Prepared By: PASS Education System (Team)

Revised By: Taimoor Hassan

CHEMISTRY (XII) CHAPTER 1 (Periodic Classification of Elements)

Short Questions:

1. **What are hydrides? What is the trend of boiling points of hydrides of group VI down the group?**

   The binary compounds of hydrogen with other elements are called hydrides.
   E.g. NaH, H2O, H2S.
   The boiling point of hydrides of group VIA increases down the group except H2O which due to hydrogen bonding, have higher boiling point than might be expected.

Group VIA (Hydrides)	Boiling point (°C)
H2O	100
H2S	-60.3
H2Se	-42
H2Te	-2

2. **Write name and symbol of an element from s block that has zero oxidation state. Also write its electronic configuration.**

   Helium (He) is the element from s black that has zero oxidation state. The electronic configuration is $1s^2$.

3. **Why melting and boiling points of elements belonging to groups VA to VIIA are lower? Discuss the trend of ionization energy in the periodic table.**

   When we move from left to right in a period the number of electrons go on increasing in the outermost shell. The tendency to un-pair the electron increase up to group IVA. In this way, the binding forces increase, hence melting and boiling points increase up to group IVA. After that, the pairing of electrons starts and binding force become less. That's why, the melting and boiling points of elements belonging to groups VA to VIIA are lower.

   Trend in Period:
   Ionization energy increases from left to right in a period.
   Reasons:
   - Due to increase in proton number effective nuclear charge increases.
   - Shielding effect remains the same.
   - Number of shells remain the same.
   - Atomic size decreases.

   Trend in Group:
   Ionization energy decreases from top to down in a group.

Reasons:

- Due to decrease in proton number effective nuclear charge decreases.
- Shielding effect increases.
- Number of shells increases down the group.
- Atomic size increases.

4. **Give two defects of Mendeleev's periodic table**.

Following are two defects of Mendeleev's periodic table:

- Position of hydrogen was not decided by him.
- His table did not give the idea of structure of atom.

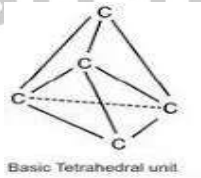
5. **Define Mendeleev's and modern periodic law.**

Mendeleev' Periodic law
"If the elements are arranged in ascending order of their atomic masses, their chemical properties repeat in a periodic manner".

Modern periodic law:
"If the elements are arranged in ascending order of their atomic numbers, their chemical properties repeat in a periodic manner".

6. **Give four improvements made in Mendeleev's periodic law**.
   - **Correct arrangement of some elements**
     Ar should be placed before K. Co should be placed before nickel. Te should be placed before I.
   - **Position of rare earths**
     Position of rare earths of lanthanides and actinides was adjusted
   - **Position of Isotopes**
     The position of isotopes was corrected.
   - **Position of noble gases**
     He arranged nobles in a separate group VIIIA.
7. **Why diamond is a non-conductor and graphite fairly a good conductor of electricity?**

Diamond is a non- conductor:
In diamond, unit cell is tetrahedral. Each carbon atom is sp3 hybridized and forms 4 sigma bonds with 4 other carbon atoms and this trend extends throughout the crystal. All the four electrons of each carbon atom are tightly bound in these covalent bonds. As a result, no free electron are available in diamond so it is a nonconductor of heat and electricity.



Basic Tetrahedral unit

Graphite is a good conductor:
In Graphite, each carbon atom is sp2 hybridized and bonded to 3 neighbor carbon atoms so one of its four valance electrons is relatively free to move along the layers. Hence, graphite is a

conductor parallel to the layers and non-conductor perpendicular to the layer.

8. **Define electron affinity. Discuss its trend in the periodic table.**

The electron affinity is the amount of energy released or absorbed when an electron is added to a gaseous atom to form a negative ion.

Trend in Period:

Electron affinity increases from left to right in a period.

Reasons:

- Due to increase in proton number effective nuclear charge increases.
- Shielding effect remains the same.
- Number of shells remain the same.
- Atomic size decreases.

Trend in Group:

Electron affinity decreases from top to down in a group.

Reasons:

- Due to decrease in proton number effective nuclear charge decreases.
- Shielding effect increases.
- Number of shells increases down the group.
- Atomic size increases.

9. How do you justify the position of hydrogen at the top of alkali metals (group IA)?

Hydrogen can be placed at the top of the group IA because the properties of hydrogen resemble with those of the elements of group IA. Some of these are:

- Hydrogen has one electron in 1s subshell like the alkali metals.
- Both hydrogen and alkali metals have a strong tendency to combine with electronegative elements such as halogens.
- Both show oxidation state of +1.
- Both form ionic compounds.

10. How does hydrogen resemble with alkali metals?

Hydrogen can be placed at the top of alkali metals because the properties of hydrogen resemble with those of the alkali metals. Some of these are:

- Hydrogen has one electron in 1s subshell like the alkali metals.
- Both hydrogen and alkali metals have a strong tendency to combine with electronegative elements such as halogens.
- Both show oxidation state of +1.
- Both form ionic compounds.

11. Why hydrogen can be placed over group IVA of the periodic table?

Hydrogen can be placed at the top of the group IVA because the properties of hydrogen resemble with those of the elements of group IVA. Some of these are:

- Valence shell of hydrogen is half filled like those of group IVA elements.
- Both hydrogen and group IVA elements combine with other elements through covalent bonding.
- Like carbon, hydrogen also possesses remarkable reducing properties

$$CuO + H_2 \longrightarrow Cu + H_2O$$
$$SnO_2 + C \longrightarrow Sn + CO_2$$

12. Why the oxidation states of noble gases are usually zero?

The oxidation state of an element is directly or indirectly related to the number of its valance electrons or the number of vacancies available in its valence shell. In case of noble gases, their outermost shells are completely filled with electrons and no vacancy is available in their outermost shells. Thus, these gases usually show zero oxidation state. That's why they are often called zero group elements.

13. Why metallic character increases from top to bottom in a group of metal?

Metallic character increases from top to bottom in a group of metal because atomic size increases from top to bottom in a group. As a result, the removal of electrons from the outermost shell becomes easier, effective nuclear charge decreases and metallic character enhanced.

14. Why do metals conduct electricity? OR Why the metals are good conductors?

Each atom in a metal crystal loses all of its valence electrons and all metal atoms become positively charged. When electric field is applied mobile electrons start moving towards positive pole. Hence, a new electron coming from negative pole finds the space. Hence due to the movement of free electrons metals conduct electricity.

15. Why alkali metals give ionic hydrides?

Alkali metals are more electro positive than hydrogen. They have strong tendency to lose electron and form a uni-positive ion. This electron is accepted by hydrogen to form a hydride ion (H^-). These cations and anions then combine to form ionic bond. That's why alkali metals give ionic hydrides. E.g. $Na^+ H^-$ and K^+H^-

16. Zn, Cd, Hg were placed along with alkaline earth metals in Mendeleev's periodic table. How this confusion was removed in Modern periodic table?

In modern periodic table, the groups were divided into the subgroups to separate the elements of different categories. Zn, Cd and Hg were arranged separately into the subgroup of group II that is IIB. In Mendeleev's periodic table, Zn, Cd and Hg were placed along with the alkaline earth metals however, their properties do not resemble.

17. What is Lanthanide contraction?

The gradual or progressive decrease in the atomic size of the elements in the lanthanide series is

significant and is called lanthanide contraction. Same decrease is observed in actinide series. This is due to poor shielding effect of f sub-shell which is being gradually filled along the series.

18. **Name various classes of hydrides.**
There are three classes of hydrides:
- Ionic hydrides
- Polymeric or intermediate hydrides
- Covalent hydrides

19. **Oxidation states usually remain same in a group. Why?**
The number of electrons in the outermost shells go on changing in period from left to right, so oxidation states go on changing but, the number of electrons in the outermost shell remains same in a group so the oxidation states remains the same. Anyhow, the process of un-pairing of electrons may happen in a group and oxidation states may change.

20. **Give any two resemblances of hydrogen with IVA elements.**
Hydrogen can be placed at the top of the group IVA because the properties of hydrogen resemble with those of the elements of group IVA. Some of these are:
- Valence shell of hydrogen is half filled like those of group IVA elements.
- Both hydrogen and group IVA elements combine with other elements through covalent bonding.

21. **What are amphoteric oxides? Give an example.**
The oxides which show both acidic and basic properties are called amphoteric oxides.
E.g. ZnO, BeO, Al_2O_3, Bi_2O_3

22. **Hydration energies of ions are in the following order. Al+3>Mg+2>Na+1 justify it.**
Hydration energy depends upon the charge to size ratio, greater the charge to size ratio greater the hydration energy. Hence, in the given order (Al+3>Mg+2>Na+1), Al+3 has greater charge to size ratio than Mg+2, and Na+1. That's why, the hydration energies are in this order.

Al+3>Mg+2>Na+1
-4613 > -1903 > -510

23. **Why do ionization energies decrease down the group and increase left to right?**
Trend in Period:
Ionization energy increases from left to right in a period.
Reasons:
- Due to increase in proton number effective nuclear charge increases.
- Shielding effect remains the same.
- Number of shells remain the same.
- Atomic size decreases.

Trend in Group:
Ionization energy decreases from top to down in a group.

Reasons:

- Due to decrease in proton number effective nuclear charge decreases.
- Shielding effect increases.
- Number of shells increases down the group.

- Atomic size increases.

24. Why PbCl2 is ionic but PbCl4 is fairly covalent compound?

When a metal forms more than one halide, the halides in which metal has lower oxidation state tends to be ionic while that in higher oxidation state is covalent. Similarly, high polarizing power of Pb+4 as compare to Pb+2 makes PbCL2 mainly ionic but, PbCL4 fairly covalent.

25. What happens when acidic and basic oxides combine with each other?

Basic oxides and acidic oxides react with one another to give salts.

For example: Na_2O + SO_3 $\longrightarrow$ Na_2SO_4

(basic oxide) (acidic oxide) (salt)

CHEMISTRY (XII) CHAPTER 2 (s-Block Elements)

Short Questions:

1. Why is the aqueous solution of Na_2CO_3 alkaline in nature?

Ans: The aqueous solution of Na_2CO_3 alkaline in nature because when it is dissolved in water, it gives NaOH and H_2CO_3 as shown below:

$$Na_2CO_3\,(s) + 2H_2O\,(l) \rightarrow NaOH\,(aq) + H_2CO_3\,(aq)$$

Since H_2CO_3 is a weak acid and NaOH is a strong base, hence the solution is alkaline in nature.

2. How $LiNO_3$ and $NaNO_3$ differ in application of heat. Give corresponding equations.

Ans: $LiNO_3$ on heating decomposes to give Li_2O and NO_2 gas whereas $NaNO_3$ gives $NaNO_2$ and oxygen gas as shown below:

$$4\,LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$$

$$2NaNO_3 \rightarrow 2NaNO_2 + O_2$$

3. Solution of Na_2O in water is alkaline. Justify the statement.

Ans: When Na_2O is dissolved in water, it produces NaOH which is a strong alkali. Hence solution of Na_2O in water is alkaline.

$$Na_2O + H_2O \rightarrow 2NaOH$$

4. Why 2% gypsum is added into the cement?

Ans: 2% gypsum is added into cement because it prevents the cement from hardening too rapidly. The addition of gypsum increases the setting time of cement.

5. What happens when:

a. Li_2CO_3 is heated

b. Na_2CO_3 is heated

Ans: a. $Li_2CO_3 \rightarrow 2Li_2O + CO_2$

b. $2Na_2CO_3 \rightarrow 2NaNO_2 + O_2$

6. Give formulae of Natron and Halite.

Ans:

Natron	$Na_2CO_3.\,H_2O$
Halite	NaCl

7. Write two points of difference of Beryllium with its family members.

Ans: 1. Beryllium metal is almost as hard as iron and hard enough to scratch the glass. The other alkaline earth metals are much softer than beryllium.

2. Beryllium is the only member of its group which reacts with alkalies to give hydrogen. The other members do not react with alkalies.

$$Be\,(s) + NaOH\,(aq) \rightarrow Na_2Be_2O\,(s) + H_2\,(g)$$

8. Prove that decomposition of lithium nitrate gives different products than nitrates of other alkali metals?

Ans: Decomposition of lithium nitrate gives different products than nitrates of other alkali metals as

shown below:

$4\ LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$

$2NaNO_3 \rightarrow 2NaNO_2 + O_2$

9. How lime and sand are used to make glass?
Ans: The ability of lime to react with sand at high temperature forming calcium silicate (CaSiO3) serves as an important basis for glass manufacture. Lime is added in sand and on heating gets converted to limestone and then it forms calcium silicate. Addition of lime in glass increases the hardness and chemical durability of glass.

10. Why lime is added to acidic soil?
Ans: Large quantities of lime are added to soil for neutralizing the acidity of soil. It has been found that application of lime to acidic soils increases the amount of readily soluble phosphorus.

11. What is the action of litmus with aqueous solution of Na_2CO_3?
Ans: The aqueous solution of Na_2CO_3 is alkaline due to formation of strong alkali NaOH and it turns litmus solution red.

$$Na_2CO_3 + 2H_2O \rightarrow NaOH + H_2CO_3$$

12. What is Plaster of Paris?
Ans: When gypsum is heated under carefully controlled conditions, it loses three quarters of water of crystallization. The resulting product is called Plaster of Paris.

$$2CaSO_4.2H_2O\ (s) \rightarrow (CaSO_4)_2.H_2O\ (s) + 3H_2O$$

Gypsum → Plaster of Paris

13. What is Plaster of Paris? Give its two applications.
Ans: When gypsum is heated under carefully controlled conditions, it loses three quarters of water of crystallization. The resulting product is called Plaster of Paris.

$$2CaSO_4.2H_2O\ (s) \rightarrow (CaSO_4)_2.H_2O\ (s) + 3H_2O$$

Gypsum → Plaster of Paris

Applications: 1. It is used for making plaster walls, casts of statuary, coins, etc.
. It is used in surgery. Plaster of Paris bandages are used for holding in place fractured bones after they have been set.

14. Why lime water turns milky by passing CO_2 gas but becomes clear with excess of CO_2?
Ans: Lime water turns milky by passing CO_2 gas due to formation of insoluble $CaCO_3$

$$Ca(OH)_2\ (s) + CO_2 \rightarrow CaCO_3\ (s) + H_2O\ (l)$$

On further addition of CO_2, insoluble $CaCO_3$ changes into soluble $CaHCO_3$

$$CaCO_3\ (s) + H_2O\ (l) + CO_2 \rightarrow CaHCO_3\ (aq)$$

15. Why KO_2 is used in breathing equipment used by mountaineers and astronauts?
Ans: KO_2 is used in breathing equipment used by mountaineers and astronauts because it has ability to absorb carbon dioxide while giving out oxygen at the same time.

$$4KO_2\ (s) + 2CO_2 \rightarrow 2K_2CO_3\ (s) + 3O_2\ (g)$$

16. Give four points in which lithium differs from its own family members?
Ans: 1.Lithium reacts very slowly with water while other alkali metals react violently.
2. Lithium hydride is more stable than the hydrides of other alkali metals.

3. The lithium salts of anions with high charge density are generally less soluble in water than those of the other alkali metals, e.g. LiOH, LiF etc.
4. Lithium is the least reactive metal of all the alkali metals.

17. Reaction of alkali metal oxide with water is acid-base reaction and not an oxidation-reduction reaction. Justify.

Ans: Alkali metal oxides dissolve in water to give strong alkaline solution. This reaction is an acid base reaction and not an oxidation reduction reaction since no element undergoes a change in its oxidation number. It has been shown by the following reaction:

$Li2O\ (s) + H_2O\ (l) \rightarrow 2LiOH\ (aq)$

18. Give two major problems that may arise in Nelson's cell.

Ans: 1. Chlorine produced can react with hydroxide ions in cold giving hypochlorite ions.

$Cl_2\ (g) + 2OH^-\ (aq) \rightarrow OCl^-\ (aq) + Cl^-\ (aq) + H_2O\ (l)$

2. Hydroxide ions may be attracted towards anode, where they can be discharged releasing oxygen gas. This oxygen gas may contaminate the chlorine and renders it impure.

19. Give advantages of Down's Cell.

Ans: 1.The metallic fog is not produced.

2. Liquid sodium can easily be collected at 600^0C.

3. Material of the cell is not attacked by the products formed during the electrolysis.

20. Why alkali and alkaline earth metals are the most reactive elements of the periodic table?

Ans: Since ionization energies of alkali and alkaline earth metals are very low and they have large atomic sizes, therefore they are the most reactive elements of the periodic table.

21. BeO is Amphoteric. Prove it.

Ans: BeO is amphoteric as it can behave both as an acid as well as a base as shown by the following equation s:

$BeO + H_2SO_4 \rightarrow BeSO_4 + H_2O$

$BeO + NaOH \rightarrow Na_2BeO_2 + H_2O$

22. What is lime water and milk of magnesia?

Ans:

Lime water	$Ca(OH)_2$
Milk of magnesia	$Mg(OH)_2$

23. How gypsum is converted into plaster of Paris?

Ans: When gypsum is heated under carefully controlled conditions, it loses three quarters of water of crystallization. The resulting product is called Plaster of Paris.

$2CaSO_4.\ 2H_2O\ (s) \rightarrow (CaSO_4)_2.H_2O\ (s) + 3H_2O$

Gypsum Plaster of Paris

24. What is lime mortar? How is it formed?

Ans: Lime mortar or Ordinary mortar is prepared by mixing freshly prepared slaked lime (one volume) with sand (three or four volumes) and water to form a thick paste. This material when placed between the stones and bricks hardens or sets, thus binding the blocks firmly together. The equations for the chemical reactions which take place when lime mortar hardens are:

$CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (s)$

$Ca(OH)_2(s) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$
$Ca(OH)_2(s) + SiO_2(s) \rightarrow CaSiO_3(s) + H_2O(l)$

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CHEMISTRY (XII) CHAPTER 03 (Group IIIA and IVA Elements

Short Questions:

1. **What is boric acid? Give its uses**.

Boric acid (H3BO3) is a white lustrous crystalline solid having a soft soapy touch, which is very slightly soluble in cold water but, fairly soluble in hot water. It is formed when water Is added into metaboric acid (HBO2)

HBO_2 + H_2O ⟶ H_3BO_3

(Metaboric acid) (Boric Acid)

Uses:

- Boric acid is used in medicines as an antiseptic.
- It is used in pottery as a glaze.
- It is used in candle industry for stiffening of wicks

2. **Why carbon behaves differently from other members of its group?**

Carbon differs from the remaining members of group IVA in the following respects:
Carbon and silicon are non-metals while the other members of the family are metalloids or metals.
Carbon shows remarkable property of self-linkage or catenation while the other members of the family do not show his property.

3. **How weathering phenomenon converts potassium feldspar into clay?**

Earth crust is rich in aluminum silicates existing in the form of rocks. The weathering (rains, storms, freezing etc.) of these rocks results in the disintegration of the complex silicates which they contain. The boiling and freezing of water in the rocks, and the chemical action of water and carbon dioxide convert these silicates into potassium carbonate, sand and clay.
The following reaction explains the weathering of an aluminium silicate known as potassium feldspar.

$K_2O.Al_2O_3.6SiO_2 + H_2CO_3 + H_2O \longrightarrow K_2CO_3 + 4SiO_2 + Al_2O_3.(SiO_2)_2.2H_2O$

4. **Give uses of lead sub oxide.**

Following are the two uses of lead sub oxide:

- It is used as a pigment.
- It is used in a manufacture of lead storage battery.

5. **Show that H3BO3 is a monobasic acid.**

H3BO3 (Boric acid) reacts with water and releases H+ ions from water. It accepts OH- ion and acts as a monobasic acid

$H_3BO_3 + H_2O \longrightarrow [B(OH)_4]^- + H^+$

It releases only one H^+ ion in solution. From this it can be easily evident that H3BO3 is a

monobasic acid.

6. How Al finds its uses in metallurgy and photoflash bulbs?

Use in metallurgy:

Aluminum being highly reactive is used in the extraction of chromium and manganese from their oxides. Al reduces oxides of these metals.

$$Cr_2O_3 + 2Al \longrightarrow 2Cr + Al_2O_3$$

$$3Mn_3O_4 + 8Al \longrightarrow 9Mn + 4Al_2O_3$$

Use in photoflash bulbs

Photoflash bulbs are made up of glass containing a thin filament or foil of Aluminum. Bulb is filled with oxygen at low pressure. The foil is ignited using electricity. Oxygen atmosphere increases the brilliance of the flash.

7. Why CO2 is a gas while SiO2 is a solid at room temperature?

Gaseous physical state of CO_2:

Carbon forms double bond with oxygen(O=C=O) atoms resulting in the formation of a small, independent stable gaseous molecule with linear structure CO_2.It has very weak intermolecular forces of attraction .That is why it is gas at room temperature.

Solid physical state of SiO_2:

Silicon atoms are much larger than carbon atoms and surrounded by more oxygen neighbors. Silicon atom can be approached by four oxygen atoms and forms a single bond to each at tetrahedral angles. In this ways a huge solid crystal is formed.

8. Borate glazes are better than silicate glazes. Explain.

Borate glazes are used in pottery which are more fusible than silicate glazes and possesses higher co-efficient of expansion. In this way, Borate glazes are better than silicate glazes.

9. Write two principle uses of Borax? OR Write four uses of Borax?

- It is used in the softening of water.
- It is used in metallurgical operations
- It is used in making washing powders
- It is used in leather industry for tinning and dyeing.

10. How Boron differs from members of its family?

Boron differs from members of its family in various aspects:

- Boron is nonmetallic in nature while the other elements of the family are metallic in nature.
- It is the only element in the family with less than 4 electrons in outermost shell.
- Unlike other members of the family boron form ionic compounds with sulphates.

11. Write down formulas of Bauxite and corundum

Bauxite: $Al_2O_3.2H_2O$ corundum: Al_2O_3

12. **What is chemistry of Borax bead test**?

Borax, when fused, is decomposed into sodium metaborate and boric anhydride

$$Na_2B_4O_7 \longrightarrow 2NaBO_2 + B_2O_3$$

The metallic oxide formed from a substance, under examination, combines with B_2O_3 giving the colored metallic borates. With cupric oxide, the beads are colored blue in the oxidizing flame because cupric borates are blue in color.

$$CuO + B_2O_3 \longrightarrow Cu(BO_2)_2$$

13. How will you convert boric acid into borax and vice versa?

when boric acid is neutralized by soda ash borax is formed.

$$4H_3BO_3 + Na_2CO_3 \longrightarrow Na_2B_4O_7 + 6H_2O + CO_2$$

Aqueous solution of borax reacts with HCl or H2SO4 to form boric acid.

$$Na_2B_4O_7 + 2HCl + 5H_2O \longrightarrow 2NaCl + 4H_3BO_3$$

14. Write four uses of sodium silicate.

Uses of Sodium Silicate:

1. It is used as filler for soap in soap industry.

2. It is used in textile as a fire proof.

3. It is used as furniture polish.

4. It is used to prepare chemical garden

15. Write the reactions of boric acid with i. Ethyl alcohol ii. NaOH

Reaction of H_3BO_3 with NaOH:

It reacts with NaOH like an acid reacts with some base to make salt and water in neutralization reaction.

$$2NaOH + 4H_3BO_3 \longrightarrow Na_2B_4O_7 + 7H_2O$$

Reaction of H_3BO_3 with C_2H_5OH:

It reacts with ethyl alcohol forming ethyl borate $(C_2H_5)_3BO_3$.

$$H_3BO_3 + 3C_2H_5OH \longrightarrow (C_2H_5)_3BO_3 + 3H_2O$$

16. What is meant by chemical garden?

When crystals of a water soluble, colored salt like nickle chloride ,ferrous sulphate ,copper sulphate or cobalt nitrate etc. are added in solutions of sodium silicate (Na_2SiO_3), a very beautiful growth like plant which is called Chemical garden.

17. Give the formulae of four boric acids.

Names and formulae of four oxy acids of boron are as follows:

1.Orthoboric Acid, H_3BO_3

2.Metaboric Acid, HBO_2

3.Tetraboric Acid, $H_2B_4O_7$

4.Pyroboric Acid, $H_6B_4O_9$

18. What is the action of heat on orthoboric acid?

On heating at about 100°C, it loses a molecule of water and forms metaboric acid, which on heating to about 140°C forms tetra boric acid.

$$H_3BO_3 \xrightarrow{100^oC} HBO_2 + H_2O$$

Meta boric acid

$$4HBO_2 \xrightarrow{140^oC} H_2B_4O_7 + H_2O$$

Tetra boric acid

$$4H_2B_4O_7 \xrightarrow{\text{Red Hot}} 2B_2O_3 + H_2O$$

(Boric anhyride)

19. **Why aqueous solution of borax is alkaline**?

