1. The volume occupied by 16g of oxygen at S.T.P.
   a) 22.4 L  b) 44.8 L  c) 11.2 L  d) 5.6 L
2. Avogadro's number represents the number of atoms in
   a) 12g of C\(^{12}\)  b) 320g of S  c) 32g of Oxygen  d) 12.7g of iodine.
3. The value of gram molecular volume of ozone at S.T.P is
   a) 22.4 L  b) 2.24 L  c) 11.2 L  d) 67.2 L
4. The number of atoms present in 0.5 gram- atoms of Nitrogen is same as the atoms in
   a) 12g of C  b) 32g of S  c) 8g of the oxygen  d) 24g of magnesium.
5. The number of gram-atoms of oxygen in 128g of oxygen is
   a) 4 b) 8 c) 128 d) 8 \times 6.02x10^{23}
6. The total number of moles present in 111 g of CaCl\(_2\) is
   a) One mole  b) Two moles  c) Three moles  d) Four moles
7. Which of the following weighs the most?
   a) One gram-atom of N\(_2\)  b) One mole of water  c) One mole of Sodium  d) One molecule of H\(_2\)SO\(_4\)
8. Which of the following contains same number of carbon atoms as are in 6.0g of carbon (C-12)?
   a) 6.0g ethane  b) 8.0g methane  c) 21.0g Propane  d) 28.0g CO
9. Which of the following contains maximum number of atoms?
   a) 2.0g hydrogen  b) 2.0g oxygen  c) 2.0g nitrogen  d) 2.0g methane
10. Which one among the following is the standard for atomic mass?
    a) H  b) C\(^{12}\)  c) C\(^{14}\)  d) O\(^{16}\)
11. Which of the following pair of species have same number of atoms under similar conditions?
    a) 1L each of SO\(_2\) and CO\(_2\)  b) 2L each of O and O\(_2\)
    c) 1L each of NH\(_3\) and Cl\(_2\)  d) 1L each of NH\(_2\) and 2L of SO\(_2\)
12. 2.0 g of oxygen contains number of atoms same as in
    a) 4 g of S  b) 7 g of nitrogen  c) 0.5 g of H\(_2\)  d) 12.3 g of Na
13. The number of gm-molecules of oxygen in 6.02 x 10^{24} CO molecules is
    a) 1 gm-molecule  b) 0.5 gm-molecule  c) 5 gm-molecule  d) 10 gm-molecule
14. Hydrogen phosphate of certain metal has a formula MHPO\(_4\), the formula of metal chloride is
    a) MCl  b) MCl\(_3\)  c) MCl\(_2\)  d) MCl\(_4\)
15. A compound contains 50% of X (atomic mass 10) and 50% Y (at. mass 20). Which formulate pertain to above date?
    a) XY  b) X\(_2\)Y  c) X\(_2\)Y\(_2\)  d) (X\(_2\))\(_3\) Y
16. Which of the following compound has / have percentage of carbon same as that in ethylene (C2H4)?
    a) propene  b) Cyclohexane  c) Ethyne  d) Benzene
17. 5L of 0.1 M solution of sodium Carbonate contains
    a) 53 g of Na\(_2\)CO\(_3\)  b) 106 g of Na\(_2\)CO\(_3\)  c) 10.6 of Na\(_2\)CO\(_3\)  d) 5 x 10^{2} millimoles of Na\(_2\)CO\(_3\)

B. Fill in the blanks
1. One mole of a triatomic gas contains ------atoms.
2. One mole of Sulphuric acid contains------ Oxygen atoms.
3. 11.2 L of carbon dioxide at S.T.P contains------ oxygen atoms.
4. Equal volumes of different gases under similar conditions of temperature and pressure contain equal number of ---------
5. A decimolar solution of NaOH contains of ------NaOH per litre of the solution.
6. 7 g of CO contains--------- O atoms.
7. The mass of 1 x 10^{22} formula units of CuSO\(_4\).5H\(_2\)O is ---------

C. Match the following

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CaC(_2)</td>
<td>a. 106 g</td>
</tr>
<tr>
<td>2. Law of multiple proportions</td>
<td>b atoms</td>
</tr>
<tr>
<td>3. Hydrguryum</td>
<td>c. Molarity of solution</td>
</tr>
<tr>
<td>4. 2 gm-equivalents of Na(_2)CO(_3)</td>
<td>d. 0.01 moles of solute in one L of solution</td>
</tr>
</tbody>
</table>
5. 22.4 L at S.T.P  
6. Number of gm-molecules per litre of solution  
7. 1 gm-atom of rhombic Sulphur  
8. Centimolar solution  
9. Mohr’s salt

2. GENERAL INTRODUCTION TO METALLURGY
1. The earthy impurities associated with ores are ..................
2. Froth flotation process is suitable for concentrating .......... ores.
3. Highly pure metals are obtained by .............. process.
4. Gangue + flux →..........................  
5. A mineral from which metal can be profitably extracted is called ..............  
6. A mixture containing sulphides of copper and iron is called .............  
7. ...................... is used as a foaming agent.

3. ATOMIC STRUCTURE – I
1. Atomic mass of an element is not necessarily a whole number because :  
(a) It contains electrons, protons and neutrons (b) It contains allotropic forms  
(c) Atoms are no longer considered indivisible (d) It contains isotopes (e) None of these.
2. No two electrons in an atom will have all four quantum numbers equal.  
The statement is known as  
(a) Exclusion principle (b) Uncertainty principle (c) Hund’s rule (d) Aufbau principle  
(e) Newlands law.
3. When the 3d orbital is complete, the new electron will enter the  
(a) 4p orbital (b) 4f orbital (c) 4s orbital (d) 4d orbital (e) 5s orbital.
4. The preference of three unpaired electrons in the nitrogen atom can  
be explained by : (a) Pauling’s exclusion principle (b) Aufbau principle (c) Uncertainty principle  
(d) Hund’s rule (e) None of these.
5. The number of orbitals in a p-sub-shell is  
(a) 1 (b) 2 (c) 3 (d) 6 (e) 5.
6. The nucleus of an atom contains :  
(a) Electrons and protons (b) Neutrons and protons  
(c) Electrons, protons and neutrons (d) Neutrons and electrons  
(e) None of these.
7. Which is the lightest among the following?  
(a) An atom of hydrogen  (b) An electron (c) A neutron (d) A proton (e) An alpha particle.
8. Which of the following has no neutrons in the nucleus? (a) Deuterium  
(b) Helium (c) Hydrogen (d) Tritium (e) An alpha particle.
9. When the value of the azimuthal quantum number is 3, the magnetic  
quantum number can have values :  
(a) +1, -1 (b) +1,0, 1 (c) +2,+1,0, -1,-2 (d) +3,+2, +1,0, -1,-2,-3 (e) +3,-3.
10. 2p orbitals have : (a) n = 1,l = 2 (b) n=1,l = 0 (c) n = 2, l = 0 (d) n = 2, 1=1 =1 (e) n =1, l =1.
11. The atomic number of an element is 17 and its mass number is 37.  
The number of protons, electrons and neutrons present in the neutral atom are :  
(a) 17, 37,20 (b) 20,17,37 (c) 17, 17, 20 (d) 17, 20,17 (e) 37, 20, 17.
12. The maximum number of electrons that can be accommodated in the  
nth level is : (a) n² (b) n+1 (c) n-1 (d) 2n²(e) 2 + n.
13. The magnetic quantum number decides :  
(a) The distance of the orbital from the nucleus  
(b) The shape of the orbital (c) The orientation of the orbital in space (d) The spin of the electron

B. Fill up the blanks
1. The decomposition of an electrolyte by passage of electricity is known as ...............  
2. When cathode rays are focused on thin metal foil, it gets heated up to ...............  
3. Cathode rays produce ...............on the walls of the discharge tube.
4. The radiations which were not influenced by a magnet were called.............
5. Neutrons are discovered by ………… ……………..

4. **PERIODIC CLASSIFICATION – I**

1. The elements with atomic numbers 31 belongs to :
   (a) d-block (b) f-block (c) p-block (d) s-block

2. Representative elements are those which belong to :
   (a) s and d-blocks (b) s and p-blocks (c) p and d-blocks (d) d and f-blocks

3. The most electronegative element of the periodic table is :
   (a) Iodine (b) Flourine (c) Chlorine (d) Oxygen

4. Which of the following forms stable gaseous negative ion.
   (a) F (b) Cl (c) Br (d) I

5. The elements having highest ionization energies within their periods are called :
   (a) Halogens (b) Noble gases (c) Alkali metals (d) Transition elements

6. A property which progressively increases down a group in the periods table is :
   (a) Ionization enthalpy (b) Electronegativity
   (c) Electron gain enthalpy (d) Strength as a reducing agent.

