Q.1.

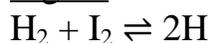| 1	2	3	4	5	6	7	8	9	10	11	12
B	C	B	C	D	B	D	B	C	B	B	D

SECTION-B (33 Marks)

Q2. Attempt any **ELEVEN** parts from the following. All parts carry equal marks. $(11 \times 3 = 33)$
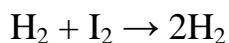
i. Show both forward and reverse reactions with the help of suitable examples.

Ans: A reversible reaction is which can proceed in forward direction as well in the reverse direction. So, forward reaction is the reaction in which reactants produce products and reverse reaction the products produce reactants.
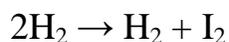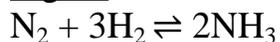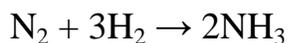E.g#1:
$H_2 + I_2 \rightleftharpoons 2H$
Forward Reaction:
$H_2 + I_2 \rightarrow 2H_2$
Reverse Reaction:
$2H_2 \rightarrow H_2 + I_2$
E.g#2:
$N_2 + 3H_2 \rightleftharpoons 2NH_3$
Forward Reaction:
$N_2 + 3H_2 \rightarrow 2NH_3$
Reverse Reaction:
$2NH_3 \rightarrow N_2 + 3H_2$
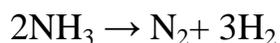
ii. Carbon is the main constituent of hydrocarbons. Why some are called unsaturated hydrocarbon? Briefly describe.

Ans: Unsaturated hydrocarbons are the hydrocarbons that have double or triple covalent bonds. The term 'Unsaturated' means more hydrogen atoms may be added to the hydrocarbon to make it saturated.
For Example:
C_2H_4 Ethene and C_2H_2 Ethyne are the example of unsaturated hydrocarbons.

iii. **Briefly explain the source, harmful effects and physical properties of oxides of nitrogen.**

Ans: Sources:
  (i) Exhaust forms of motor vehicles.
  (ii) Power stations and industries using fossil fuels.
  Harmful effects of NO_2:
  (i) Cough, headaches and lung diseases.
  (ii) Acid rain and Greenhouse effect.
  Physical Properties of NO_X:
  (i) NO is colorless, odorless gas, soluble in water.
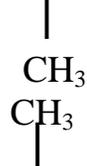 (ii) NO_2 is reddish brown gas with pungent color, soluble in water.

iv. **Draw the structure of different isomers of C_6H_{14}.**

Ans: C_6H_{14} = Hexane
Isomers of hexane = 5.
i) $CH_3 - CH_3 - CH_2 - CH_2 - CH_2 - CH_3$ (n-hexane)
ii) $CH_3 - CH - CH_2 - CH_2 - CH_3$ (iso-hexane)
           |
         CH_3

         CH_3
         |
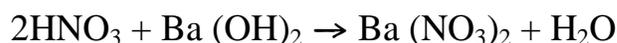iii) $CH_3 - C - CH_2 - CH_3$ (neo hexane)
        |

     CH_3

v. **Barium nitrate Ba (NO3)2 is used to produce a green color in fire work. It is the product of Barium Hydroxide with HNO3. Propose its balanced chemical equation.**

Ans: Nitric acid + Barium hydroxide → Barium nitrate + water
    $HNO_3 + Ba(OH)_2 \rightarrow Ba(NO)_3 + H_2O$
HNO_3 contains one neutralization H- atom and Ba $(OH)_2$ contains two OH-groups. So, multiply HNO_3 by 2.
    $2HNO_3 + Ba(OH)_2 \rightarrow Ba(NO_3)_2 + H_2O$
Now balance H-atoms on the right side.
    $2HNO_3 + Ba(OH)_2 \rightarrow Ba(NO_3)_2 + 2H_2O$
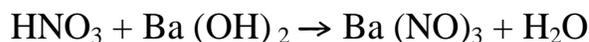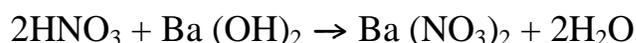
vi. **Illustrate effect of acid rain on marble and metal by chemical reactions.**