Borax when dissolved in water, ionizes as

$$Na_2B_4O_7 \longrightarrow 2Na^+ + B_4O_7^{-2}$$

Hydrolysis of $B4O7^{-2}$ ions generates hydroxyl ions which makes it alkaline in nature.

$$B_4O_7^{-2} + 7H_2O \longrightarrow 4H_3BO_3 + 2OH^-$$

so, a strong alkali (NaoH) is formed which is highly ionized.On the other hand, boric acid (H3BO3) is ionized to a little extent , because it is a weak acid .Hence, solution of borax as a whole is alkaline in nature.

20. Explain structure of CO2.

Structure of the Carbon Dioxide:

Carbon dioxide exists in the gaseous state as linear molecules (O=C=O). The observed C=O bond length is 115 pm. Solid CO_2 has a face-centered cubic structure. Being linear its dipole moment is zero.

Dipole moment of Carbon dioxide:

Being linear its net dipole moment is zero.

21. How aqueous solution of Borax is alkaline?

Borax when dissolved in water, ionizes as

$$Na2B4O7 \longrightarrow 2Na^{+} + B_4O_7^{-2}$$

Hydrolysis of $B_4O_7^{-2}$ ions generates hydroxyl ions which makes it alkaline in nature.

$$B_4O_7^{-2} + 7H_2O \longrightarrow 4H_3BO_3 + 2OH$$

so, a strong alkali (NaoH) is formed which is highly ionized.On the other hand, boric acid (H3BO3) is ionized to a little extent , because it is a weak acid .Hence, solution of borax as a whole is alkaline in nature.

22. Give two similarities between carbon and silicon.

Similarities between Carbon and Silicon are as follows:

i. Carbon and silicon both are the non-metals in Group IVA. Carbon has the peculiar property of forming long carbon chains, silicon forms long chains of alternating silicon and oxygen atoms.

ii. Carbon and silicon both form acidic oxides.

23. Why liquid silicones are preferred over ordinary organic lubricants?

There happens a very small change in viscosity with the change in temperature for silicones. When the temperature drops from 100 ^{0} C to 0 ^{0} C, then the viscosities of petroleum oils which are used as lubricants increase their viscosity 100 times. Anyhow, viscosities of silicon oils increase less than 4 times for this change of temperature. Hence, silicones are preferred over ordinary organic lubricants.

24. Write down chemical formulae of colemanite and bauxite.

Colemanite: $Ca_2B_6O_{11}$ Bauxite: $Al_2O_3.2H_2O$

25. Write any four uses of Aluminum.

Following are the four uses of Al:

1. It is an excellent conductor of heat and electricity.
2. It is non-toxic and can be used for making food and brewing equipments and packages.
3. It is used for form alloys.
4. It is used for making petrol and milk storage tanks.

26. What is vitreous silica? Give its two uses.

When crystalline silica (opal or quartz) is heated at sufficiently high temperature, it melts to give a viscous liquid having a random structure. When this liquid silica is cooled it does not crystallize readily, but usually it under-cools tremendously and eventually becomes rigid without any regular crystal pattern. This rigid, highly under-cooled liquid is called vitreous silica or silica glass.

Uses:

- It is used as an envelope of mercury vapor lamps.
- It is used for obtaining windows for space vehicles.

27. Write two reactions for the preparation of Borax.

It is prepared by the action of Colemanite with hot sodium carbonate.

$$Ca_2B_6O_{11} + 2Na_2CO_3 \longrightarrow Na_2B_4O_7 + 2NaBO_2 + 2CaCO_3$$

The precipitate of $CaCO_3$ is removed by filtration and the filtrate is cooled to get crystals of borax.

CO_2 gas is passed through sodium metaborate solution to get more crystals of borax.

$$4NaBO_2 + CO_2 \longrightarrow Na_2B_4O_7 + 6H_2O + CO_2$$

28. Define semiconductor. Write its properties.

A semiconductor is a substance which shows difference in resistance against electric current under different temperatures, e.g. Silicon, Germanium, Lead sulphide, Gallium arsenide etc.

Properties:

- Semi-conductor conducts electricity.
- When it is heated its resistance decreases.
- Semi-conductors are sensitive to light.
- The electrons of semi-conductors do not carry electric current as readily as the electrons of good electric conductors like metals.

CHEMISTRY (XII) CHAPTER 04 (Group VA and VIA Elements)

Short Questions:

Justify that conc. H2SO4 is a dehydrating agent.

H_2SO_4 has a great affinity for water because of high polarity, so it acts as dehydrating agent and eliminates water from different compounds.

(i) With **oxalic acid** it forms CO_2 and Co.

$$\begin{matrix} COOH \\ | \\ COOH \end{matrix} \xrightarrow{conc.H_2SO_4} CO_2(g) + CO(g) + H_2O(l)$$

(ii) With **formic acid**, Co is formed.

$$HCOOH(aq) \xrightarrow{conc.H_2SO_4} CO(g) + H2O(l)$$

(iii) With **ethyl alcohol** it forms ethylene.

$$C_2H_5OH \xrightarrow[100^oC]{conc.H_2SO_4} C_2H_4 + H_2O$$

(iv) With **wood, paper, sugar** and **starch** it forms carbon and water.

$$C_6H_{12}O_6 \xrightarrow{conc.H_2SO_4} 6C + 6H_2O$$

$$C_{12}H_{22}O_{11} \xrightarrow{conc.H_2SO_4} 12C + 11H_2O$$

$$(C_6H_{10}O_5)n \xrightarrow{conc.H_2SO_4} 6nC + 5nH_2O$$

2. Name three allotropic forms of phosphorus.

The three allotropes of phosphorus are

White phosphorus

Red phosphorus

Black phosphorus

3. How does aqua regia dissolve gold?

When one volume of concentrated HNO3 is mixed with 3 volumes of concentrated HCl, aqua regia is formed. It is employed to dissolve gold and platinum (Nobel metals).It contains nitrosyl chloride and chlorine gas.

$$HNO3(conc.) + 3HCl(conc.) \longrightarrow NOCl(aq) + Cl2(g) + 2H2O(l)$$

NOCl formed is decomposed giving NO and nascent Cl

$$NOCl \longrightarrow NO(g) + [Cl](g)$$

This liberated chlorine converts metals such as gold and platinum into their water soluble chlorides.

$$Au(s) + 3[Cl](aq) \longrightarrow 2AuCl3(aq)$$

4. How NO2 is prepared from: a. Lead nitrate b. Cu+HNO3

It can be prepared in small quantities by heating lead nitrate.

$$2Pb(NO3)2(s) \longrightarrow 2PbO(s) + 4NO2(g) + O2(g)$$

It can also be prepared by reacting conc. HNO3 with copper.

$$Cu(s) + 4HNO3\ (conc.) \longrightarrow Cu(NO3)2(aq) + 2H2O(l) + 2NO2(g)$$

5. How does HNO2 act as reducing agent?

Nitrous acid decolourizes acidified KMnO4 and bromine water. It readily gets oxidized to nitric acid, so it also behaves as a reducing agent.

$$2KMnO4(aq) + 3H2SO4(aq) + 5HNO2(aq) \longrightarrow K2SO4(aq) + 2MnSO4(aq) + 3H2O(l) + 5HNO2(aq)$$

$$HNO2(aq) + Br2(aq) + H2O(l) \longrightarrow HNO3(aq) + 2HBr(aq)$$

6. How does P2O5 react with water in cold and hot state?

With cold water phosphorus pentoxide forms metaphosporic acid.

$$P2O5(s) + H2O(l) \longrightarrow 2HPO3(aq)$$

With hot water, it forms orthophosphoric acid

$$P2O5(s) + 3H2O(l) \longrightarrow 2H3PO4(aq)$$

7. Why SO3 is dissolved in sulphuric acid and not in water?

When SO3 is dissolved in 98% H2SO4, we obtain Pyrosulphuric acid or (Oleum).

$$H2SO4\ (aq) + SO3\ (g) \longrightarrow H2S2O7\ (l)$$

Oleum can be converted to sulphuric acid of any required concentration by adding water.

$$H2S2O7\ (l) + H2O\ (I) \longrightarrow 2H2SO4\ (aq)$$

If SO3 is dissolved in water directly, a highly exothermic reaction occurs in which heat energy is released and it vaporizes suphuric acid to make mist or fog. This fog does not condense easily.

8. Give two reactions which show oxidizing behaviour of NO.

$$H2S(g) + 2NO(g) \longrightarrow H2O(g) + N2O(g) + S(s)$$

$$H2SO3(aq) + 2NO(g) \longrightarrow H2SO4(aq) + N2O(g)$$

9. Give two methods for the preparation of PCl3.

a. It is usually prepared by melting white phosphorus in a retort in an inert atmosphere of CO_2 and current of dried chlorine is passed over it. The vapours of PCl_3 are collected in a flask kept in ice-bath.

$$2P(s) + 3Cl_2(g) \longrightarrow 2PCl_3(l)$$

b. It may also be prepared by the action of phosphorus with thionyl chloride.

$$2P(g) + 4SOCl_2(l) \longrightarrow 2PCl_3(l) + 2SO_2(g) + S_2Cl_2(s)$$

10.Write two points of dissimilarities of oxygen and sulphur.

Oxygen	Sulphur
Oxygen helps in combustion.	Sulphur is itself combustible.
It is paramagnetic in nature.	It is diamagnetic in nature.

11.Why the elements of VIA other than oxygen show more than two oxidation states?

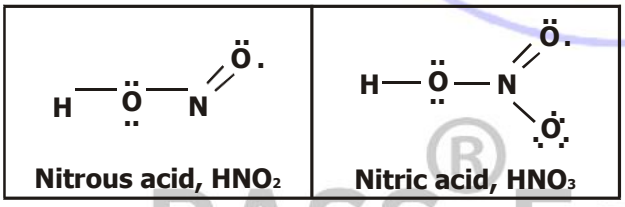
Show more than two oxidation states like -2, +2, +4 and +6 because they have also d-subshells in their valence shells.

12.Give the names of four elements which do not react with nitric acid.

Gold, platinum, iridium and titanium do not react as they are noble metals and are not oxidized by nitric acid.

13.Explain the structure of HNO_2 and HNO_3.

The two important oxyacids of nitrogen, nitrous acid and nitric acid.



Nitrous acid, HNO_2 | **Nitric acid, HNO_3**

14.P_2O_5 is powerful dehydrating agent. Give two examples.

$$H_2SO_4(aq) + P_2O_5(s) \longrightarrow SO_3(g) + 2HPO_3(aq)$$

$$2CH_3COOH(aq) + P_2O_5(s) \longrightarrow (CH_3CO)_2O(l) + 2HPO_3(aq)$$

Acetic anhydride

15.Write any four uses of Nitric acid.

It is used:

1. as a laboratory reagent.
2. in the manufacture of nitrogen fertilizers.

3. in the manufacture of explosives.
4. for making varnishes and organic dyes.

16. What happens when NO2 is dissolved in water?

In the absence of air, it dissolves in water to form nitric and nitrous acids.

$$2NO_2(g) + H_2O(l) \longrightarrow HNO_3(aq) + HNO_2(aq)$$

However in the presence of air or oxygen, nitric acid is the final product.

$$4NO_2(g) + 2H_2O(l) + O_2(g) \longrightarrow 4HNO_3(aq)$$

17. Write two reactions of preparation of nitrous acid.

It can be prepared by dissolving dinitrogen trioxide in water at 0oC.

$$N_2O_3(g) + H_2O(l) \longrightarrow 2HNO_2(aq)$$

Pure nitrous acid solution can be prepared by reaction between ice cold barium nitrite solution and ice cold dilute sulphuric acid.

$$Ba(NO_2)2(aq) + H_2SO_4(aq) \longrightarrow BaSO_4(aq) + 2HNO_2(aq)$$

18. What is the action of heat on orthophosphoric acid? Write chemical equation also.

On heating, it loses water and converted into pyro and metaphosphoric acid.

$$2H_3PO_4 \xrightarrow{-H_2O} H_4P_2O_7 \xrightarrow{-H_2O} 2HPO_3$$

Orthophosphoric acid — Pyrophosphoric acid — Metaphosphoric acid

19. Write any four properties of sulphuric acid.

Properties of sulphuric acid are

(i) Pure sulphuric acid is a colourless oily liquid without an odour.
(ii) It dissolves in water liberating a lot of heat which raises the temperature of the mixture up to 120oC. H_2SO_4 should always be poured in water in a thin stream to avoid any accident.
(iii) Pure acid is a nonconductor of electricity but the addition of a little water makes it a good conductor.
(iv) It is extremely corrosive to skin and causes very serious burns to all the tissues.

20. NO2 is a strong oxidizing agent. Prove with the help of two examples.

It is a strong oxidizing agent and oxidizes H_2S to sulphur, ferrous sulphate to ferric sulphate etc.

$$H_2S(g) + NO_2(g) \longrightarrow H_2O(l) + S(s) + NO(g)$$

$$2FeSO_4(aq) + H_2SO_4(aq) + NO_2(g) \longrightarrow Fe_2(SO_4)_3(aq) + H_2O(l) + NO(g)$$

21. Give two reactions of sulphuric acid which show its oxidizing behaviour.

H_2SO_4 acts as strong oxidizing agent.

(i) It oxidizes C and S giving CO_2 and SO_2, respectively.

$$C(s) + 2H_2SO_4(aq) \longrightarrow CO_2(g) + 2SO_2(g) + 2H_2O(g)$$

$$S(s) + 2H_2SO_4(aq) \longrightarrow 3SO_2(g) + 2H_2O(l)$$

(ii) H_2S is oxidized to S.

$$H_2(s) + H_2SO_4(aq) \longrightarrow S(s) + SO_2(g) + 2H_2O(g)$$

22. Give four dissimilarities of oxygen and sulphur.

DISSIMILARITIES

		Oxygen	Sulphur
1.	Allotropic forms	There are two allotropic form of oxygen $O_2$and O_3	There are 3 allotropic forms of sulphur i.e. rhombic, monoclinic and plastic sulphur.
2.	Physical states	It is gas at ordinary temperature.	It is solid at ordinary temperature.
3.	Water solubility	Oxygen is sparingly soluble in water.	Sulphur is not soluble in water.
4.	Reaction with water	It does not react with water.	When stem is passed through boiling sulphur a little hydrogen sulphide and sulphur dioxide are formed.

23. What is aqua regia?

Aqua regia is a mixture of 3 parts of conc. HCl and one part of conc. HNO_3. Metals like gold and platinum can dissolve in aqua regia by the formation of their chlorides

$$3HCl + HNO_3 \longrightarrow NOCl + Cl_2 + 2H_2O$$

$$2NOCl \longrightarrow 2NO + Cl_2$$

This liberated chlorine converts noble metals to their chlorides.

$$2Au + 3Cl_2 \longrightarrow 2AuCl_3$$

Over all reaction is as follows:

$$2Al + 3HCl + HNO_3 \longrightarrow AuCl_3 + NO + 2H_2O$$

24. Justify that sulphuric acid is king of chemicals.

It is called king of acid because of its direct and indirect applications in manufacture of many chemicals including fertilisers. Sulphuric acid is used to clean up rust from steel rolls and soap. It also dissolves its own compounds. It replaces salts from weaker acids. It is ideal to call sulphuric acid as king of chemicals .It is corrosive acts as good dehydrant.

25. Justify that NO acts as an oxidizing agent?

$H_2S(g) + 2NO(g) \longrightarrow H_2O(g) + N_2O(g) + S(s)$

$H_2SO_3(aq) + 2NO(g) \longrightarrow H_2SO_4(aq) + N_2O(g)$

26. How does HNO_2 act as reducing agent?

Nitrous acid decolourizes acidified $KMnO_4$ and bromine water. It readily gets oxidized to nitric acid, so it also behaves as a reducing agent.

$2KMnO_4(aq) + 3H_2SO_4(aq) + 5HNO_2(aq) \longrightarrow K_2SO_4(aq) + 2MnSO_4(aq) + 3H_2O(l) + 5HNO_2(aq)$

$HNO_2(aq) + Br_2(aq) + H_2O(l) \longrightarrow HNO_3(aq) + 2HBr(aq)$

27. Write down two chemical reactions which show that sulphuric acid is a dehydrating agent?

$C_2H_5OH \xrightarrow[100^oC]{conc.H_2SO_4} C_2H_4 + H_2O$

$C_6H_{12}O_6 \xrightarrow{conc.H_2SO_4} 6C + 6H_2O$

28. Complete and balance the following chemical equation. KMnO4+ FeSO4+ H2SO4

$2KMnO_4 + 8H_2SO_4 + 10FeSO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$

Chemistry

Chapter 05 (Halogens and Noble Gases)

1. **What is structural formula of Teflon? Mention its two uses.**

The structural formula of Teflon is $(-CF_2-CF_2-)_n$. Corrosion proof parts of machinery are made of it. It is used for coating the electrical wiring.

2. **The elements of group VIIIA are called Nobel gases. Comment.**

The elements of group VIIIA are called Nobel gases because their outermost shells are complete and they do not have tendency to react with other elements. They are inert.

3. **How halogen acids are iodized in water?**

Halogen acids ionize in water and form halide ions and hydronium ions. For example;

$$HF + H_2O \longrightarrow H_3O^+ + F^-$$

$$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$$

$$HBr + H_2O \longrightarrow H_3O^+ + Br^-$$

$$HI + H_2O \longrightarrow H_3O^+ + I^-$$

4. **Arrange the following oxyacids in the increasing order of acid strength $HClO_4$, $HClO_3$, $HClO_2$, HOCl.**

The oxyacids of halogens show their strength in the order given below:

$$HClO < HClO_2 < HClO_3 < HClO_4$$

5. **Why bleaching powder shows bleaching action?**

The bleaching action of bleaching powder is due to its oxidative character. The oxidizing property is due to the generation of hypochlorite ion (OCl^-) in water.

$$CaOCl_2\,(aq) \overset{H_2O}{\rightleftharpoons} Ca^{+2}(aq) + Cl^-\,(aq) + ClO^-(aq)$$

6. **Write four uses of halogens.**

1. Fluorine is used for the preparation of freons.
2. Chlorine is used in the manufacture of bleaching powder.
3. Silver bromide is used in photography.
4. Tincture of iodine and iodex are popular preparations of iodine.

7. Write disproportionation reaction of chlorine.

$$2NaOH\ (aq) + Cl_2\ (g) \xrightarrow{15^oC} NaCl\ (aq) + NaClO\ (aq) + H_2O\ (aq)$$

8. Write the reaction of NaOH with Cl_2 in cold state.

$$2NaOH\ (aq) + Cl_2\ (g) \xrightarrow{15^oC} NaCl\ (aq) + NaClO\ (aq) + H_2O\ (aq)$$

How NaOH reacts with Cl_2 in cold and hot state?

$$2NaOH\ (aq) + Cl_2\ (g) \xrightarrow{15^oC} NaCl\ (aq) + NaClO\ (aq) + H_2O\ (aq)$$

$$3NaClO\ (aq) \xrightarrow{70^oC} 2NaCl\ (aq) + NaClO_3\ (aq)$$

Write down reactions of chlorine with cold and hot NaOH.

$$2NaOH\ (aq) + Cl_2\ (g) \xrightarrow{15^oC} NaCl\ (aq) + NaClO\ (aq) + H_2O\ (aq)$$

$$3NaClO\ (aq) \xrightarrow{70^oC} 2NaCl\ (aq) + NaClO_3\ (aq)$$

9. Why HF is a weaker acid than other halogen acids?

HF is a weaker acid than other halogen acids because it has a zig-zag structure and hydrogen is entrapped between two fluorine atoms. So, hydrogen is not easily removed and hence acidic strength of HF decreases.

Why HF is a weaker acid than HCl?

HF is a weaker acid than other HCl because it has a zig-zag structure and hydrogen is entrapped between two fluorine atoms. So, hydrogen is not easily removed and hence acidic strength of HF decreases.

10. Why solubility of noble gases increases down the group?

The solubility of the noble gases in water increases with increasing atomic number. This is because the bigger atoms are more readily polarized by water molecules.

11. What are Freons and Teflon?

Fluorine is used for the preparation of freons. Freon is the commercial name of low molecular mass fluorochlorocarbons, CCl_2F_2, $CClF_3$. These are being used as refrigerants and aerosol propellants.

Fluorine is used to prepare Teflon $(-CF_2-CF_2-)_n$. It is a polymerized tetrafluoro ethylene compound. It is a valuable plastic which resists the action of oxidants, acids and alkalies. Corrosion proof parts of machinery are made of it. Teflon is also used as a non-stick coating for cooking pans.

12. Describe two uses of helium.

Uses of Helium

1. Helium is used in weather balloons, in welding and in traffic signal lights.
2. A mixture of 80% helium and 20% oxygen is used for breathing by the sea divers.

Write two uses of each helium and argon.

Uses of Helium

1. Helium is used in weather balloons, in welding and in traffic signal lights.
2. A mixture of 80% helium and 20% oxygen is used for breathing by the sea divers.

Uses of Argon

1. Argon is used in electric light bulbs, in fluorescent tubes and in radio tubes
2. Argon is used in Geiger counters (used to detect radioactivity).

13. Write any two uses of krypton?

Uses of Krypton

1. Krypton is used to fill fluorescent tubes
2. It is used in flash lamps for high speed photography.

14. Why the elements of VIA other than oxygen show more than two oxidation states?

Except oxygen the other members of the group show a covalency of +2, +4 and +6, for example, SCl_2, SCl_4, SCl_6. The oxidation state +2 is shown due to 2 unpaired electrons in the p-orbitals.

15. What is iodized salt? /What is iodized salt? Write its function.

To ensure the presence of iodide ion in the diet, sodium or potassium iodide is added to the common salt which is known as iodized salt.

16. On what basis perchloric acid is considered a valuable analytical reagent?

Due to its oxidizing effect, acidic strength and solubility of its salts, perchloric acid is considered a valuable analytical reagent.

17. Why iodine has metallic luster?

Iodine has big size due to which its outermost shell electrons can easily excite on absorption of energy and on de-excitation release energy which is seen in the form of metallic luster.

18. Give peculiar behaviour of fluorine?

Due to the small size of the F atom (or F- ion) there will be a better overlap of orbitals and consequently leads to shorter and stronger bonds with elements other than O, N and itself. Ionic fluorides have higher lattice energies than the other halides and these values are responsible for the insolubility of the fluorides of Ca, Mg, Ba, Sr and lanthanides in water. Due to the low

dissociation energy of fluorine molecule, it is highly reactive. The other halogens react slowly under similar conditions. The fluorides are, however, more stable with respect to dissociation into elements. Due to the restriction of valence shell to an octet many fluoro compounds show inertness e.g. CF_4 and SF_6. Also due to this restriction fluorine remains restricted to -1 oxidation state. Fluorine is the only element that combines directly with noble gases like Kr, Xe and Rn forming their fluorides.

19. What is meant by Available chlorine? How quality of bleaching powder is tested?

The amount of chlorine thus set free is called "available chlorine". The activity of bleaching powder is measured in terms of available chlorine. The average percentage of available chlorine in bleaching powder is 35-40 percent. The bleaching action of bleaching powder is due to its oxidative character.

20. What factors affect the oxidizing power of halogens?

The oxidizing power of halogens depends upon the following factors:

1. Energy of dissociation
2. Electron affinity of atoms
3. Hydration energy of ions
4. Heats of vapourization (for Br_2 and I_2)

21. What is iodex and tincture of iodine?

Iodex and tincture of iodine are popular preparations of iodine. It is used as disinfectant and germicide.

Chemistry

Chapter 06 (Transition Elements)

1. **Explain chromyl chloride test. Give chemical equation.**

When solid potassium dichromate is heated with solid metal chloride in the presence of concentrated sulphuric acid chromyl chloride is produced.

$$K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \longrightarrow 2KHSO_4 + 4NaHSO_4 + 2CrO_2Cl_2(\text{chromyl chloride}) + 3H_2O$$

2. **How $KMnO_4$ can be prepared by electrolytic method?**

In electrolytic method mangnate is converted to permanganate by electrolytic oxidation. During electrolysis of an aqueous solution of K_2MnO_4, water is decomposed to evolve hydrogen gas at the cathode and oxygen gas at the anode. Oxygen liberated at the anode oxidizes manganate ion $(MnO_4)^{2-}$ into permanganate ion $(MnO4)^{1-}$ while hydrogen is liberated at the cathode.

$$2K_2MnO_4 + H_2O + [O] \longrightarrow 2KMnO_4 + 2KOH$$

3. **Write formulas of chromate and dichromate ions. In which colour they usually exist?**

The formula of chromate ion is CrO_4^{2-} and that of dichromate ion is $Cr_2O_7^{2-}$. All the chromates are yellow in colour.

4. **Give coordination number and oxidation number of iron (Fe) in $K_4[Fe(CN)_6]$.**

The coordination number of iron (Fe) in $K_4[Fe(CN)_6]$ is 6 and the oxidation number is 2.

