Inter (Part-II) 2019

Chemistry	Group-I	PAPER: II
Time: 2.40 Hours	(SUBJECTIVE TYPE)	Marks: 68

SECTION-I

2. Write short answers to any EIGHT (8) questions: (16)

(i) Define periodic table. How many groups and periods are present in it?

Ans The Periodic Table provides a basic framework to study the periodic behaviour of physical and chemical properties of elements as well as their compounds.

There are eight groups, each group is divided into two sub-groups, designated as A and B.

There are seven periods in periodic table.

(ii) Define (i) Mendeleev's periodic law, (ii) Modern periodic law.

Ans **(i) Mendeleev's periodic law:**

The law states, "The physical and chemical properties of elements are the periodic functions of their atomic masses."

(ii) Modern periodic law:

It states that "If the elements are arranged in ascending order of their atomic numbers, their chemical properties repeat in a periodic manner."

(iii) Differentiate between alkali metals and alkaline earth metals. Give one example in each case.

Ans

Alkali Metals	Alkaline Earth Metals
1. The elements of group I-A are called Alkali metals, because they form alkalis with water.	1. The elements of group II-A are called alkaline earth metals, due to their presence in earth's crust.
2. For example, Na, K, etc.	2. For example, Mg, Ca, Ba, etc.

(iv) Write down the formulas of the following minerals: (i) Borax (ii) Colemanite

Ans **(i) Borax:** $Na_2B_4O_7.10H_2O$

(ii) Colemanite: $Ca_2B_6O_{11}.5H_2O$

(v) Write down four uses of borax.

Ans Following are the four uses of borax:

1. It is used in the softening of water.
2. It is used in metallurgical operations.
3. It is used to prepare borate glass, which is heat resistance.
4. It is employed in making washing powder.
5. It is used as a flux in welding.

(vi) Define chemical garden.

Ans When crystals of soluble coloured salts are placed in a solution of sodium silicate, Na_2SiO_3, they produce a very beautiful growth, like plant, which is called chemical garden.

(vii) Write down two similarities and two dissimilarities of oxygen and sulphur.

Ans **Two similarities are:**

1. Both are typical non-metals.
2. Both are found in free and combined states on earth.

Dissimilarities of oxygen and sulphur

	Oxygen		Sulphur
1.	It is a gas at ordinary temperature.	1.	It is solid at ordinary temperature.
2.	Oxygen helps in combustion.	2.	Sulphur is itself combustible.

(viii) Write four differences of nitrogen from its family.

Ans Following are the four differences of nitrogen from its family:

1. Nitrogen is gas while other family members are solids.
2. Nitrogen occurs in free state, while others occur in the combined state.
3. The oxides of nitrogen are mostly gases, while those of others are solids.
4. Nitrogen is chemically inert while others are very reactive.

(ix) Why does aqua regia dissolve gold and platinum?

Ans **Aqua regia:**

When one volume of concentrated HNO_3 is mixed with 3 volumes of concentrated HCl, aqua regia is formed. It is employed to dissolve gold and platinum.

$$HNO_3(conc.) + 3HCl(conc.) \longrightarrow NOCl(aq) + Cl_2(g) + 2H_2O(l)$$

NOCl formed is decomposed giving NO and Cl_2.

$$2NOCl \longrightarrow 2NO(g) + Cl_2(g)$$

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

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

(x) Write down four essential qualities of a good fertilizer.

Ans Four important qualities of a good fertilizer are:

1. The nutrient elements present in it, must be readily available to the plant.
2. It must be fairly soluble in water so that it thoroughly mixes with the soil.
3. It should not be injurious to plant.
4. It should be cheap.

(xi) What are raw materials for the manufacture of cement?

Ans The important raw materials used for the manufacture of cement are as follows:

1. Calcarious material
2. Argillaceous material
3. Gypsum

(xii) Define environmental chemistry. Name components of environment.

Ans **Environmental Chemistry:**

The branch of chemistry which deals with the chemicals and other pollutants in the environment is called environmental chemistry.

