H_5$
(d) CH_3-CH_2-COOH

9) Which of the following is not a fatty acid?
(a) Propanoic acid
(b) Acetic acid
(c) Phthalic acid
(d) Butanoic acid

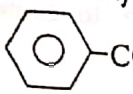
10) Acetamide is prepared by:
(a) heating ammonium acetate
(b) heating methyl cyanide
(c) heating ethyl acetate
(d) the hydrolysis of methyl cyanide

Important MCQs

11. A carboxylic acid with one carboxyl group:
(a) monocarboxylic acid (b) dicarboxylic acid
(c) tricarboxylic acid (d) polycarboxylic acid

12. A compound containing carboxyl group in them are called:
(a) ketone (b) ether
(c) carboxylic acids (d) aldehyde

13. A carboxylic acid containing Ar group in it is called:
(a) aromatic carboxylic acid (b) aliphatic carboxylic acid
(c) dicarboxylic acid (d) carboxylic acid

14.  is an example of carboxylic acid:
(a) aromatic carboxylic acid (b) aliphatic carboxylic acid
(c) dicarboxylic acid (d) carboxylic acid

15. In preparation method of carboxylic acids from alkyl halide always carboxylic acid formed which have carbon atoms:
(a) one less than in R—X (b) one more than in R—X
(c) equal to in R—X (d) double to R—X

16. Which is not carboxylic acid with pungent smell?
(a) formic acid (b) acetic acid
(c) ethanoic acid (d) butyric acid

17. Carboxyl group has functional group in it:
(a) one (b) two
(c) three (d) four

18. Carboxylic acids react with acids releasing gas from it:
(a) H_2O as steam (b) CO
(c) CO_2 (d) O_2

19. Active metals react with carboxylic acids releasing gas:
(a) CO (b) CO_2
(c) H_2O as steam (d) H_2

20. Acetic acid reacts with PCl_5 giving:
(a) acetamide (b) acetyl chloride
(c) alcohol (d) ether

21. Which are used as essences (flowers)?
(a) aldehydes (b) ketones
(c) alcohols (d) esters

22. Carboxylic acids are reduced to in the presence of $NaAlH_4$:
(a) esters (b) acetyl chloride
(c) alcohol (d) aldehydes

23. Carboxylic acids on complete reduction in the presence of HI and red phosphorus gives:
(a) esters (b) alcohols
(c) alkanes (d) aldehydes

24. Vinegar is dilute solution of:
(a) acetic acid (b) formic acid
(c) butyric acid (d) propionic acid

25. Glacial acetic acid freezes to ice like solid at (°C):
(a) 07 (b) 17
(c) 27 (d) 37

26. Boiling point of acetic acid is °C:
(a) 116 (b) 117
(c) 118 (d) 119

27. Acetic acid is miscible in:
(a) water (b) alcohol
(c) ether (d) a, b, c

28. Amino acids contain functional groups in it:
(a) –CO– (b) –OH
(c) $-NH_2$ (d) a, b, c

29. Amino acids are building blocks of:
(a) protein (b) carbohydrates
(c) lipids (d) fats

30. Amylacetate flavour is present in:
(a) banana (b) apple
(c) jasmine (d) orange

INTRODUCTION

31. The organic compounds containing $-\overset{\overset{O}{\|}}{C}-$ —OH group are called:
a) phenol b) aldehyde
c) ketones d) carboxylic acids

32. The organic compounds containing Ph—OH group are called:
a) phenol b) aldehyde
c) ketones d) carboxylic acids

33. Carboxylic acids functional group is:
a) —COOH b) —COH
c) —CO— d) —OH

34. Functional group in carboxylic acids consists of functional groups:
a) —OH & X b) $-\overset{\overset{O}{\|}}{C}-H$ & —OH
c) $-\overset{\overset{O}{\|}}{C}-$ & —OH d) $-\overset{\overset{O}{\|}}{C}-$ & X

35. The word "carb" is derived from functional group in carboxyl group:
a) —OH b) $-\overset{\overset{O}{\|}}{C}-H$
c) $-\overset{\overset{O}{\|}}{C}-$ d) $-\overset{\overset{O}{\|}}{C}-OH$

36. Aliphatic carboxylic acids have carboxyl group attached to:
a) alkyl group b) aryl group
c) phenyl group d) benzyl group

37. Aromatic carboxylic acids have carboxyl group attached to group:
a) alkyl group b) aryl group
c) phenyl group d) benzyl group

38. General formula of aliphatic carboxylic acids is:
a) R—OH b) R—COH
c) R—CO—R d) RCOOH

39. General formula of aromatic carboxylic acids is:
a) R—OH b) RCOOH
c) RCOR d) ArCOOH

40. Carboxylic acids having carboxyl group one is called:
a) mono carboxylic acid b) di-carboxylic acid
c) tri carboxylic acid d) tetra carboxylic acid

41. Carboxylic acids having two carboxyl groups are:
a) mono carboxylic acid b) di-carboxylic acid
c) tri carboxylic acid d) tetra carboxylic acid

42. Carboxylic acids having three carboxyl groups are:
a) mono carboxylic acid b) di-carboxylic acid
c) tri carboxylic acid d) tetra carboxylic acid

43. Carboxylic acids having more than one carboxyl groups are called:
a) mono carboxylic acid b) di-carboxylic acid
c) tri carboxylic acid d) poly carboxylic acid

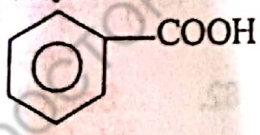
44. Formula of methanic acid or formic acid is:

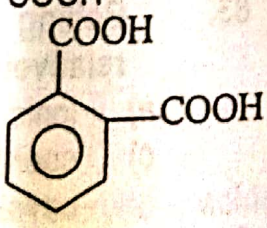
a) HCOOH b) CH_3COOH
c) COOH d) COOH
|
COOH
CH_2
|
COOH

45. Formula of acetic acid (ethanoic acid) is:
a) HCOOH b) CH_3COOH
c) COOH d) COOH
|
COOH
CH_2
|
COOH

46. Formula of oxalic acid (Ethane 1-2, dioic acid) is:
a) HCOOH b) CH_3COOH
c) COOH d) COOH
|
COOH
CH_2
|
COOH

47. Formula of malonic acid (propane-1,3-dioic acid) is:
a) HCOOH b) CH_3COOH
c) COOH d) COOH
|
COOH
CH_2
|
COOH

48. Formula of benzoic acid is:
a) HCOOH b) CH_3COOH
c) COOH d) 
|
COOH

49. Formula of phthalic acid is:
a) CH_3COOH b) COOH
|
COOH
c) COOH d) 
|
CH_2
|
COOH

13.2 NOMENCLATURE

50. Fatty acids are:
a) aliphatic monocarboxylic acids
b) dicaroxylic acids
c) tricarboxylic acids
d) tetracarboxylic acids
e) poly carboxylic acids