5. **What are chelates? Give an example.**

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 and hence is called a chelate.

Example

$[Pt(C_2O_4)_2]^{2-}$.

6. Why does damaged tin plated iron get rusted quickly?

If the protective coating is damaged, then iron comes into contact with moisture. A galvanic cell is established in which tin acts as a cathode and iron as an anode. The electrons flow from iron to tin, where they discharge H^+ ions, leaving behind OH^- in the solution. These hydroxide ions react with iron forming $Fe(OH)_3$, which dissolves rapidly in water. From this, it can be concluded that plated iron gets rusted more rapidly when the protective coating is damaged than the non-plated iron.

7. What are typical and non-typical transition elements?

The elements of group IIB and group IIIB are referred to as non-typical transition elements and the elements in the remaining transition series are called typical transition elements.

8. Give reason for the development of colours in the transition metal complexes.

In transition elements, the d orbitals are responsible for the colour development in their compounds. When these orbitals are involved in bonding, they split up into two energy levels, one set has a higher energy than the other. The electrons residing in low energy d-orbitals absorb a part of the visible light and jump to high energy d orbitals. The process is called d-d transition. The energy difference of d-orbitals varies from ion to ion. Thus, every ion absorbs a different wavelength and transmits the remaining set of wavelengths that gives different colours to the ions.

9. Give formulas of Magnetite and Haematite.

The formula of magnetite is Fe_3O_4 and of haematite is Fe_2O_3.

10. Write carbon content in pig iron and cast iron.

The carbon content in pig iron or cast iron is 2.5 to 4.5%.

11. What is the %age of carbon in different types of steel?

Steel is an alloy of iron containing 0.25 to 2.5% of carbon and traces of S,P,Si and Mn. Mild steel has 0.1 to 0.2% C. The medium carbon steel has 0.2 to 0.7% carbon and the high carbon steel has 0.7 to 1.5% carbon.

12. Why transition elements have variable oxidation states?

Transition elements have variable oxidation states because of the involvement of the unpaired d electrons in addition to s electrons in bond formation.

13. What is ligand? Give types of ligands/ Define Ligand with an example.

The atoms or ions or neutral molecules, which surround the central metal ion and donate electron pairs to it are called ligands. They may be anions or neutral molecules e.g. $K_4[Fe(CN)_4]$, $[Ag(NH_3)_2]Cl$. In the above examples, CN^- and NH_3 are the anionic and neutral ligands, respectively. Ligands having two donor atoms are called bidentate ligands, e.g.

Oxalate ion is a bidentate ligand and its coordination with the metal ion occurs through its both negatively charged oxygen atoms.

14. Complete and balance the following chemical equation? $KMnO_4 + FeSO_4 + H_2SO_4 \longrightarrow$

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$$

15. Define sacrificial corrosion.

Galvanizing is done by dipping a clean iron sheet in a zinc chloride bath and heating. The iron sheet is then removed, rolled into zinc bath and air cooled. In this case, if a protective layer of zinc is damaged a galvanic cell is established in the presence of moisture. Iron serves as a

cathode and zinc as an anode. Electrons flow from zinc to iron, as a result Zn decays while Fe remains intact. This is called sacrificial corrosion.

$$Fe^{2+} + Zn \longrightarrow Zn^{2+} + Fe$$

16. $KMnO_4$ acts as an oxidizing agent. Show with two examples.

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$$

$$2KMnO_4 + 5H_2C_2O_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$$

17. What is Stadeler's process?

In this method Cl_2 is passed through the green solution of K_2MnO_4 until it becomes purple due to the formation of $KMnO_4$. Here, Cl_2 oxidizes K_2MnO_4 into $KMnO_4$.

$$2K_2MnO_4 + Cl_2 \longrightarrow 2KCl + 2KMnO_4$$

18. What are chromates and dichromates?

Chromates and dichromates are the salts of chromic acid, H_2CrO_4 and dichromic acid, $H_2Cr_2O_7$, respectively. Both acids exist only in aqueous solution and when attempts are made to isolate them from solution they decompose immediately into chromic anhydride (CrO_3) and water. Their salts are, however, quite stable.

19. How entrapped bubbles of air removed from molten steel?

In order to remove entrapped bubbles of gases (blow holes) such as O_2, N_2, CO_2, a little aluminium or ferro-silicon is added. Aluminium removes nitrogen as nitride.

$$2Al + N_2 \longrightarrow 2AlN$$

20. What is meant by interstitial compound and substitutional alloy?

When small non-metal atoms like H,B,C,N enter the interstices of transition metals and impart useful features to them, they are called interstitial compounds. These are non-stoichiometric compounds. Sometimes they are also termed as interstitial alloys.

21. Define Paramagnetism, diamagnetism and Ferromagnetism.

Paramagnetism

Substances which are weakly attracted by a strong magnetic field are called paramagnetic substances.

Example

Mn^{2+}.

Diamagnetism

Those substances which are weakly repelled by a strong magnetic field are called diamagnetic substances.

Example

Zn^{2+}.

Ferromagnetism

A ferromagnetic substance contains permanent atomic magnetic dipoles that are spontaneously oriented. Ferromagnetism is a kind of magnetism that is associated with iron, cobalt, nickel, and some alloys or compounds containing one or more of these elements.

22. What is meant by outer transition metals and inner transition metals?

f-block elements, i.e., Lanthanides and Actinides are also called inner transition metals, whereas, d-block elements are called outer transition metals.

23. Why d and f block elements are called transition elements?

The d-block and f-block elements are called transition elements because they are located between the s and p-block elements and their properties are in transition between the metallic elements of the s-block and non-metallic elements of the p-block.

24. What is galvanizing? How it is done?

Galvanizing is coating iron or steel with a protective layer of zinc. Galvanizing is done by dipping a clean iron sheet in a zinc chloride bath and heating. The iron sheet is then removed, rolled into zinc bath and air cooled.

CHEMISTRY CHAPTER 7(XII)

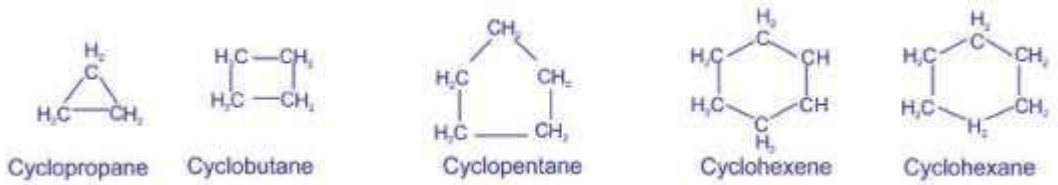
Short Questions:

1. What is thermal cracking?

Ans: Breaking down of large molecules by heating at high temperature and pressure is called Thermal Cracking. It is particularly useful in the production of unsaturated hydrocarbons such as ethene and propene.

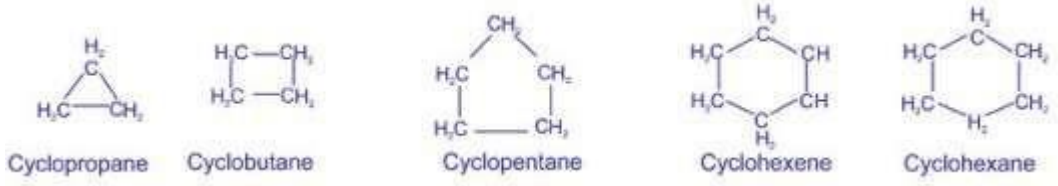
2. Define homocyclic compounds. Give examples.

Ans: The compounds in which the ring consists of only carbon atoms, Homocyclic or carbocyclic compounds. Homocyclic compounds are further classified as : 1. Alicyclic compounds 2. Aromatic compounds



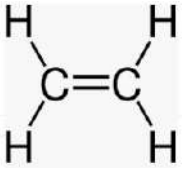
3. What are alicyclic compounds? Give two examples.

Ans: The homocyclic compounds which contain a ring of three or more carbon atoms and resembling aliphatic compounds are called alicyclic compounds. The saturated alicyclic hydrocarbons have the general formula Cn H2n. Typical examples of alicyclic compounds are given below.



4. Mention shapes angles of Ethene and Ethyne.

Ans: Carbon atoms in ethene are sp2 hybridized, the shape of the molecule is trigonal planar with a bond angle of 120o. ethyne molecule has sp hybridized carbon atoms and its shape is linear with 180o bond angle.



5. What are fused ring aromatic compounds?

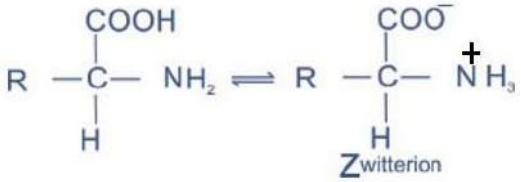
Ans: Those in which the benzene rings are fused together at ortho positions so that the adjacent rings have a common carbon to carbon bonds, e.g. naphthalene, phenanthrene and anthracene.

6. Branched hydrocarbons are better as a fuel as compared to straight chain. Explain.

Ans: Straight chain hydrocarbons e.g., n-Octane have low octane number and burn rapidly in internal combustion engine producing sharp metallic sound called knocking. Branched chain hydrocarbons e.g., Isoocante on the other hand are a good quality fuel as they do not cause knocking. This is because branched chain hydrocarbons have a higher octane number and burn smoothly.

7. Define tautomerism. Give an example.

Ans: The type of isomerism arises due to shifting of proton from one atom to other in the same molecule.



8. What is octane number and how it can be improved?

Ans: Percentage by volume of Isooctane relative to that of n-Heptane in a fuel is called octane number. Octane number is improved by making Isooctane through the process of reforming and adding it to a low octane number fuel.

9. How does cracking and reforming differ from each other?

Ans:

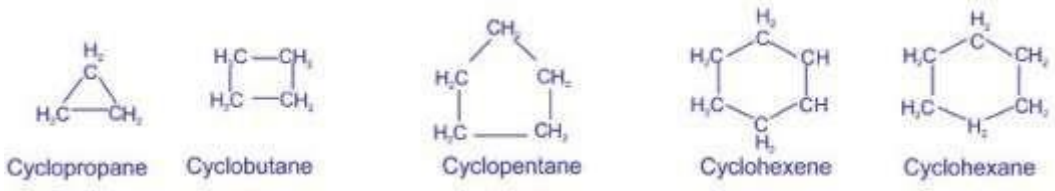
	Cracking	Reforming
1.	Conversion of long chain hydrocarbons having higher boiling points to lower hydrocarbons which are more volatile	Conversion of straight chain hydrocarbons which are low quality fuel to branched chain hydrocarbons which are good quality fuel
2.	It is used to increase the amount of hydrocarbons suitable for making gasoline	It is used to improve the octane number of fuel
3.	It is done using heat, steam or heating hydrocarbons in presence of a catalyst	It is done in by heating hydrocarbons in presence of a catalyst.

10. What are alicyclic and aromatic compounds? Give one example in each case.

Ans:

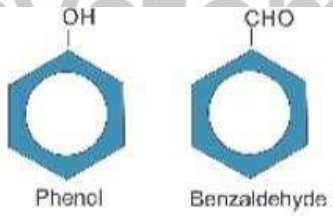
Alicyclic Compounds

The homocyclic compounds which contain a ring of three or more carbon atoms and resembling aliphatic compounds are called alicyclic compounds. The saturated alicyclic hydrocarbons have the general formula CnH2n. Typical examples of alicyclic compounds are given below.



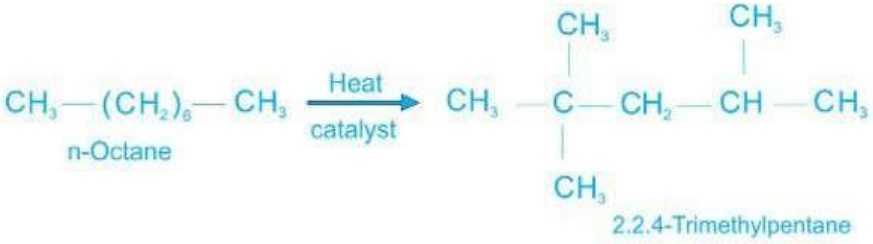
Aromatic Compounds

These carbocyclic compounds contain at least one benzene ring, six carbon atoms with three alternate double and single bonds. These bonds are usually shown in the form of a circle. Typical examples of aromatic compounds are given below. The aromatic compounds may have a side-chain or a functional group attached to the ring.



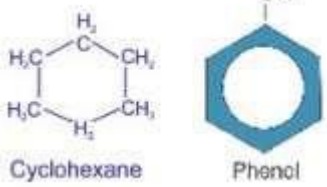
11. Define reforming of petroleum.

Ans: Conversion of straight chain hydrocarbons which are low quality fuel to branched chain hydrocarbons which are good quality fuel by heating in presence of a catalyst is called reforming. It is used to improve the fuel quality by increasing its octane number.



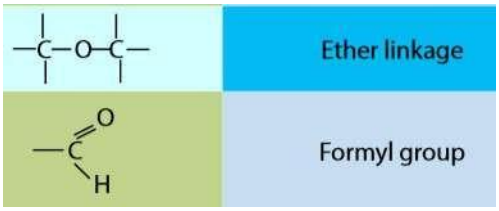
12. Differentiate between homocyclic and heterocyclic compounds.

Ans:

	Homocyclic Compounds	Heterocyclic Compounds
1.	The compounds in which the ring consists of only one type of atoms.	The compounds in which the ring consists of atoms of more than one kind
2.	Organic homocyclic compounds have ring made of carbon atoms only.	Generally one or more atoms of elements such as nitrogen (N), oxygen (O) or sulphur (S) are present in the ring.
3.	 Cyclohexane Phenol	 Pyridine

13. Define functional group. Give two examples of functional groups containing oxygen.

Ans: An atom or a group of atoms or a double bond or a triple bond whose presence imparts specific properties to organic compounds is called a functional group, because they are the chemically functional parts of molecules.

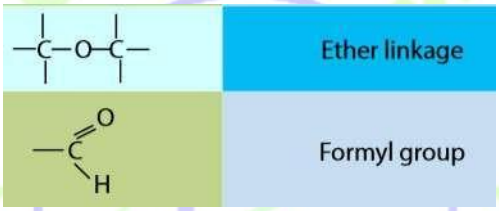


14. What are aromatic hydrocarbons? Give two examples.

Ans: The compounds of carbon and hydrogen containing at least one benzene ring, six carbon atoms with three alternate double and single bonds. These bonds are usually shown in the form of a circle. Typical examples of aromatic hydrocarbons are given below.

15. Define functional group isomerism. Give one example.

Ans: An atom or a group of atoms or a double bond or a triple bond whose presence imparts specific properties to organic compounds is called a functional group, because they are the chemically functional parts of molecules.

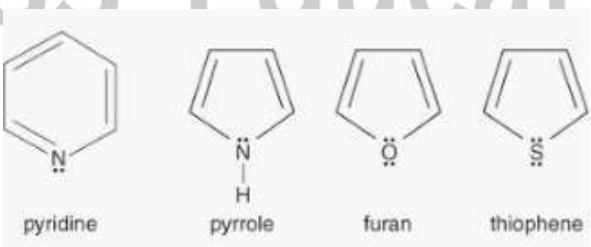


16. What is carbonization or destructive distillation of coal?

Ans: Carbonization or destructive distillation is when coal is heated in the absence of air (temperature ranging form 500-1000° C); it is converted into coke, coal gas and coal tar. Coal tar contains a large number of organic compounds, which separate out on fractional distillation.

17. What are heterocyclic compounds? Give names and formulas of two heterocyclic compounds.

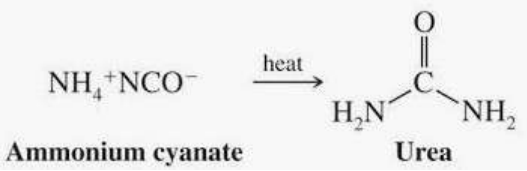
Ans: The compounds in which the ring consists of atoms of more than one kind are called heterocyclic compounds or heterocycles. In heterocyclic compounds generally one or more atoms of elements such as nitrogen (N), oxygen (O) or sulphur (S) are present. The atom other than carbon viz, N, O, or S, present in the ring is called a hetero atom.



18. Name the organic compound first of all prepared in the laboratory and how?

Ans: Friedrick Wohler obtained the first synthetic organic compound urea $(NH_2)_2CO$, an organic compound in the urine of mammals, from ammonium cyanate NH_4CNO on heating. His

work therefore resulted in rejection of vital force theory which stated that organic compounds can not be synthesized in laboratory.



19. Give an idea about the knocking in the internal combustion engine.

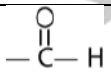
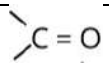
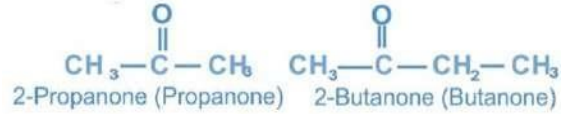
Ans: Straight chain hydrocarbons e.g., n-Heptane have low octane number and burn rapidly in internal combustion engine producing sharp metallic sound called knocking. Tetraethyl lead $(C_2H_5)_4Pb$, is an efficient antiknock agent but has one serious disadvantage; its combustion product, lead oxide, is reduced to metallic lead which is discharged into the air through the exhaust pipe and causes air pollution. These days quality of fuel is improved by increasing its octane number i.e., the percentage of branched chain hydrocarbons, through reforming. Branched chain hydrocarbons e.g., Isoocante do not cause knocking as they burn smoothly in internal combustion engine.

20. What are aromatic compounds? Explain with an example.

Ans: The compounds of carbon and hydrogen containing at least one benzene ring, six carbon atoms with three alternate double and single bonds. These bonds are usually shown in the form of a circle. Typical examples of aromatic hydrocarbons are given below.

21. Write the functional group of aldehyde and ketone. Give one example.

Ans:

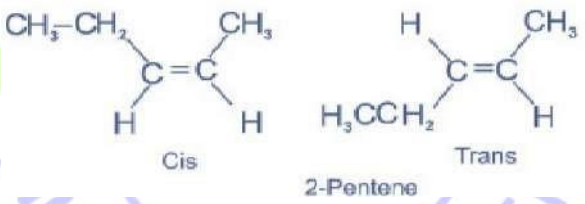
	Functional Group	Example
Aldehyde	 Formyl	 Formaldehyde Acetaldehyde
Ketone	 Carbonyl	 2-Propanone (Propanone) 2-Butanone (Butanone)

22. Define Metamerism with an example.

Ans: This type of isomerism arises due to the unequal distribution of carbon atoms on either side of the functional group. Such compounds belong to the same homologous series. For example, diethyl ether and methyl n-propyl ether are metamers.

23. Explain cis-trans isomerism. Give an example.

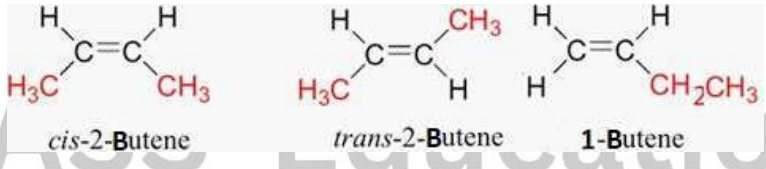
Ans: Such compounds which possess the same structural formula, but differ with respect to the positions of the identical groups in space are called cis - trans isomers and the phenomenon is known as the cis-trans or geometric isomerism.



24. 2-Butene shows geometric isomerism but 1-Butene does not. Why?

Ans: The conditions for cis – trans isomerism are

1. Restricted rotation of carbon atoms due to a double bond.
2. Two different groups attached to each carbon atom making the double bond.



2-Butnene meets both these conditions therefore shows geometric or cis-trans isomerism. 1-Butene has two hydrogen atoms on first carbon atom therefore it does not fulfill the second condition necessary for geometric isomerism hence has no cis or trans isomers.

25. Why is there no free rotation around a double bond but free rotation around a single bond?

Ans: A single bond is a sigma bond formed by the head to head overlap of half filled orbitals. The electrons of this bond are on the line joining the nuclei and allow rotation of atoms on nuclear axis in alkanes. A double bond consists of a sigma and a pi bond. A pi bond is formed by the parallel overlap of the half filled orbitals and its electron could lies above and below the

nuclear axis. This parallel overlap of the orbitals in a pi bond restricts rotation of the double bonded carbon atoms in alkenes.

26. What are the important conditions of cis-trans isomerism?

Ans: The conditions for cis – trans isomerism are

1. Restricted rotation of carbon atoms due to a double bond.
2. Two different groups attached to each carbon atom making the double bond.

27. What is importance of gasoline and gas oil?

Ans: Gasoline fraction of petroleum has hydrocarbons from C_4H_{10} to $C_{13}H_{28}$ with a boiling point range of 40 to 220 ^oC. Gasoline is used as a motor fuel. Gas oil fraction ranges from $C_{12}H_{26}$ to $C_{18}H_{38}$ with boiling points above 275 ^oC. This fraction is used as diesel and heating fuel.

28. What are the uses of Asphalt and Kerosene?

Ans: Asphalt of the petroleum coke is the solid fraction of crude oil and is obtained as residue after fractional distillation. It is used for paving, roofing and a fuel reducing agent. Kerosene fraction ranges from C_8H_{18} to $C_{14}H_{30}$. Its boiling point ranges from 175 – 325 ^oC and it is used as a heating agent.

29. Define homologous series.

Ans: A series of chemically similar organic compounds having same general formula is called a homologous

Homologous Series	General Formula
Alkanes	C_nH_{2n+2}
Alkenes	C_nH_{2n}
Alkynes	C_nH_{2n-2}

Fundamental Concepts of Organic Chemistry

LONG QUESTIONS:

1. Explain reforming of petroleum with the help of suitable examples.

2. Define sp3 and sp2 Hybridization. Give one example in each case.

3. Explain sp2 Hybridization along with describing structure of Ethene.

4. Write a note on classification of organic compounds.

5. Differentiate between homocyclic and heterocyclic compounds with two examples in each case.

6. Define isomerism. Explain the term Metamerism by giving two examples.

7. What is orbital Hybridization? Explain sp3 mode of hybridization.

8. What is sp Hybridization? Explain the structure of acetylene according to this theory.

9. What do you know about Cracking of petroleum? OR Define cracking and give its types.

10.Explain the structure of Ethene on the basis of sp2 Hybridization.

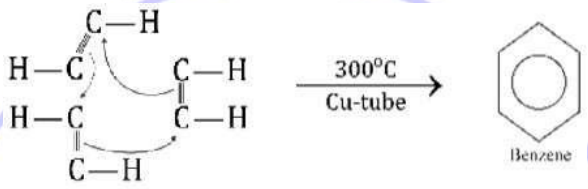
CHEMISTRY CHAPTER 8(XII)

(Aliphatic Hydrocarbons)

SHORT QUESTIONS:

1. How would you establish that benzene is a polymer of acetylene?

Ans: When acetylene is passed through a copper tube at 300°C, it polymerizes to benzene.



2. How do you distinguish between1-Butyne and 2-Butyne?

Ans: 1-Butyne is a terminal alkyne and thus acidic in nature. It therefore reacts with cuprous chloride Cu_2Cl_2 in presence of NH_4OH to produce a red precipitate. In 2-Butyne triple bond is not terminal hence triple bonded carbon atoms do not have a hydrogen atom attached and therefore lack acidic character. It gives no reaction with cuprous chloride Cu_2Cl_2 in presence of NH_4OH.

$$\underset{\text{1-Butyne}}{2CH_3CH_2{-}C{\equiv}CH} + Cu_2Cl_2 + 2NH_4OH \longrightarrow \underset{\text{red ppt.}}{2CH_3CH_2{-}C{\equiv}C{\cdot}Cu\downarrow} + 2NH_4Cl + 2H_2O$$

$$\underset{\text{2-Butyne}}{CH_3{-}C{\equiv}C{-}CH_3} + Cu_2Cl_2 + 2NH_4OH \longrightarrow \text{No reaction}$$

3. Mention four uses of ethene.

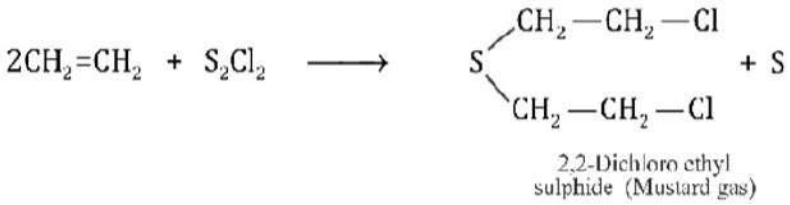
Ans:

1. for the manufacture of polythene, a plastic material used for making toys, cables, bags, boxes, etc.

2. for artificial ripening of the fruits.