Components of Environments:

The environment consists of the following components:

1. Atmosphere
2. Hydrosphere
3. Lithosphere
4. Biosphere / ecosphere

3. Write short answers to any EIGHT (8) questions: (16)

(i) Define organic chemistry. What is vital force theory?

Ans **Organic Chemistry:**

Organic chemistry is that branch of chemistry which deals with the study of compounds of carbon and hydrogen (hydrocarbons) and their derivatives.

Vital Force Theory:

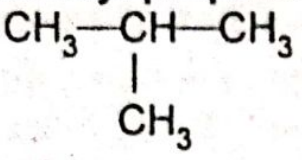
The early chemists never succeeded in synthesizing organic compounds and their failure led them to believe that organic compounds could be manufactured only by and within living things and these compounds could never by synthesized from inorganic materials. This theory was referred to as vital force theory.

(ii) Write down structural formulas of the following:

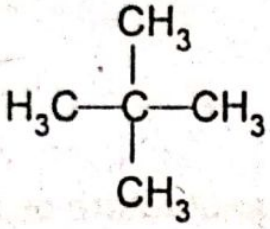
(a) 2-Methyl propane **(b) Neopentane**

(c) 3-Ethyl pentane **(d) 2,2-Dimethyl pentane**

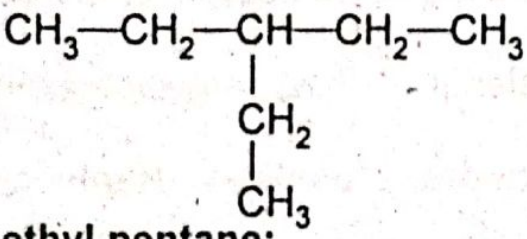
Ans **(a) 2-Methyl propane:**



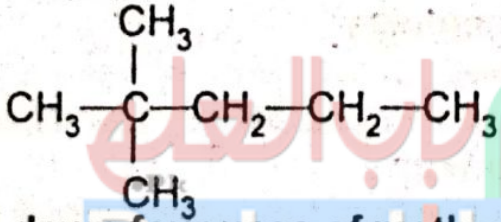
(b) Neopentane:



(c) 3-Ethyl pentane:



(d) 2,2-Dimethyl pentane:



(iii) Write down four uses of methane.

Ans Methane is used:

1. as a fuel and as an illuminating gas.
2. for the preparation of methyl chloride, methylene chloride and chloroform.
3. for the industrial preparation of methyl alcohol and formaldehyde.
4. for preparation of carbon black.

(iv) Define aromatic hydrocarbons. How they are classified?

Ans **Aromatic hydrocarbons:**

"When one or more than one hydrogen atoms of benzene ring are substituted by saturated or unsaturated group consisting of carbon and hydrogen, then the resulting compounds are aromatic hydrocarbons."

They are classified on the basis of no. of benzene rings, as follows:

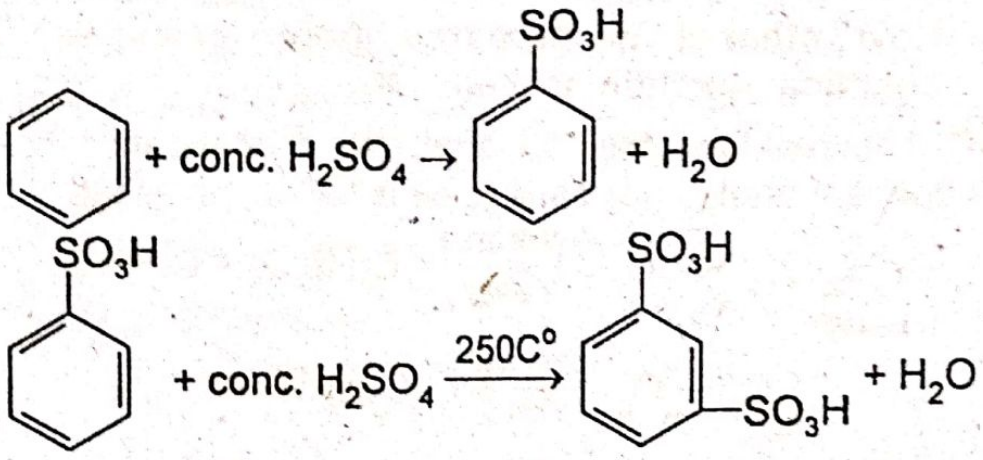
1. Monocyclic aromatic hydrocarbons
2. Polycyclic aromatic hydrocarbons

(v) What happens when:

(a) Benzene is heated with conc. H_2SO_4 at 250°C.