Ans:
Acid Rain on Metal:
Sulphuric acid eats away metals to form water soluble salts and hydrogen.
    $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

Acid Rain on Marble building and Statue:
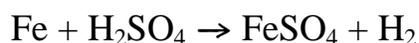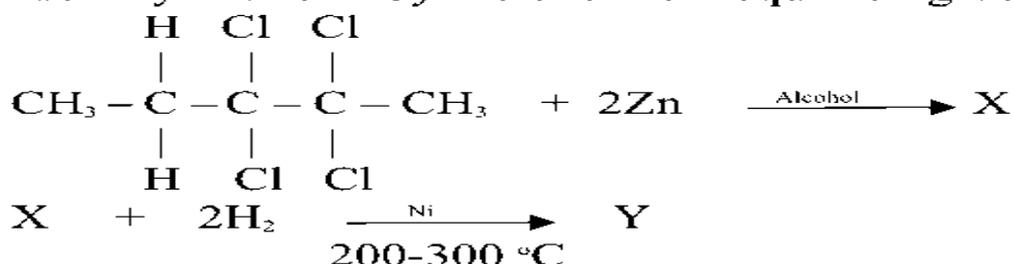Marble building and statue are disintegrated by acid rain.

$$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$$

$$CaCO_3 + HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$$

vii:

Identify X and Y by the chemical equation given below:

$$\begin{array}{ccccc} & H & Cl & Cl \\ & | & | & | \\ CH_3 - C - & C - & C - CH_3 & + 2Zn & \xrightarrow{\text{Alcohol}} X \\ & | & | & | \\ & H & Cl & Cl \end{array}$$

$$X + 2H_2 \xrightarrow[200\text{-}300\ °C]{Ni} Y$$

Ans:

$$\begin{array}{c} Cl \ \ Cl \\ |\ \ | \\ CH_3^- C\text{-} C \text{-}CH^- CH_3 \ \ + 2Zn \xrightarrow{\text{Alcohol}} CH_3\text{-}CH_2\text{-}C{\equiv}C\text{-}CH_3 \\ |\ \ | \\ Cl \ \ Cl \end{array}$$

$$CH_3\text{-}CH_2\text{-}C{\equiv}C\text{-}CH_3 + 2H_2 \quad \xrightarrow[200\text{-}300\ °C]{Ni}$$
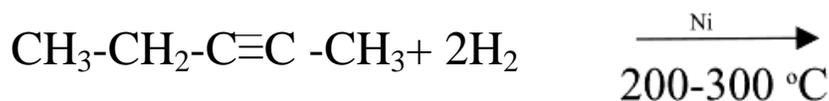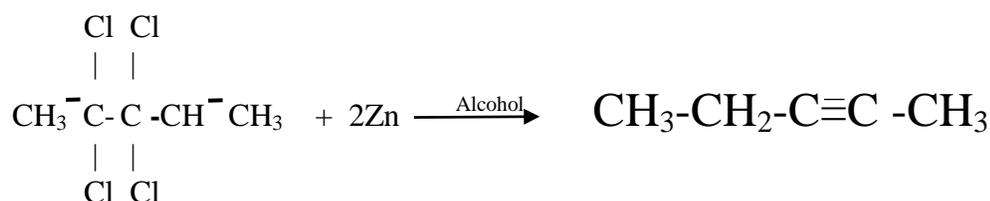
(Pentane)
$$CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_3$$

X = Pentyne
Y = Pentane

**vii.** **Differentiate between mono saccharide and disaccharide with at least two examples.**

Ans:

Mono Saccharides	Disaccharide
1) Mono saccharides are the simple molecules of carbohydrates that cannot be broken into other carbohydrates.	1) Disaccharides are carbohydrates made of two mono saccharides and with the loss of one molecule of water.
2) They cannot be hydrolyzed.	2) They can be hydrolyzed.
3) Glucose and fructose are the examples of Mono Saccharides	3) Sucrose and maltose are the examples of disaccharide.

viii.   Draw the structures of heterocyclic compounds. (Any three)

Ans: Cyclic compounds that contain one or more atoms other than carbon atoms in the ring are called heterocyclic compounds.