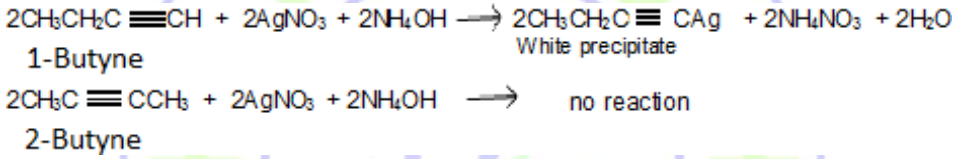
3. as a general anaesthetic.

4. for preparing 'Mustard gas' a chemical used in World War I. The name comes from its mustard like odour. It is not a gas, but a high boiling liquid that is dispersed as a mist of tiny droplets. It is a powerful vesicant i.e., causes blisters.



4. How Ammonical solution of AgNO3 can be used to distinguish between 1-Butyne and 2-Butyne.

Ans: 1-Butyne is a terminal alkyne and thus acidic in nature. It therefore reacts with ammonical silver nitrate $AgNO_3$ in presence of NH_4OH to produce a white precipitate. In 2-Butyne triple bond is not terminal hence triple bonded carbon atoms do not have a hydrogen atom attached and therefore lack acidic character. It gives no reaction with ammonical silver nitrate.

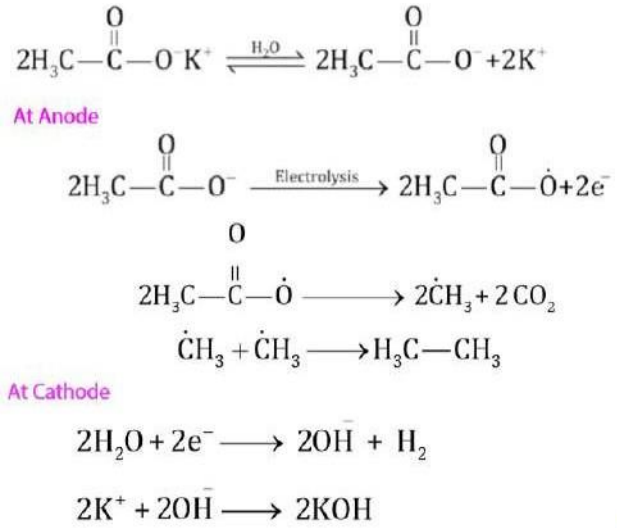


5. State Markownikov's rule. Give example.

Ans: The rule states that; in the addition of an unsymmetrical reagent to an unsymmetrical alkene, the negative part of the adding reagent goes to that carbon, constituting the double bond, which has least number of hydrogen atoms.

6. Write mechanism for Kolbe's electrolytic method for preparation of an alkane.

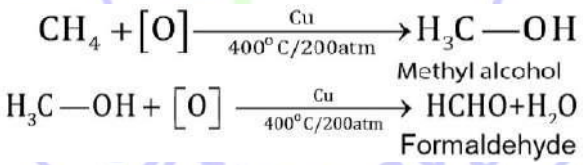
Ans:



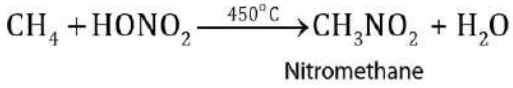
7. Convert methane into i. Formaldehyde ii. Nitromethane

Ans:

Methane into Formaldehyde



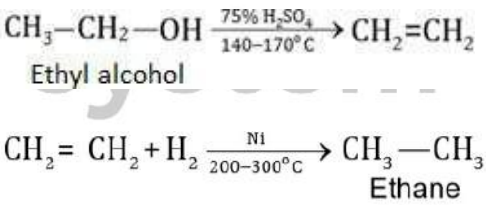
Methane into Nitromethane



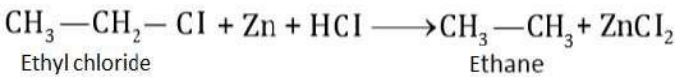
8. Prepare Ethane from i. Ethyl alcohol ii. Ethyl chloride

Ans:

Ethane from Ethyl alcohol

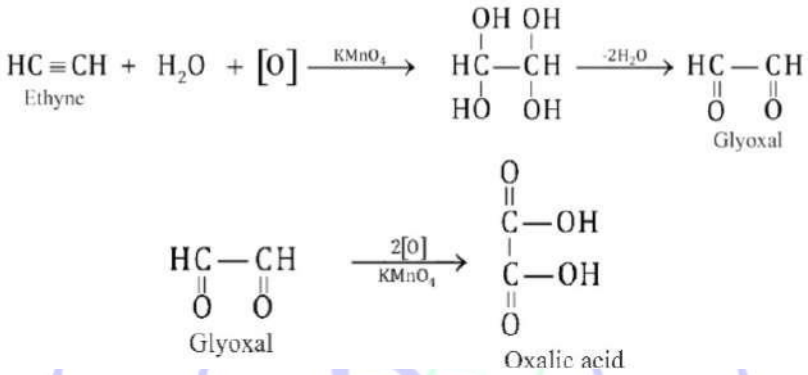


Ethane from Ethyl chloride



9. Write the chemical equation when alkaline $KMnO_4$ reacts with ethyne.

Ans:



10.Alkanes are less reactive than alkenes. Comment.

Ans:

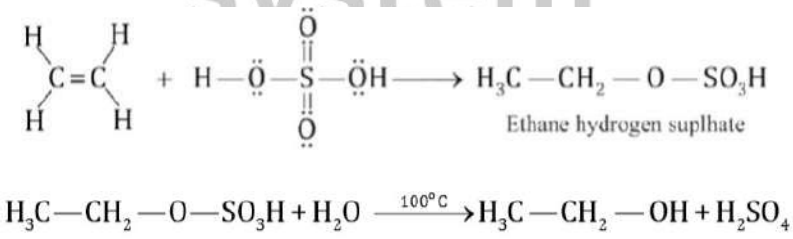
The unreactivity of alkanes under normal conditions may be explained on the basis of the non-polarity of the bonds forming them. The eletronegativity values of carbon (2.5) and hydrogen (2.1) do not differ appreciably and the bonding electrons between C-H and C-C are equally shared making them almost nonpolar. In view of this, the ionic reagents such as acids, alkalies, oxidizing agents, etc find no reaction site in the alkane molecules to which they could be attached.

Inertness of s-bond

The unreactivity of alkanes can also be explained on the basis of inertness of a s-bond. In a s -bond the electrons are very tightly held between the nuclei which makes it a very stable bond. A lot of energy is required to break it. Moreover the electrons present in a σ-bond can neither attack on any electrophile nor a nucleophile can attack on them. Both these facts make alkanes less reactive.

11. Ethene can be converted to ethyl alcohol. Write equation.

Ans:



12.Give four uses of Methane.

Ans:

(i) as a fuel and as an illuminating gas.

(ii) for the preparation of methylchloride, dichloromethane, chloroform and carbon tetrachloride.

(iii) for the industrial preparation of methyl alcohol, formaldehyde and hydrogen cyanide.

(iv) for the preparation of carbon black used in paints, printing inks and automobile tyres.

(v) is used to manufacture urea fertilizer.

13.What is Baeyer's test? What is its use?

Ans:

When alkenes are treated with mild oxidizing reagents like dilute (1%) alkaline $KMnO_4$ solution (Baeyer's Reagent) at low temperature, hydroxylation of duoubie bond occurs resulting in the formation of dihydroxy compounds known as vicinal glycols. The pink colour of $KMnO_4$ solution is discharged during the reaction. This test is used to check the presence of unsaturation in the molecules. For example,

$$3H_2C{=}CH_2 + 2KMnO_4 + 4H_2O \xrightarrow{\text{Cold}} \underset{\text{Ethylene glycol}}{H_2C(OH)-CH_2(OH)} + 2MnO_2 + 2KOH$$

14. How cis and trans alkenes are produced? Give reactions.

Ans:

Controlled hydrogenation of alkynes with hydrogen gas in an equimolar ratio over heated catalysts, gives alkenes. The catalyst is finely divided palladium supported on $BaSO_4$ and poisoned by treatment with quinoline (Lindlar's catalyst).

$$R{-}C{\equiv}C{-}R + H_2 \xrightarrow[\text{Quinoline}]{Pd(BaSO_4)} \underset{\text{Cis-Alkene}}{\text{R, R, H, H around C=C}}$$

A trans alkene can be obtained by treating an alkyne with Na in liquid NH3 at -33°C.

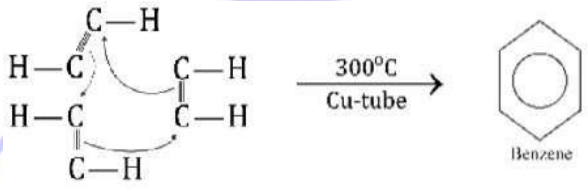
$$R{-}C{\equiv}C{-}R + 2[H] \xrightarrow[-33^{\circ}C]{Na/\text{liquid}.NH_3} \underset{\text{trans-Alkene}}{\text{R, H, H, R around C=C}}$$

15. How will you synthesize following compounds from ethyne (acetylene). i. Benzene ii. Chloroprene
OR Convert (i) acetylene to benzene (ii) vinyl acetylene to chloroprene

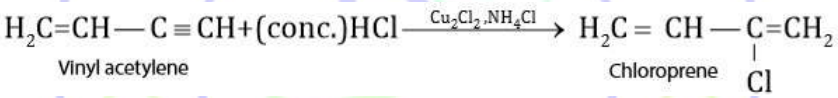
Ans:

(i) acetylene to benzene

When acetylene is passed through a copper tube at 300°C, it polymerizes to benzene.

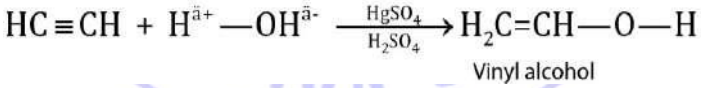


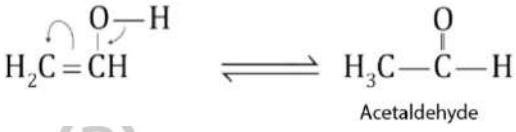
(ii) vinyl acetylene to chloroprene



16.Convert ethyne into acetaldehyde.

Ans:





17. Sigma bond is inert. Justify it.

Ans:

The unreactivity of alkanes can also be explained on the basis of inertness of a s-bond. In a s -bond the electrons are very tightly held between the nuclei which makes it a very stable bond. A lot of energy is required to break it. Moreover the electrons present in a σ-bond can neither attack on any electrophile nor a nucleophile can attack on them. Both these facts make alkanes less reactive.

18.Why alkanes are less reactive organic compounds?

Ans:

The unreactivity of alkanes under normal conditions may be explained on the basis of the non-polarity of the bonds forming them. The eletronegativity values of carbon (2.5) and hydrogen (2.1) do not differ

appreciably and the bonding electrons between C-H and C-C are equally shared making them almost nonpolar. In view of this, the ionic reagents such as acids, alkalies, oxidizing agents, etc find no reaction site in the alkane molecules to which they could be attached.

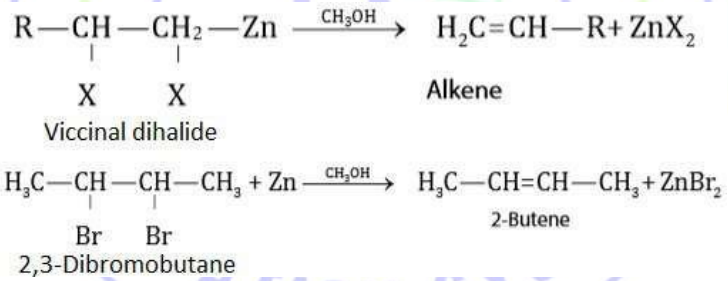
Inertness of s-bond

The unreactivity of alkanes can also be explained on the basis of inertness of a s-bond. In a s -bond the electrons are very tightly held between the nuclei which makes it a very stable bond. A lot of energy is required to break it. Moreover the electrons present in a σ-bond can neither attack on any electrophile nor a nucleophile can attack on them. Both these facts make alkanes less reactive.

19. What happens when vicinal dihalide is treated with Zinc dust?

Ans:

Vicinal dihalides have two halogens on adjacent carbon atoms. Dehalogenation occurs when dihalide is treated with Zinc dust in an anhydrous solvent like methanol or acetic acid.



20. Why alkanes are called Paraffins and alkenes as Olefins?

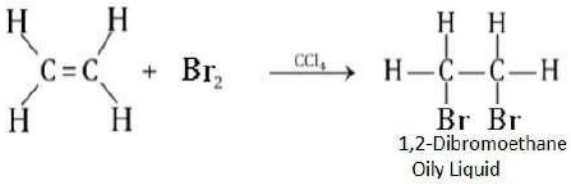
Ans:

The alkanes or paraffins (Latin: parum = little, affins = affinity) under ordinary condition are inert towards acids, alkalis, oxidizing and reducing agents. However, under suitable conditions, alkanes do undergo two types of reactions.

1. Substitution Reactions

2. Thermal and Catalytic Reactions

They are also known as Olefins (derived from Latin word olefiant meaning oil forming) because lower members form oily products on treatment with chlorine or bromine.



LONG QUESTIONS:

1. Give one method of preparation of each of Ethane, Ethene and Ethyne.

2. Discuss acidic nature of alkynes with at least two examples.

3. Convert (i) acetic acid into methane (ii) 1-Propanol to 1-Chloro-2-propanol.

4. How can you convert i. 2,3-Dibromo butane into 2-Butene ii. Acetone into propane iii. Acetylene into vinyl acetylene iv. Acetylene into Disilver acetylide

5. How can you convert v. Propyne into acetone vi. Ethyne into oxalic acid

6. Discuss acidic behaviour of alkynes. What are the main uses of alkynides?

7. How will you distinguish between Ethane, Ethene and Ethyne? Give comparison of reactivity of alkane, alkene and alkyne.

8. Prepare Ethane from Kolbe's electrolysis?

9. How is ethene prepared by Kolbe's electrolytic method? Write its mechanism.

10. Write a note on Halogenation of alkanes.

11. Write chemical reactions of Ethene with the following. i. HCl ii. Br2 iii. O3 iv. HOX

12. Why are some hydrocarbons called saturated and others unsaturated? Write down their characteristic reactions.

13. What are the rules for naming alkynes? Give suitable examples.

CHEMISTRY CHAPTER 9(XII)
(Aromatic Hydrocarbons)

Short Questions:

1. Write general mechanism of electrophilic substitution reactions in benzene.

OR

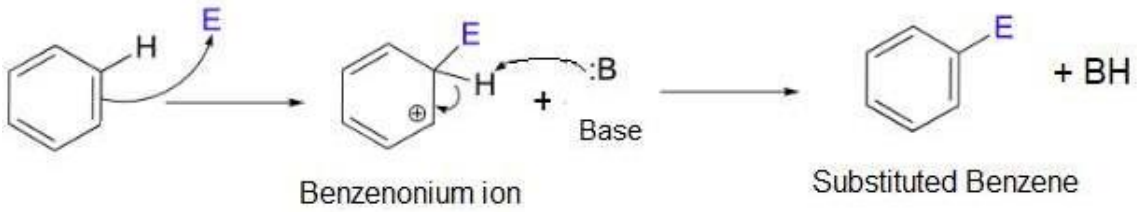
Give general pattern of reactivity of benzene towards electrophiles.

Mechanism of electrophilic substitution reaction:

The general pattern of the chemical reactivity of benzene towards electrophiles can be shown as follows.

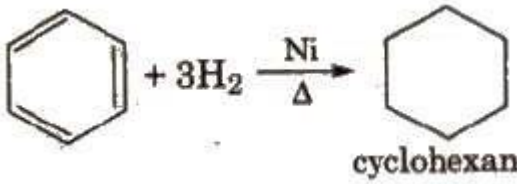
i. Pi electrons of benzene ring are donated to the strong electrophile (E^+) and benzenonium ions are formed. Benzenonium ions are unstable.

ii. A proton is released with the help of strong base from benzenonium ion and stability of benzene is retained.

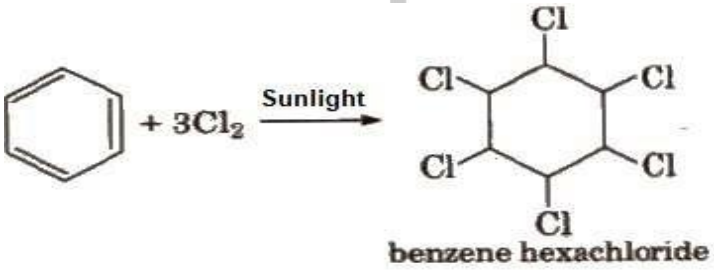


2. Benzene has three pi bonds. Prove it by two points.

i. Benzene adds three hydrogen molecules in the presence of a catalyst. It indicates that it has three pi bonds in it.



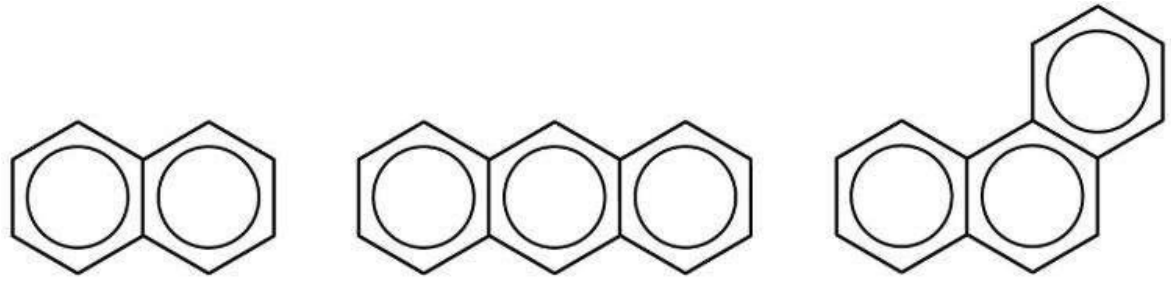
ii. Benzene adds three molecules of chlorine in the presence of sunlight, showing the presence of three pi bonds.



3. What are fused ring aromatic compounds? Give examples.

Fused ring aromatic compounds

The compounds in which the benzene rings are fused together so that the adjacent rings have a common carbon to carbon bonds are called fused ring aromatic compounds. For e.

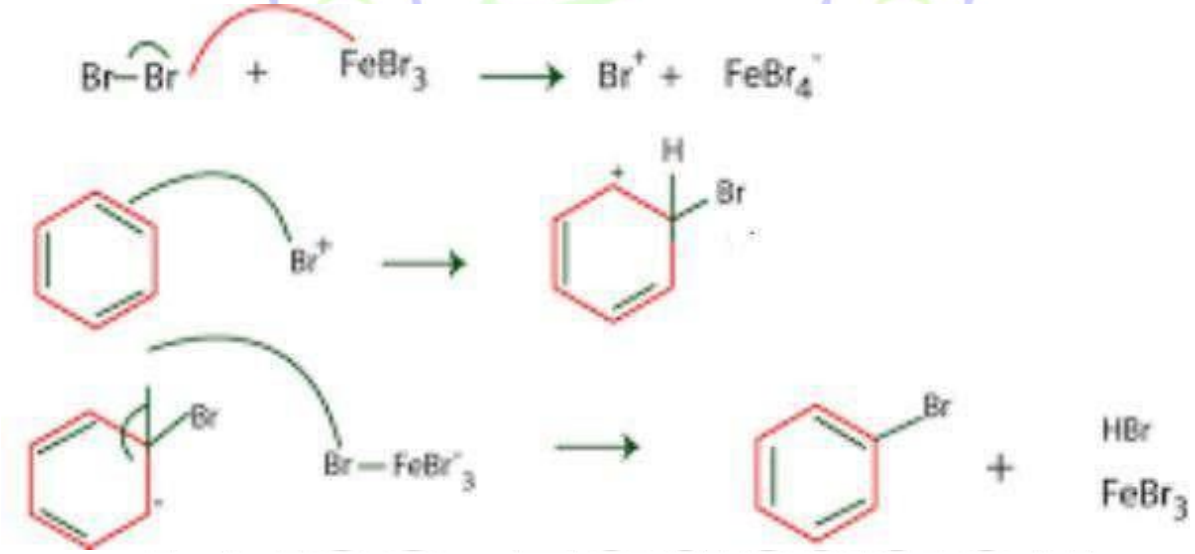


Naphthalene Anthracene Phenanthrene

4. Predict major product of the bromination of benzene. Also give equation.

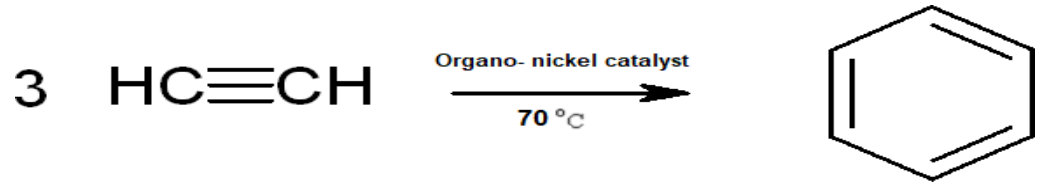
Bromination of benzene ring:

If hydrogen atom of benzene ring is substituted by bromine atom, it is called Bromination.

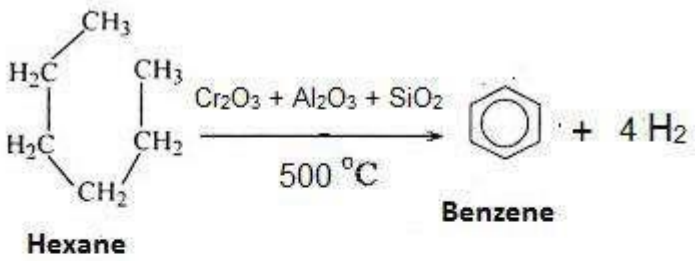


5. Benzene can be prepared commercially from acetylene. Give reaction with Conditions.

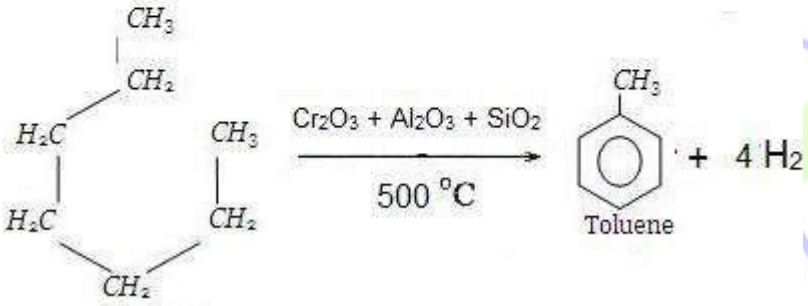
Benzene is formed by passing acetylene under pressure over an organo-nickel catalystat 70°C.



6. How Hexane and Heptane can give Benzene and Toluene respectively?



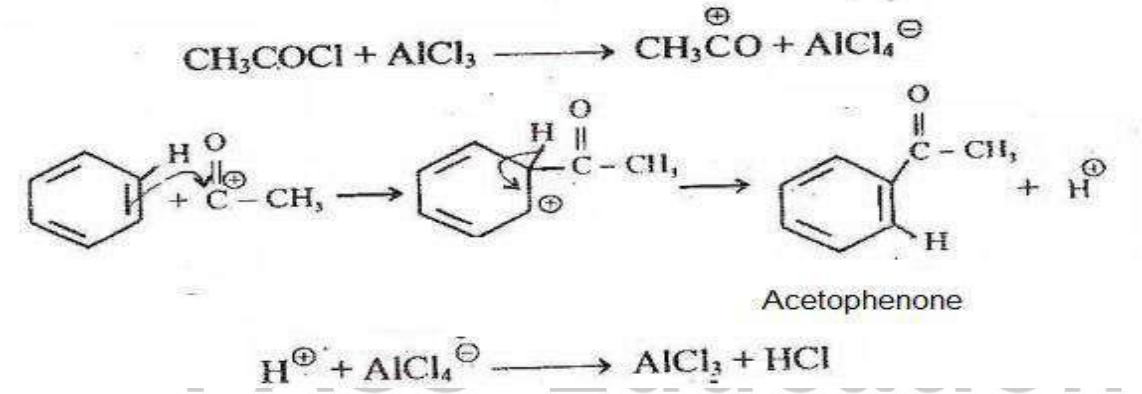
Hexane **Benzene**



n-Heptane Toluene

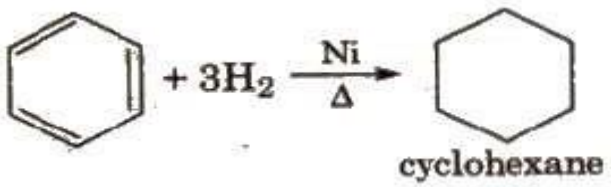
7. How Benzene can be converted to Acetophenone? Give mechanism.

Benzene can be converted to Acetophenone by Friedel Craft Acylation. The mechanism of reaction is given below.