(b) Chlorine is passed through benzene in sunlight.

Ans

(a) 

(b) $C_6H_6 + \xrightarrow[\text{Sunlight}]{3Cl_2} C_6H_6Cl_6$

(vi) Define alkyl halides. What are primary alkyl halides? Give one example.

Ans "Those organic compounds which are derived from the hydrocarbons by the replacement of one or more hydrogen atoms by the halogen atoms are called alkyl halides."

"Those alkyl halides in which the halogen atom (X) is attached with a carbon which is further attached to one or no carbon atoms, are called primary alkyl halides." For example:

$$\underset{\text{Chloroethane}}{CH_3\text{—}\overset{\alpha}{C}H_2\text{—}Cl}$$

α-carbon is primary carbon. It has two hydrogen atoms and one alkyl group.

(vii) Define Grignard reagent. Give one example.

Ans Grignard reagents RMgX are derivatives of alkyl halides belonging to class of organo-metallic compounds. Grignard reagent was first prepared by Victor Grignard in 1900. These reagents are so important in organic synthesis that almost all the classes of organic compounds can be prepared from them. Due to their importance and applications, Victor Grignard was awarded Nobel prize in chemistry.

Preparation:

Grignard reagents are prepared by the reaction of magnesium metal with alkyl halides in the presence of dry ether (alcohol free, moisture free).

$$R^{\delta+} - X^{\delta-} + Mg \xrightarrow{\text{Ether}} R - Mg - X$$

$$CH_3 - CH_2 - Br + Mg \xrightarrow{\text{Ether}} \underset{\text{Ethyl magnesium bromide}}{CH_3 - CH_2 - Mg - Br}$$

(viii) How ethanol is prepared from Molasses? Write chemical reaction as well.

Ans The residue obtained after the crystallization of sugar from concentrated sugar-cane juice is called molasses.

$$\underset{\text{Molasses}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{Yeast}]{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$C_6H_{12}O_6 \xrightarrow[\text{Yeast}]{\text{Zymase}} 2\underset{\text{Ethanol}}{C_2H_5OH} + 2O_2$$

(ix) Define: (a) Absolute alcohol (b) Methylated spirit (c) Rectified spirit (d) Denaturing of alcohol

Ans **(a) Absolute alcohol:**

Absolute alcohol can be obtained by the distillation of rectified spirit with CaO which absorbs moisture. Absolute alcohol is 100% pure and also called dry alcohol.

(b) Methylated spirit:

Ethyl alcohol can be obtained by adding 10% methyl alcohol to avoid its use for drinking purposes. This mixture is called methylated spirit.

(c) Rectified spirit:

Alcohol obtained by fermentation is only up to 12% and never exceeds 14% because beyond this limit enzymes become inactive. This alcohol is distilled again and again to obtain 95% alcohol which is called rectified spirit.

(d) Denaturing of alcohol:

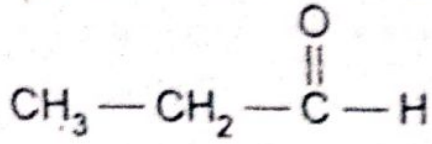
Sometimes ethanol is denatured by addition of 10% methanol to avoid its use for drinking purposes. Such alcohol is called methylated spirit. A small quantity of pyridine or acetone may also be added for this purpose.