7. Elements whose atoms have their s and p-sub-levels complete are the :
   (a) Normal elements (b) Transition elements (c) Halogens (d) Inert gases.

8. The law of triad is applicable to :
   (a) Chlorine, bromine and iodine
   (b) Hydrogen, oxygen and nitrogen
   (c) Sodium, neon and calcium
   (d) All of the above

9. The law of octaves was stated by :
   (a) Dobereiner (b) Mendeleev (c) Moseley (d) Newland

10. Which of the following property decreases down a group :
    (a) Ionization enthalpy (b) Atomic radii (c) Valency (d) All the above properties

11. Which of the following has the lowest melting point :
    (a) CsCl (b) RbCl (c) KCl (d) NaCl (e) LiCl.

12. Which of the following hydroxide is most basic :
    (a) Mg (OH)₂ (b) Ba (OH)₂ (c) Ca(OH)₂ (d) Be (OH)₂

13. Excluding hydrogen and helium, the smallest element in the periodic table is :
    (a) lithium (b) Oxygen (c) Fluorine (d) Chlorine

14. Which one among the following species has the largest atomic radius:
    (a) Na (b) Mg (c) Al (d) Si

15. Which of the following is the lightest metal ?
    (a) Calcium (b) Lithium (c) Magnesium (d) Sodium

16. Which of the following has highest ionization potential?
    (a) Sodium (b) Magnesium (c) Carbon (d) Fluorine

17. With respect to chlorine, hydrogen will be :
    (a) Electropositive (b) Electronegative (c) Neutral (d) None of these.

18. Which element has the greatest tendency to lose electrons ?
    (a) Chlorine (b) Sulphur (c) Francium (d) Beryllium.

19. Halogens belong to the :
    (a) s-block (b) p-block (c) d-block (d) f- block
    (e) Zero group of the periodic table.

20. Compared to first ionization enthalpy of an atom, the second is :
    (a) Greater (b) Less (c) Same (d) Negligible

21. Which arrangement of the following set of atoms is in order of increasing atomic radius: Na, Rb, K and Mg :
    (a) Na, Mg, K, Rb (b) Na, K, Mg, Rb (c) Mg, Na, K, Rb (d) Na, Mg, Rb, K

22. The first attempt to classify the elements was made by :
    (a) Mendeleev (b) Newland (c) Lother Meyer (d) Dobereiner

23. Characteristic of transition elements is incomplete in :
    (a) d-orbitals (b)f-orbitals (c) p-orbitals (d) s-orbitals

24. Which of the following will have lowest first ionization enthalpy ?
    (a) Na (b) Al (c) Mg (d) Si

25. Which of the following atoms is likely to give off more energy on gaining an electron ?
    (a) Na (b) Mg (c) Al (d) Cl

26. Transition metals have the electronic configuration :
    (a) ns.nd.₁₀(b)ns.np(n-1)d₉₋₁₀ (c) ns₁₋₉(n-1)d₁₋₁₀ (d) ns.np.(n-1)d₁₋₁₀

27. In the first transition series the incoming electron enters the :
(a) 4d-orbital (b) 3d-orbital (c) 5d-orbital (d) 6d-orbital

**B. Fill in the Blanks**

1. Mendeleev’s periodic law states that the properties of the elements are the periodic functions of the .................
2. The Modern periodic law states that the physical and chemical properties of the elements are periodic functions of their ..........
3. The long form of the periodic table is constructed on the basis of repeating electronic .......... of the atoms when they are arranged in the order of increasing atomic numbers.
4. The first three periods containing 2, 8 and 8 elements respectively are called ..............
5. The valency of representative elements is given by the number of electrons in the outermost orbital and/or equal to .......... Minus the number of outermost electrons.

**5. GROUP 1S BLOCK ELEMENTS**

1. Atoms of the same element having same atomic number but different mass number are called (a) isotopes (b) isobars (c) isotones (d) isomerism
2. Deuterium nucleus consists of (a) 2 protons only (b) one neutron (c) one proton and one neutron (d) 2 protons and one neutron
3. Deuterium with oxygen gives (a) oxydeuterium (b) water (c) heavy water (d) all the above
4. Tritium is prepared by bombarding lithium with (a) deuterons (b) mesons (c) slow neutrons (d) all helium nucleus
5. At room temperature ordinary hydrogen consists of about (a) 25% para and 75% ortho (b) 75% para and 25% ortho (c) 99% para and 1% ortho (d) 1% para and 99% ortho
6. D.O reacts with P.O and gives (a) DPO (b) DPO (c) DPO (d) DPO.
7. .................. is used for the preparation of deuterium (a) deuterium oxide (b) heavy water (c) both a and b (d) deuterium peroxide
8. H:O is a powerful agent (a) dehydrating (b) oxidising (c) reducing (d) desulphurising
9. .................. is used as a propellant in nucleus (a) H:O (b) D:O (c) ND (d) CH = CH
10. The oxidation state of alkali metals is (a) +2 (b) 0 (c) +1 (d) +3
11. When heated in bunsen flame, lithium gives colour (a) yellow (b) blue (c) lilac (d) crimson red
12. On moving down the group, density of the alkali metals (a) increases (b) decreases (c) increases and then decreases (d) decreases and then increases
13. If the element can lose an electron readily, they are said to be (a) electronegative (b) electropositive (c) electronative (d) electrovalent

**B. Fill in the blanks**

1. The first element in the periodic table is ........... .
2. is the common formed of hydrogen ........... .
3. The half-life of tritium is ........... .
4. Deuterium reacts with ammonia to form ........... .
5. The rare isotope of hydrogen is ........... .
6. ........... is employed in nuclear reactor to slow down the speed of fast moving neutrons.
7. The magnetic moment of para hydrogen is ........... .
8. Deuterium with salt and other compounds forms ........... .
9. Hydrogen peroxide was first prepared by ........... in ........... .
10. Pure H:O is ........... .
12. The electronic configuration of potassium is ........... .
13. All alkali metals have ........... melting and boiling points.
14. On moving down the group of alkali metals, ionization energy ........... .
15. ........... is the lightest of all solid elements.

6. GROUP 2 s - BLOCK ELEMENTS
1. Among the following, which is known as ‘alkaline earth metal’.
   (a) Sodium (b) Calcium (c) Lithium (d) Potassium
2. Alkaline earth metals are
   (a) monovalent (b) trivalent (c) divalent (d) zerovalent
3. Among alkaline earth metals ________ is having the highest ionization energy. (a) Beryllium (b) magnesium (c) Calcium (d) Barium
4. The colour given by barium in flame is
   (a) Brick red (b) Apple Green (c) Red (d) Blue
5. The third most abundant dissolved ion in the ocean is
   (a) Beryllium (b) Barium (c) Calcium (d) Magnesium
6. Quick lime is
   (a) Calcium oxide (b) Calcium hydroxide (c) Calcium nitrate (d) Calcium sulphate
7. The formula of bleaching powder is
   (a) CaCl$_2$. H$_2$O (b) CaOCl$_2$. H$_2$O (c) CaSO$_4$. 2H$_2$O (d) CaSO$_4$. ½H$_2$O
8. Plaster of paris is
   (a) CaSO$_4$. ½H$_2$O (b) CaCl$_2$. CaSO$_4$. (d) CaSO$_4$. ½H$_2$O
9. The compound used in making moulds for statues is
   (a) Epsom salt (b) Calcium sulphide (c) Plaster of paris (d) Gypsum
10. The element used in pyrotechnics is
    (a) Magnesium (b) Barium (c) Calcium (d) Beryllium

B. Fill in the Blanks
1. The general electronic configuration of alkaline earth metals is_______.
2. The ionic radius________ on moving down the group 2.
3. In flame, calcium gives_________ colour.
4. Beryllium resembles more with an element in 13th group ________.
5. Magnesium comes from the name of the mineral __________.
6. __________ is present chlorophyll.
7. Magnesium is prepared by the electrolysis of fused __________.
8. With air, Magnesium forms ________ and ________.
9. The formula of epsom salt is ________ and ________.
10. Epsom salt is used as ________.