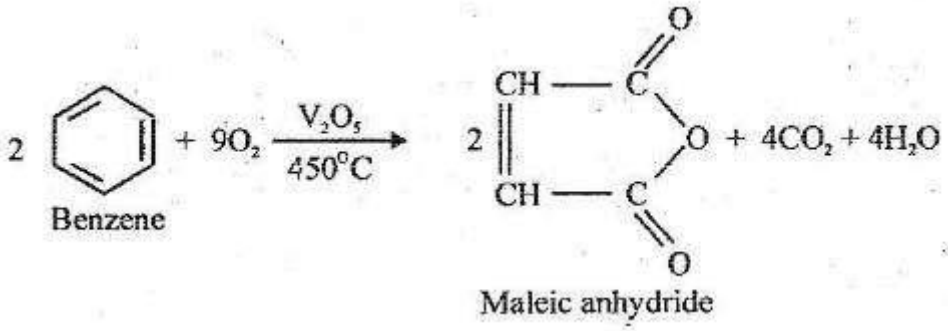


8. Convert benzene into:

i. Cyclohexane ii. Maleic anhydride



cyclohexane



9. Give two reasons that rule out straight chain structures of benzene.

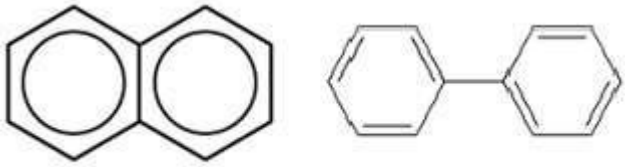
i. Considering a straight chain structure for benzene and further assuming that each carbon carries one H-atom, it should be capable of forming three mono substitution products. But benzene only gives one mono substituted product. Which shows it does not have straight chain structure.

ii. The molecular formula of benzene is C_6H_6. This formula does not correspond to any aliphatic hydrocarbon like Alkane C_nH_{2n+2}, Alkene C_nH_{2n} or Alkyne C_nH_{2n-2}.

All above points indicate that benzene does not belong to open chain hydrocarbons and has cyclic structure.

10. What are polycyclic aromatic hydrocarbons? Give examples.

Polycyclic aromatic hydrocarbons:
Aromatic compounds containing two or more benzene rings in their molecules are called polycyclic aromatic hydrocarbons.
The benzene rings present in polycyclic aromatic hydrocarbons can be isolated (e.g. Biphenyl) or they may be fused together (e.g. Naphthalene).



11. Briefly describe X-rays studies of benzene.

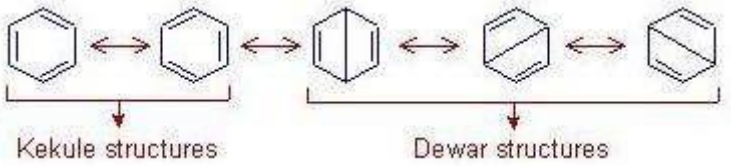
X-rays studies of benzene:

i. The X-ray studies have confirmed the hexagonal structure for it.
ii. The studies have also revealed that all the carbon and hydrogen atoms are in the same plane. All the angles are of 120°.
iii. All C-C and C-H bond lengths are 1.397 A° and 1.09 A°, respectively.

12. Define Resonance and write down resonance structures of benzene.

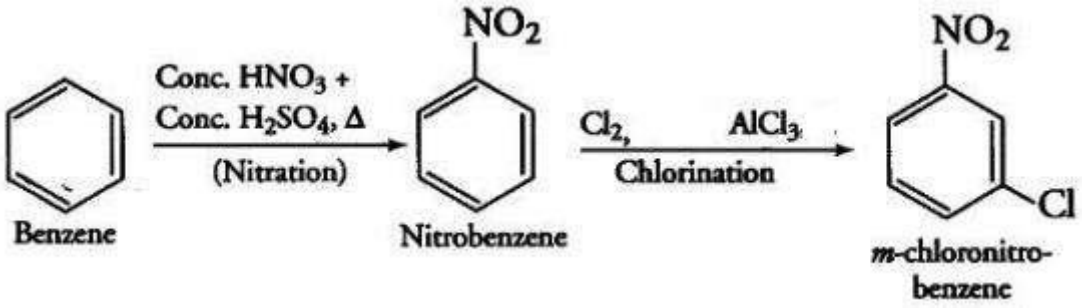
Resonance:
The possibility of different pairing schemes of valence electrons of atoms in a molecule is called resonance, and the different structures thus arranged are called resonance structures.

Resonance structures of benzene:

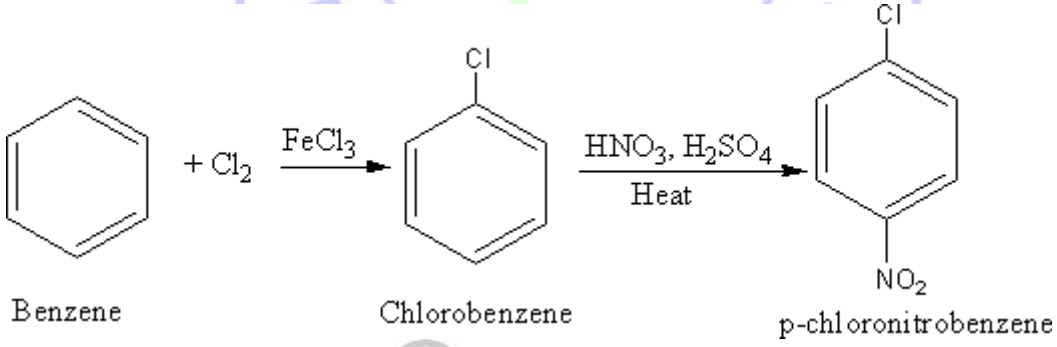


13. How will you prepare following compounds from benzene in two steps?
i. m-Chloronitrobenzene ii. P-Chloronitrobenzene

Conversion of benzene to m-Chloronitrobenzene

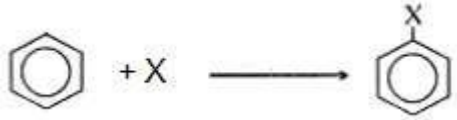


Conversion of benzene to P-Chloronitrobenzene

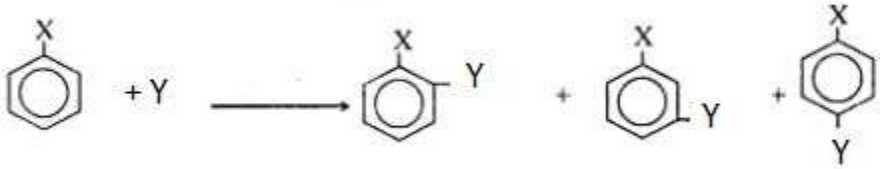


14. Prove that Benzene has cyclic structure.

i. Benzene gives only one mono substituted product.



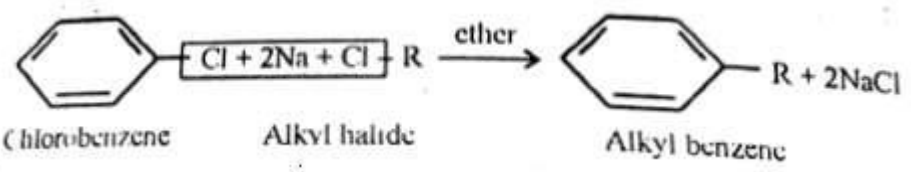
ii. Benzene gives only three di substituted products.



These points confirm the regular hexagonal structure for benzene in which all the carbon atoms are occupying identical positions in the molecule. So, we can say that benzene has a cyclic structure, therefore benzene forms only one toluene, one phenol and one nitrobenzene.

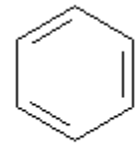
15. What is Wurtz-Fittig reaction? Give an example.

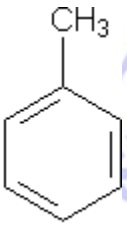
Wurtz-Fittig reaction:
The Wurtz reaction for the synthesis of alkanes was extended by Fittig in 1864 to the synthesis of alkyl aromatic hydrocarbons.
When a mixture of alkyl halide and an aryl halide is treated with sodium metal in dry ether, the sodium preferentially attack the alkyl halide to form alkylated aromatic compound. Thus mixed Wurtz reaction is called Wurtz –Fittig reaction.
Example:



16. What are aromatic hydrocarbons? Give two examples.

Aromatic hydrocarbons:
The aromatic hydrocarbons are closed-chain hydrocarbons containing a benzene ring or its derivatives.
Examples:


benzene



toluene

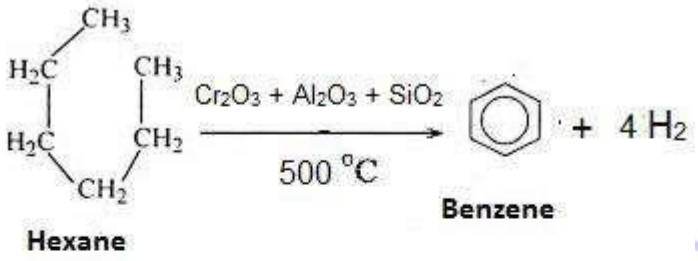
17. Define resonance energy. Give resonance energy of benzene.

Resonance energy:
The difference in energy between hypothetical structure (1,3,5-cyclohexatriene) and actual structure (benzene) is called resonance energy.
Resonance energy of benzene:
The resonance energy of benzene is 150.5 kJ/mol, which shows that it is more stable than 1,3,5-cyclohexatriene by 150.5kJ/mol.

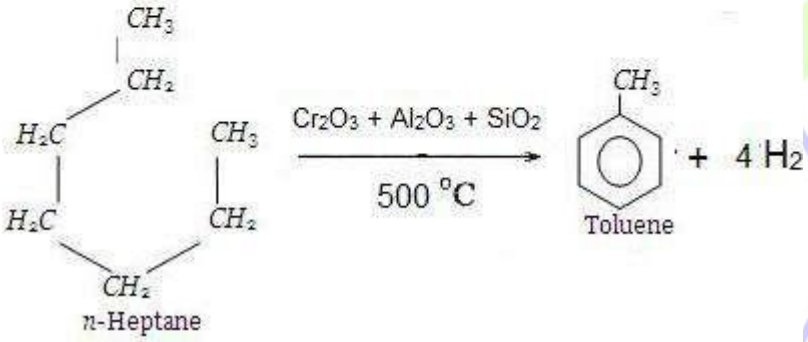
18. What is aromatization?

Aromatization:

Aromatization is the conversion of a nonaromatic hydrocarbon to an aromatic hydrocarbon. Benzene and toluene can be formed by aromatization of n-hexane and n-heptane as follows.

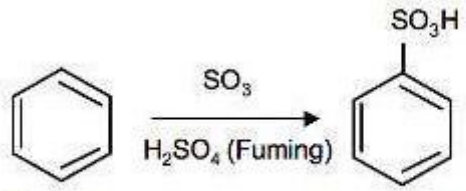


Hexane **Benzene**



19. Give reaction of benzene with SO_3.

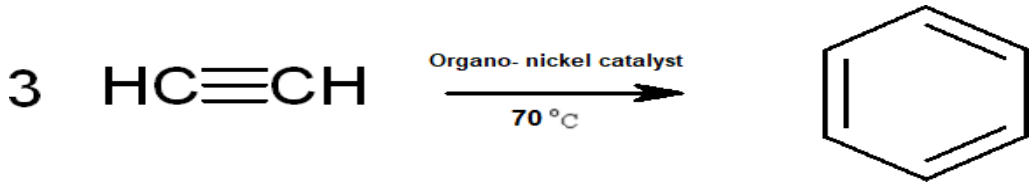
Benzene reacts with sulphur trioxide in the presence of concentrated sulphuric acid to produce Benzene sulfonic acid.



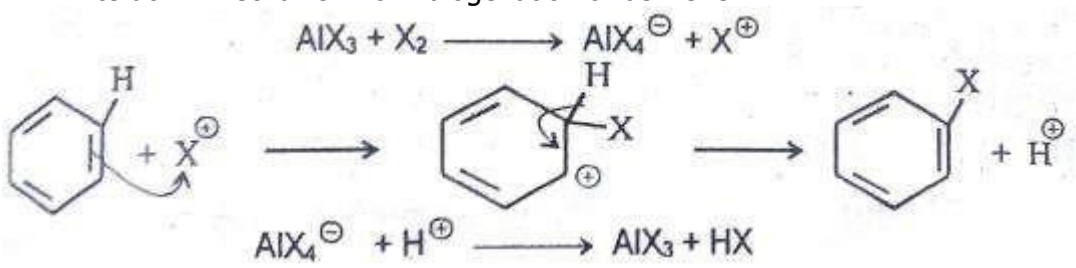
Benzene Benzenesulfonic acid

20. How will you synthesize benzene from Ethyne?

Benzene is formed by passing ethyne under pressure over an organo-nickel catalystat 70°C.



21. Write down mechanism for Halogenation of benzene.

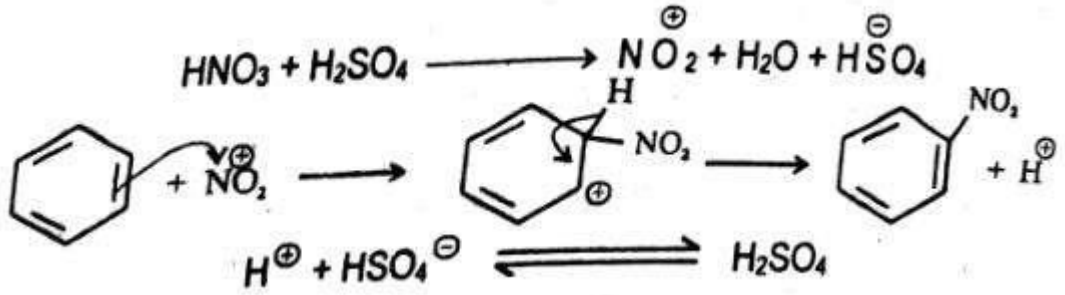


22. Give mechanism for nitration of benzene. **OR** What is meant by nitration of benzene?

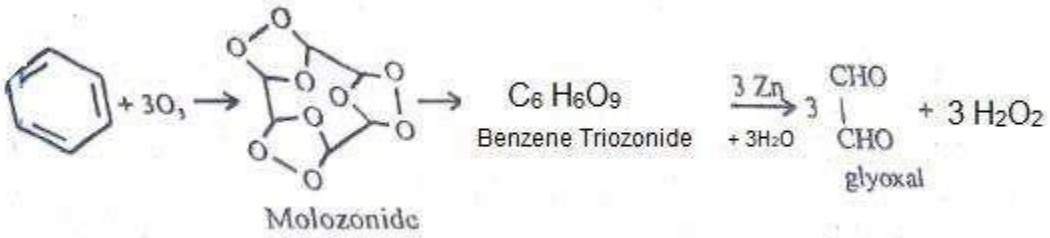
Nitration of benzene:

Introduction of nitro group in the benzene ring is called nitration of benzene. It takes place when benzene is heated with conc. HNO_3 and conc. H_2SO_4 at 50°C.

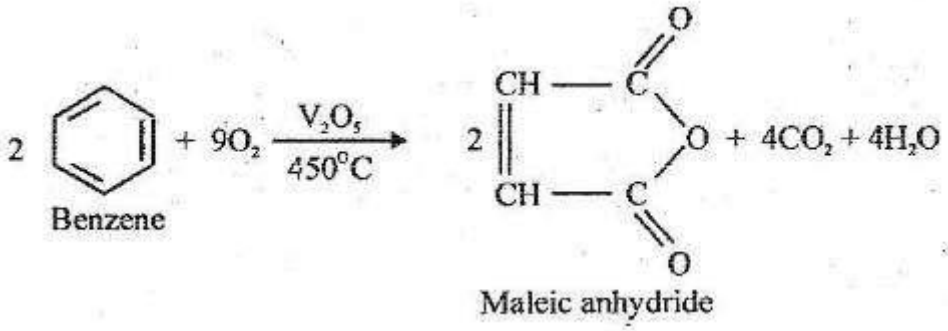
Mechanism:

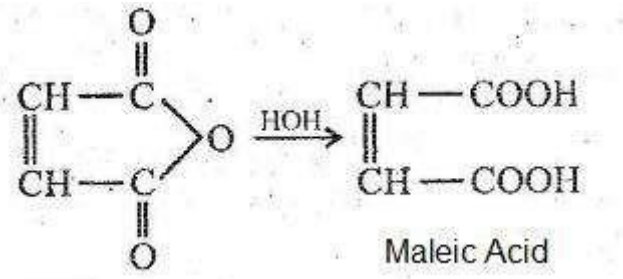


23. Give reaction of benzene with ozone.



24. How benzene is converted into Maleic acid by catalytic oxidation?





25. What happens when benzene is burnt in free supply air? Give equation.

When benzene is burnt in free supply of air, it is completely oxidized to CO_2 and H_20.

$$2C_6H_6 + 15O_2 \text{ --------> } 12CO_2 + 6H_2O$$

LONG QUESTIONS:

1. Write three methods of preparation of benzene.
2. What is meant by orientation in Benzene? Why certain substituents are ortho-para directive and others meta directive? Give one example of each.
3. Describe the structure of Benzene on the basis of resonance method.
4. Write a note on Friedal-crafts reactions.
5. What happens when toluene is reacted with **i.** Cl_2 in sunlight **ii.** $KMnO_4$ in presence of H_2SO_4.
6. Convert benzene into:
i. Cyclohexane **ii.** Maleic acid **iii.** Glyoxal **iv.** Benzene sulphonic acid
7. Give reaction of benzene with respect to i. Nitration ii. Sulphonation
8. Write down four chemical methods for the preparation of benzene.
9. Write down the classification of aromatic hydrocarbons giving one example in each.
10. Write down two reactions in which benzene behaves as saturated hydrocarbon and two reactions in which as unsaturated hydrocarbon.ive equation.

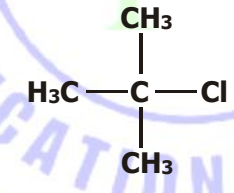
Chemistry Part II Chapter#10 (Alkyl Halides)
SHORT QUESTIONS

1. What are primary and tertiary alkyl halides? Give one example of each.

Ans: **Primary alkyl halides:**
The alkyl halides in which halogen atom is attached to a carbon atom which is further attached with one carbon atom or no carbon atom are called primary alkyl halides.
Tertiary alkyl halides:
The alkyl halides in which halogen atom is attached to a carbon atom which is further attached with three carbon atoms are called tertiary alkyl halides.
Examples:
Primary alkyl halide:

CH_3-Br
Methyl bromide

Tertiary alkyl halide:



2-Chloro-2-methylpropane

2. How alkyl halides can be prepared by alcohols? Give two examples.

Ans: **(a) Reaction of alcohols with halogen acids:**
Alcohols may be converted to the corresponding alkyl halides by the action of halogen acid in the presence of $ZnCl_2$, which acts as a catalyst

$$CH_3CH_2 - OH + HX \xrightarrow{ZnCl_2} CH_3CH_2 - X + H_2O$$

Ethyl halide

(b) Reaction of alcohols with thionyl chloride:
Alcohols react with thionyl chloride in pyridine as a solvent to give alkyl chlorides. This is the best method because HCl, and SO_2 gases escape leaving behind the pure product.

$$ROH + SOCl_2 \xrightarrow{Pyridine} R - Cl + SO_2 + HCl$$

3. **Write down reactions of ethanol with (i) PBr_3 (ii) PCl_5**

Ans: **Reactions of ethanol with phosphorus halides:**
Phosphorus tribromide and Phosphorus pentachloride react with Ethanol to produce alkyl halides as follows.

$$3CH_3—CH_2—OH + PBr_3 \longrightarrow 3CH_3—CH_2—Br + H_3PO_3$$
$$CH_3—CH_2—OH + PCl_5 \longrightarrow CH_3—CH_2—Cl + POCl_3 + HCl$$

4. Explain the order of reactivity of alkyl halides on the basis of bond polarity.

Ans: According to this factor, greater the electronegativity difference between carbon and halogen greater the bond polarity. Greater the polarity greater the reactivity. So with this rule the alkyl fluorides should be the most polar and the most reactive and alkyl iodides least polar and least reactive.
It means reactivity order must be like this;

R-F>R-Cl>R-Br>R-I

5. What is the order of reactivity of HX with Ethene?

Ans: Ethene reacts with HX to form Ethyl halide.

$$CH_2 = CH_2 + HX \dashrightarrow CH_3 - CH_2\text{-}X$$

The order of reactivity of HX is given below.

Hl > HBr > HCl > HF

6. How the bond dissociation energy of carbon suggests that alkyl iodides should have maximum reactivity?

Ans: Bond energy directly depends on bond polarity. The bond dissociation energy of C-X bond is in the order:

C – F > C – Cl > C – Br > C –I

Greater the bond energy, stronger the bond and lesser the reactivity. With this rule the reactivity order must be like this;

R-I>R-Br>R-Cl>R-F

Alkyl iodides should be most reactive due to least bond energy.

7. What is Wurtz's synthesis reaction?

Ans: Alkyl halides react with sodium in ether (solvent) to give alkanes. This is called Wurtz's synthesis. The reaction is particularly useful for preparation of symmetrical alkanes with double number of carbon atoms as compared with that in alkyl halide used.

$$CH_3 - CH_2 - Cl + 2Na + Cl - CH_2 - CH_3 \xrightarrow{\text{Ether}} CH_3 - CH_2 - CH_2 - CH_3 + 2NaCl$$

n-Butane

8. What is difference between molecularity and order of reaction?

Ans:

Molecularity	Order of Reaction
Molecularity is defined as the number of molecules taking part in the rate determining step of reaction.	Sum of exponents of conc. terms in the rate expression of a chemical equation is called order of reaction.
It is calculated through balanced chemical equation	It is always experimentally determined.

9. How antiknocking agents are prepared?

Ans: **Preparation of anti-knocking agents:**

Methyl chloride and Ethyl chloride can react with sodium lead alloy to produce anti-knocking agents, Tetramethyl lead and Tetraethyl lead respectively.

$$4CH_3Cl + Na_4Pb \longrightarrow \underset{\text{Tetramethyl lead}}{(CH_3)_4Pb} + 4NaCl$$

$$4CH_3CH_2Cl + Na_4Pb \longrightarrow \underset{\text{Tetraethyl lead}}{(CH_3CH_2)_4Pb} + 4NaCl$$

10. In tertiary alkyl halides, S_N1 reaction takes place but not S_N2 reaction. Why?

Ans In ter-alky halide, attacking neucleophile cannot reach directly at the electrophilic center (carbon) due to steric hindrance. So attachment of attacking nucleophile and removal of leaving group can't occur simultaneously as occurs in S_N2 reactions. As a result in tertiary alkyl halides nucleophilic substitution occurs in two steps i.e. S_N1 mechanism occurs. In first step halogen (leaving group) is removed to reduce steric hindrance and planar carbocation is formed. In second step attack of new nucleophile takes place.

11. What is the role of Carbonium ion for determining SN_1 or SN_2 mechanism?

Ans: Greater the stability of the carbonium ion, greater the possibility for two step mechanism which is S_N1. These alkyl halides which can provide unstable carbonium ion give S_N2 mechanism, which is a single step reaction. Carbonium ion is stable if it is bonded to maximum number of alkyl groups.

12. What is meant by attacking nucleophile? Give examples.

Ans: In S_N reactions, the nucleophile which attacks on the electrophilic carbon of alkyl halide from outside is called attacking nucleophile.

Examples:

$-OH^-$, -CN etc.

13. Reaction of Ethyl bromide with OH^- nucleophile is S_N2. Why?

Ans: Reaction of ethyl bromide with OH^- is SN_2 because it is a bimolecular reaction. The rate of reaction depends upon the concentration of nucleophile as well as substrate.

$$CH_3-CH_2-Br + OH^- \rightarrow CH_3-CH_2-OH + Br^-$$

$$\text{Rate} = k[CH_3CH_2Br][OH]$$

$$\text{Order} = 2$$

14. What is difference between Electrophile and Nucleophile?

Ans:

Electrophile	Nucleophile
(i) It is an electron deficient species.	It is electron rich species.
(ii) It always acts as Lewis acid.	It always acts as Lewis base.
(iii) It may be neutral or positively charged.	It may be negatively charged or neutral with one or more lone pairs.
(iv) Examples: NO_2^+, SO_3	Examples: Cl^-, NH_3

15. What are differences between S_N1 and S_N2 reactions?

Ans:

S_N1	S_N1
(i) It is a two step mechanism.	It is a single step mechanism.
(ii) First step is slow and second is fast.	It has only one step and that is slow.
(iii) It is unimolecular reaction.	It is a bimolecular reaction.
(iv) It is a favored in polar solvents.	It is favored in non-polar solvents.