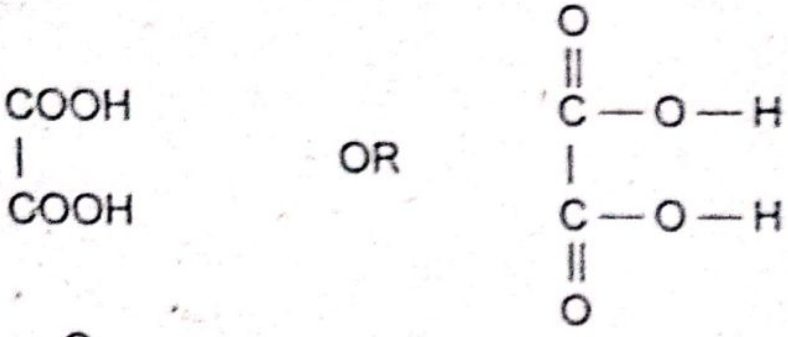
(x) Write down the structural formulae of the following:

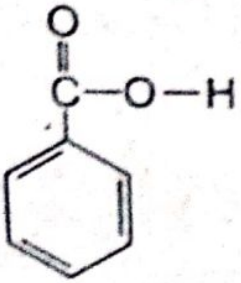
(a) Propanoic acid (b) Oxalic acid

(c) Benzoic acid (d) Acetic anhydride

Ans

(a) 

(b) 

(c) 

(d) 

(xi) How acetic acid is converted into the methane?

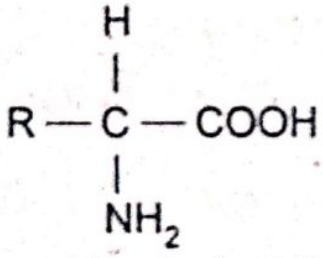
Ans $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

$$CH_3COONa + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$$

(xii) Define amino acids. Give two examples.

Ans Amino acids are organic compounds containing both amino ($-NH_2$) group and carboxyl ($-COOH$) group.

General formula



Amino acids are building blocks of proteins. The amino acids which contain two carboxyl groups are called acidic amino acids *e.g.*, Glutamic acid and Aspartic acid.

While those containing two amino groups are called basic amino acids *e.g.*, lysine is a basic amino acid.

4. Write short answers to any SIX (6) questions: (12)

(i) What is iodized salt?

Ans Diet with insufficient iodide ions leads to an enlargement of the thyroid (Goiter). 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.

(ii) Why iodine has metallic luster?

Ans Iodine has large atomic size and shielding effect and least nuclear charge. The electrons in the valence shell are not tightly bound with the nucleus. These electrons can easily excite. Because of which iodine has metallic luster.

(iii) Give four applications of noble gases.

Ans Following are the four applications of noble gases:

1. Xenon is used in bactericidal lamps.
2. Neon and helium arc is used in making glass lasers.
3. Argon is also used for arc welding and cutting.
4. Helium is used as a cooling medium for nuclear reactors.

(iv) What are interstitial compounds?

Ans 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.

(v) How will you convert ethanal into lactic acid?

Ans

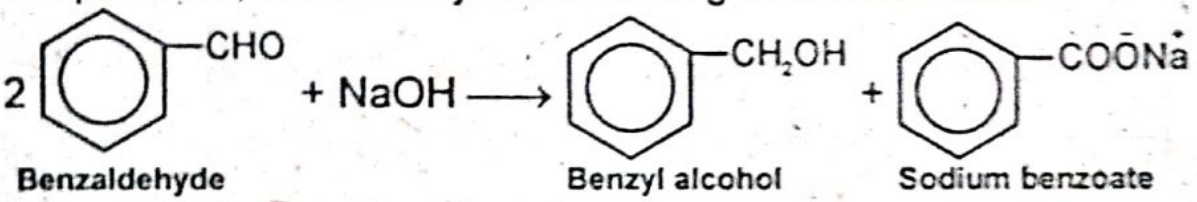
$$CH_3CHO \xrightarrow{HCN} CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CN \xrightarrow{H_2SO_4+2H_2O} NH_4HSO_4 + CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-COOH$$

lactic acid

(vi) How will you distinguish between ethanal and benzaldehyde? Give respective chemical reaction.

Ans Aldehydes that have no α-hydrogen atoms undergo Cannizzaro's reaction. It is a disproportionation (self- oxidation-reduction) reaction. Two molecules of the aldehyde are involved, one molecule being converted into the corresponding

alcohol (the reduced product) and the other into the acid in the salt form (the oxidation product). The reaction is carried out with 50 percent aqueous solution of sodium hydroxide at room temperature, Acetaldehyde does not give such reaction.