1) (pyridine with N)   2) (furan with O)   3) (thiophene with S)
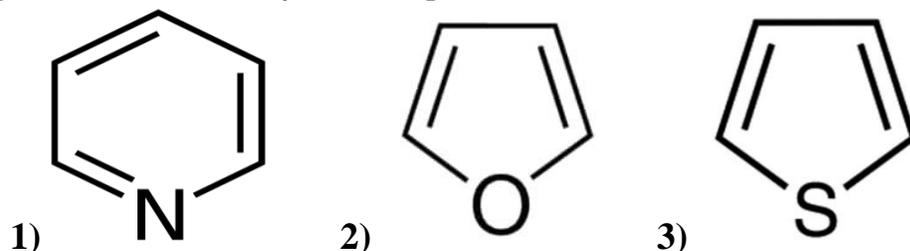
ix.   List down three uses of proteins.

Ans: The uses of proteins are as follows:
   i.   We require protein in our diet, to provide amino acids to make muscles, hair enzymes and repair of body tissues.
   ii.   Proteins are essential for the formation of protoplasm and components of cells.
   iii.   A protein called gelation is obtained by heating bones and tendons are water, it is used in bakery goods.

x.   List down three importance of nucleic acid.

Ans:
   i.   Nucleic acids are vital component of all life. They are found in every living cell.
   ii.   Nucleic acids are the main information carrying molecules and controls centers of the cell.
   iii.   Nucleic acids help in in determining the inherited characteristics by directing the process of protein synthesis.

xi.   Briefly describe major air pollutant.

Ans: Anything that is in the air, water or soil which has harmful effect on some part of the environment is called pollution.
Major Air pollutants are:
   i.   Sulphur Oxides (SO_x)
   ii.   Carbon Monoxides (CO)
   iii.   Nitrogen Oxides (NO_x)
   iv.   Chlorofluorocarbons (CFCs)
   v.   Lead Compounds

xii.   Identify three water pollutants.

Ans: Water pollutants are as follows:
   i.   House hold wastes

ii.   Industrial wastes
iii. Agricultural wastes

xiii.   List three uses of urea.

Ans:
    i.   Urea is used as fertilizers to make up the deficiency of soil.
    ii.   Urea is used in pharmaceutics industry.
    iii. Urea is used in manufacturing synthetic fibers.

xiv.   Illustrate structural formula of iso pentane, pentene and pentyne.

Ans:

Iso pentane:
$$CH_3 - CH - CH_2 - CH_3$$
with CH_3 branch on the CH

Pentene:
$$CH_2 = CH - CH_2 - CH_2 - CH_3$$
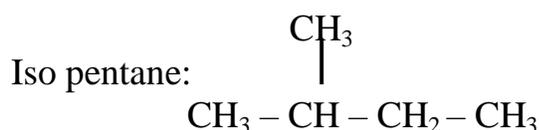
Pentyne
$$CH = C - CH_2 - CH_2 - CH_3$$

SECTION – C (Marks 20)

Q.3.a. Propose the basic reactions of Solvay process for the manufacturing of washing soda.

Ans:
The Solvay process is an industrial process that uses limestone ($CaCO_3$) to produce carbon dioxide (CO_2) which reacts with ammonia (NH_3) dissolved in brine (concentrated NaCl(aq)) to produce sodium carbonates.

The key reaction in Solvay synthesis is,

1. $2 NH_3(aq) + 2 CO_2(g) + 2 H_2O(\ell) \longrightarrow 2 NH_4HCO_3(aq)$
2. $2 NH_4HCO_3(aq) + 2 NaCl(aq) \longrightarrow 2 NaHCO_3(s) + 2 NH_4Cl(aq)$
3. $2 NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$
4. $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$
5. $CaO(s) + H_2O(\ell) \longrightarrow Ca(OH)_2(aq)$
6. $2 NH_4Cl(aq) + Ca(OH)_2(aq) \longrightarrow 2 NH_3(aq) + CaCl_2(aq) + 2 H_2O(\ell)$

CaO makes a strong basic solution. The ammonia from reaction (III) is recycled back to the initial brine solution of reaction (I).