C. Match the following
1. Magnetite CaSO$_4$. 2H$_2$O
2. Dolomite Mg Cl$_2$. KCl. 6H$_2$O
3. Epsom salt MgCO$_3$. 2H$_2$O
4. Carnallite MgCO$_3$. CaCO$_3$
5. Gypsum MgSO$_4$. 7H$_2$O

7. P- BLOCK ELEMENTS
1) The elements of group 13 to 18 of the periodic table are known as
   a) s - block elements b) p - block elements c) d - block elements d) f - block elements
2) The general electronic configuration of group 18 elements is
   a) ns b) ns np c) ns np$^6$ d) ns np$^6$
3) The basic oxide among the following
   a) Bi.O b) SnO.c) HNO.d) SO$_3$
4) The most stable hydride of the following
   a) NH$_3$ b) PH$_3$. c) ASH d) BiH$_3$
5) The formula of Borax is
   a) NaBO$_2$.b) Na$_2$.B.O.c) H$_2$.BO$_2$.d) None of the above
6) The general electronic configuration of carbon group elements is
   a) ns np b) ns c) ns np d) ns np
7) The process used for the manufacture of ammonia is
a) Contact process b) Ostwald process c) Haber's process d) Linde's process
8. The oxides of non-metals are usually
a) ionic b) coordinate c) covalent d) none of the above
9. Metallic oxides are generally
a) acidic b) basic c) amphoteric d) neutral
10. Fixation of nitrogen is a source for
a) Various oxygen compounds b) Various phosphorus compounds
c) Various nitrogen compounds d) Various sulphur compounds
11. The oxyacid of nitrogen which is used in the manufacture of azo dyes.
a) Nitrous acid b) Nitric acid c) Hyponitrous acid d) Pernitric acid
12. The hydride of V group element which is used in the manufacture of artificial silk
a) ammonia b) stibine c) phosphine d) bismuthine
13. Anaesthetic used for minor operation dentistry
a) nitrous oxide b) nitric oxide c) nitrous oxide + oxygen d) nitrogen dioxide

a) graphite b) diamond c) fullerene d) carbon black

B. Fill in the blanks
1. The general electronic configuration of Boron group elements is------- .
2. Boron combines with nitrogen to form-------- .
3. ----------is used to identify the metallic radicals in the qualitative analysis.
4. ---------- is known as ‘inorganic benzene’.
5. In diamond, every carbon atom is bonded with the other by ------- bond.
6. C₆₀ Buckminster fullerene was nicknamed as .
7. Carbon tetrachloride---------- hydrolysis.
8. Nitrogen was discovered by---------- .
9. Nitric acid means------------.
10. Oxidising power of nitric acid ------------------with dilution.
11. Dioxygen is also called as-----------
12. Atomic oxygen combines with molecular oxygen to give ----------------
13. The ozoniser commonly used in the preparation of ozone are and-------
14. Ozone can liberate a -------------- oxygen easily.
15.---------- is used in the manufacture of synthetic camphor.

C. Match the following
(a)
1. Borax a. Allotrope of carbon
2. Graphite b. Na₂B₄O₇
3. ZnO c. Ozone
4. CFCs d. Neutral oxide
5. NH₃ e. Fertilizer
f. Fixation of nitrogen

(b.)
1. Inert pair effect a. Nitric acid
2. Oxyacid b. Cell fuel
3. Liquid nitrogen c. Stabilisation of lower oxidation state
4. Ostwald process d. Ozone
5. Molecular oxygen e. Platinum gauze
f. Refrigerant

(c.
Borax bead test
1. Copper a. Blue
2. Iron b. Grey
3. Manganese c. Red
4. Cobalt d. Bottlegreen
5. Chromium e. Colorless
f. Green
PHYSICAL CHEMISTRY

8. THE SOLID STATE – I

1. The structure of sodium chloride crystal is:
   (a) body centred cubic lattice (b) face centred cubic lattice (c) octahedral (d) square planar
2. The number of atoms in a face centred cubic unit cell is:
   (a) 4 (b) 3 (c) 2 (d) 1
3. The 8:8 type of packing is present in:
   (a) CsCl (b) KCl (c) NaCl (d) MgF₂
4. In a simple cubic cell, each point on a corner is shared by
   (a) 2 unit cells (b) 1 unit cells (c) 8 unit cells (d) 4 unit cells
5. An amorphous solid is :
   (a) NaCl (b) CaF₂ (c) glass (d) CsCl
6. Each unit cell of NaCl consists of 4 chlorine ions and:
   (a) 13 Na atoms (b) 4 Na atoms (c) 6 Na atoms (d) 8 Na atoms
7. In a body centred cubic cell, an atom at the body of centre is shared by:
   (a) 1 unit cell (b) 2 unit cells (c) 3 unit cells (d) 4 unit cells
8. In the sodium chloride structure, formula per unit cell is equal to
   (a) 2 (b) 8 (c) 3 (d) 4
9. In a face centred cubic cell, an atom at the face centre is shared by:
   (a) 4 unit cell (b) 2 unit cells (c) 1 unit cells (d) 6 unit cells

B. Fill in the Blanks :

1. In NaCl ionic crystal each Na⁺ ion is surrounded by -------- Cl⁻ ions and each Cl⁻ ion is
   surrounded by -------- Na⁺ ions.
2. The coordination number of Cs⁺ in CsCl crystal is -----------
3. -------- solids do not possess sharp melting points and can be considered as ------ liquids.
4. A body centred unit cell has an atom at the each vertex and at -------- of the unit cell.
5. The three types of cubic unit cells are --------, --------- and -------
6. A crystal may have a number of planes or axes of symmetry but it possesses only one ------ of
   symmetry.
7. Amorphous solids that exhibit same physical properties in all the directions are called --------.
8. Crystalline solids that exhibit different physical properties in all directions are called ---------
9. The number of atoms in a single unit cell of cubic close packed sphere is ----------
10. In a bcc, an atom of the body centre is shared by ----------- unit cell.
11. The Weiss indices of a plane are 1/2, 1/2, 1/2. Its miller indices will be ------ and the plane is
    designated as ---------
12. A plane is parallel to x & z axes and makes unit intercepts along y-axis. Its Weiss indices are
    ----. Its Miller indices are --------. The plane is designated as --------.

9. GASEOUS STATE

1. A curve drawn at constant temperature is called an isotherm. This shows relationship between
   (a) P and 1/V (b) PV and V (c) P and V (d) V and 1/P
2. The critical temperature of a gas is that temperature
   (a) Above which it can no longer remain in the gaseous state
   (b) Above which it can not be liquifited by pressure
   (c) At which it solidifies
   (d) At which volume of gas becomes zero.
3. If a gas expands at constant temperature.
   (a) Number of molecules of the gas decreases (b) The kinetic energy of the molecules decreases
   (c) The kinetic energy of the molecules decreases (d) The kinetic energy of the molecules increases
4. If a gas expands at constant temperature.
   (a) Number of molecules of the gas decreases (b) The kinetic energy of the molecules decreases
   (c) The kinetic energy of the molecules decreases (d) The kinetic energy of the molecules increases
5. The molecules of a gas A travel four times faster than the molecules of gas B at the same
   temperature. The ratio of molecular weight (Mₒ/Mₐ) will be
   (a) 1/16 (b) 4 (c) 1/4(d) 16

B. Fill in the blanks
6. The correction term for pressure deviation is ……in the Vanderwaal equation of state.
7. The relation between inversion temperature and Vanderwaal’s constants ‘a’ and ‘b’ is ---------
----
8. To liquefy Helium--------- method is exclusively used.
9. The adiabatic expansion of a real gas results in---------
10. The rate of diffusion of gas is------- to square root of both------ and molecular mass.

C. Match the following

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Ideal gas behaviour</td>
<td>(a) Critical temperature</td>
</tr>
<tr>
<td>12. Adiabatic demagnetization</td>
<td>(b) Liquid oxygen</td>
</tr>
<tr>
<td>13. CO₂ at 31.1°C</td>
<td>(c) Mole fraction of the gas</td>
</tr>
<tr>
<td>14. Joule Thomson Experiment</td>
<td>(d) Number of moles of the gas</td>
</tr>
<tr>
<td>15. Ratio of the partial pressure to the total pressure</td>
<td>(e) Low pressure and high temperature</td>
</tr>
<tr>
<td></td>
<td>(f) Liquid Helium</td>
</tr>
</tbody>
</table>

10. CHEMICAL BONDING

1. The crystal lattice of electrovalent compounds is composed of
   (a) Atoms (b) Molecules (c) Oppositely charged ions (d) Both molecules and ions
2. The compound which contains both ionic and covalent is
   (a) CH₄ (b) H₂ (c) KNC (d) KCl

B. Fill in the blanks

3. In NaCl, Na⁺ ion has--------------- and Cl⁻ ion has--------------- electron configurations.
4. Linear overlap of two atomic p orbitals leads to---------------.
5. Born-Haber cycle is related with---------------.
6. Two atoms of similar electronegativity are expected to form __compounds,
7. Repulsion between bond pair-bond pair is than in between lone pair - lone pair.