51. Palmitic acid & steanic acid are obtained from process of fats & oils:
a) reduction b) neutralization
c) oxidation d) hydrolysis

52. Formula of palmitic acid is:
a) $C_{11}H_{23}COOH$ b) $C_{13}H_{27}COOh$
c) $C_{15}H_{31}COOH$ d) $C_{17}H_{35}COOH$

53. Formula of stearic acid is:
a) $C_{11}H_{23}COOH$ b) $C_{13}H_{27}COOh$
c) $C_{15}H_{31}COOH$ d) $C_{17}H_{35}COOH$

54. Common names of carboxylic acids are given by then:
a) source b) person discovered
c) place d) habit

55. Formic acid is given names from Latin word a "formic" which means:
a) red out b) vinegar
c) butter d) milk

56. Acetic acid is obtained from:
a) red out b) vinegar
c) butter d) milk

57. Butyric acid was named from butyrum means:
a) red out b) vinegar
c) butter d) milk

58. Formic acid is obtained from red out by:
a) distillation b) crystallization
c) filtration d) sublimation

59. Carboxylic are given name by replacing "e" of alkane by:
a) "oic" acid b) "one"
c) "al" d) "ol"

60. Acetic acid is also named:
a) methanoic acid b) ethanoic acid
c) propanoic acid d) butanoic acid

61. CH_3CH_2COOH is also named as:
a) propionic acid b) propanoic acid
c) acetic acid d) both (a) & (b)

13.3 GENERAL METHODS OF PREPARATION

62. Carboxylic acids can be prepared from:
a) oxidation of alkane b) oxidation of alcohols
c) oxidation of aldehydes d) All of these

63. Carboxylic acids can be prepared from:
a) hydrolysis of alkyl nitrites
b) reaction of CO_2 with Grignard's reagent
c) hydrolysis of esters
d) All of these

64. Which method is used to prepare carboxylic

acid?

a) Hydrolysis of Al_4C_3 b) hydrolysis of CaC_2

c) hydrolysis of alkyl nitrites d) hydrolysis of alkenes

65. **Which method is not used in preparation of acetic acid?**

a) oxidation of ethane
b) hydrolysis of ethyl acetate
c) reaction of CO_2 with CH_3MgX
d) oxidation of methane

66. **Primary alcohols and aldehydes are oxidized to corresponding:**

a) alkanes b) alkenes
c) alkynes d) carboxylic acids

67. **Aldehydes are easily oxidized to corresponding carboxylic acids in the presence of:**

a) Strong oxidizing agents
b) Highly strong oxidizing agents
c) Tollen's reagent
d) Tollen's reagent and Fehling solution

68. **Compounds containing cyanide group (—C≡N) are called:**

a) nitrides b) nitrites
c) nitriles d) cyanides

69. **Hydrolysis of alkyl nitriles gives:**

a) alkane b) alkyl halide
c) alkyl nitrilde d) carboxylic acids

70. **Hydrolysis of alkyl nitriles is done to get carboxylic acids in the presence of:**

a) mineral acids b) mineral alkalies
c) organic acids d) minerals acids & alkalies

71. **Reaction of alkyl halides with potassium cyanide in the presence of alcohols give:**

a) carboxylic acids b) aldehydes
c) alkyl nitriles d) acid amides

72. **Always carboxylic acid produced will have number of carbon atoms from carbon atoms in alkyl nitriles:**

a) one more b) two more
c) equal & same d) one less

73. **Carboxylic acids can be prepared from the reaction of Grignards reagent with:**

a) aldehydes b) ketones
c) formaldehyde d) CO_2

74. **Which process of ester will yield carboxylic acid?**

a) hydration b) hydrolysis
c) oxidation d) reduction

75. $R—CH=CH—R + 4[O] \xrightarrow[\Delta]{KMnO_4,\ OH^-}$

a) RCOH b) ROH
c) ROR d) RCOOH

76. **Oxidation of 2-butene gives:**

a) Ethanaol b) Ethanal
c) Ethanone d) Ethanoic acid

13.4 PHYSICAL PROPERTIES

77. **First three carboxylic acids (C_1 to C_3) have smell like:**

a) impleasant b) flowers
c) fruits d) purgent

78. **Aliphatic carboxylic acids from C_4 to C_6 have odour:**

a) impleasant b) flowers
c) fruits d) purgent

79. **First six members (C_1 to C_6) of aliphatic carboxylic acids are in state:**

a) gas b) liquid
c) solid d) semisolid

80. **Aliphatic carboxylic acids are soluble easily in water:**

a) C_1 to C_2 b) C_1 to C_3
c) C_1 to C_4 d) C_1 to C_5

81. **Solubility of aliphatic carboxylic acids in water has trend with increase in molecular masses:**

a) increases b) suddenly increases then decreases
c) gradually decreases d) gradually increases

82. **Solubility of carboxylic acids in water are due to bonding:**

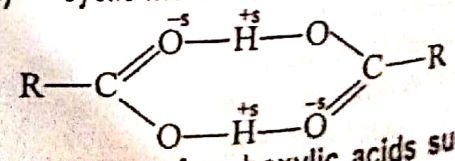
a) ionic b) covalent
c) coordinate covalent d) hydrogen

83. **Boiling points of carboxylic acids are relatively high due to bonding:**

a) ionic b) covalent
c) coordinate covalent d) hydrogen

84. **Molecular mass determination analysis shows that carboxylic acids exist as:**

a) simple molecules b) simple monomers
c) cyclic monomer d) cyclic dimer

85. 

structure of carboxylic acids suggest that

exists as:
a) simple molecules b) simple monomers
c) cyclic monomer d) cyclic dinner

86. Boiling point of formic acid is (in °C):
a) 100 b) 118
c) 151 d) 160

87. Boiling point of formic acetic acid is (in °C):
a) 100 b) 118
c) 151 d) 160

88. Boiling point of propanoic acid is (in °C):
a) 100 b) 118
c) 151 d) 160

89. Melting point of carboxylic acids increases with increasing molecular mass:
a) regularly b) commonly
c) always d) irregularly

90. Melting point of carboxylic acids having even number of carbon atoms is then next and previous ood number of carbon atoms:
a) 100 b) lower
c) the lowest d) higher

91. Melting point of propanoic acid is (in °C):
a) –22°C b) –6°C
c) –36°C d) –16°C

92. Melting point of butanoic acid is (in °C):
a) –22°C b) –6°C
c) –36°C d) –16°C

93. Melting point of pentanoic acid (in °C) is:
a) –22°C b) –6°C
c) –36°C d) –16°C

94. Carboxyl group displays chemistry of both carboxyl and:
a) —OH b) —X
c) —O— d) —O—R

95. Generally reactions occur in carboxyl groups containing compounds at:
a) —OH b) $-\overset{\overset{O}{\|}}{C}-$
c) $-\overset{\overset{O}{\|}}{C}-OH$ d) $R-\overset{\overset{O}{\|}}{C}$