Benzaldehyde — Benzyl alcohol — Sodium benzoate

(vii) How is polyvinyl chloride prepared and give its uses?

Ans It is a polymer of vinyl chloride.

$(CH_2 = CH - Cl)$

Vinyl chloride is subjected to a pressure of 9 atm at 52°C. The catalyst used in benzoyl peroxide. The reaction goes according to free radical mechanism.

$$n\,CH_2=CH(Cl) \xrightarrow[\text{Temp.} = 52^\circ C]{\text{Pressure} = 9\ atm} (-CH_2-CH(Cl)-)_n$$

Uses:

PVC is used for making:

1. Gramophone recorders
2. Pipes
3. Floor coverings
4. Rubber-like texture

(viii) How is nylon –6, 6 prepared?

Ans **Polyamide resins (Nylon –6,6):**

It can be obtained by heating adipic acid with hexamethylenediamine, both of which have six carbon atoms.

$$nHOC(CH_2)_4COH + nH_2N(CH_2)_6NH_2 \xrightarrow[-H_2O]{\text{Heat}} -C(CH_2)_4C(=O)-NH(CH_2)_6NH-$$

Adipic acid — Hexamethylenediamine

$$[NH(CH_2)_6NHC(CH_2)_4C]_{n-1}NH(CH_2)_6NH-$$

Nylon -6,6

(ix) What is function of DNA and RNA?

Ans Both DNA and RNA are formed by joining together a large number of nucleotide units or mononucleotide units, each of which is a nitrogenous base-sugar phosphoric acid complex. Deoxyribonucleic acid (DNA) carries the genetic information

and ribonucleic acid (RNA) is involved in putting this information to work in the cell.

SECTION-II

NOTE: Attempt any Three (3) questions.

Q.5.(a) Write eight points to describe role of lime in industries. (4)

Ans Role of Lime in Industries:

1. Large quantities of lime are used in the extraction and refining of metals.
2. Lime is also used in paper, cement and leather industries.
3. The ability of lime to react with sand at high temperature forming calcium silicate ($CaSiO_3$) serves as an important basis for glass manufacture.
4. Lime is used in ceramic industry for producing different types of sanitary materials.
5. Ordinary mortar, also called lime 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 mortar hardens are:

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

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

$$Ca(OH)_2 + SiO_2 \rightarrow CaSiO_3 + H_2O$$

6. Lime is also used in refining of sugar and other food products.
7. Lime is used in the manufacturing of bleaching powder, which is used for the bleaching of the fabric and paper pulp.
8. A suspension of the calcium hydroxide is called milk of lime and is used as white-wash.

(b) What are hydrides? Describe different types of hydrides. (4)

Ans Hydrides:

"The binary compounds of hydrogen with other elements are called hydrides."

According to the nature of bonding, hydrides are broadly classified into three classes: (1) Ionic, (2) Intermediate, (3) Covalent.

1. Ionic Hydrides:

The elements of group IA and IIA form Ionic hydrides, which contain H^- (hydride) ion. These hydrides are crystalline solid compounds, with high melting and boiling points and which conduct electricity in molten state. The tendency towards covalent character increases by moving from left to right in the periodic table.

2. Intermediate hydrides:

Hydrides of beryllium and magnesium represent the class of intermediate hydrides. Their properties are in between the ionic and covalent hydrides. They have polymeric structures and covalent nature.

3. Covalent hydrides:

The covalent hydrides are usually gases or volatile liquids. They are non-conductors and dissolve in organic solvents. Their bond energies depend on the size and the electronegativity of the element. Stability of covalent hydrides increases from left to right in a period and decreases from top to bottom in a group. Fluorine forms the most stable hydride and the least stable are those of thallium, lead and bismuth. These hydrides are formed by elements with electronegativity values (Pauling Scale). Since the electronegativity of hydrogen is 2.1, most of these hydrides have polar covalent bonds in which hydrogen is carrying a slight positive charge. On moving from left to right across a period, the electronegativity of the other element increases and the hydrogen-element bond becomes more polar. Due to high polarity, the hydrides like H_2O and HF are capable of forming hydrogen bonds between their molecules. The boiling points of covalent hydrides generally increase on descending a group, except the hydrides like H_2O, HF and NH_3 which, due to hydrogen bonding, have higher boiling points than might be expected.