C. Match the following

| 1. Electrovalent bonding | a. Benzene |
| 2. Covalent bonding | b. Heitler and London |
| 3. Valence Bond theory | c. Electron transfer |
| 4. Polarised Bond | d. Electron sharing |
| 5. Resonance | e. Fajen's theory |
| | f. Aluminium chloride |

11. COLLAGIVETE PROPERTIES

1. Properties which depend only on number of particles present in solution are called
   (a) Additive (b) Constitutive (c) Colligative (d) None
2. Which solution would possess the lowest boiling point
   (a) 1% NaCl solution (b) 1% Urea solution (c) 1% glucose solution (d) 1% sucrose solution
3. In cold countries, ethylene glycol is added to water in the radiators of cars during winters.
   It results in :
   (a) Lowering boiling point (b) Reducing viscosity (c) Reducing specific heat
4. Which of the following 0.1M aqueous solutions will have the lowest freezing point?
   (a) Potassium sulphate (b) Sodium chloride (c) Urea (d) Glucose
5. The Van't Hoff factor of 0.005M aqueous solution of KCl is 1.95. The degree of ionisation of KCl is
   (a) 0.94 (b) 0.95 (c)0.96 (d) 0.59

B. Fill in the blanks

6. Relative lowering of vapour pressure is equal to in--------------- in solution.
7. A liquid having high vapour pressure has -------------- boiling point.
8. The least count of Beckmann's thermometer is ____________.
9. Molal elevation constant is a characteristic constant for a given --------------.
10. Semipermeable membrane allows the passage of ____________through it.
11. For a deliquescence to occur, the vapour pressure of water in the air must be______than that of the saturated solution.
12. Depression in freezing point is pronounced if camphor is used as a solvent in place of water for same amount of solute and solvent.
13. Every solution behaves as ideal solution _______.
14. The osmotic pressures of 0.1M glucose and 0.1M NaCl solutions are_________.

12. THERMODYNAMICS – I
1. Which of the following is not a state functions?
   (a) q (b) q + w (c) V +PV (d) V -PV
2. Which of the following is an extensive property?
   (a) volume (b) density (c) refractive index (d) molar volume
3. Which of the following is an exothermic reaction?
   (a) melting of ice (b) combustion reactions (c) hydrolysis (d) boiling of water
4. Which of the following is a reversible process?
   (a) Diffusion (b) melting (c) neutralization (d) combustion
5. In which process, work is maximum?
   (a) reversible (b) irreversible (c) exothermic (d) cyclic

B. Fill in the blanks
1. Translational energy of molecules is a part of __________ energy of the system.
2. Specific heat of a liquid system is________ property.
3. Work done in the reversible expansion is________.
4. Combustion is an ___________ process.
5. Heat of neutralisation of a strong acid is _____ than that of a weak acid.

13. CHEMICAL EQUILIBRIUM – I
1. In which equilibrium pressure has no effect
   (a) PCl₅(g) ↔ PCl₃(g) + Cl₂(g)
   (b) H₂(g) + I₂(g) ↔ 2HI(g)
   (c) 2SO₂(g) + O₂(g) ↔ 2SO₃(g)
   (d) NH₄Cl(g) ↔ NH₃(g) + HCl(g)
2. For the equilibrium N₂O₄(g) ↔ 2NO₂(g), the K_p and K_c values are related as
   (a) K_p = K_c (RT) (b) K_p > K_c (RT) (c) K_p = K_c (RT) (d) K_p = K_c (RT)
3. For endothermic equilibrium, increase in temperature changes the K_eq value as
   (a) No change (b) Increases (c) Decreases (d) None
4. In the heterogenous equilibrium CaCO₃(s) ↔ CaO(s) + CO₂(g) the K_eq value is given by
   (a) partial pressure of CO₂ (b) activity CaO
   (c) activities of CaCO₃ (d) [CaO] / [CaCO₃]
5. For the equilibrium reaction H₂(g) + I₂(g)↔ 2HI(g)
   (a) K_p = K_c (b) K_p > K_c (c) K_p < K_c (d) K_p = 1/K_c
B. Fill in the blanks
6. In endothermic equilibrium reaction the increase in temperature ___________ the reaction.
7. When the reactant is a liquid which decomposes to gaseous products. Then the equilibrium is called as---
8. When reactants and products are in gaseous state, the equilibrium constant can be expressed in terms of__________
9. Value of the equilibrium constant is ________ of the initial concentration of reactants.
10. According to law of mass action, the rate of a chemical reaction is proportional to ________ of reactants.
C. Match the following
11. $K_p$  
   a. homogeneous equilibrium
12. $CaCO_3 \leftrightarrow CaO(s) + CO_2(g)$  
   b. active mass of reactants
13. Rate of reaction  
   c. irreversible reaction
14. $H_2(g) + I_2(g) \leftrightarrow 2HI(g)$  
   d. Degree of dissociation
15. $C(s) + O_2(g) \leftrightarrow CO_2(g)$  
   e. $K_c(RT) \Delta n_{\text{eq}}$
   f. Heterogeneous equilibrium

14. CHEMICAL KINETICS – I
1. mol dm$^{-3}$ sec$^{-1}$ is the unit of
   (i) rate (ii) rate constant (iii) order (iv) active mass
2. The elementary step with slow rate represents
   (i) rate determining step (ii) maximum rate step (iii) third order rate (iv) overall order
3. Molecularity is determined for (i) an elementary reaction (ii) an overall reaction
   (iii) an over all stoichiometric reaction (iv) a fractional order reaction

B. Fill up the blanks
4. Decomposition of aqueous $NH_4NO_2$ proceeds by $--------------$-reaction.
5. Fractional orders are found in$---------$-reaction.
6. In a $-----------$-reaction rate does not depend on the reactant concentration.

C. Match the following
7. slow step  
   a. experimentally determined
8. order  
   b. zero order
9. molecularity  
   c. rate determining step
10. unit of first order ‘k’  
    d. maximum rate
11. rate is independent of reactant  
    e. theoretical concept concentration
    f. sec$^{-1}$

15. BASIC CONCEPTS OF ORGANIC CHEMISTRY
Write the IUPAC name of the following
(a) $CH_3 - \overline{\text{CH}} - CH_3$
   (b) $CH_3 - \overline{\text{C}} - CH_3$
   (c) $CH_3 - \overline{\text{CH}} - \overline{\text{CH}} - CH_3$
   (d) $CH_3 - \overline{\text{C}} - CH_2 - CH_3$
   (e) $CH_2 = \overline{\text{CH}} - \overline{\text{CO}}CH_2CH_3$
   (f) $CH_3CH_2CHO$
   (g) $CH_3 - \overline{\text{CH}} - CH_2 - COOH$
   (h) $CH_3CH_2OCH_2CH_3$
   (i) $CH_3OCH_2CH_2CH_3$
   (j) $CH_3 - O - \overline{\text{CH}} - CH_3$
   (k) $CH_3CH_2CH_2CH_2NH_2$
16. PURIFICATION OF ORGANIC COMPOUNDS

1. Organic compounds are soluble in
   a) Non-polar Solvents b) Polar solvents c) Water d) HCl

2. Decolourisation of coloured compounds can be effected by using
   a) Animal charcoal b) Carbon c) Coke d) Infra-red rays

3. Compounds having boiling points widely apart 40 K and above can be purified by
   a) Crystallisation b) Simple distillation c) Fractional distillation d) Sublimation

4. Nitrobenzene and benzene can be separated by the method of
   a) Steam distillation b) Crystallisation c) Fractional crystallisation d) Chromatography

5. Purification of two miscible liquids possessing very close boiling points can be separated using
   a) Fractional distillation b) Sublimation c) Simple distillation d) Steam distillation

6. Purification of mixture of compounds can be done by steam distillation only if the impurities are
   a) Non-volatile b) Volatile c) Insoluble in Water d) both a & c

7. When the stationary phase is solid, then the compounds can be separated on the basis of
   a) Adsorption b) Partition c) Both partition and adsorption d) Either

8. Column Chromatography is based on the principle of
   a) Adsorption b) Partition c) Absorption d) Distribution

9. In Ascending paper Chromatography, the solvent moves
   a) Upwards b) Downwards c) Horizontally d) None

10. The existence of wide range of organic compounds is due to their
    property of a) Extensive catenation b) Lower boiling points c) Polymerisation d) Isomerism

B. Fill in the blanks

1. The Compounds separated and purified by crystallisation can be dried over

2. Camphor can be purified by the process of ______________.

3. In simple distillation the compounds should not decompose at ________

4. Water insoluble compounds can be purified by ____________.

5. In T.L.C the stationary phase is a__________.

6. Chromatographic technique was first introduced by ____________.

7. In paper chromatography, the mobile phase travels by ____________action through the paper.

8. The adsorbent used in column Chromatography method is__________.

9. In Chromatographic technique, the separation of compounds are brought about by ____________ movement of the compounds.