96. Types of reactions, carboxylic acids undergo:
a) reactions due to hydrogen
b) reactions due to OH group
c) reactions due to carboxyl group as a whole
d) All of these

97. $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$ is a type of reaction involving:
a) reactions due to hydrogen
b) reactions due to OH group
c) reactions due to carboxyl group as a whole
d) All of these

98. $2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + CO_2 + H_2O$ is a type of reaction due to:
a) reactions due to hydrogen
b) reactions due to OH group
c) reactions due to carboxyl group as a whole
d) All of these

99. $CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2 + H_2O$ is a type of reaction involving:
a) reactions due to hydrogen
b) reactions due to OH group
c) reactions due to carboxyl group as a whole
d) All of these

100. Reactions of acetic acid with PCl_5, $SOCl_2$, ethanol, ammonia are due to involvement of:
a) reactions due to hydrogen
b) reactions due to OH group
c) reactions due to carboxyl group as a whole
d) All of these

Answers

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

8. Macromolecules

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to describe and explain

a) Formation and uses of Addition polymers such as polyethene, polystyrene and polyvinylchloride (PVC).
b) Formation and uses of Condensation polymers such as polyesters (terylene), polyamide (Nylon-6,6).
c) Structure of proteins i.e. primary and secondary structures.
d) Structure and function of nucleic acid (DNA).

Definitions and Statements

1. Define Polymer or Macromolecules
The large molecules built up from small repeating units (monomers) are called macromolecules or polymers."

2. Define Monomer
The simplest repeating unit of a polymer is called monomer."
Example $[—CH_2—CH_2—]$

3. Define Polymer
A large molecule formed due to the combination of repeated small and simple units (monomer) is called polymer."

4. Define Degree of Polymerization (D.P)
It is the number of repeating units in the main chain." It is represented by D.P.
It measures the length of the polymer chain.

5. Define Molecular Mass
It is the product of molar mass of repeating unit and the D.P."
Formula: Molar mass of polymer = molar mass of repeating unit × D.P

6. Define Homopolymer
When two or more similar monomers combine together, they form a homopolymer."
Examples: Polymerization of vinyl acetate

7. Define Copolymer
When two different monomers combine, they form copolymers."
Examples: Polymerization of vinyl acetate and butyl maleate

8. Define Terpolymer
A polymer formed by combining three different monomers is called ter-polymers."
Example: Polymerization of butyl acrylate, methacrylate and acrylic acid gives a hard, highly tough polymer.

9. Define Thermoplastics Polymer
A polymer which can be soften on heating and harden on cooling repeatedly with a little change in properties is called thermoplastic polymer."
Examples: PVC pipes, plastics, toys etc.

10. Define Thermosetting Plastics
A polymer which once soften on heating and harden on cooling can never be reshaped (soften) again on heating is called thermosetting plastics."

11. Define Addition Polymerization
When two or more monomers add up to form a single polymer, it is called addition polymerization.
Mechanism: Addition polymerization involves free radical mechanism.

12. Define Condensation Polymerization
When two or more monomers combine mutually with two functional groups of two monomers they combine with removal of a small molecule, it is called condensation polymerization."

13. Define Thermoplastics Polymer
A polymer which can be soften on heating and harden on cooling repeatedly with a little change in properties is called thermoplastic polymer."
Examples: PVC pipes, plastics toys etc.

14. Define Thermosetting Plastics
A polymer which once soften on heating and harden on cooling can never be reshaped (soften) again on heating is called thermosetting plastics."

15. Define Carbohydrates
The organic compounds containing carbon, hydrogen and oxygen are called carbohydrates."

16. Define Monosaccharides

These are simple sugars and cannot be hydrolysed. General formula: The general formula of monosaccharides is $(CH_2O)_n$

17. Define Disaccharides or Oligosaccharides

When two to nine monosaccharides units combine with each other releasing a water molecule, it forms disaccharides or oligosaccharides."

A carbohydrate which when hydrolysed in the presence of an acid or enzyme, gives two monosaccharides. It is called disaccharides or oligosaccharides."

18. Define Glycosidic linkage

The bond between two monosaccharides formed is called glycosidic linkage.

19. Define Trisaccharides

The carbohydrate which yields three monomers on hydrolysis are called trisaccharides. Molecular formula: $C_{18}H_{32}O_{16}$ Example: Raffinose

20. Define Polysaccharides

Carbohydrates of high molecular mass which yield many monosaccharides on hydrolysis are called polysaccharides."

Fully Solved Textual Exercise

1. In which of these processes are small organic molecules made into macromolecules?

(a) The cracking of petroleum fractions
(b) The fractional distillation of crude oil
(c) The polymerization of ethane
(d) The hydrolysis of proteins

2. Which of these polymers is an addition polymer?

(a) Nylon-6, 6 (b) Polystyrene
(c) Terylene (d) Epoxy resin

3. Which of these polymers is a synthetic polymer?

(a) Animal fat (b) Starch
(c) Cellulose (d) Polyester

4. Plastics are a pollution problem because many plastics:

(a) Are made from petroleum
(b) Are very inflammable
(c) Burn to produce toxic fumes
(c) Decompose to produce toxic products

5. The fibre which is made from acrylonitrile as monomer:

(a) PVC
(b) Rayon fibre
(c) Acrylic fibre
(d) Polyester fibre

6. A polymeric substance that is formed in the liquid state and then hardened to a rigid solid is called a:

(a) Fibre
(b) Plastic
(c) Varnish
(d) Polyamide resin

7. Vegetable oils are:

(a) Unsaturated fatty acids
(b) Glycerides of unsaturated fatty acids
(c) Essential oils obtained from plants

8. Which one of the following elements is not present in all proteins?

(a) Carbon (b) Hydrogen
(c) Nitrogen (d) Sulphur

9. Which one of the following is a water soluble vitamin?

(a) Niacin (b) Riboflavin
(c) Trypsin (d) Ascorbic acid

10. Which one of the following enzymes brings about the hydrolysis of fats?

(a) Urease (b) Maltase
(c) Zymase (d) Lypase

11. The reaction between fat and NaOH is called:

(a) Esterification
(b) Hydrogenolysis
(c) Fermentation
(d) Sponification

12. Which one of the following statements about glucose and sucrose is incorrect?

(a) Both are soluble in water
(b) Both are naturally occurring
(c) Both are carbohydrates
(d) Both are disaccharides