16. Why tertiary alkyl halides follow S_N1 mechanism and not S_N2 mechanism? OR During S_N1 reaction, what is the significance of first step?

Ans: S_N1 mechanism involves two steps. Due to steric (space) hindrance, the attack of nucleophile on the α-carbon of substrate is not directly possible. In order to create space for the attack, older nucleophile means halogen needs to be removed first. This is the reason that reaction occurs in two steps. The first step is the reversible ionization of the alkyl halide. This step provides a **carbocation** as an intermediate. In the second step this carbocation is attacked by the nucleophile to give the substitution product.

In S_N2 reactions, the there is no issue of steric hindrance as α-carbon of primary alkyl halide is surrounded by small groups e.g. Hydrogen atoms and attacking nucleophile finds space to attack on carbon.

17. What are leaving group and substrate?

Ans: **Leaving Group:**

Leaving group (L) is also a nucleophile. In S_N reactions of alkyl halides, the halogens are the leaving groups. It is called leaving group because it departs from alkyl halide.

Examples:

Cl^-, Br^-, I^-, HSO_4^-

Substrate Molecule:

The alkyl halide molecule on which a nucleophile attacks is called a substrate molecule.

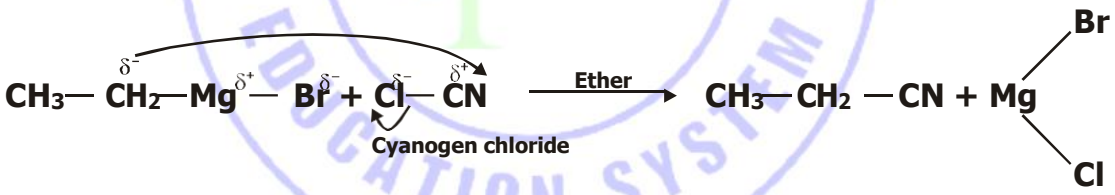
18. What is difference between Elimination and substitution reactions?

Ans:

Elimination	substitution
Elimination of two atoms or groups from adjacent carbon atoms in the presence of a nucleophile or a base is called elimination reaction.	Substitution reaction involves the breakage of C-X bond and the formation of C-Nu bond.
The product of an elimination reaction is alkene usually.	Substitution reaction yields substitution product
Example: $CH_3CH_2X+OH^- \longrightarrow H_2C=CH_2+ H_2O$	**Example:** $CH_3\text{-}X + OH^- \rightarrow CH_3\text{-}OH + X^-$

19. How do we get alkyl nitriles from Grignard's reagent?

Ans: When Cl–CN is reacted with Grignard's reagent. The alkyl group of the Grignard's reagent combines with –CN group to give Alkyl nitrile. See example below;



20. Explain the structure and reactivity of Grignard's reagent.

Ans: Grignard's reagent are much reactive than most of the organic compounds. The reactivity is due to the nature of C-Mg bond which is highly polar.

$$CH_3^{\delta-}CH_2-Mg^{\delta+}X^{\delta-}$$

Magnesium is more electropositive than carbon and C-Mg bond though covalent is highly polar, giving alkyl carbon the partial negative charge. The negative charge is an unusual character which makes the alkyl groups highly reactive towards electrophilic centers.

21. What is the nature of C-Mg bond in R-Mg-X?

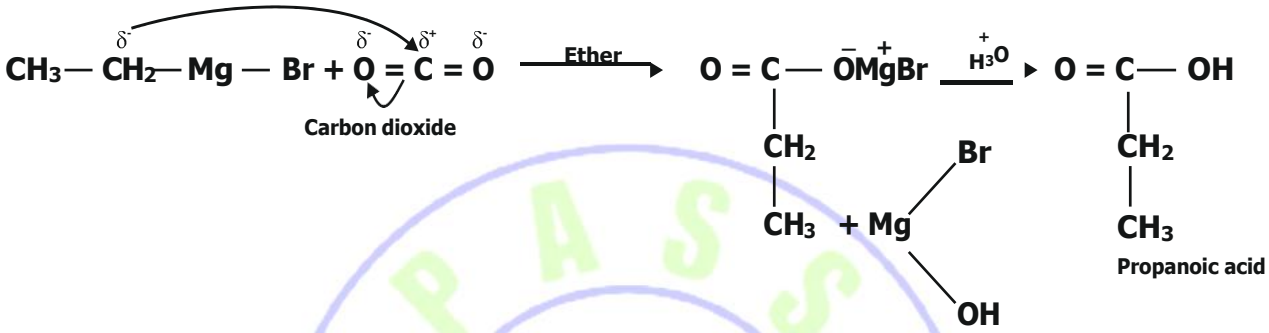
Ans: Grignard's reagents are very reactive organic compounds. Their reactivity is due to C-Mg bond which is highly polar.

$$CH_3\overset{\delta-}{C}H_2-\overset{\delta+}{Mg}-\overset{\delta-}{X}$$

Magnesium is less electronegative that carbon so partial positive charge appears on magnesium and partial negative on carbon attached to it. This –ve charge on carbon is very unusual which makes alkyl group very reactive towards electrophiles.

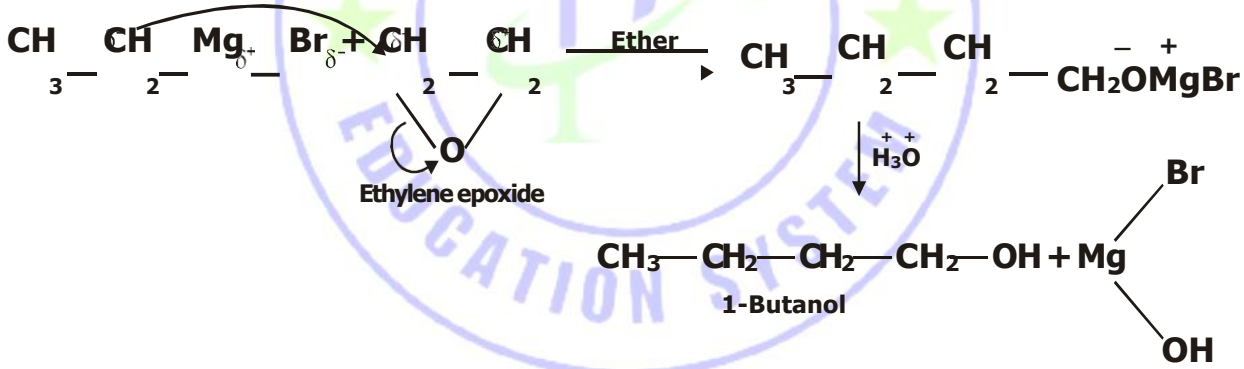
22. How is carboxylic acid prepared from Grignard's reagent?

Ans: When Grignard's reagent is reacted with carbon dioxide gas, we get carboxylic acids as follows;



23. How Grignard reagent reacts with epoxides to form alcohol?

Ans: Grignard's reagent reacts with epoxide in dry ether to generate primary alcohols.



CHEMISTRY(XII) CHAPTER 11 (Alcohols, Phenols and Ethers)

Short Questions:

1. How will you distinguish between primary secondary and tertiary alcohols by Lucas test?

Primary, secondary and tertiary alcohols are identified and distinguished by reacting them with concentrated HCl in anhydrous $ZnCl_2$. An oily layer of alkyl halides separates out in these reactions as follows;

(i) Tertiary alcohols form an oily layer immediately.

$R_3C\text{-}OH + HCl \longrightarrow R_3C\text{-}Cl + H_2O$

(ii) Secondary alcohols for an oily layer in 5 to 10 minutes primary.

$R_2CHOH + HCl \longrightarrow R_3CH\text{-}Cl + H_2O$

(iii) Primary alcohols form an oily layer only on heating.

$R\text{-}CH_2OH + HCl \longrightarrow R\text{-}CH_2\text{-}Cl + H_2O$

2. Picric acid is a phenol which behaves like an acid. Justify.

Picric acid 2,4,6 trinitrophenol has 3 nitro groups present which have electron withdrawing nature. Nitro groups can engage the negative charge on benzene ring in delocalization, setting the proton free for longer time. So picric acid act as acid.

3. Why ethers are referred to as inert compounds.

Ethers are comparatively inert substances. The reagents like ammonia, alkalies, dilute acids and metallic sodium, have no reaction on ethers in cold state. Moreover, they are not oxidized or reduced easily. That's why ethers are considered as inert.

4. Compare the reaction of conc.H_2SO_4 with

(i) Ethyl alcohol

Ethyl Alcohol gives different products with conc H_2SO_4 on different temperatures;

At 180C with conc. H_2SO_4.

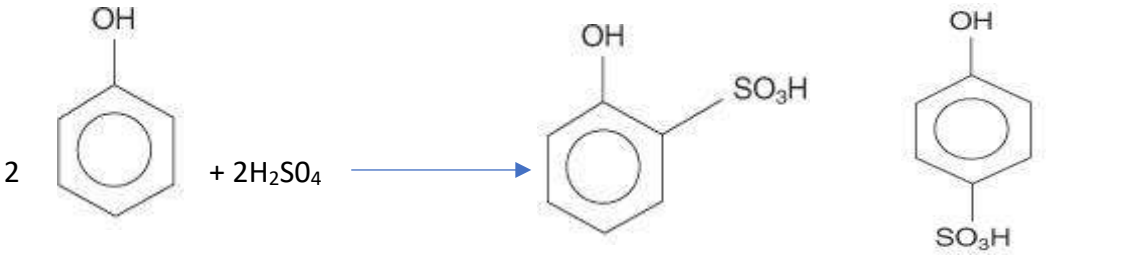
$C_2H_5\text{-}OH \longrightarrow CH_2 = CH_2 + H_20$

At 140C with conc. H_2SO_4.

$2C_2H_5\text{-}OH \longrightarrow C_2H_5\text{-}O\text{-}C_2H_5 + H_20$

(ii) Phenol.

Phenol reacts with conc sulfuric acid at room temp. as follows;



o-hydroxybenzene sulphonic acid

p-hydroxybenzene sulphonic acid

5. Give preparation of methanol by the reaction between CO and H_2 (i.e. water gas).

On industrial scale methanol is prepared from a mixture of carbon monoxide and hydrogen. The gaseous mixture is subjected to 200 atmospheres and then passed over heated catalyst mixture of ZnO and Cr_2O_3 kept at 400° C to 450° C. This reaction results the formation of methanol vapors which are then condensed to liquid state.

$$CO + 2H_2 \longrightarrow CH_3\text{-}OH$$

6. Distinguish ethanol and tertiary butyl alcohol by Lucas Test.

Ethanol and tertiary butyl alcohol are distinguished by reacting them with concentrated HCl in anhydrous $ZnCl_2$. An oily layer of alkyl halides separates out in these reactions

1 Ethyl alcohol form an oily layer immediately

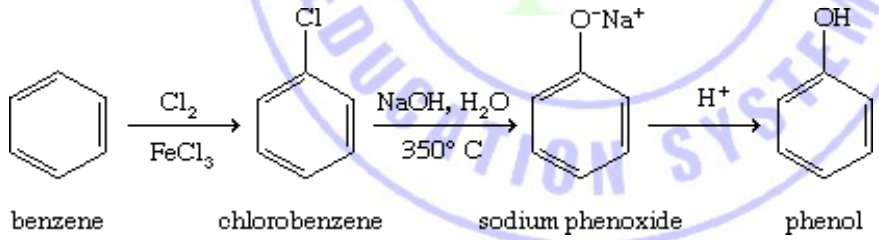
$$CH_3\text{-}CH_2\text{-}OH + HCl \longrightarrow CH_3\text{-}CH_2\text{-}Cl + H_2O$$

2. Tertiary Butyl alcohol form an oily layer only on heating

$$(C_4H_9)_3C\text{-}OH + HCl \longrightarrow (C_4H_9)_3C\text{-}Cl + H_2O$$

7. Prepare Phenol from Chlorobenzene by Dow's method.

In this method chlorobenzene is treated with 10% NaOH at 360°C and 150 atmospheres pressure sodium phenoxide is produced which is treating with HCl gives phenol.



8. How Will you convert:

i. Methanol into Ethanol

$$CH_3OH \xrightarrow{HI} CH_3I$$

$$CH_3I + Mg \xrightarrow{\text{Ether}} CH_3MgI$$

$$CH_3MgI + HCHO \xrightarrow{H3O^+} CH_3CH_2OH$$

ii. Ethanol into Methanol

$$CH_3CH_2OH + H_2SO_4\ (\text{conc.}) \xrightarrow{170-180C} CH_2{=}CH_2$$

$$CH_2{=}CH_2 + Zn/H_20 \xrightarrow{Ozonolysis} 2HCHO$$

$$HCH0 \xrightarrow{LiAlH} CH_3OH$$

9. Write structural formulas of:

i. Methoxy ethane $CH_3\text{-}O\text{-}CH_3$

ii. Ethoxy benzene $C_6H_5\text{-}O\text{-}C_2H_5$

10. What are alcohols? How are they classified?

Alcohols are represented by a general formula ROH where R is an alkyl group.

On the bases of hydroxyl group, alcohols are classified into monohydric and polyhydric alcohols. Monohydric alcohols contain one -OH group while polyhydric alcohol as may contain two, three or more OH groups and and named as dihydric or trihydric alcohol, etc.

Monohydric alcohols are further classified into primary secondary and tertiary alcohols.

Primar Alcohol $R\text{-}CH_2\text{-}OH$

Secondary Alcohol $R_2CH\text{-}OH$

Tertiary Alcohol $R_3C\text{-}OH$

11. Why absolute alcohol can't be prepared by fermentation?

Alcohol obtained by fermentation is only up to 12% and never exceeds 14% because beyond this limit enzymes become inactive. That's why absolute alcohol cannot be prepared by fermentation.

12. What are primary and secondary alcohols? Give one example of each.

Primar Alcohols are in which alpha carbon is further attached with only one carbon atom.

Ethanol $CH_3\text{-}CH_2\text{-}OH$

Secondary Alcohols are in which alpha carbon is further attached with two carbon atoms.

Isopropyl Alcohol $(CH_3)_2CH\text{-}OH$

Tertiary Alcohols are in which alpha carbon is further attached with three carbon atoms.

2-Methyl-2-Propanol $(CH_3)_3C\text{-}OH$

13. Give any four uses of Methyl alcohol.

1. Methanol is widely used in the production of acetic acid and formaldehyde
2. In order to discourage the recreational consumption of ethanol, methanol is often added to it as a denaturant
3. This compound is also used as an antifreeze (an additive that is used to lower the freezing point of a liquid) in many pipelines
4. It is also used as solvent for fats, oils and paints.

14. Write two uses of each of methanol and ethanol.

Uses of Methanol;

i. Methanol is used as an antifreeze
ii. It is also used as solvent for fats, oils and paints

Uses of Ethanol;

i. It is used as a fuel in some countries
ii. It is used as preservative for biological specimens

15. How does phenol react with alkali?

Phenol reacts with sodium hydroxide solution to give a colorless solution containing sodium phenoxide.

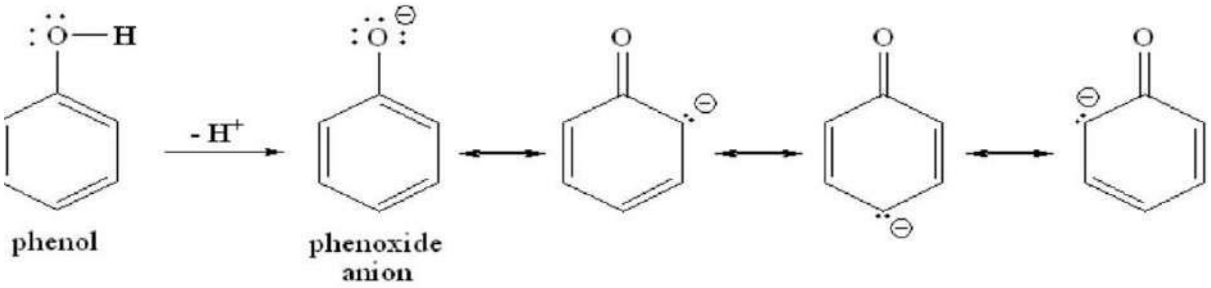
16. How is Methylated spirit prepared?

Sometimes ethanol is denatured by addition of 10% methanol to avoid its use for drinking purpose. Such alcohol is called methylated spirit. A small quantity of pyridine or acetone may also be added for this purpose.

17. Why Phenol is acidic in nature?

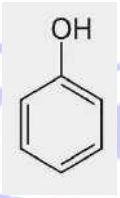
Phenol is much more acidic than alcohols but less acidic than carboxylic acids. The reason why phenol is acidic lies in the nature of the phenoxide ion. The negative

charge on oxygen atom can become involved with the ∏- electron cloud on the benzene ring. The negative charge is thus delocalized in the ring and the phenoxide ion becomes relatively stable. This type of delocalization is not possible with alcohols.

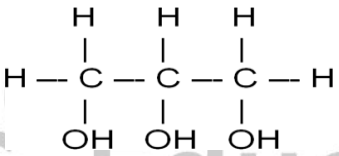


18. Write structural formulas of:

i. Carbolic acid



ii. Glycerol



19. Convert acetone into ethyl alcohol.

$$CH_3COCH_3 \xrightarrow{\text{Reduction}} CH_3CHOHCH_3 + H_2SO_4 \xrightarrow{170-180C} CH_3CH{=}CH_2 \xrightarrow{Ozonolysis} CH_3CH_2CHO + HCHO$$

$$CH_3CH_2CHO \xrightarrow{\text{Reduction}} CH_3CH_2OH$$

20. Water has higher boiling point than Ethanol. Explain.

There is less extensive hydrogen bonding between ethanol molecules than between water molecules, thus less energy is needed to vaporize ethanol than water. That's why water has higher boiling point than ethanol.

21. How will you distinguish between methanol and ethanol by one test?

Ethanol gives iodoform with iodine in presence of sodium hydroxide. formation of yellow crystals indicate that alcohol is ethanol. Whereas Methanol does not give iodoform test.

$$C_2H_5OH + 4I_2 + 6NaOH \longrightarrow CHI_3 + HCOONa + 5NaI + 5H_2O$$

$CH_3OH + I_2 + NaOH \longrightarrow$ No yellow ppt.

22. Write any four uses of ethyl alcohol.

Uses of Ethanol are as follows;

(i) It is used as solvent
(ii) It is used as a drink
(iii) It is used as a fuel
(iv) It is used as a preservative for biological specimen.

23. What is denaturing of alcohols?

Sometimes to avoid the use of ethanol for drinking, 10% methanol is added into it. This is called denaturing of alcohol, also known as methylated spirit. A small quantity of pyridine or acetone may also be added for this purpose.

24. How Lucas test is used to distinguish between primary secondary and tertiary alcohols?

Primary, secondary and tertiary alcohols are identified and distinguished by reacting them with concentrated HCl in anhydrous $ZnCl_2$. An oily layer of alkyl halides separates out in these reactions as follows;

(i) Tertiary alcohols form an oily layer immediately.

$R_3C\text{-}OH + HCl \longrightarrow R_3C\text{-}Cl + H_2O$

(ii) Secondary alcohols for an oily layer in 5 to 10 minutes primary.

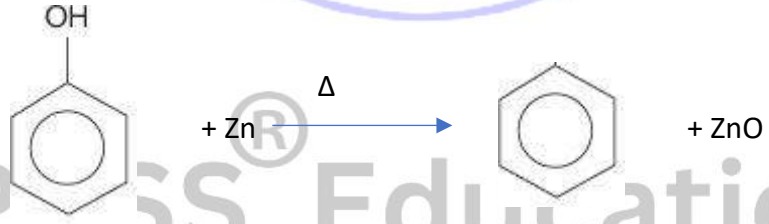
$R_2CHOH + HCl \longrightarrow R_3CH\text{-}Cl + H_2O$

(iii) Primary alcohols form an oily layer only on heating.

$R\text{-}CH_2OH + HCl \longrightarrow R\text{-}CH_2\text{-}Cl + H_2O$

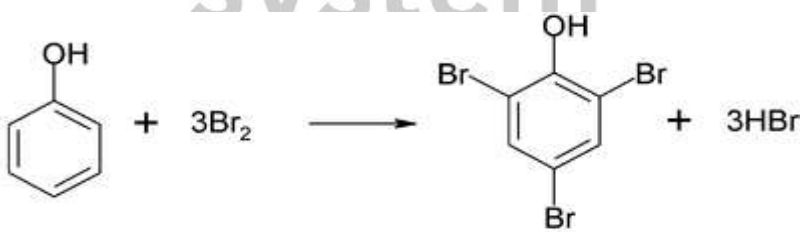
25. How phenol can be converted to benzene?

Phenol can be converted into Benzene by the reduction with Zinc.



26. How does phenol react with bromine water?

An aqueous solution of phenol reacts with bromine water to give white ppts of 2,4,6-Tribromophenol.



27. What is Williamson's synthesis?

Alcohols are reacted with metallic sodium to form alkoxides. this alkoxide ion is a strong nucleophile and readily reacts with alkyl halide to produce an ether. This method is called Williamson's synthesis.

$2C_2H_5OH + 2Na \longrightarrow 2C_2H5O^-Na^+ + H_2$

$C_2H_5O^-Na^+ + C_2H_5Br \longrightarrow C_2H_5OC_2H_5 + NaBr$

28. Ethanol gives different products with conc. H_2SO_4 under different conditions. Justify?

Ethyl Alcohol gives different products with conc H_2SO_4 on different temperatures;

At 180C with conc. H_2SO_4.

$$C_2H_5\text{-}OH \longrightarrow CH_2 = CH_2 + H_20$$

At 140C with conc. H_2SO_4.

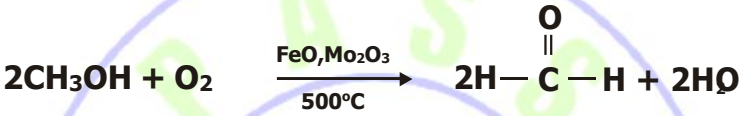
$$2C_2H_5\text{-}OH \longrightarrow C_2H_5\text{-}O\text{-}C_2H_5 + H_20$$

Chemistry Part II Chapter#12 (Aldehydes and Ketones)
SHORT QUESTIONS

1. Describe preparation of formalin from methanol on commercial scale.

Ans: **Industrial (Commercial) Method:**

Formaldehyde (Formalin) is manufactured commercially by passing a mixture of methanol vapours and air over iron oxide-molybdenum oxide or silver catalyst at 500°C.



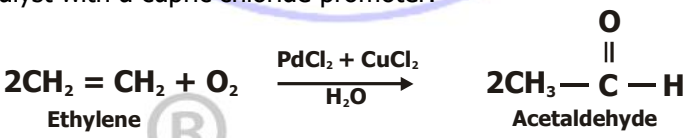
2. Explain one method of formation of formaldehyde from methyl alcohol.

Ans: Formaldehyde is prepared in the laboratory by passing a mixture of methyl alcohol vapours and air over platinized asbestos or copper or silver catalyst at 300°C.

3. Write a method for the commercial preparation of acetaldehyde?

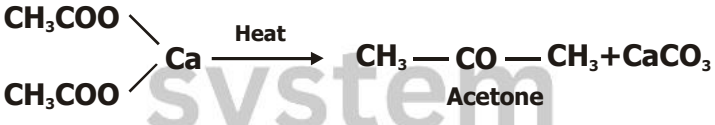
Ans: **Industrial Method:**

Acetaldehyde is prepared industrially by oxidation of ethylene in air using palladium chloride catalyst with a cupric chloride promoter.



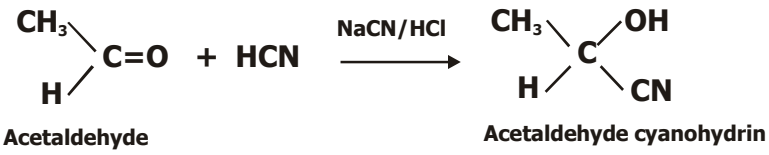
4. Convert calcium acetate to acetone .

Ans: Calcium acetate is converted to acetone when its dry distillation is done.

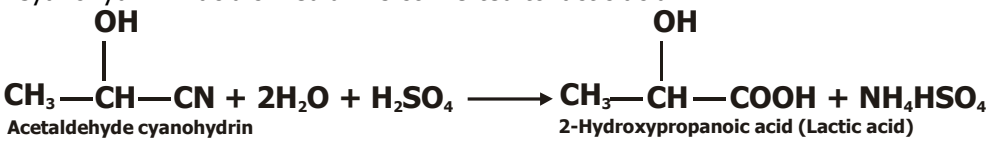


5. Convert acetaldehyde into lactic acid.

Ans: **Acetaldehyde is reacted with hydrogen cyanide to produce acetaldehyde cyanohydrin.**



Cyanohydrin in acidic medium is converted to lactic acid.