10. Paper Chromatography is ____________ Chromatography.

18. HYDROCARBONS

1) Alkanes can be represented by the formula
   a) CₙH₂ₙ₊₂ b) CₙH₂c) CₙH₄d) CₙH₃

2) Alkenes are represented by the formula
   a) CₙH₂ₙ₋₂ b) CₙH₅c) CₙH₆d) CₙH₄

3) Alkynes are represented by the formula
   a) CₙH₂₋₁ b) CₙH₃c) CₙH₄d) CₙH₅

4) The type of substitution reaction that takes place when methane is treated with Cl₂ in presence of light
   a) ionic c) nucleophilic b) electrophilic d) radial

5) When n-hexane is passed over hot alumina supported chromium, vanadium or molybdenum oxide the compound formed is
   a) cyclopentaene b) cyclohexane c) toluene d) benzene

6) When the identical groups are on the same or opposite sides of the bonds in alkenes the isomerism is called as
   a) chain isomerism b) geometrical isomerism c) position isomerism d) optical isomerism

7) Diels-Alder reaction is the reaction between
   a) diene and dienophile b) electrophile and nucleophile c) oxidant and reductant d) none.

8) Unsaturated compounds with two double bonds are called as

a) diene  b) alkadiene  c) olefins  d) paraffins.
9) The hybridization of carbons in ethylene is
a) $\text{sp}^2$  b) $\text{sp}$  c) $\text{sp}^3$  d) $\text{dsp}^2$
10) Alcohols can be dehydrated to olefins using
a) $\text{H}_2\text{SO}_4$  b) $\text{SOCl}_2$  c) $\text{Pd}$  d) $\text{Zn/Hg}$
11) When alkyl halides are treated with alcoholic KOH, the products are
a) olefins  b) alkanes  c) alcohols  d) aldehydes
12) Wittig reaction is used to prepare
a) an alkene  b) an alkyne  c) an alkane  d) none of the above.
13) Electrolysis of potassium succinate gives
a) ethylene  b) ethane  c) acetylene  d) none of the above.

B. Fill up the blanks
1) In alkanes, the carbon atoms are connected by \________-bonds.
2) Treatment of 1,2-dibromopropane with zinc and ethanol gives
\________.
3) Cis But-2-ene is an \________ isomer.
4) Addition of HCl to an olefin follows
\________ rule.
5) An alkene reacts with ozone to form
\________
6) CaC on hydrolysis gives
\________
7) Ethylenedibromide on treatment with KOH gives
\________
8) Electrolysis of sodium maleate gives
\________

19. AROMATIC HYDROCARBONS
1. Aromatic compounds are
a) benzenoid compounds  b) non-benzenoid compounds
  c) aliphatic compounds  d) alicyclic compounds
2. Benzene was first isolated by
a) Huckel  b) Faraday  c) Hofmann  d) Barthelot
3. Benzene undergoes
a) addition reactions  b) oxidation reactions
  c) polymerisation reactions  d) electrophilic substitution reactions
4. The modern theory of aromaticity was introduced by
a) Faraday  b) Huckel  c) Hofmann  d) Berthelot
5. Any compound can be aromatic if they have
\________ delocalised electrons.
6. The function of FeCl3 in chlorination of benzene is to produce
a) Cl  b) Cl\textsubscript{2}  c) Cl\textsubscript{3}  d) C
7. The ortho and para directing groups are
a) activating group  b) deactivating group  c) both  d) none
8. The purpose of adding conc. H\textsubscript{2}SO\textsubscript{4} in nitration of benzene is to produce
a) NO\textsubscript{2}  b) NO\textsubscript{2}\textsuperscript{-}  c) NO\textsubscript{2}\textsuperscript{+}  d) NO\textsubscript{3}\textsuperscript{-}
9. An example of polycyclic aromatic hydrocarbon
a) pyridine  b) pyrole  c) naphthalene  d) cyclohexane
10. The compound which is used as a solvent for the extraction of fats and oils
a) naphthalene  b) benzene  c) cyclohexane  d) butane

B. Fill in the blanks
1. Many synthetic drugs used are \________ in part.
2. The \________ forms the source of many organic compounds.
3. The modern theory of aromaticity was introduced by \________.
4. Ortho and para directing groups are called as \________ groups.
5. Meta directing groups are called as \________ groups.
6. Alkyl substituted benzenes are prepared by \________-reaction.
7. Naphtha obtained by fractional distillation of \________ is passed over platinum.
8. Aromatic compounds readily undergo \________ substitution reactions.
9. \________ reacts vigorously with aromatic hydrocarbons even in the absence of catalyst.
10. In the presence of \________-benzene reacts with hydrogen to give cyclohexane.
20. ORGANIC HALOGEN COMPOUNDS

1. The IUPAC name of
   \[ \text{CH}_3 \]
   \[ \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_3 \]
   \[ \text{Br} \]
   \[ \text{Cl} \]

   a. 2-Bromo-3-chloro-4-methylpentane
   b. 2-Methyl-3-chloro-4-bromopentane
   c. 2-Bromo-3-chloro-3-isopropyl propane
   d. 2,4-Dimethyl-4-Bromo-3-chloro butane.

2. For reacting with HCl, the alcohol which does not require ZnCl₂ is
   a. \( \text{CH}_3 \text{CH}_2 \text{OH} \)
   b. \( \text{CH}_3 - \text{CH}_2 \text{CH}_2 \text{OH} \)
   c. \( \text{CH}_3 - \text{CH} \text{OH} \)
   d. \( \text{C} (\text{CH}_3)_3 \text{C-OH} \).

3. For converting alcohols into alkyl halides, the best reagent is
   a. \( \text{PCl}_3 \)
   b. \( \text{PCl}_5 \)
   c. \( \text{SOCl}_2 \)
   d. None of the above

4. The olefin, which is not important for Markovnì Koff’s addition of HCl, is
   a. Propeneb. But-1-ene c. 2-Methyl-propene d. Ethylene

5. The \( S_N_1 \) reaction of alkyl halides is not affected by the nature of the
   a. alkyl group b. the halogen c. medium d. nucleophile

B. Fill in the blanks
1. Markonikoff’s rule is followed for the addition of HCl to....................
2. In Swarts reaction metallic fluorides are added to....................
3. Hoffmann’s rule is applicable to elimination ....................
4. Chloropicrin is prepared by adding nitric acid to....................

MR. B. UTHRAKUMAR
PGT CHEMISTRY
VMHSS
SURAPET, CHENNAI-66
### Chapter: Chemical Calculations

**Calculation of Empirical Formula**

1. **A Substance on Analysis**
   - Given: The following percentage composition.
   - Na = 43.4%, C = 11.3%, O = 45.3%.
   - Calculate the empirical formula.

   \[ \text{Na}_x \text{C}_y \text{O}_z \]

   - **Solution**
   - \( x = \frac{43.4}{23} = 1.92 \approx 2 \)
   - \( y = \frac{11.3}{12} = 0.94 \approx 1 \)
   - \( z = \frac{45.3}{16} = 2.83 \approx 3 \)

   **Hence, the empirical formula is** \( \text{Na}_2 \text{C}_1 \text{O}_3 \)

2. **What is the Simplest Formula of the Compound**
   - Given: The following composition.
   - Carbon 50.80%, Hydrogen 49.20%.

   \[ \text{C}_x \text{H}_y \]

   - **Solution**
   - \( x = \frac{50.80}{12} = 4.23 \approx 4 \)
   - \( y = \frac{49.20}{1} = 49.20 \approx 50 \)