Important MCQs

13. Which behaves as insulator for animals body?

(a) carbohydrates (b) proteins
(c) fats (d) skin

14. The steroids of fungi and yeast are called:

(a) vitamin D (b) vitamin D_2
(c) ergosterol (d) cholesterol

15. An oil or fat with no double bond have iodine number:

(a) zero (b) 100%

(c) 50% (d) minimum

16. Which property is not present in lipids?
(a) liquid (b) solid or semi solid
(c) soluble in water (d) form emulsion

17. Which is the derived lipid?
(a) common fats (b) vitamin–D
(c) common oils (d) spinolipids

18. Major food factors are:
(a) fats and oils (b) carbohydrates
(c) proteins (d) All of these

19. Factors affecting denaturation of proteins:
(a) change in temp and pH (b) strong reducing agent
(c) strong oxidizing agent (d) All of these

20. The high molecular weight materials which yield on hydrolysis the amino acids is called:
(a) carbohydrates (b) lipids
(c) fatty acids (d) proteins

21. Cellulose does:
(a) satisfy human appetite (b) stimulates intestinal peristalsis
(c) gives fibre and bulk to the food (d) All of these

22. Cotton has cellulose in it:
(a) 96% (b) 97%
(c) 98% (d) 99%

23. Simple sugars are:
(a) monosaccharides (b) disaccharides
(c) oligo saccharides (d) trisaccharides

24. Poly hydroxyl compounds of aldehyde and ketones are:
(a) carbohydrates (b) proteins
(c) fats (d) lipids

25. The simplest separating unit of a polymer is called:
(a) monomer (b) dimer
(c) trimer (d) macromer

26. Molar mass of high molecular w.f. polymers ranges from:
(a) 1000 to 10000 (b) 10000 to 100000
(c) 100000 to 1000000 (d) 1000 to 10000000

27. Two or more similar monomers combine to form:
(a) homopolymer (b) copolymer
(c) ter polymer (d) thermoplastic polymers

28. Polymer formed by the combining of three different monomers is called:
(a) homopolymer (b) copolymer
(c) ter polymer (d) thermoplastic polymers

29. Polyester resins have special use in:
(a) clothing (b) paints
(c) emulsion (d) floor covering

30. $C_6H_{12}O_6$ is molecular formula of:
(a) Glucose (b) Dextrose
(c) Fructose (d) All of these

31. A combination of glucose and fructose is called:
(a) sucrose (b) table sugar
(c) a & b (d) lactose

32. Tasteless sugars are:
(a) monosaccharides (b) trisaccharides
(c) oligo saccharides (d) polysaccharides

INTRODUCTION

33. Macromolecular hypothesis acceptance due to efforts of Standinger came about in:
a) 1910 b) 1920
c) 1930 d) 1940

34. Acceptance of macromolecular hypothesis was due to efforts of:
a) Kekule b) Gibbs
c) Standinger d) Anderson

35. Standinger proposed long chain formulas for:
a) polystyrene b) rubber
c) polyoxymethylene d) All of these

36. Large molecules with high molecular mass formed due to smaller units are called:
a) polymer b) macromolecule
c) micromolecule d) polymer and macromolecule

37. Large molecule formed by combination of smaller units these smaller units are called:
a) polymer b) macromolecule
c) micromolecule d) polymer and macromolecule

38. For better or worst we are living in society:
a) wood b) food
c) diseased d) plastic

39. The word polymer is derived from words poly means many and mer means unit. These words are in origin:
a) Latin b) Greek
c) English d) French

40. Macromolecules are classified:
a) inorganic b) organic
c) biopolymer d) synthetic

41. Diamond, graphite and sand grant molecules are belonged to:
a) inorganic b) organic
c) biopolymer d) synthetic

42. Lipids, proteins, carbohydrates and nucleic acids belong to macromolecules:
a) inorganic b) organic
c) biopolymer d) synthetic

43. Plastic, rubber, synthetic fibers belong to macromolecules:
a) inorganic b) organic
c) biopolymer d) synthetic

44. Which is biopolymer?
a) plastic b) rubber
c) synthetic fiber d) lipid

45. Which is inorganic polymer?
a) plastic b) rubber
c) synthetic fiber d) lipid

STRUCTURE OF PROTEINS

46. Repetition is macromolecular is:
a) linear b) branched
c) interconnected d) All of these

47. The length of the polymer chain is specialized by repeating units in the chain:
a) number b) degree of polymerization
c) Both (a) & (b) d) nature

48. The length of the polymer chain is specialized by the number of repeating units called:
a) number b) degree of polymerization
c) Both (a) & (b) d) nature

49. Repeating unit in polyethene —CH_2—CH_2—CH_2—CH_2—CH_2—
a) —CH_2— b) —CH_2—CH_2—
c) —CH— d) —CH—CH—

50. The product of the molecular mass of repeating units and the D.P is called of polymer:
a) molecular formula b) empirical formula
c) molecular mass d) empirical mass

51. A polymer of polyvinyl chloride with DP 1000 has molecular or molar mass:
a) 630 b) 6300
c) 63000 d) 630000

52. A polymer of PVC having D.P 500 has molar mass:
a) 6300 b) 63000
c) 3150 d) 31500

53. Molar mass of repeating unit of PVC monomer is:
a) 43 b) 53
c) 63 d) 73

54. Most of high molecular mass polymers, used to make plastic rubbers or fibers have molecular masses between:
a) 1000—10000 b) 1000—100000
c) 10000—100000 d) 10000—100000

55. Properties of polymeric material depends upon:
a) chemical nature of macromolecule
b) chemical composition of macromolecule
c) structure of macromolecule
d) All of these

56. Polymers class is:
a) homopolymer b) copolymer
c) ter polymer d) All of these

TYPES OF POLYMERS

57. Type of polymer formed by the polymerization of single type of monomer is:
a) homopolymer b) copolymer
c) ter polymer d) All of these

58. Type of polymer formed by the polymerization of two monomers is:
a) homopolymer b) copolymer
c) ter polymer d) All of these

59. Polymerisation of vinyl acetate is a type of:
a) homopolymer b) copolymer
c) ter polymer d) All of these

Answers

1	c	2	b	3	d	4	c	5	c
6	b	7	b	8	c	9	c	10	d
11	d	12	d	13	c	14	c	15	a
16	c	17	b	18	d	19	d	20	d
21	d	22	d	23	a	24	a	25	a
26	c	27	a	27	c	29	a	30	d
31	c	32	d	33	b	34	c	35	d
36	d	37	d	38	d	39	b	40	d
41	a	42	c	43	d	44	d	45	d
46	d	47	c	48	b	49	b	50	c
51	c	52	a	53	c	54	d	55	d
56	d	57	a	58	b	59	a		

9. Environmental Chemistry

- Learning Outcomes
- Definitions and Statements
- Fully Solved Textual Exercise
- Important MCQs

Learning Outcomes
Students should be able to

In this topic, student should be able to:

a) Describe air pollutants.
b) Understand the chemistry and cause of Acid Rain.
c) Depletion of Ozone layer by chlorofluorocarbons (CFCs).