The sodium bicarbonate (NaHCO$_3$) precipitate from reaction (I) is then converted to the final product, sodium carbonate (washing soda: Na$_2$CO$_3$), by calcination (160–230 °C), producing water and carbon dioxide as byproducts:

The carbon dioxide from step (IV) is recovered for re-use in step (I). When properly designed and operated, a Solvay plant can reclaim almost all its ammonia, and consumes only small amounts of additional ammonia to make up for losses. The only major inputs to the Solvay process are salt, limestone and thermal energy, and its only major byproduct is calcium chloride, which is sometimes sold as road salt.

b. State and explain necessary conditions for equilibrium. (4)

Ans:
Conditions for chemical equilibrium
1. Concentration of the reactants and products are changed.
2. Temperature of the system kept constant.
3. Pressure and volume of the system kept constant.

Q.4.a.Show by chemical reactions that water is amphoteric in nature. (4)

Ans:
An amphoteric compound either act as acid as well as a base.
Water is an amphoteric compound it acts as a base in the presence of acid and act as acid in the presence of a base.
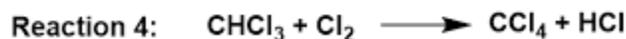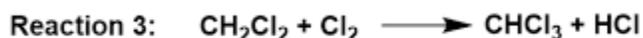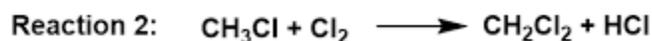An amphoteric substance has a transferable hydrogen and an atom with lone pair of electrons.
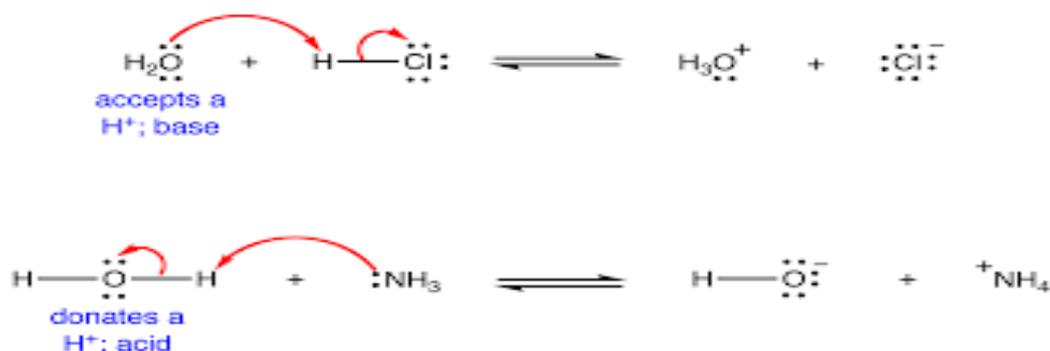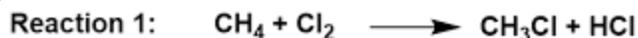

b. Predict chemical equations showing halogenation of ethane, ethene and ethyne. (6)

Ans:

Halogenation is the addition of hydrogen in unsaturated hydrocarbons. Halogenation occurs in saturated hydrocarbon as well by substitution reaction.
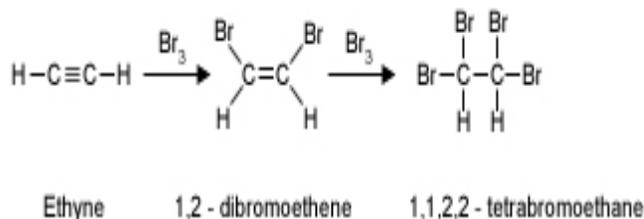
1. Halogenation of alkanes:

Reaction 1: $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

Reaction 2: $CH_3Cl + Cl_2 \longrightarrow CH_2Cl_2 + HCl$

Reaction 3: $CH_2Cl_2 + Cl_2 \longrightarrow CHCl_3 + HCl$

Reaction 4: $CHCl_3 + Cl_2 \longrightarrow CCl_4 + HCl$

2. Halogenation of alkene:

| Ethylene | Bromine (brownish-red) | 1,2-Dibromoethane (colorless) |

3. Halogenation of alkyne:

Ethyne   1,2 - dibromoethene   1,1,2,2 - tetrabromoethane

Q.5.a.Describe the occurrence of water and its importance in environment including industry. (3+3)

Ans:
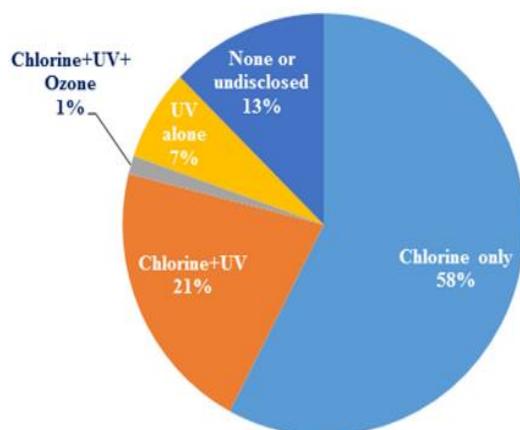
Air is the mixture of the gases. The pi chart shows the composition of dry air by volume.

Importance of water in industry:
i. 80% of the human body is made up of water.
ii. Water is a crucial element of our food and environment.
iii. 75% of the earth's surface is made up of water.
iv. Only 3% is fresh water.
v. Only 1% of the water is suitable for human consumption.

<ol type="i" start="6">
Much of this water contains chemicals that make it unsuitable for human consumption.
We distinguish between quality of water and quantity of problems.

On average, we have sufficient water to meet human needs. The problem is water distribution.

Why Water Is So Important:
<ol type="i">
The presence of water on Earth is essential for the development and sustenance of life.
Water is important because it is the basis of all forms of life and without this valuable resource the Earth would not exist.
The daily life itself and conduct of the simplest actions require the use of water in the field of agriculture and industry.

b. Prove that $10^{-14}=[H^+]\,[OH^-]$ for the self-ionization of water at 25°C. (4)

Ans:

The self-ionization of water (also autoionization of water, and auto dissociation of water) is an ionization reaction in pure water or in an aqueous solution, in which a water molecule, H_2O, deprotonates (loses the nucleus of one of its hydrogen atoms) to become a hydroxide ion, OH^-.The hydrogen nucleus, H^+, immediately protonates another water molecule to form hydronium, H_3O^+.
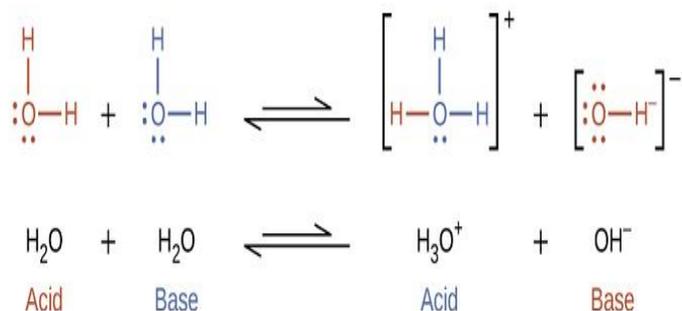
According to the law of mass action

$Kc = [H]^+[OH]^-/[H_2O]$

$KC.\ H_2O = K_W$

$K_W = [H]^+[OH]^-$

As, $H^+ = OH^-$

At 25°C the concentration of H^+ is equal to 1×10^{-7} and same for OH^- ion.

By putting the value in equation

$k_w = (1 \times 10^{-7})\,(1 \times 10^{-7})$

$k_{w} = 1 \times 10^{-14}$

as k_w is the water dissociation constant.

$1 \times 10^{-14} = [H^+][OH^-]$