   **Hence, the empirical formula is** \( \text{C}_4 \text{H}_5 \)

### Calculation of Molecular Formula From Empirical Formula

- Molecular Weight = \( n \times \text{empirical formula weight} \)
- \[ n = \frac{\text{molecular weight}}{\text{empirical formula weight}} \]
- % Molecular Mass = \( n \times \text{vapor density} \)
- Molecular Formula = \( n \times \text{empirical formula} \)
### Problem for Practice (Page 1011)

1. **Given:**
   - \( C = 40.65\% \)
   - \( H = 8.55\% \)
   - \( N = 23.7\% \)
   - Vapour density = 29.5

   **Solution:**
   - \( O = 27.1\% \)

   **Relative No. of Moles:**
   - C: 40.65 \( \frac{12}{1} \)
   - H: 8.55 \( \frac{1}{1} \)
   - N: 23.7 \( \frac{1}{1} \)
   - O: 27.1 \( \frac{1}{16} \)

   - Simplest ratio of No. of moles:
     - C: 53.8
     - H: 8.55
     - N: 1.67
     - O: 1.69

   - Simplest ratio of empirical formula:
     - C: 2
     - H: 5
     - N: 1

   - Molecular formula = \( \text{Empirical formula} \times \text{Molar mass} \)
   - \( \text{M. mass} = \text{Empirical formula} \times \text{Molar mass} \)
   - \( \text{Empirical formula} = \text{C}_2\text{H}_5\text{N}_0 \)

   **Hence, Molecular formula:** \( \text{Empirical formula} \)

   - \( 1 \times \text{C}_2\text{H}_5\text{N}_0 = \text{C}_2\text{H}_5\text{N}_0 \)

2. **Given:**
   - \( C = 32.4\% \)
   - \( H = 4.6\% \)
   - \( O = 64\% \)
   - V.D. = 75

   **Solution:**
   - \( \text{M. mass} = \text{Empirical formula} \times \text{Molar mass} \)
   - \( \text{Empirical formula} = \text{C}_4\text{H}_8\text{O}_3 \)

   - Molecular mass = \( 2 \times 4 + 8 + 3 \times 16 = 150 \)

   - \( \text{M. mass} = \text{Empirical formula} \times \text{Molar mass} \)
   - \( \text{Empirical formula} = \text{C}_4\text{H}_8\text{O}_3 \)

   **Hence, Molecular formula:** 

3. **Given:**
   - \( \text{M. mass} = 1041 \)
   - \( C = 34.6\% \)
   - \( H = 3.85\% \)
   - \( O = 61.5\% \)

   **Solution:**
   - \( \text{M. mass} = \text{Empirical formula} \times \text{Molar mass} \)
   - \( \text{Empirical formula} = \text{C}_3\text{H}_4\text{O}_4 \)

   - Molecular mass = 104

4. **Given:**
   - \( C = 80\% \)
   - \( H = 10\% \)
   - \( \text{M. mass} = 30 \)

   **Solution:**
   - \( \text{M. mass} = \text{Empirical formula} \times \text{Molar mass} \)
   - \( \text{Empirical formula} = \text{CH}_3 \)

   - Molecular mass = 30

---

**CHEMISTRY**

17. Detection and Estimation of Elements

I. Estimation of Carbon and Hydrogen

Example 1 (Pg: 155)

0.20g of substance gives 0.88g of carbon dioxide and 0.54g water.

Calculate the percentage of carbon and hydrogen in it.

**Solu:**

Weight of organic compound \( w \) = 0.20g

Weight of carbon dioxide \( w_2 \) = 0.88g

Weight of water \( w_1 \) = 0.54g

Percentage of Carbon:

\[
100g \text{ of Compound Contains} = \frac{12}{44} \times \frac{w_2}{w} \times 100g \text{ of Carbon}
\]

\[
= \frac{12}{44} \times \frac{0.88}{0.20} \times 100
\]

= 80% of Carbon.

Percentage of Hydrogen:

\[
100g \text{ of Compound Contains} = \frac{2}{18} \times \frac{w_1}{w} \times 100g \text{ of Hydrogen}
\]

\[
= \frac{2}{18} \times \frac{0.54}{0.20} \times 100
\]

= 20% of Hydrogen.

Example 2 [Pg: 156 - 157]

A. No: 3 (Pg:119)

0.2004g of glucose gave on combustion 0.2948g of CO\(_2\) and 0.1202g of H\(_2\)O. Find the percentage composition.

**Solu:**

Weight of organic compound \( w \) = 0.2004g

Weight of carbon dioxide \( w_2 \) = 0.2948g

Weight of water \( w_1 \) = 0.1202g

Percentage of Carbon:

\[
100g \text{ of Compound Contains} = \frac{12}{44} \times \frac{w_2}{w} \times 100g \text{ of Carbon}
\]

\[
= \frac{12}{44} \times \frac{0.2948}{0.2004} \times 100
\]

= 40.9 of Carbon.

Percentage of Hydrogen:

\[
100g \text{ of Compound Contains} = \frac{2}{18} \times \frac{w_1}{w} \times 100g \text{ of Hydrogen}
\]

\[
= \frac{2}{18} \times \frac{0.1202}{0.2004} \times 100
\]

= 6.666 of Hydrogen.

Percentage of Oxygen:

\[
100 - [40 + 6.66] = 53.33\%
\]
1. 0.12 g of an organic compound gave on combustion 0.18 g of water and 0.11 g of CO₂. Calculate the percentage of C and H in the organic compound. 

**Solution:**

- Weight of organic compound (w) = 0.12 g
- Weight of Carbon dioxide (w₂) = 0.11 g
- Weight of water (w₁) = 0.18 g

**Percentage of Carbon:**

\[
\text{Percentage of Carbon} = \frac{12}{44} \times \frac{w_2}{w} \times 100
\]

\[
= \frac{12}{44} \times \frac{0.11}{0.12} \times 100
\]

\[
= 0.2727 \times 0.9161 \times 100
\]

\[
= 0.2497 \times 100
\]

\[
= 24.97\% \text{ C}
\]

**Percentage of Hydrogen:**

\[
\text{Percentage of Hydrogen} = \frac{2}{18} \times \frac{w_1}{w} \times 100
\]

\[
= \frac{2}{18} \times \frac{0.18}{0.12} \times 100
\]

\[
= 0.12 \times 1.5 \times 100
\]

\[
= 16.5\% \text{ H}
\]

**Percentage of Oxygen:**

\[
\text{Percentage of Oxygen} = 100 - [\text{Percentage of C} + \text{Percentage of H}]
\]

\[
= 100 - [24.97 + 16.5]
\]

\[
= 100 - 41.5
\]

\[
= 58.5\% \text{ O}
\]

2. An organic compound contains C₂H₂O and 0.2475 g of the organic compound yielded on combustion 0.4950 g of CO₂ and 0.2025 g of H₂O. Find the percentage composition of the organic compound.

**Solution:**

- Weight of organic compound (w) = 0.2475 g
- Weight of Carbon dioxide (w₂) = 0.4950 g
- Weight of water (w₁) = 0.2025 g

**Percentage of Carbon:**

\[
\text{Percentage of Carbon} = \frac{12}{44} \times \frac{w_2}{w} \times 100
\]

\[
= \frac{12}{44} \times \frac{0.4950}{0.2475} \times 100
\]

\[
= 0.5454 \times 2 \times 100
\]

\[
= 109.09\%
\]

**Percentage of Hydrogen:**

\[
\text{Percentage of Hydrogen} = \frac{2}{18} \times \frac{w_1}{w} \times 100
\]

\[
= \frac{2}{18} \times \frac{0.2025}{0.2475} \times 100
\]

\[
= 0.1111 \times 0.5181 \times 100
\]

\[
= 9.09\%
\]

**Percentage of Oxygen:**

\[
\text{Percentage of Oxygen} = 100 - [\text{Percentage of C} + \text{Percentage of H}]
\]

\[
= 100 - [109.09 + 9.09]
\]

\[
= 100 - 118.18
\]

\[
= 36.82\%
\]
4. 0.2560 g of an organic compound gave on combustion 0.114 g of H₂O and 0.880 g of CO₂. Find the percentage of hydrogen, and carbon in the organic compound.

Solution:

Wt of Organic Compound (W) = 0.2560 g
Wt of CO₂ (W₂) = 0.880 g
Wt of H₂O (W₁) = 0.114 g

Percentage of Carbon:

\[ \% \text{ of C} = \frac{12}{44} \times \frac{W₂}{W} \times 100 \]

\[ = \frac{12}{44} \times \frac{0.880}{0.2560} \times 100 \]

\[ = 0.2727 \times 3.375 \times 100 \]

\[ = 93.74\% \]

Percentage of Hydrogen:

\[ \% \text{ of H₂O} = \frac{2}{18} \times \frac{W₁}{W} \times 100 \]

\[ = \frac{0.1111}{0.2560} \times 100 \]

\[ = 0.4453 \times 100 \]

\[ = 44.53\% \]

5. On Complete Combustion, 0.246 g of an organic compound gave 0.198 g of CO₂ and 0.1014 g of H₂O. Find the Percentage Composition of organic compound.