Definitions and Statements

1. Environmental Chemistry:
The breath of chemistry which deals with the chemicals and other pollutants in the environment is called environmental chemistry."

2. Atmosphere:
The layer of gases around the earth is called atmosphere."

3. Hydrosphere ("Hydro" — "Water" and "Sphere" — "area")
The surface of earth covered with water is called hydrosphere."

4. Lithosphere:
The rigid rocky part of earth rust extending up to 100 km in depth is called lithosphere."

5. Biosphere or Ecosphere:
Region of earth which is able to support life is called biosphere or ecosphere."

6. Ecosystem:
It is a smaller unit of biosphere."

7. Environmental Pollutants:
The substances in the environment affecting adversely the human health, quality of life and natural functioning of ecosystem are called environmental pollutants."

8. Air Pollution:
The addition of harmful substances which damage the environment, human health and quality of life is called air pollution."

9. Reducing Smog:
A smog chemically reducing in nature and have high concentration of SO_2 is called reducing smog."

10. Oxidizing smog (Photochemical smog):
A yellowish brownish grey haze consisting of high concentration of some oxidants is called oxidizing smog."

11. Ozone:
The allotropic form of oxygen having low b.p and with formula O_3 is called ozone."

12. Depletion of Ozone Layer:
The removal of ozone is called depletion of ozone."

13. Ozone hole:
The depletion of ozone layer in the atmosphere continued until whole ozone layer at a place was depleted making a hole called ozone hole.

14. Water Pollution:
The contamination of water making it unable to use by human is called water pollution."

15. Petroleum or crude oil:
It is a complex mixture of many organic compounds containing mainly hydrocarbons."

16. Pesticide:
The substances which are used either to kill the unwanted or to control their reproduction process are called pesticides."

17. Pests:
These are the harmful organism which destroy the crops and transmit diseases both to plants and animals."

18. Industrial Waste Effluents:
The waste chemicals as by-products formed during production of a product in industry is called industrial waste effluents."

19. Dissolved Oxygen (D.O):
The most important oxidizing agent in water is dissolved molecular oxygen (O_2).

20. Biochemical Oxygen Demand (BOD):
The ability of organic matter in water to consume oxygen within five days. This consumed oxygen is called biochemical oxygen demand."

Fully Solved Textual Exercise

1. The pH range of the acid rain is:
a) 7-6.5 b) 6.5-6
c) 6-5.6 d) less than 5

2. Peroxyacetylnitrate (PAN) is an irritant to human beings and it affects:
a) eyes b) ears
c) stomach d) nose

3. The range of UV-B is:
a) 320 to 400 nm
b) 200 to 280 nmc) 280 to 320 nm
d) 50 to 400 nm

4. A single chloride free radical can destroy bow many ozone molecules?
a) 100 b) 100000
c) 10000 d) 10

5. Fungicides are the pesticides which:
a) control the growth of fungus
b) kill insects
c) kills plants
d) kill herbs

6. DDT is a:
a) fungicide b) insecticide
c) herbicide d) all

7. The main pollutant of leather tanneries in the waste water is due to the salt of:
a) lead
b) chromium (VI)
c) copper
d) chromium (III)

8. In purification of potable water the coagulant used is:
a) nickel sulphate
b) copper sulphate
c) barium sulphate
d) aluminium sulphate

9. The temperature in the incineration process has a range:
a) 900 to 1000°C
b) 650 to 1100°C
c) 950 to 1300°C
d) 500 to 900°C

10. Newspaper can be recycled again and again by how many times?
a) 2 b) 3
c) 4 d) 5

Important MCQs

11. Chloroform is carcinogenic:
(a) heart (b) lungs
(c) liver (d) kidney

12. Which is used as a coagulant:
(a) Ferric salts (b) Potash alum
(c) a and b both (d) chlorine

13. Water is purified by the process:
(a) aeration (b) coagulation
(c) chlorination (d) All of these

14. BOD is the oxygen demand with in day(s):
(a) four (b) two
(c) three (d) five

15. Factors affecting quality of water:
(a) D.O (b) BOD
(c) COD (d) all a, b, c

16. Contamination of water of tanning industries is due to:
(a) Cr(III) (b) Cr(VI)
(c) Mn(III) (d) Mn(VII)

17. Forms of waste products:
(a) heat (b) smoke
(c) solid (d) All of these

18. How much pesticides have been synthesized at present?
(a) four thousand (b) six thousands
(c) eight thousand (d) ten thousands

19. A single free chlorine radical can destroy ozone molecules upto:
(a) 100000 (b) 100
(c) 1000 (d) 10000

20. Depletion of ozone is more during the month:
(a) Jan–March (b) April–Jun
(c) July–Aug (d) Sept–Nov

21 Unit of ozone is:
(a) Debye (b) Dobson
(c) esu (d) Coulumb

22. Main cause of reducing map is:
(a) combustion of coal (b) NO and NO_2
(c) un-burnt hydrocarbons (d) All of these

23. Coal contains sulphur in it:
(a) 1–3% (b) 1–6%
(c) 1–9% (d) 1–12%

24. Volcanoes produce SO_2:
(a) 47% (b) 57%
(c) 67% (d) 77%

25. Reason of pollution are:
(a) Population and urbanization (b) transportation
(c) industrialization (d) All of these

26. Nitrogen in the atmosphere is:
(a) 78% (b) 21%

(c) 0.9% (d) 0.03%

27. The layer of earth around the earth is called:
(a) Atmosphere (b) Hydrosphere
(c) Lithosphere (d) Biosphere

28. Components of environment are:
(a) Atmosphere (b) Hydrosphere
(c) Lithosphere (d) All of these

29. Atmosphere thickness is (in km) around the earth:
(a) 10 km (b) 100 km
(c) 1000 km (d) 1500 km

30. The rigid rocky part of earth crust called lithosphere extends upto a depth of:
(a) 10 km (b) 100 km
(c) 1000 km (d) 1500 km

INTRODUCTION

31. Chemistry related to the study of environment affected by the chemicals and pollutants is called:
a) biochemistry b) physical chemistry
c) pharmaceutical chemistry d) environmental chemistry

32. The branch of chemistry interlinked with biology, physics, medicines, agriculture, public health and sanitary engineering etc. is:
a) biochemistry b) physical chemistry
c) pharmaceutical d) environmental

33. The scope of environmental chemistry is to study:
a) sources of chemicals
b) transportation of chemicals
c) transportation of toxic chemicals
d) All of these