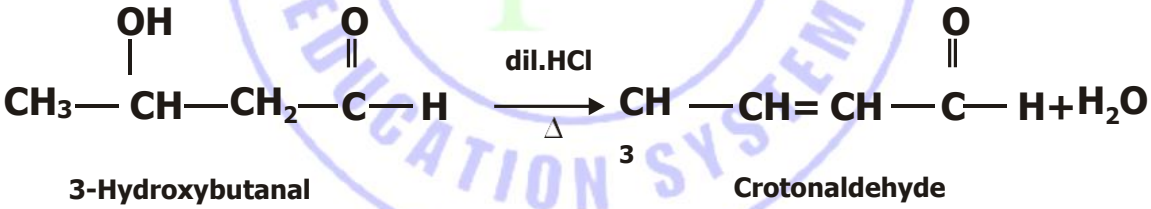
6. For Aldol condensation the presence of α−hydrogen is must in aldehydes and ketones. Give reasons.

Ans: Aldol condensation proceeds through the formation of carbanion in the first step. This ion is produced when the acidic hydrogen at the α–carbon is removed by the base (OH^-). In the absence of α–hydrogen, carbanion cannot be produced, so aldol condensation cannot take place.

7. How is crotonaldehyde obtained from Aldol?

Ans: **Conversion of Aldol to Croton aldehyde:**

The aldol undergoes dehydration on heating in the presence of dilute acid to form α,β-unsaturated carbonyl compound. A carbon-carbon double bond is formed between the α- and β-carbon atoms.



8. What are disproportionation reactions?

Ans: It is a disproportionation (self oxidation-reduction) reaction. The molecules being oxidized and reduced are the same chemical species.

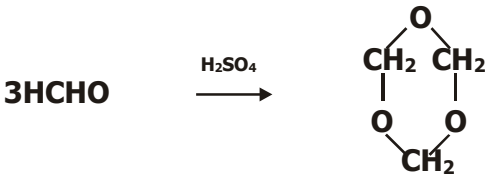
Example:

9. Justify t hat Cannizaro's reaction is a self redox reaction.

Ans: In Cannizaro's reaction, one of the molecules of aldehyde is oxidized and the other is reduced. The oxidation yields carboxylic acid and reduction alcohol. (Mechanism already discussed in exercise questions section given above.
Benedict's solution are some examples of mild oxidizing agents.

10. Convert formaldehyde to meta - formaldehyde?

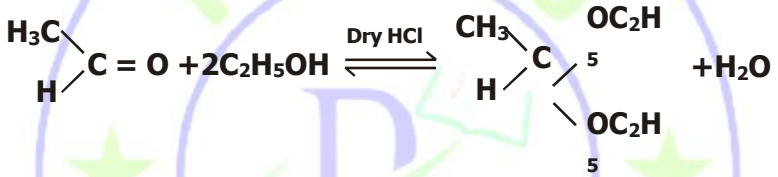
Ans Formaldehyde polymerizes in the presence of dil.H_2SO_4 to give Meta formaldehyde as shown below.



Metaformaldehyde

11. What is the importance of converting aldehyde to Acetal?

Ans: Aldehydes combine with alcohols in the presence of hydrogen chloride gas to form acetal as shown below.



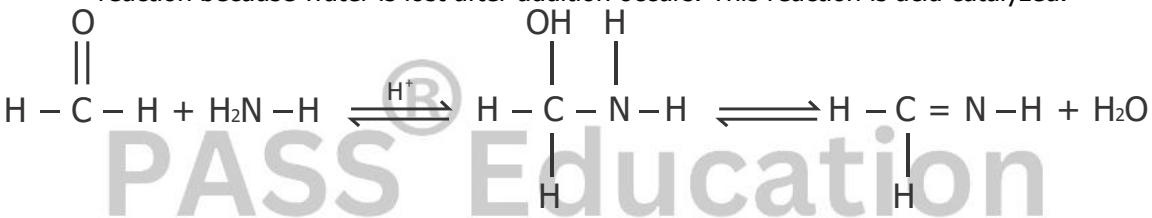
1,1-Diethoxyethane (an acetal)

Importance of reaction:

The reaction may be used to protect the aldehyde group against alkaline oxidizing agents. To regenerate Aldehyde, the Acetal is hydrolyzed in the presence of an acid.

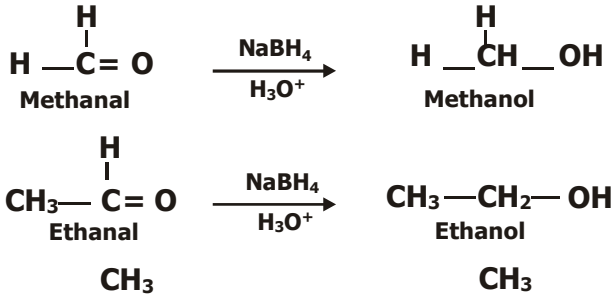
12. Describe reaction of aldehyde with ammonia?

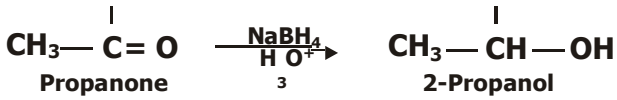
Ans: Aldehyde and Ketones react with ammonia (H–NH_2) to form compounds containing the group -C = N and water. The reaction is known as condensation reaction or elimination reaction because water is lost after addition occurs. This reaction is acid catalyzed.



13. How aldehydes and Ketones are reduced to alcohols?

Ans: Aldehydes and ketones are reduced to alcohols with sodium borohydride ($NaBH_4$) in acidic medium.





14. Write the names of those weak oxidizing agents which can oxidize aldehydes but not ketones.

Ans: Some examples of such oxidizing agents are as follows

(i) Fehling's solution (an alkaline solution containing a cupric tartarate complex ion)
(ii) Benedict's solution (an alkaline solution containing a cupric citrate complex ion)
(iii) Tollen's reagent (ammonical silver nitrate solution)

15. Why the oxidation of Ketones is difficult?

Ans: Ketones do not undergo oxidation easily because they require breaking of strong carbon – carbon bond. They give no reaction with mild oxidizing agents. They are only oxidized by strong oxidizing agents such as $K_2Cr_2O_7/H_2SO_4$, $KMnO_4/H_2SO_4$, and conc. HNO_3

16. What are the factors which make aldehydes more reactive than Ketones?

Ans: The following two factors account for this:

i) The presence of hydrogen atom with the carbonyl group in aldehyde decreases steric hindrance around carbonyl carbon. In ketones there is more steric hindrance.

ii) In ketones the two alkyl groups (electron donating groups) decrease the electrophilic character of carbonyl carbon atom to a great extent while one alkyl group in aldehyde does not decrease the electrophilic character of carbonyl carbon atom to that extent.

17. How aldehydes are identified by Tollen's test? ***OR***
Tollen's test is also called silver mirror test. Justify it.

Ans: **Tollen's Test [Silver Mirror Test]:**

Aldehydes form silver mirror with Tollens' reagent (ammonical silver nitrate solution). Add Tollens' reagent to an aldehyde solution in a test tube and warm. A silver mirror is formed on the inside of the test tube.

$$AgNO_3 + 3NH_4OH \longrightarrow [Ag(NH_3)_2]OH + NH_4NH_4NO_3 + 2H_2O$$

$$R\text{-}CHO + 2[Ag(NH_3)_2]OH \longrightarrow R\text{-}COONH_4 + 2Ag + 2NH_3 + H_2O$$

Silver mirror

18. Give examples of mild oxidizing agents?

Ans: The reagents or compounds which can only oxidize aldehydes and not the ketones are called mild oxidizing agents such as Tollen's reagent, Fehling's solution etc.

19. Fehling's solution reacts with aldehydes to give red ppt. justify it.

Ans: Fehling's solution is a mixture of $Cu(OH)_2$, NaOH and tartaric acid. It reduces aldehyde and produces brick red ppt of Cu_2O on heating.

$$H-\overset{\overset{O}{\|}}{C}-H + Cu(OH)_2 + NaOH \xrightarrow{\text{Tataric acid}} R-\overset{\overset{O}{\|}}{C}-ONa + Cu_2O\downarrow + H_2O$$

Sodium salt of acid — Red ppt.

20. How is acetaldehyde distinguished from formaldehyde?

Ans:

Acetaldehyde (Ethanal)	Formaldehyde (Methanal)
Ethanal produces yellow ppt of Iodoform (CHI_3) with NaOH and I_2. **CH_3-CHO+3I_2+ 4NaOH →CHI_3 + HCOONa + 3NaI + 3H_2O**	Methanal does not produce Iodoform with NaOH and I_2. **H-CHO + I_2 + NaOH → No reaction**

21. How Iodoform is prepared from ethanol and acetaldehyde?

Ans: **Preparation of iodoform from ethanol and acetaldehyde:**

Heating ethanol or acetaldehyde with NaOH and solid iodine gives Iodoform as follows:-

C_2H_5OH +4I_2 + 6NaOH → CHI_3 + HCOONa + 5NaI + 5H_2O
CH_3-CHO+3I_2+ 4NaOH → CHI_3 + HCOONa + 3NaI + 3H_2O

22. Give 4 uses of formaldehyde.

Ans: **Uses of formaldehyde:**

i) It is used in the manufacture of resins (polymers) like urea-formaldehyde and plastics such as Bakelite.

ii) It is used in the manufacture of dyes such as indigo, para-rosaniline (green crystalline solid) etc.

iii) Its 40% aqueous solution called formalin is used as an antiseptic, a disinfectant, a germicide, a fungicide and for preserving animal specimens and sterilizing surgical instruments.

iv) It is used as a decolorizing agent in vat dyeing (dying of cotton and wool in vessels).

Chemistry (Part 2)

Chapter 13. Carboxylic acids

Short Questions

Q1. What are Fatty acids? How acid chlorides are made by them?

The aliphatic mono carboxylic acids are commonly called fatty acids, because higher members of this series such as palmitic acid, stearic acid etc. are obtained by the hydrolysis of fats and oils.

Formation of acid chlorides: Acid chlorides can be made by reacting mono carboxylic acids with phosphorous penta chloride or with thionyl chloride as follows.

$CH_3COOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$

$CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 + HCl$

Q2. How carboxylic acids can be obtained from Alkene?

Oxidative cleavage of alkenes

Alkenes when heated with alkaline $KMnO_4$ are cleavaged at the double bond to form Carboxylic acids.

$H_3C\text{-}CH{=}CH\text{-}CH_3 + 4[O] \rightarrow 2CH_3COOH$

2-butene ethanoic acid

Q3. Why do mostly carboxylic acids exist as dimmers?

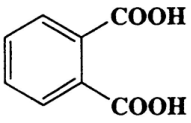
In pure carboxylic acids Hydrogen bonding can occur between two molecules of acid to produce a dimer. This immediately doubles the size of the molecule and so increases Vander Waals dispersion forces between one of these dimmers and its neighbors, resulting in a high boiling point.

Q4. Differentiate between acidic and basic amino acids.

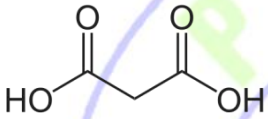
Acidic amino acid	Basic amino acid
1. The amino acids which contain two carboxyl groups are called acidic amino acids.	1. The amino acids which contain two amino groups are called basic amino acids.
2. For example, Glutamic acid and Aspartic acid.	2. For example, Lysine and Histidine.

Q5. Write structural formulae of Phthalic acid and Malonic acid .

Phthalic acid



Malonic acid



Q6. Prepare ethane from acetic acid by reduction.

Acetic acid on reduction with HI and red phosphorus give ethane.

$CH_3COOH + 6HI \rightarrow CH_3\text{-}CH_3 + 2H_2O + 3I_2$

Q7. Write reactions of acetic acid with:

HI/red phosphorus:

Acetic acid on reduction with HI and red phosphorus give ethane.

$CH_3COOH + 6HI \rightarrow CH_3\text{—}CH_3 + 2H_2O + 3I_2$

NH_3/ heat :

Acetic acid react with ammonia to form ammonium salts which on heating produce acid amides

$CH_3COOH + NH_3 \rightarrow CH_3COONH_4$

$CH_3COONH_4 \rightarrow CH_3CONH_2 + H_2O$

Q8. How carboxylic acids are prepared by oxidative cleavage of alkenes?

Oxidative cleavage of alkenes

Alkenes when heated with alkaline $KMnO_4$ are cleavaged at the double bond to form Carboxylic acids.

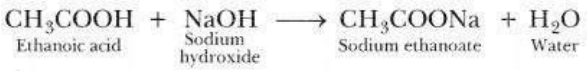
$H_3C\text{-}CH{=}CH\text{-}CH_3 + 4[O] \rightarrow 2CH_3COOH$

2-butene ethanoic acid

Q9. How will you convert acetic acid in to methane and acetic anhydride?

Acetic acid to Methane:

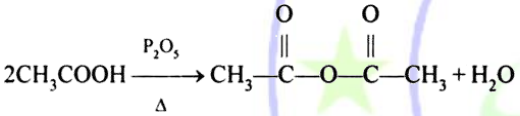
Acetic acid is treated with sodium hydroxide to form sodium acetate and water.



Then, sodium ethanoate is heated with sodalime to get methane.

Acetic acid to acetic anhydride:

Acetic acid dehydrates on heating strongly in the presence of phosphorus pentaoxide.



Q10. How will you convert acetic acid in to acetamide?

Acetic acid react with ammonia to form ammonium salts which on heating produce acetamide

$CH_3COOH + NH_3 \rightarrow CH_3COONH_4$

$CH_3COONH_4 \rightarrow CH_3CONH_2 + H_2O$

Q11. What happens when following compounds are heated?

Sodium formate and sodalime:

Sodium formate on heating with sodalime give hydrogen.

$HCOONa + NaOH \rightarrow Na_2CO_3 + H_2$

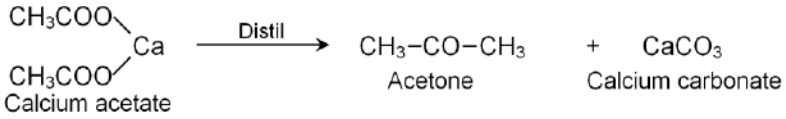
Ammonium acetate:

On heating Ammonium acetate, it will give acetamide.

$CH_3COONH_4 \rightarrow CH_3CONH_2 + H_2O$

Q12. What happens when following compounds are heated?

Calcium acetate: Calcium acetate on heating undergoes dry distillation.



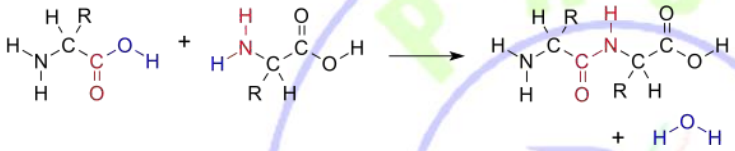
Ammonium acetate:

On heating Ammonium acetate, it will give acetamide.

$CH_3COONH_4 \rightarrow CH_3CONH_2 + H_2O$

Q13. What is peptide bond? Write formula of a dipeptide?

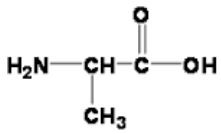
The chemical bond formed between amino acids, constituting the primary **linkage** in all protein structures. In a **peptide** bond, the carboxyl group (COOH) of one amino acid bonds with the amino group (NH2) of another, forming the sequence CONH and releasing water (H2O).



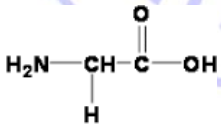
Q14. Define neutral amino acid with example.

Since an **amino acid** has both an amine and **acid** group which have been neutralized in the zwitterion, the **amino acid** is **neutral** unless there is an extra **acid** or base on the side chain. If neither is present then the whole **amino acid** is **neutral**. eg. glycine, alanine, valine etc.

Q15. Write formulae of glycine and alanine.



alanine



glycine

Q16.How amino acid is prepared by Strecker's synthesis?

When hydrogen cyanide is added to an aldehyde in the presence of ammonia α-amino acid is obtained: $RCHO + HCN + NH_3 \rightarrow R—CH—CN + H_2O$

|

NH_2

α-amino nitrile on acid hydrolysis yields an α-amino acid.

R—CH—CN → R—CH--COOH

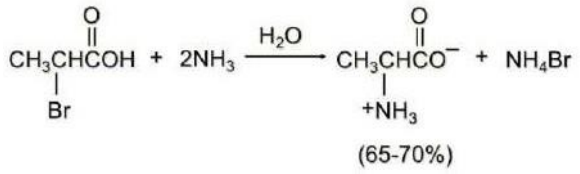
| |

NH_2 NH_2

Q17. How carboxylic acids can be converted in to α-amino acid?

Amino acids can be synthesized by the reaction of α-bromo acid with ammonia.

Synthesis of Amino Acids From α-Halo Carboxylic Acids



Q18. What is difference between essential and non essential amino acids?

Essential amino acid	Non essential amino acids
1. The amino acids which our body can't prepare are called essential amino acids. 2. These we have to take in to our diet for proper health and growth.	1. The amino acids which our body can prepare are called non essential amino acids. 2. These are not required in diet.

Q19. How acetic acid reacts with:

<u>PCl_3:</u>

Acetic acid reacts with phosphorus trichloride to give acid halide.

$3CH_3COOH + PCl_3 \rightarrow 3CH_3COCl + H_3PO_3$

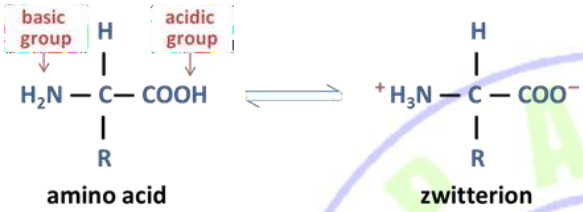
<u>$SOCl_2$:</u>

Acetic acid reacts with thionyl chloride to give acid halide.

$CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 + HCl$

Q20. Define Zwitter ion or internal salt.

Zwitterion, also known as inner salt or dipolar ion, is an ion with a positive and a negative electrical charge at different locations within a molecule. In the formation of zwitter ion, the proton goes from carboxyl group to amino group.



Q21. What is meant by glacial acetic acid?

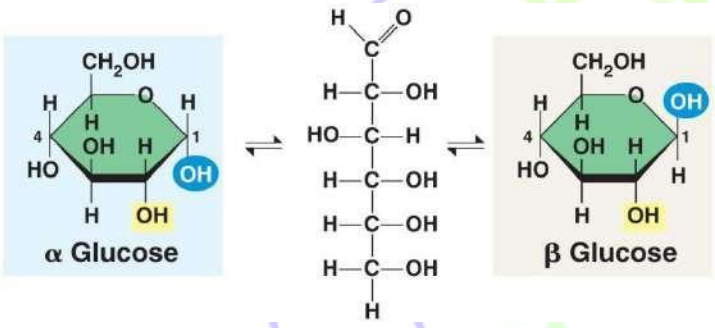
The pure, **anhydrous acetic acid**, forming ice-like crystals at temperatures below 16.7°C, is called **glacial acetic acid**. (CH_3COOH).

Chemistry (Part 2)

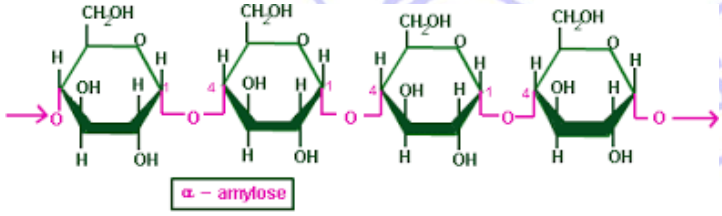
Chapter 14. Macromolecules

Short Questions

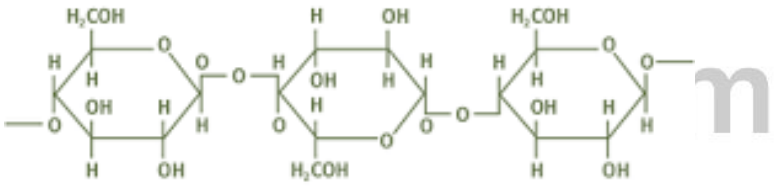
Q1. Justify by writing the structural formulas that amylase is condensation polymer of α-D glucose and cellulose is polymer of β-D glucose.



Amylase is a condensation polymer of α- D Glucose.



Cellulose is a condensation polymer of β-D glucose .



Q2. Define Enzymes. Write their two properties.

Enzymes: Enzymes can be defined as reaction catalysts of biological systems produced by living cells and are capable of catalyzing chemical reactions.
Properties of enzymes:
1. Specificity: Enzymes are specific in their action which means that enzymes can act on only one substrate or group of closely related substrates. For example Hexokinase catalyses the conversion of hexoses like glucose, fructose and manose to their 6-phosphate derivatives but glucokinase is specific for glucose only.
2.Protein Nature: Enzymes with few exceptions are protein in nature. They are produced by living cells but act in vivo as well as in vitro.

Q3. Discuss Saponification number.

It is defined as the number of milligrams of Potassium Hydroxide or Sodium Hydroxide required to saponify one gram of the fat or oil. For example one mole of Glycerol Tripalmitate (mol. wt=807) requires 168,000mg of KOH for saponification. Therefore one gram of fat will require 168000/807 mg of KOH. Hence the saponification number of Glycerol Tripalmitate is 208.

Q4. Discuss saponification number and give example.

It is defined as the number of milligrams of Potassium Hydroxide or Sodium Hydroxide required to saponify one gram of the fat or oil. For example one mole of Glycerol Tripalmitate (mol. wt=807) requires 168,000mg of KOH for saponification. Therefore one gram of fat will require 168000/807 mg of KOH. Hence the saponification number of Glycerol Tripalmitate is 208.

Q5.Define saponification and Iodine number.
Saponification:
It is defined as the number of milligrams of Potassium Hydroxide or Sodium Hydroxide required to saponify one gram of the fat or oil. For example one mole of Glycerol Tripalmitate (mol. wt=807) requires 168,000mg of KOH for saponification. Therefore one gram of fat will require 168000/807 mg of KOH. Hence the saponification number of Glycerol Tripalmitate is 208.
Iodine number:
The extent of unsaturation in a fat or oil is expressed in terms of its iodine number. It is defined as the number of grams of iodine which will add to 100g of a fat or an oil. The value of iodine number depends on the number of double bonds present in the acid component of glycerides. The glycerides with no double bond will have zero iodine number.

Q6. Define Iodine number.

Iodine number:

The extent of unsaturation in a fat or oil is expressed in terms of its iodine number. It is defined as the number of grams of iodine which will add to 100g of a fat or an oil. The value of iodine number depends on the number of double bonds present in the acid component of glycerides. The glycerides with no double bond will have zero iodine number.

Q7. What are differences between DNA and RNA.

DNA	RNA
1. DNA is Deoxyribonucleic acid .	1. RNA is ribonucleic acid.
2. It carries genetic information.	2. It puts this information to work in cell
3. Sugar in DNA is 2-deoxyribose	3. Sugar in RNA is ribose.
4. It is double stranded .	4. It is single stranded.
5.Four bases are found in DNA. Cytosine, Thymine, Adenine & Guanine.	5. In RNA thymine is replaced by Uracil.

Q8. What is the difference between fat and oil?

Difference between fats and oils is that **fats** are composed **of** high amounts **of** saturated fatty acids which will take a solid form at room temperature whereas **oils** are composed **of** mainly unsaturated fatty acids which will take a liquid form at room temperature.

Q9. In what ways fats and oil are different?

Difference between fats and oils is that **fats** are composed **of** high amounts **of** saturated fatty acids which will take a solid form at room temperature whereas **oils** are composed **of** mainly unsaturated fatty acids which will take a liquid form at room temperature.

Q10. What are lipids? Give two physical properties.

Lipids:

Lipids (Greek, lipo means fat) are naturally occurring organic compounds of animal and plant origin which are soluble in organic solvents and belong to a very heterogeneous group of substances.

Properties:

1. They are insoluble in water and soluble in non polar solvents eg. ether, chloroform and benzene.etc.
2. Their primary building blocks are fatty acids, glycerols and sterols.

Q11. Define polymerization. Explain the term degree of polymerization.

Polymerization:

Polymerization is a process of reacting monomer molecules together in a chemical reaction to form polymer chains or three-dimensional networks.

Degree of polymerization:

The degree of polymerization, or DP, is the number of monomeric units in a macromolecule or *polymer* , or in other words the number of repeating units in a chain of a polymer is called degree of polymerization. It is very helpful in calculating the molecular mass of the polymer. The molecular mass of the polymer is the product of molecular mass of the repeating unit and the DP. For example poly vinyl chloride, a polymer of DP 1000 has a molecular mass

Mol.mass of P.V.C = Mol.mass of the repeating unit × DP

$-(CH_2—CH)_n-$ = 63 × 1000

| = 63000

Cl

Q12. Define acid number. What is Rancidity?