Solution:

Wt of Organic Compound, [W] = 0.246 g
Wt of CO₂, [W₂] = 0.198 g
Wt of H₂O, [W₁] = 0.1014 g

Percentage of Carbon:

\[ \% \text{ of Carbon} = \frac{12}{44} \times \frac{W₂}{W₁} \times 100 \]

\[ = \frac{12}{44} \times \frac{0.198}{0.1014} \times 100 \]

\[ = 0.2727 \times 1.98 \times 10^2 \]

\[ = 53.92\% \]

Percentage of Hydrogen:

\[ \% \text{ of H₂O} = \frac{2}{18} \times \frac{W₁}{W} \times 100 \]

\[ = \frac{0.1014}{0.246} \times 100 \]

\[ = 0.4121 \times 100 \]

\[ = 41.21\% \]
Example 1 [Pg No: 155]

The ammonia evolved from 0.219 g of an organic compound by Kjeldahl method neutralised 15 ml of $\frac{N}{20}$ H$_2$SO$_4$ solution. Calculate the percentage of nitrogen.

Solution:

Weight of organic compound (W) = 0.219 g

Volume of std. acid $V_1$ = 15 ml

Normality of acid $N_1 = \frac{1}{20}$ N

Normality of acid $N_1 = \frac{1}{20}$ N

$\%$ of hydrogen = $\frac{14 \times V_1 \times N_1}{1000 \times W} \times 100$

$= \frac{14 \times 15 \times 1}{1000 \times 0.219 \times 20}$

$= \frac{210}{42.00}$

$= \frac{210}{42}$

$= 5$

$\therefore$ Percentage of nitrogen = 5.1.

Example 2 [Pg: 159]

0.359 g of an organic compound was Kjeldahllized and NH$_3$ obtained was passed into 100 ml of $\frac{N}{5}$ H$_2$SO$_4$. The excess acid required 15 ml of $\frac{N}{10}$ NaOH for neutralization. Calculate the percentage of nitrogen in the compound.

Solution:

Weight of organic compound (W) = 0.359 g

Normality of acid $N_1 = \frac{1}{5}$ N

Volume of $\frac{N}{5}$ H$_2$SO$_4$ solution ($V_1$) = 100 ml

Volume of $\frac{N}{5}$ H$_2$SO$_4$ solution = 100 ml

The Volume of $\frac{N}{5}$ H$_2$SO$_4$ neutralised by $\frac{N}{10}$ NaOH is

$\frac{V_1}{5}$ = $\frac{1}{10} \times 15 \times 40$ ml

$\therefore$ $V_{\text{acid}} = \frac{154 \times 8}{10^2}$

$V_{\text{acid}} = 11$ ml

$\therefore$ Volume of $\frac{N}{5}$ H$_2$SO$_4$ solution ($V_1$) = 100 - 77 = 23 ml

$\%$ Nitrogen = $\frac{14 \times V_1 \times N_1}{1000 \times W} \times 100$

$= \frac{14 \times 2.3 \times 1}{156 \times 0.35 \times 5}$

$= \frac{32.2}{17.5}$

$= 1.84$ %

$\therefore$ $\%$ of nitrogen = 1.84 %.
1. 1.15g of an organic compound was analysed by Kjeldahl's method and the ammonia produced was collected in 20ml of normal HCl solution. The excess acid consumed 18.4ml of normal NaOH solution for back titration. Calculate the % of N in the solution (Pg: 163)

Solution:

Weight of organic compound (w) = 1.15g
Normality of HCl acid Na = 1N.
Volume of Normal HCl used (V1) = ?
Volume of normal HCl taken = 30ml.
Volume of NaOH consumed \( V_2 \) = 18.4ml
by normal HCl

\[
\text{NaOH} \times N_{\text{NaOH}} = \text{Valuer} \times N_{\text{Valuer}};
\]

\[
\text{NaOH} \times N_{\text{NaOH}} = \text{Valuer} \times N_{\text{Valuer}};
\]

\[
\text{NaOH} = \frac{\text{Valuer} \times N_{\text{Valuer}}}{V_2}.
\]

\[
V_2 = 18.4 \text{ ml}.
\]

Volume of

\[
\text{Normal HCl used for } \text{neutralising } \text{NH}_3 \quad \left( V_1 \right) = 30 - 18.4 \text{ ml}.
\]

\[
V_1 = 11.6 \text{ ml}.
\]

% of nitrogen = \[
\frac{14 \times V_1 \times N_{\text{Valuer}}}{1000 \times w} \times 100
\]

\[
= \frac{14 \times 11.6 \times 1 \times 100}{1000 \times 1.15} \times 100
\]

\[
= 14.89 \%
\]

2. 0.80g of a substance was digested with H₂SO₄ and then distilled with an excess of NaOH. The ammonia was passed through 100ml of IN H₂SO₄. The excess of the acid required 80ml of IN NaOH (Caustic soda). Solution for its complete neutralization. Calculate the % of nitrogen in the organic compound. (Pg: 163)

Solution:

Weight of organic compound (w) = 0.80g
Normality of NaOH acid Na = 1N.
Volume of acid used \( V_1 \) = ?
Volume of IN H₂SO₄ taken = 100ml.
IN H₂SO₄ neutralised by IN NaOH

\[
\text{NaOH} \times V_1 = \text{Valuer} \times \text{Valuer}.
\]

\[
V_1 = \frac{\text{Valuer} \times \text{Valuer}}{IN \times 80 \text{ml}}.
\]

\[
\text{Valuer} = 80 \text{ml}.
\]

Volume of

\[
\text{IN H₂SO₄ used for neutralising } \left( V_1 \right) = 100 - 80 \text{ml}.
\]

Ammonia \( V_1 \) = 20 ml.

% of N = \[
\frac{14 \times V_1 \times N_{\text{Valuer}}}{1000 \times w} \times 100
\]

\[
= \frac{14 \times 20 \times 1 \times 100}{1000 \times 0.80}
\]

\[
= \frac{14 \times 20 \times 10^2}{10^3 \times 80 \times 10^{-2}}
\]

\[
= \frac{280}{80}
\]

\[
= 3.5 \%
\]
3. 0.36g of a heterogeneous organic compound was Kjeldahlised and the ammonia liberated was exactly neutralised by 20ml of 0.3N H₂SO₄. Calculate the percentage of hydrogen in the compound. [Pg:163]

Solution:

Cut of organic compound (w) = 0.36g
Normal of acid (N₁) = 0.3N.
Volume of the acid used (V₁) = 20ml

% of nitrogen = \[
\frac{14 \times V₁ \times N₁ \times 100}{w \times 1000}
\]

\[
= \frac{14 \times 20 \times 0.3 \times 100}{0.36 \times 1000}
\]

\[
= \frac{280 \times 10^2}{0.36 \times 10^3}
\]

\[
= \frac{280 \times 10^{-1} \times 10^2}{36 \times 10^{-2} \times 10^3}
\]

\[
= \frac{840 \times 10^{0}}{36}
\]

\[
= 23.33\%.
\]

4. 0.257g of an organic substance was Kjeldahlised and ammonia evolved was absorbed in 50ml of \(\frac{N}{10}\) HCl which required 23.2ml of 1/10 NaOH for neutralisation. Determine the percentage of nitrogen in the compound. [Pg:163]

Solution:

Weight of organic compound (w) = 0.257g
Normal of HCl (N₁) = \(\frac{1}{10}\) N.

Volume of HCl required for neutralising ammonia (Vi) = ?

Volume of HCl (Vi) taken = 25ml.