COMPONENTS OF THE ENVIRONMENT

34. What is component of environment?
a) atmosphere b) hydrosphere
c) lithosphere d) All of these

ATMOSPHERE

35. The layer of gases around the earth are called:
a) atmosphere b) hydrosphere
c) lithosphere d) All of these

36. Water bodies are included in:
a) atmosphere b) hydrosphere
c) lithosphere d) All of these

37. Rigid rocky crust earth upto a depth of 100 km is called:
a) atmosphere b) hydrosphere
c) lithosphere d) All of these

38. Region of earth capable of supporting life is called:
a) atmosphere b) hydrosphere
c) lithosphere d) All of these

39. Atmosphere consists of gases:
a) N_2 b) O_2
c) Ar d) all

40. Nitrogen percentage in atmosphere is:
a) 76% b) 77%
c) 78% d) 79%

41. Oxygen present in atmosphere is:
a) 78% b) 21%
c) 0.9% d) 0.3%

42. Argon in atmosphere is:
a) 78% b) 21%
c) 0.9% d) 0.3%

43. CO_2 in atmosphere is:
a) 78% b) 21%
c) 0.9% d) 0.3%

44. H_2, O_3, CH_4, CO, He, Ne, Kr and Xe are present in atmosphere:
a) 78% b) 21%
c) 0.9% d) traces

45. Thickness of atmosphere is about kilometer:
a) 10 b) 100
c) 1000 d) 10000

46. Half of mass of atmosphere is present in lower part of it (in km)
a) 5.2 b) 5.3
c) 5.4 d) 5.6

47. Atmosphere absorbs:
a) ultraviolet rays b) cosmic rays
c) harmful electromagnetic rays
d) All of these

48. The gas essential for containing life is:
a) O_2 b) CO_2
c) N_2 d) Ar

49. Gas required by plants for photosynthesis:
a) O_2 b) CO_2
c) N_2 d) Ar

50. Bacteria fixes the gas:
a) O_2 b) CO_2
c) N_2 d) Ar

51. Components of environment necessary for sustaining life are:
a) O_2 for breathing b) CO_2 for photosynthesis
c) N_2 for fixation d) All of these

52. Heat balance of earth is maintained by sphere:
a) hydrosphere b) atmosphere

c) lithosphere d) biosphere

HYDROSPHERE

53. Hydrosphere covers the surface of earth:
a) 70.8% b) 71.8%
c) 72.8% d) 73.8%

54. Ocean contains part of earth's water:
a) 95% b) 96%
c) 97% d) 98%

55. Polar ice caps and glaciers consists total earth water:
a) 1% b) 2%
c) 3% d) 4%

56. Fresh water of total earth water is:
a) 1% b) 2%
c) 3% d) 4%

57. Agriculture consumes part of fresh water:
a) 1% b) 2%
c) 69% d) 23%

58. Part of fresh water consumed in industry is:
a) 1% b) 2%
c) 69% d) 23%

59. Part of fresh water consumed in domestic purpose:
a) 1% b) 2%
c) 69% d) 8%

LITHOSPHERE

60. Lithosphere extends upto kilometer of earth crust in depth:
a) 10 km b) 100 km
c) 1000 km d) 10000 km

61. Eleven elements made part of earth mass:
a) 97.5% b) 98.5%
c) 99.5% d) 100%

62. Elements in lithosphere exist generally as:
a) metals b) non-metals
c) metalloids d) minerals

BIOSPHERE

63. Smaller unit of biosphere is:
a) specie b) ecosystem
c) plankton d) troposphere

64. Pollution due to adverse affect of substances on human health, quality of life, and natural functioning of ecosystem is called:
a) environmental pollution
b) soil pollution
c) noise pollution
d) water pollution

TYPES OF POLLUTION

AIR POLLUTION

65. The waste products given out from chimneys, automobiles produce pollution:
a) environmental pollution
b) soil pollution
c) noise pollution
d) air pollution

66. Which gas produces air pollution?
a) oxides of sulphur b) oxides of carbon
c) oxides of nitrogen d) All of these

67. Primary pollutants are:
a) oxides of sulphur b) oxides of carbon
c) oxides of nitrogen d) All of these

68. Secondary pollutants are:
a) PAN & Ozone b) aldehydes & ketones
c) sulphuric acid and peroxybenzol d) All of these

CARBON MONOXIDE

69. Carbonmonoxide is:
a) colourless b) odourless
c) highly toxic d) All of these

70. Which is property of CO?
a) soluble in water b) insoluble in water
c) no toxic d) pole coloured

71. Natural source(s) of emission of carbonmonoxide:
a) volcanic eruption b) natural gas emission
c) oxidation of methane d) All of these

72. Major source of generation of CO is:
a) transportation b) volcanic eruption
c) emission of natural gas d) methane oxidation

73. Transportation causes to produce CO_2 in atmosphere:
a) 72% b) 73%
c) 74% d) 75%

74. Poisoning of CO can be reversed by giving oxygen at pressure:
a) low b) least
c) medium d) high

75. Headache, fatigue, unconsciousness and eventually death is caused by the excessive supply of gas:
a) O_2 b) N_2
c) CO_2 d) CO

NITROGEN OXIDES (NO_x)

76. Which are gases taken as oxides of nitrogen?
a) N_2O & NO b) NO & NO_2
c) NO_2 & N_2O d) N_2O_4 & NO

77. The residence time of NO & NO_2 in atmosphere are respectively in days:
a) two and three b) three and two
c) three and four d) four and three

SULPHUR OXIDES (SO_x)

78. The percentage of SO_2 produced by volcanoes is:
a) 47% b) 57%
c) 67% d) 77%

79. Coal contains percentage of sulphur:
a) 1–9% b) 5–9%
c) 6–9% d) 7–9%

80. Oxides of sulphur react in atmosphere by various reactions to form:
a) sulphates b) sulphites
c) sulphides d) sulphate aerosols