Q.6.(a) Define corrosion. Explain electrochemical theory of corrosion. **(4)**

Ans Corrosion:

"Any process of chemical decay of metals due to action of surrounding medium is called corrosion."

Electrochemical theory of Corrosion:

It is a known fact that 100% pure metals don't corrode. The impurities present in the metal promote corrosion. In order to understand why impurities accelerate the corrosion of metals, let us consider two different metals which are in contact with each other in the moist air.

Take the example of copper and aluminium which are touching each other. After sometime, Al gets corroded while Cu remains intact. Electrochemical theory explains it.

The moisture and CO_2 are present on the surface of metal. Water ionizes into H^+ and OH^- ions. CO_2 dissolves in water forming H_2CO_3 which ionizes into $H^{\oplus}$ and $HCO_3^{\ominus}$

$$H_2O \rightleftharpoons H^{\oplus} + OH^{\ominus}$$

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

$$H_2CO_3 \rightleftharpoons H^{\oplus} + HCO_3^{\ominus}$$

In other words, copper and aluminium are immersed in the solution having $H^{\oplus}$, $OH^{\ominus}$ and $HCO_3^{\ominus}$ ions. In this way, Galvanic cell is set up in which aluminium releases the electrons and changes to Al^{+3} ions and acts as a positive electrode. These electrons are accepted by copper and copper acts as a negative electrode.

$$Al \longrightarrow Al^{+3} + 3e^{\ominus}$$

Al^{+3} combines with $OH^{\ominus}$ ions to give $Al(OH)_3$.

$$Al^{+3} + 3OH^- \longrightarrow Al(OH)_3$$

So Al starts dissolving. $H^{\oplus}$ ions present on the Cu receive the electrons of Al through copper electrode and hydrogen gas is released.

$$3H^+ + 3e^- \longrightarrow \frac{3}{2} H_2$$

Actually, the copper is lower in electrochemical series, than Al. Hence Al has lost electrons and $H^{\oplus}$ has gained electrons.

Conclusion:

Hence when an active metal like aluminium is in contact with less reactive metal say copper, then a Galvanic cell is developed. Active metal corrodes rapidly, while other remains intact.

(b) How water is disinfected by chlorine? Write down harmful effects of chlorination of water. (4)

Ans Chlorine treatment of water is very effective. It kills the pathogens that may cause serious water-borne diseases such as:

(i) Typhoid (ii) Cholera

Process of chlorination:

The most commonly used disinfectant is HOCl. It is called hypochlorous acid. It is not a stable compound and cannot be stored. It is generated by dissolving molecular chlorine and calcium hypo-chlorites in water.

$$Cl_2 + H_2O \longrightarrow H^+ + HClO + Cl^-$$

Sometimes sodium and calcium hypochlorides are reacted with water to get HClO. In this way, we can avoid the transportation and use of chlorine cylinders.

HClO is a covalent compound and kills the microorganisms by passing through their cell membranes.

Harmful effects of chlorination:

Chlorination of water containing organic materials also forms some organic compounds which are toxic. For example, if phenol is present in water then chlorinated phenols are formed which have offensive odour and taste and are toxic. Chloroform $CHCl_3$ is formed when hypochlorous acid reacts with organic matter (humic acid) dissolved in water. Chloroform is suspected liver carcinogen and also has negative reproduction and development effects in humans. The risk of bladder and rectal cancer increases by drinking chlorinated water.

Alternatives to Chlorination:

In order to avoid the formation of toxic compounds with chlorine, some other alternatives are used. One of the best is to use ozone or chlorine dioxide for the disinfection of water.

Q.7.(a) What is orbital hybridization? Explain sp^3 hybridization with an example. (4)

Ans **Definition:**

It is an hypothetical process in which atomic orbitals of different energy and shape mix to form a set of equivalent orbits of same energy and same shape.