Volume of HCl neutralised by \(\frac{N}{10}\) HCl

\[\text{Vi} \times \frac{N}{10} \times V₁ = 23.2 \times \frac{N}{10}\]

\[\text{Vi} = \frac{23.2 \times N}{10 \times \frac{N}{10}} = 23.2 \text{ ml}\]

Volume \(\frac{N}{10}\) HCl required for neutralisation

\[\text{V₁} = 26.8\text{ ml}\]

% of nitrogen = \[
\frac{14 \times V₁ \times N₁ \times 100}{w \times 1000}
\]

\[
= \frac{14 \times 26.8 \times 100}{0.257 \times 1000}
\]

\[
= \frac{3752}{257} = 14.599
\]

5. During nitrogen estimation present in an organic compound by Kjeldahl's method, the ammonia evolved from 0.5g of the compound in Kjeldahl's estimation of nitrogen neutralised 10ml of 1M H₂SO₄. Find the percentage of nitrogen in the compound. (Pg:163)

Solution 5-
Mass of the organic compound \( M \) = 0.5g

Volume of \( \text{H}_2\text{SO}_4 \) required for 1 mole of ammonia  
\[ V(N) = 10 \text{mL} \]

Normality of \( \text{H}_2\text{SO}_4 = \text{mole} \times \text{liter} \]
\[ = 1 \times 2 \]
\[ N_1 = 2 \text{N} \]

\[ \text{percentage of Nitrogen} = \frac{V \times N_1 \times 14 \times 100}{1000 \times M} \]
\[ = \frac{16 \times 2 \times 14 \times 100}{10 \times 0 \times 6.5} \]
\[ = 56.5 \% \]

Percentage of Nitrogen = 56.5%

Estimation of Sulphur

Mass of the Substance formed (\( M \)) = 233.4

\[ \text{Percentage of Sulphur} = \frac{32 \times \frac{W}{1}}{233.4 \times \frac{W}{1} \times 100} \]

Example 1:- (Pg No: 160-161) Q. no: 8

0.316g of an organic compound after heating with fuming \( \text{HNO}_3 \) and barium nitrate crystals in a sealed tube gave 0.466g of the precipitate of barium sulphate. Determine the percentage of sulphur in the compound.

Solution

Mass of the Substance taken (\( M \)) = 0.316g

Mass of Baso4 formed (\( M \)) = 0.466g

Molecular mass of Baso4 = 233.4

\[ \text{Percentage of Sulphur} = \frac{32 \times \frac{W}{1}}{233 \times \frac{W}{1} \times 100} \]

\[ = \frac{32 \times 0.466}{233 \times 0.316} \times 100 \]

= 6.66%

Solution:

Mass of the Substance taken (\( M \)) = 0.520g

Mass of Baso4 formed (\( M \)) = 0.90g

Molecular mass of Baso4 = 233.4

\[ \text{Percentage of Sulphur} = \frac{32 \times \frac{W}{1}}{233 \times \frac{W}{1} \times 100} \]

\[ = \frac{32 \times 0.90}{233 \times 0.520} \times 100 \]

= 6.28%

Solutions:

Mass of the Substance taken (\( M \)) = 0.520g

Mass of Baso4 formed (\( M \)) = 0.90g

Molecular mass of Baso4 = 233.4

\[ \text{Percentage of Sulphur} = \frac{32 \times \frac{W}{1}}{233 \times \frac{W}{1} \times 100} \]

\[ = \frac{32 \times 0.90}{233 \times 0.520} \times 100 \]

= 6.28%
1. Weight of organic compound (W) = 0.15 g
   Weight of AgBr (W) = 0.12 g

   \[ \% \text{ of bromine} = \frac{80 \times \text{W}}{188 \times \text{W}} \times 100 \]

   \[ = \frac{80 \times 0.12}{188 \times 0.15} \times 100 \]

   \[ = \frac{80 \times 12 \times 10^2}{188 \times 15 \times 10^2} \times 10^2 \]

   \[ = \frac{960}{2820} \times 10^2 \]

   \[ = 0.3404 \times 10^2 \]

   \[ = 34.04 \% \]

2. 0.3018 g of an organic compound gave 0.282 g of silver bromide by Carius method. Find the percentage of bromine.

   Solution:
   Weight of organic compound (W) = 0.3018 g
   Weight of silver bromide (W) = 0.282 g

   \[ \% \text{ of bromine} = \frac{80 \times \text{W}}{188 \times \text{W}} \times 100 \]

   \[ = \frac{80 \times 0.282}{188 \times 0.301} \times 100 \]

   \[ = \frac{22.56}{56.588} \times 100 \]

   \[ = 0.3983 \times 100 \]

   \[ = 39.83 \% \]

4. 0.196 g of an organic compound gave 0.22 g of CO₂ and 0.0675 g of H₂O. In Carus determination 0.3925 g of the substance gave 0.111 g of dry AgCl. Find the composition of the substance (Pg 164)

   Solution:
   \[ \% \text{ of Carbon} = \frac{12 \times 0.22}{44 \times 0.196} \times 100 \]

   \[ = \frac{2.65}{8.624} \times 100 \]

   \[ = 0.3061 \times 100 \]

   \[ = 30.61 \% \]

   \[ \% \text{ of Hydrogen} = \frac{8 \times 0.0675}{18 \times 0.196} \times 100 \]

   \[ = \frac{0.135}{3.528} \times 100 \]

   \[ = 0.0382 \times 100 \]

   \[ = 3.82 \% \]

   \[ \% \text{ of Chlorine} = \frac{35.5 \times 0.717}{143.5 \times 0.3925} \times 100 \]

   \[ = \frac{94.4535}{56.3227} \times 100 \]

   \[ = 0.4337 \times 100 \]

   \[ = 43.37 \% \]

\[
\text{Percentage of Sulphur} = \frac{32 \times W}{233 \times W} \times 100
\]

\[
= \frac{32 \times 0.90}{233 \times 0.530} \times 100
\]

\[
= \frac{28.8}{123.49} \times 100
\]

\[
= 0.2332 \times 100
\]

\[
\% \text{ of Sulphur} = 2.32\%.
\]

\[
\text{Estimation of Halogens}:
\]

\[
\text{Percentage of Chlorine} = \frac{35.5 \times W}{142.5 \times W} \times 100
\]

\[
= \frac{35.5 \times W}{142.5 \times W} \times 100
\]

\[
\text{Percentage of Bromine} = \frac{80 \times W}{188 \times W} \times 100
\]

\[
= \frac{80 \times W}{188 \times W} \times 100
\]

\[
\text{Percentage of Iodine} = \frac{127 \times W}{235 \times W} \times 100
\]

\[
= \frac{127 \times 0.2682 \times 100}{235 \times 0.15}
\]

\[
= \frac{35.0614}{35.25} \times 100
\]

\[
= 0.9662 \times 100
\]

\[
\% \text{ of Iodine} = 96.62\%.
\]

\[
\text{O.24 g of an organic compound gave 0.287 g of AgI in the Corinuss method. Calculate the percentage of Chlorine in the compound. (Pg: 164)}
\]

\[
\text{Solution}:
\]

\[
\text{Weight of Compound (W)} = 0.24 g
\]

\[
\text{Weight of AgI (W)} = 0.287 g
\]

\[
\% \text{ of Chlorine} = \frac{35.5 \times W}{143.5 \times W} \times 100
\]

\[
= \frac{35.5 \times 0.287}{143.5 \times 0.24} \times 100
\]

\[
= \frac{10.1885}{34.44} \times 100
\]

\[
= 0.2958 \times 100
\]

\[
\% \text{ of Chlorine} = 29.58\%.
\]

\[
\text{In Corinuss method of estimation of halogen 0.15 g of an organic compound gave 0.12 g of AgBr. Find the percentage of bromine in the compound. (Pg: 164)}
\]

\[
\text{Example: (Pg: 162)}
\]

\[
0.15 g of Iodoform gave 0.2682 g of AgI. Calculate the percentage of Iodine.
\]

\[
\text{Solution}:
\]

\[
\text{Weight of Compound = 0.15 g (W)}
\]

\[
\text{Weight of Silver Iodoform = 0.2682 g (W)}
\]

\[
\text{Molecular weight of AgI = 235}
\]

\[
\]
(5) 0.25 g of an organic compound was found to produce 0.35 g of AgCl after heating with strongly HNO₃ and AgNO₃ in a sealed Corinuth method. Determine the percentage of chlorine in the compound. (Pg: 164)

Solution:

Mass of Organic Compound \( m \) = 0.25 g
Mass of Silver Chloride \( m_1 \) = 0.35 g

\[ \% \text{ of Chlorine} = \frac{35.5 \times m_1}{143.5 \times m} \times 100 \]

\[ = \frac{35.5 \times 0.35}{143.5 \times 0.25} \times 100 \]

\[ = \frac{35.5 \times \frac{7}{2}}{143.5 \times 25} \times 100 \]

\[ = \frac{2465}{3587.5} \times 100 \]

\[ = 70.17\% \]

\[ \therefore \% \text{ of Chlorine} = 70.17\% \]