81. Aerosols cause severe infections in old people of:
a) nose b) chest & respiratory
c) kidney d) lever

HYDROCARBONS

82. Paddy fields produce a significant amount of gas:
a) CH_4 b) C_2H_6
c) C_3H_8 d) C_4H_{10}

83. Mean residence time of methane in atmosphere in years is:
a) 1—7 b) 2—7
c) 3—7 d) 4—7

THE EFFECTS OF POLLUTED AIR ON ENVIRONMENT

1. ACID RAIN

84. Augus Smith discovered in the mid of seventeenth century:
a) acid b) bae
c) acid rain d) fertilizer

85. Phenomenon of acid rains gain importance in:
a) 1930s b) 1940s
c) 1950s d) 1960s

86. CO_2 in atmosphere changes to:
a) carbonic acid b) carbolic acid
c) sulphuric acid d) nitric acid

87. NO_x is atmosphere changes to:
a) carbonic acid b) carbolic acid
c) sulphuric acid d) nitric acid

88. SO_2 in atmosphere changes to:
a) carbonic acid b) carbolic acid
c) sulphuric acid d) nitric acid

89. Acidification of soil can leach metals:
a) Al b) Hg
c) Pb d) Ca

90. The elevated concentration of metal causes clogs of gills in fish:
a) Al b) Hg
c) Pb d) Ca

2. SMOG

91. The word smog is a combination of smoke and:
a) fog b) foke
c) fork d) fizzy

92. Reducing smog contains:
a) CO_2 b) CO
c) SO_2 d) NO

93. Photochemical smog consists of higher concentration of:
a) oxidants b) ozone
c) a & b d) NO_2

94. The yellow colour in photochemical smog is due to the presence of gas:
a) NO b) NO_2
c) SO_2 d) SO_3

95. Conditions for formation of smog are:
a) sufficient amount of NO, hydrocarbons, and volatile organic compounds
b) VOC emitted by vehicles
c) sunlight
d) all

96. Which oxidizing agent is eye irritant and toxic to plants?
a) H_2O_2 b) HNO_3
c) PAN d) Ozone

3. OZONE

97. Ozone gas has boiling point:
a) low b) high
c) medium d) highest

98. Amount of ozone in atmosphere is expressed in units:
a) kilograms b) cm^3
c) molarity d) DU

99. The normal amount of overhead ozone is about in DU:
a) 150 b) 250

c) 350 d) 450

100. Ozone layer is high:
a) 20—23 km b) 22—25 km
c) 23—26 km d) 25—28 km

101. Ozone is present in layer around earth:
a) atmosphere b) troposphere
c) stratosphere d) thermosphere

102. A large hole in the ozone layer over antartic region was discovered in:
a) 1960s b) 1970s
c) 1980s d) 1990s

103. Ozone is produced in regions:
a) tropical b) polar
c) antartic d) equator

104. Ozone acts as:
a) pollutant b) saver
c) oxidant d) All of these

105. By the mid of 1980s depletion of total overhead ozone in antartic region is:
a) 20% b) 30%
c) 40% d) 50%

106. Term ozone hole is used for depletion of ozone during months of:
a) Jan—Feb b) March—Sep
c) Sep—Nov d) Dec—Feb

107. Ozone in stratosphere extends upto km:
a) 0—15 km b) 10—15 km
c) 15—40 km d) 15—25 km

108. Troposphere extends upto km:
a) 0—15 km b) 10—15 km
c) 15—40 km d) 15—25 km

109. Chlorofluorocarbons (CFCs) and aerosols are inert in sphere:
a) troposphere b) stratosphere
c) lithosphere d) hydrosphere

110. A single chloride free radical of CFCs can destroy upto ozone molecules:
a) 10 b) 100
c) 1000 d) 100000

WATER POLLUTION

111. Diseases like dysentery, typhoid and hepatitis are caused by mixing of in water:
a) live stock wastes b) oil spillage
c) detergents d) pesticides

112. Petroleum or crude oil is a complex mixture of compounds mainly:
a) benzene b) minerals
c) hydrocarbons d) phenols

113. Many petroleum products are:
a) coloured b) colourless
c) tasty d) poisonous

114. Which does mobilize the bond toxic heavy metals ions as Pb, Cd, Hg from sediments into water:
a) pesticides b) oil spillage
c) live stock wastages d) detergents

115. Synthetic organic pesticides formulated nowadays are more than:
a) one thousand b) ten thousands
c) two thousands d) twenty thousands

116. The most important pesticides are:
a) Herbicides b) Insecticides
c) fungicides d) all

117. Chemicals used to kill insects are:
a) Herbicides b) Insecticides
c) Pesticides d) fungicides

118. Chemicals used to kill pests are:
a) Herbicides b) Insecticides
c) Pesticides d) fungicides

119. Chemicals used to kill herbs are:
a) Herbicides b) Insecticides
c) Pesticides d) fungicides

120. Chemicals used to kill fungi are:
a) Herbicides b) Insecticides
c) Pesticides d) fungicides

121. Causes of infection to man are:
a) leather tanneries
b) industrial waste effluents
c) pesticides & livestock wastes
d) All of these

122. The wastes released as a by product during manufacturing of some chemicals are called:
a) leather tanneries
b) industrial waste effluents
c) pesticides & livestock wastes
d) All of these

123. Which one is more toxic?
a) Fe b) C
c) Hg d) Ag

124. Which is least toxic among the givens?
a) Hg & Mo b) Pb & Sb
c) Cr & As d) Si & C

125. Which is the most toxic among the givens?
a) heavy metals b) non-metals
c) metals d) metalloids

126. Heavy metals are dangerous as:
a) these are directly eaten
b) contaminate underground water
c) mix in cooked food
d) mix in medicines

127. **Injestion of heavy toxic metals (Pd, Hg, Cr, As, Sb etc.) have safe limit:**
a) do not have same limit
b) in least amount not toxic
c) even can be taken in high amounts
d) different metals have minimum safe limit at least upto 5 gm

128. **Injestion of heavy metals can cause disease:**
a) anemia b) kidney diseases
c) nervous disorder d) All of these

129. **Leather tanneries use big quantities of:**
a) Cr VI salts b) Cr III salts
c) Mn-salts d) Pb-salts

130. **Leather tanneries cause water pollution by converting Cr VI-salts into a chromium with oxidation state:**
a) +1 b) +2
c) +3 d) +4

131. **Chromium VI is highly toxic causing disease of:**
a) kidney b) lungs
c) nervous disorder d) cancer

FACTORS AFFECTING THE QUALITY OF WATER

132. **Quality of water is measured by the term:**
a) dissolved oxygen
b) biochemical oxygen demand
c) chemical oxygen demand
d) All of these

133. **The amount of oxygen dissolved in water to oxidize organic matter is called:**
a) dissolved oxygen
b) biochemical oxygen demand
c) chemical oxygen demand
d) All of these

134. **The capacity of organic matter dissolved in water to consume oxygen with a period of five days is called:**
a) dissolved oxygen
b) biochemical oxygen demand
c) chemical oxygen demand
d) All of these

135. **The amount of potassium dichromate consumed during supply of oxygen to the organic compound dissolved in water is called:**
a) dissolved oxygen
b) biochemical oxygen demand
c) chemical oxygen demand
d) All of these

136. **DO abbreviation is used for:**
a) dissolved oxygen
b) biochemical oxygen demand
c) chemical oxygen demand
d) All of these

137. **BOD is termed for:**
a) dissolved oxygen
b) biochemical oxygen demand
c) chemical oxygen demand
d) All of these

138. **COD is termed for:**
a) dissolved oxygen
b) biochemical oxygen demand
c) chemical oxygen demand
d) All of these