Acid number:

The acid number of a fat or oil tells the amount of free fatty acids present in it. It is expressed as the number of milligrams of potassium hydroxide required to neutralize one gram of fat.

Rancidity:

Fats or oils are liable to spoilage and give off an odour known as rancidity. It is mainly caused by the hydrolytic or oxidative reactions which release foul smelling aldehydes and fatty acids. Oils from sea animals which contain a relatively high proportion of unsaturated acid chains deteriorate rapidly.

Q13. What is acid number?

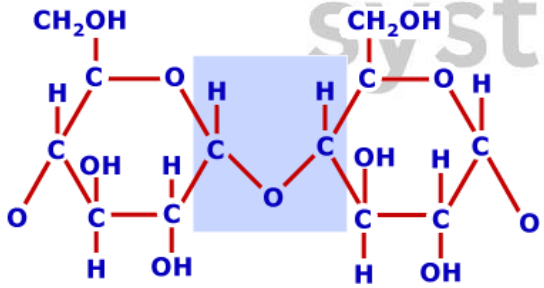
Acid number:

The acid number of a fat or oil tells the amount of free fatty acids present in it. It is expressed as the number of milligrams of potassium hydroxide required to neutralize one gram of fat.

Q14. Write the structure of Starch.

Starch is a polymer of α-D glucose.

Simple starch



Q15. Give classification of macromolecules.

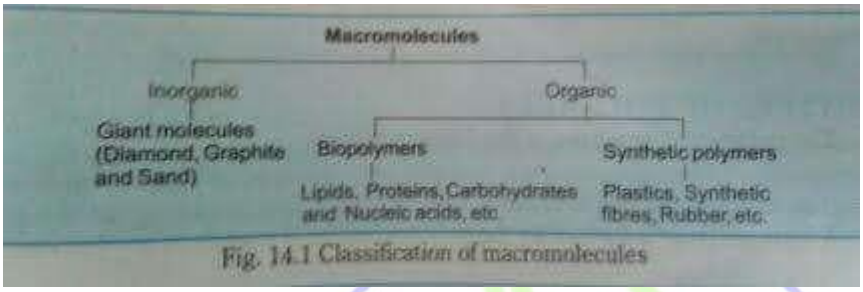


Fig. 14.1 Classification of macromolecules

Q16. What are Carbohydrates? Why are they called so?

The term carbohydrate is applied to a large number of relatively heterogeneous compounds. They are the most abundant bio-molecules on earth. The name carbohydrate (hydrate of carbon) is derived from the fact that the first compound of this group which was studied had an empirical formula $C_x(H_2O)_y$. They are commonly called sugars and are poly-hydroxy compounds of aldehydes and ketones.

Carbohydrates are so called because they are bio-molecules made up of carbon, hydrogen and oxygen.

Q17. What are thermoplastic and thermosetting polymers?

Thermoplastic polymer: A thermoplastic polymer is one which can be softened repeatedly when heated and hardened when cooled with a little change in properties. For example, PVC pipes, plastic toys etc.

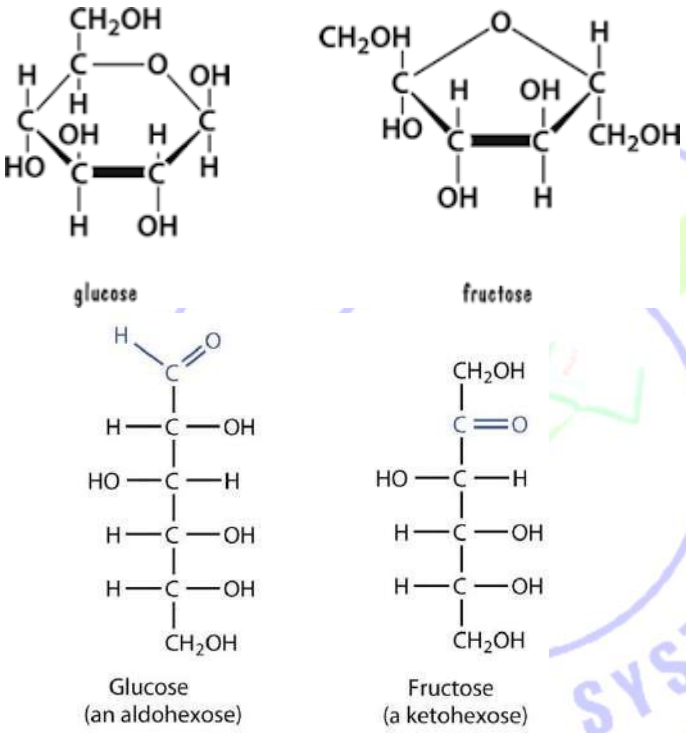
Thermosetting polymer: The polymers which become hard on heating and cannot be softened again are called thermosetting polymers. A thermosetting polymer, on heating, decomposes instead of melting. For example, synthetic varnish, epoxy resins etc.

Q18. What are thermosetting polymers?

Thermosetting polymer: The polymers which become hard on heating and cannot be softened again are called thermosetting polymers. A thermosetting polymer, on heating, decomposes instead of melting. For example, synthetic varnish, epoxy resins etc.

Q19. What is difference between glucose and fructose?

The **difference** in **glucose and fructose** is their chemical **structure**. Both are sugars, but **glucose** in solution forms a 6 atom ring, while **fructose** makes a 5 atom ring.

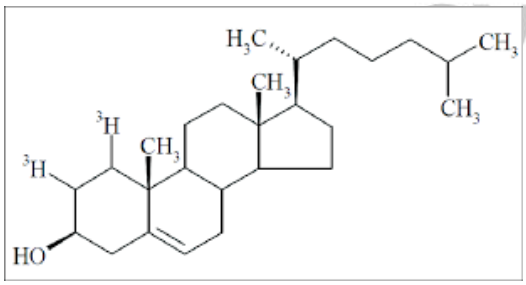


Q20. What is rancidity of fats and oils?

Rancidity:

Fats or oils are liable to spoilage and give off an odour known as rancidity. It is mainly caused by the hydrolytic or oxidative reactions which release foul smelling aldehydes and fatty acids. Oils from sea animals which contain a relatively high proportion of unsaturated acid chains deteriorate rapidly.

Q21. Write structure of cholesterol.



Q22. What are polymers? Give two examples.

Polymers:

The word polymer is derived from Greek word, poly means **many** and mer means **parts**. Polymers or macromolecules are defined as large molecules build up from small repeating units called monomers. The repetition may be linear or branched or interconnected to form three dimentional network.

Examples: Artificial fibres, plastics, synthetic varnish etc.

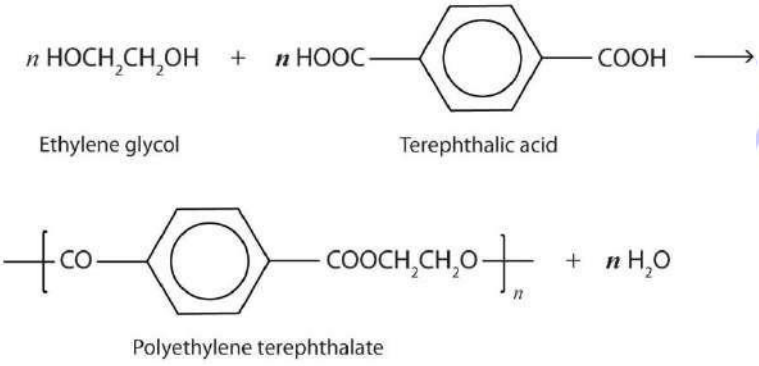
Q23. Define with example condensation polymerization.

Condensation polymerization:

Condensation polymerization is that which results from the mutual reaction of two functional groups. The reaction usually involves the removal of a water molecule or a methanol molecule. It takes place at both ends of the growing chain.

Example:

Dicarboxylic acids or esters combine with Diols to get the desired polymer like Nylon and polyester fibre. Such polymerizations are generally ionic in nature.



Q24. Give four properties of enzymes.

Properties of enzymes:

1. Specificity: Enzymes are specific in their action which means that enzymes can act on only one substrate or group of closely related substrates. For example Hexokinase catalyses the conversion of hexoses like glucose, fructose and manose to their 6-phosphate derivatives but glucokinase is specific for glucose only.

2.Protein Nature: Enzymes with few exceptions are protein in nature. They are produced by living cells but act in vivo as well as in vitro.

3.The direction of enzyme reactions: Most enzymatic reactions are reversible i.e the same enzyme can catalyze reactions in both directions.

4.Isoenzymes: These are the enzymes from the same organisms which catalyze the same reaction but are chemically and physically distinct from each other.

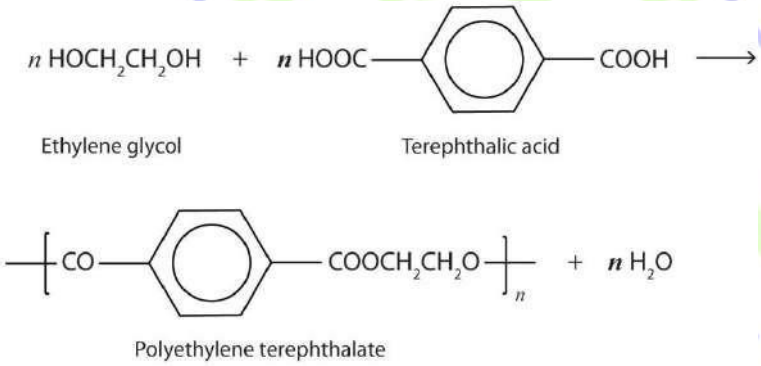
Q25. Write a note on condensation polymerization.

Condensation polymerization:

Condensation polymerization is that which results from the mutual reaction of two functional groups. The reaction usually involves the removal of a water molecule or a methanol molecule. It takes place at both ends of the growing chain.

Example:

Dicarboxylic acids or esters combine with Diols to get the desired polymer like Nylon and polyester fibre. Such polymerizations are generally ionic in nature.



Q26. Define iodine number and acid number.

Iodine number:

The extent of unsaturation in a fat or oil is expressed in terms of its iodine number. It is defined as the number of grams of iodine which will add to 100g of a fat or an oil. The value of iodine number depends on the number of double bonds present in the acid component of glycerides. The glycerides with no double bond will have zero iodine number.

Acid number:

The acid number of a fat or oil tells the amount of free fatty acids present in it. It is expressed as the number of milligrams of potassium hydroxide required to neutralize one gram of fat.

Q27. What is denaturation of proteins.

Denaturation of Proteins:

The structure of proteins can be disrupted easily by heat, change in PH and under strong oxidizing and reducing conditions. Under such conditions the proteins undergo denaturation. The most familier example of denaturation is the change that takes place in albumin, the principle component of egg white, when it is cooked. In this particular case the change is irreversible.

Q28. Briefly describe the two factors that affect the activity of enzymes.

Factors affecting enzyme activity:

1. Enzyme concentration:

The rate of an enzymatic reaction is directly propotional to the concentration of the substrate. The rate of reaction is also directly propotinal to the square root of the concentration of enzyme. It means that the rate of reaction also increases with the increase in the concentration of enzyme.

2. Temperature:

The enzymatic reaction occurs best at or around 37^{o}C which is the average normal body temperature. The rate of chemical reactions is increased by a rise in temperature but this is true only over a limited range of temperature. Enzymes usually destroy at high temperature. The activity of enzymes is reduced at low temperature. The temperature at which an enzyme reaction occurs the fastest is called its optimum temperature.

CHEMISTRY (XII) **CHAPTER 15** **(Common Chemical Industries in Pakistan)**

Short Questions:

1. How paper industry can be made progressive in Pakistan?

Since Pakistan has enough sources of non-woody materials, So Paper industry can be made progressive in Pakistan if we use every source of raw material like non-woody and woody.

2. Give any four important (essential) qualities of a good fertilizer.

Essential qualities of good fertilizers are given below:

(i) It should be cheap
(ii) It should not be injurious to plants
(iii) It should not alter the pH of the soil
(iv) Nutrient elements present in it must be readily available to the plants

3. Classify elements essential for plant growth.

Elements essential for the growth of plants are classified as Micro nutrients and Macro nutrients.

Micro Nutrients:

Elements required in very small amount for the growth of plants are considered as Micro nutrients. These includes Boron, Copper, Iron, Manganese, Zinc, Molybdenum and Chloride. These are required in range from 6grams to 200grams.

Macro Nutrients:

Elements required in large amount are considered as Macro nutrients. These include Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Carbon, Hydrogen and Oxygen. These are required in range from 5kg to 200kg.

4. Give significance of potash fertilizer?

Potash fertilizers are required for the formation of starch, sugar and fibrous material of the plant. Also increase resistance to diseases and make the plants strong by helping in healthy root development. It also helps in ripening of seeds, fruits and cereals.

5. Enlist the steps involved in the manufacture of urea.

Steps involved are given below;

(i) Preparation of Hydrogen and Carbon dioxide
(ii) Preparation of Ammonia
(iii) Preparation of Ammonium Carbamate
(iv) Preparation of Urea
(v) Concentration of Urea
(vi) Prilling

6. Write a note on diammonium phosphate.

This compound of high purity is prepared by continuous process that consists of reacting anhydrous ammonia gas and pure phosphoric acid at 60-70◦C and pH 5.8-6.0.

$$2NH_3\,(g) + H_3PO_4\,(l) \longrightarrow (NH_4)_2HPO_4 + \text{Heat}$$

It is an exothermic reaction. The heat of reaction vaporizes water from the liquor and the crystals of diammonium phosphate are taken out, centrifuged, washed and dried. It contains 16% Nitrogen and 48% P_2O_5. This product contains

about 75% plant nutrients and it can be used alone or in mixed with other fertilizers.

7. Give preparation of Portland cement as carried out by Joseph Aspdin, Why it is named so?

Mixture of Lime stone and clay is strongly heated, then this heated mixture is mixed with water and allowed to stand. It gets hardened to a stone like mass. This way Portland cement is prepared.

This is named as Portland because the stone like mass resembles Portland rock, which is a famous building stone of England.

8. Distinguish micronutrients and macronutrients for plants.

Essential nutrients for plants are classified as

Micro Nutrients:

Elements required in very small amount for the growth of plants are considered as Micro nutrients. These includes Boron, Copper, Iron, Manganese, Zinc, Molybdenum and Chloride. These are required in range from 6grams to 200grams.

Macro Nutrients:

Elements required in large amount are considered as Macro nutrients. These include Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Carbon, Hydrogen and Oxygen. These are required in range from 5kg to 200kg.

9. What are micronutrients?

Elements required in very small amount for the growth of plants are considered as Micro nutrients. These includes Boron, Copper, Iron, Manganese, Zinc, Molybdenum and Chloride. These are required in range from 6grams to 200grams.

10. Give reactions of preparation of urea by using NH_3 and CO_2.

Reactions for the preparation of Urea are given below;

$$CO_2\,(g) + 2NH_3\,(g) \longrightarrow NH_2COONH_4 \text{ (Ammonium Carbamate)}$$

$$NH_2COONH_4 \longrightarrow (NH_2)_2CO \text{ (Urea)} + H_2O$$

11. Write down four characteristic features for a good fertilizer.

A good fertilizer should have following features:

(i) It should be cheap
(ii) It should not be injurious to plants
(iii) It should not alter the pH of the soil
(iv) Nutrient elements present in it must be readily available to the plants

12. What are essential nutrient elements? Why are they needed?

Essential nutrient elements are needed for the proper growth of plants.

There are two different types of essential nutrients;

Micro Nutrients:

Elements required in very small amount for the growth of plants are considered as Micro nutrients. These includes Boron, Copper, Iron, Manganese, Zinc, Molybdenum and Chloride. These are required in range from 6grams to 200grams.

Macro Nutrients:

Elements required in large amount are considered as Macro nutrients. These include Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Carbon, Hydrogen and Oxygen. These are required in range from 5kg to 200kg.

13. How ammonium nitrate is prepared? Describe the process.

Ammonium Nitrate is prepared by neutralization reaction between Ammonia and Nitric Acid as given below,

$$NH_3\ (g) + HNO_3\ (g) \longrightarrow NH_4NO_3$$

After neutralization, water is evaporated. The solid ammonium nitrate is melted and sprayed down from a tall tower. Falling droplets are dried by upward air. Ammonium Nitrate is solidifying as tiny, hard pellets called prills.

14. Give the important qualities of fertilizer.

Important qualities of fertilizers are given below:

(i) It should be cheap
(ii) It should not be injurious to plants
(iii) It should not alter the pH of the soil
(iv) Nutrient elements present in it must be readily available to the plants

15. Give different zones in the rotary kiln and their temperature ranges.

There four different zones:

(i) Drying or pre-heating zone with temperature range around 500◦C
Here moisture is removed, and clay is broken into Al_2O_3, SiO_3 and Fe_2O_3.
(ii) Decomposition zone with temperature around 900◦C
Here lime stone ($CaCO_3$) is broken into Lime and CO_2

$$CaCO_3 \longrightarrow CaO + CO_2$$

(iii) Burning zone with temperature around 1500◦C
In this zone oxides combine to form Calcium Silicate, Calcium Aluminate and Calcium Ferrite
(iv) Cooling zone with temperature range 150-200◦C
Here the charge is cooled.

16. What is clinker formation?

Resulting product obtained from the cooling zone of kiln is known as clinker. These are greenish black or grey colored balls of small size.

17. What are fertilizers?

Fertilizers are the substances added to the soil to make up the deficiency of essential elements like nitrogen, phosphorous and potassium required for the proper growth of plants. Fertilizers enhance the natural fertility of the soil.

18. Why is there a need for fertilizers?

Fertilizers are required for the proper growth of plants. Mainly fertilizers are required for the growth of stem, leaves and roots, also enhance the yield and quality of plant followed by the formation of starch, sugar and fibrous materials. Fertilizers also accelerate the formation of seeds and fruits and increase the resistance to the diseases. All these things are made possible by using fertilizers.

19. Give any four important qualities of fertilizers.

Important qualities of fertilizers are given below:

(v) It should be cheap
(vi) It should not be injurious to plants
(vii) It should not alter the pH of the soil

(viii) Nutrient elements present in it must be readily available to the plants

20. Name the essential constituents of cement?

Essential constituent of cement are as follows;

(i) Calcareous materials which include lime stone, marble or chalk as a source of CaO
(ii) Argillaceous materials like clay, shale or slate that provide aluminates and silicates
(iii) Gypsum

21. Why wet cleaning is done in paper manufacture.

After dry cleaning, raw material is subjected to the wet cleaning. Wet cleaning is done to remove dust particles and water-soluble materials.

22. Write down two woody and two non-woody raw materials for paper pulp manufacture.

Woody Raw materials

(i) Poplar
(ii) Eucalyptus

Non-woody Raw materials

(i) Wheat straw
(ii) Bagasse

23. Name two woody and two non-woody raw materials.

Woody Raw materials

(iii) Poplar
(iv) Eucalyptus

Non-woody Raw materials

(iii) Wheat straw
(iv) Bagasse

24. Which types of woody raw materials are used in paper industry?

Two types of woody raw materials are used in paper industry;

(i) Hard wood
(ii) Soft wood

25. What reactions take place in decomposition zone during manufacturing of cement?

In decomposition zone, temperature ranges around 900C. Here lime stone ($CaCO_3$) is broken into Lime and CO_2

$$CaCO_3 \longrightarrow CaO + CO_2$$

26. What do you mean by prilling of urea?

Molten Urea is sprayed from the top of the tower and these droplets are cooled and solidified by the air rising upward. This process is called prilling.

27. What do you mean by setting of cement?

When cement is used as a paste with water and allowed to stand for some time, then its property to get hard is called setting of cement.

28. Why is cement known as Portland cement?

Cement is named as Portland because when it gets into hard stone like mass, it resembles like Portland rock, which is a famous building stone of England.

29. Write down digestion process for the preparation of pulp.

As the raw material enters the digester, steam is introduced at the bottom and a liquor containing sodium sulphite is injected simultaneously to cover the raw material. Sodium Sulphite used is buffered with sodium carbonate or sodium hydroxide to maintain its pH 7-9. The digester is closed carefully. It is revolved at 2.5R.P.M and a temperature of 160-180C is maintained. The digester takes 45minutes to attain the desired temperature after which it gets switched off automatically and pressure is released.

30. Define DAP. Write reaction for its preparation.

DAP stands for Diammonium Phosphate. Reaction for its preparation is given below;

$$2NH_3\ (g) + H_3PO_4\ (l) \longrightarrow (NH_4)_2HPO_4 + Heat$$

31. What is the chemical composition of a good Portland cement?

Chemical composition for a good Portland cement is;

(i) Calcarious materials which include lime stone, marble or chalk as a source of CaO
(ii) Argillaceous materials like clay, shale or slate that provide aluminates and silicates
(iii) Gypsum

32. Why lignin is removed from pulp?

Lignan is an aromatic polymer that causes paper to become brittle. That's why it is removed from the pulp.

33. What are the prospects of paper industry in Pakistan?

Fortunately, Pakistan has enough source of non-woody material, which in future can meet the requirements of our pulp and paper industry. The efforts are being made to install more pulp and paper industries in country.

Chemistry Part II Chapter#16 (Environmental Chemistry)
SHORT QUESTIONS

i. What are the components of environment?

Ans: Environment is consisted of following four components:-
i. Atmosphere
ii. Hydrosphere
iii. Lithosphere
iv.Biosphere/Ecosphere

ii. What is lithosphere? Give its composition.

Ans: Lithosphere consists of rigid rocky crust of earth. Lithosphere is composed of 46.6% oxygen, 27.72% silicon, 8.13% aluminium, 5% Fe and rest are some other metals.

iii. What is ecosphere?

Ans: It is the component of environment which includes the area of earth which has ability to support life. Some of the areas are atmosphere, rivers, solid sediments, lakes, oceans etc.

iv. What are the primary air pollutants?

Ans: The primary pollutants of air are:-
i. Gases such as oxides of nitrogen, oxides of Sulphur, volatile organic compounds, radioactive substances, CO etc.
ii. Automobile exhausts.
iii. Industrial waste effluents.

v. What are the secondary air pollutants?

Ans: The secondary air pollutants are N_2O, HF, PAN, aldehydes, ketones, H_2CO_3, H_2SO_4, O_3 etc.

vi. CO is a quiet killer. Justify.

Ans: CO is quiet killer because it binds with haemoglobin which results in decrease in oxygen carrying capability. Eventually death may occur if the exposer to CO is for longer period.

vii. What happens to the human body, when it is exposed to CO for longer time?

Ans: When human body is exposed to CO for a longer time, it creates following problems:-

i. Fatigue
ii. Headache
iii. Unconsciousness
iv. Eventual death

viii. What are the adverse effects of acid rain on earth?

Ans: The adverse effects of acid rain on earth are:-

i. Acid rain makes the soil, rivers, lakes slightly acidic.
ii. Leaching occurs due to acidic pH of soil which leaches the metals like Al, Pb, Hg etc.

ix. What is reducing smog?

Ans: A smog contains higher concentration of SO_2 and has reducing property is known as reducing smog. The main sources of reducing smog are the combustion of coal and the chemical reactions of pollutants in the air.

x. What is oxidizing/photochemical smog?

Ans: A smog contains higher concentration of agents like O_3, NO_x, hydrocarbons and has oxidizing property is called oxidizing or photochemical smog. It is yellowish brown, grey, hazy and has unpleasant odour.

xi. What is BOD?

Ans: The value of biological oxygen demand (BOD) is the amount of oxygen which is consumed due to biological oxidation of dissolved organic matter in the given sample of water. It is measured experimentally by calculating the concentration of oxygen at the beginning and at the end of 5 days period.

xii. What is COD?

Ans: The value of chemical oxygen demand (COD) is the amount of oxygen which is consumed due to chemical oxidation of dissolved organic matter in the given sample of water. It can be determined directly by the addition of dichromate ions in water. The organic matter in water is oxidized while the remaining dichromate ions are determined titrimetrically.

xiii. What are the various stages of water purification?

Ans: There are four stages to purify raw water:-

i. Aeration
ii. Coagulation
iii. Precipitation and removal of solid matter
iv. Chlorination

xiv. What are the harmful effects of chlorination of water?

Ans: The harmful effects of chlorination of water are:-

i. The chlorination of water produces NCl_3, which is a powerful eye irritant.

$Cl_2 + H_2O \longrightarrow HCl + HClO$

$NH_3 + 3HOCl \longrightarrow NCl_3 + 3H_2O$

ii. Cholrinated water may cause bladder and rectal cancer.
iii. If humic aicd is present in water then chlorine combines with humic acid to form $CHCl_3$, which is a liver carcinogen.

xv. Define incineration.

Ans: The waste treatment process in which waste is heated at high temperature ranging from 900 to 1000℃ is called incineration.

xvi. How many ways are there for recycling plastics?

Ans: Plastics are recycled in three ways:-

i. Reprocessing
ii. Depolymerization
iii. Transformation