139. **Range of DO is (in ppm):**
a) 1—4 b) 1—3
c) 4—8 d) 4—7

PURIFICATION OF WATER

140. **Water is purified by:**
a) filtration b) aeration
c) coagulation d) All of these

141. **Underground or surface water is treated because it is:**
a) dirty b) contains wastages
c) impure d) unfit for drinking and industrial use

142. **Suspended matter is settled in purification of water by:**
a) aeration b) coagulation
c) chlorination d) treatment

143. **Passing of air to remove foul gases, dissolved gases, organosulphur compounds and volatile organic compounds is done in step:**
a) aeration b) coagulation
c) chlorination d) treatment

144. **Materials suspended in water or present in colloidal form in raw water are removed by:**
a) aeration b) coagulation
c) chlorination d) treatment

145. Chemicals like $Al_2(SO_4)_3$ or alum are used in purification of water during step:
a) aeration b) coagulation
c) chlorination d) treatment

146. Water is made disinfectant during purification of water in the step:
a) aeration b) coagulation
c) chlorination d) treatment

147. Pathogens in raw water are killed in step:
a) aeration b) coagulation
c) chlorination d) treatment

148. Chlorinating agent most commonly used in disinfection of water is now-a-days:
a) chlorine b) HOCl
c) calcium hypochlorite d) All of these

149. Substance(s) used for disinfecting water is(are):
a) chlorine b) HOCl
c) calcium hypochlorite d) calcium hypochloride and chlorine both

150. Alum or aluminium sulphate used as coagulant in alkaline medium change into precipitate of radicals of aluminium:
a) sulphates b) oxides
c) hydroxides d) chlorides

151. Commonly used coagulants are ions of:
a) Ferrous b) Al
c) Cr d) Ferric

152. Suspended particles separate with gelatinous $Al(OH)_3$ ppt:
a) absorbed b) mixed
c) adsorbed d) soluble

153. Insoluble ferric oxide is produced in the pH range:
a) 1 to 8 b) 6 to 9
c) 3 to 13 d) 8 to 13

154. Coagulation removes suspended particles (solid) in ran water:
a) 60% b) 70%
c) 80% d) 90%

155. The hardness of water is due to ions of:
a) Mg^{+2} b) Ca^{+2}
c) Cl^{-1} d) all

156. HOCl is a compound:
a) polar inorganic b) organic
c) ionic d) covalent

157. Chlorination of water has harmful effect due to its reactions with dissolved:
a) ammonia b) organic compound
c) ammonia and organic compound d) SO_2

158. Reaction of hypochlorous acid with dissolved ammonia in raw water gives:
a) chloramines b) NH_2Cl
c) $NHCl_2$ d) NCl_3

159. Which one is eye irritant?
a) chloramines b) NH_2Cl
c) $NHCl_2$ d) NCl_3

160. Which pH can prevent formation of chloramines during chlorination of water?
a) alkaline b) neutral
c) acidic d) slightly acidic

161. Chlorination of raw water containing phenol produce a compound of offensive odour and taste and is toxic. This compound is:
a) chlorinated phenol b) chloroform
c) CH_3Cl d) CH_2Cl_2

162. Chlorination of raw water containing organic matter (humic acid) having reaction with HOCl will produce:
a) chlorinated phenol b) chloroform
c) CH_3Cl d) CH_2Cl_2

163. Chloroform produced in sane water have effects:
a) suspected liver carcinogen
b) rectal cancer
c) bladder cancer
d) All of these

164. Risks associated with drinking of chlorinated water can be avoided by using for disinfection in place of chlorine:
a) ozone b) chlorine dioxide
c) SO_2 d) both (a) & (b)

SOLID WASTE MANAGEMENT

165. Subject solid waste management covers:
a) disposal of domestic refuse
b) disposal of industrial refuse

c) industrial solid wastes
d) All of these

EFFECTS OF DUMPING WASTE IN SEA & RIVERS

166. Water covers earth surface more than:
a) 50% b) 60%
c) 70% d) 80%

LANDFILL

167. A hole used to dump the municipal wastes is called:
a) landfill b) effluents
c) leachate d) incineration

168. The semi solid wastes in landfills is called:
a) landfill b) effluents
c) leachate d) incineration

169. Site of land for landfill is selected based upon:
a) topography b) location of ground
c) water table d) All of these

170. Site of land for landfills is selected based upon:
a) type of soil
b) location of disposal zone
c) water table
d) all

171. Gases produced in leachate are:
a) NH_3 b) CH_4
c) H_2S d) all

172. Leachate contains:
a) fatty acids b) bacteria
c) heavy metals d) All of these

INCINERATION OF THE MUNICIPAL SOLID WASTE

173. A process in which solid waste is burned at high temperature ranging from 900 to 1000°C is called:
a) effluents b) solid waste management
c) incineration d) leachate

174. For incineration temperature range is (in °C):
a) 700–800 b) 800–900
c) 900–1000 d) 1000–1100

175. The incineration may reduce volume of wastes upto:
a) 1/4th b) 1/2nd
c) 2/3rd d) 3/4th

Answers

1	d	2	a	3	d	4	b	5	a
6	b	7	b	8	d	9	a	10	d
11	c	12	c	13	d	14	d	15	d
16	b	17	d	18	d	19	a	20	d
21	b	22	a	23	c	24	c	25	d
26	a	27	a	28	d	29	c	30	b
31	d	32	d	33	d	34	d	35	a
36	b	37	c	38	d	39	d	40	c
41	b	42	c	43	d	44	d	45	b
46	d	47	d	48	a	49	b	50	c
51	d	52	b	53	a	54	c	55	b
56	a	57	c	58	d	59	d	60	b
61	c	62	d	63	b	64	a	65	d
66	d	67	d	68	d	69	d	70	a
71	d	72	a	73	d	74	d	75	d
76	b	77	d	78	d	79	a	80	d
81	b	82	a	83	c	84	c	85	c
86	a	87	d	88	c	89	d	90	a
91	a	92	b	93	c	94	b	95	d
96	c	97	a	98	d	99	c	100	b
101	c	102	c	103	a	104	d	105	d
106	c	107	c	108	a	109	a	110	d
111	d	112	c	113	d	114	d	115	b
116	d	117	b	118	c	119	a	120	d
121	d	122	b	123	c	124	d	125	a
126	b	127	a	128	d	129	a	130	c
131	d	132	d	133	a	134	b	135	c
136	a	137	b	138	c	139	d	140	d
141	d	142	a	143	a	144	b	145	b
146	c	147	c	148	b	149	d	150	c
151	d	152	c	153	c	154	c	155	d
156	d	157	c	158	d	159	d	160	a
161	a	162	b	163	d	164	d	165	d
166	c	167	a	168	c	169	d	170	d
171	d	172	d	173	c	174	c	175	c

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