Types of Hybridization:

Following are three types of hybridization:

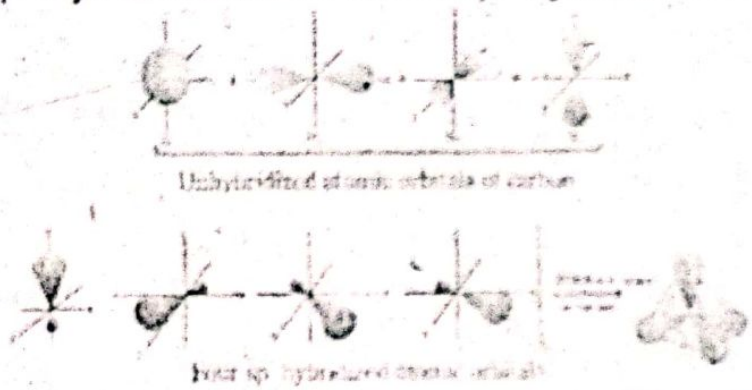
1. sp^3 hybridization

2. sp^2 hybridization
3. sp hybridization

sp^3 hybridization:

Definition:

The process of mixing one s-orbital and three p-orbitals to give four sp^3 hybrid orbitals is called sp^3 hybridization.



Carbon atom is supposed to undergo sp^3 hybridization if it is to link with four other atoms.

Electronic Configuration in Ground State:

It is $1s^2\ 2s^2\ 2p^2_x\ 2p^1_y\ 2p^0_z$.

Electronic Configuration in Excited State:

It is $1s^2\ 2s^1\ 2p^1_x\ 2p^1_y\ 2p^1_z$. It is supposed that an electron from 2s orbital is promoted to empty $2p_z$ orbital, it is then imagined that the 2s and three 2p orbitals are mixed to give four equivalent sp^3 orbitals.

$$2s^1 + 2p^1_x + 2p^1_y + 2p^1_z = 4sp^3$$

Characteristics:

(i) Each sp^3 orbital has character 1 : 3.
(ii) These orbitals are directed from the centre of a regular tetrahedron to its four corners.
(iii) The angle between any two sp^3 hybrid orbitals is 109.5°.
(iv) The four sp^3 orbitals are non co-planar.
(v) The geometry of methane is tetrahedral.

In the formation of methane, four hybrid atomic orbitals of carbon overlap separately with four 1s atomic orbitals of hydrogen atoms forming sp^3-s bonds.

(b) Discuss atomic orbital treatment to explain structure of benzene. (4)

Ans For Answer see Paper 2017 (Group-I), Q.9.(a).

Q.8.(a) How can following conversions be carried out: (4)

(i) Ethane → Methane (ii) Methane → Ethane

Ans **(i) Ethane into methane:**

$$CH_3 - CH_3 + Cl_2 \xrightarrow{hv} CH_3 - CH_2Cl + HCl$$

$$CH_3 - CH_2Cl + KOH_{(aq)} \longrightarrow CH_3 - CH_2 - OH + KCl$$

$$CH_3 - CH_2 - OH + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3 - \overset{\overset{O}{\|}}{C} - H + H_2O$$

$$CH_3 - \overset{\overset{O}{\|}}{C} - H + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3 - \overset{\overset{O}{\|}}{C} - OH$$

$$CH_3 - \overset{\overset{O}{\|}}{C} - OH + NaOH \longrightarrow CH_3 - \overset{\overset{O}{\|}}{C} - ONa + H_2O$$

$$CH_3 - \overset{\overset{O}{\|}}{C} - ONa + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$$

(i) Methane into ethane:

$$CH_4 + Cl_2 \xrightarrow{hv} CH_3Cl + HCl$$

$$2CH_3Cl + 2Na \longrightarrow CH_3 - CH_3 + 2NaCl$$

(b) How can ethers be prepared by Williamsons method and from Ag_2O? (2,2)

Ans Ethers are prepared by following methods:

(i) By Williamsons 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.

$$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5O^-Na^+ + H_2$$

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

(ii) Alkyl halides are heated with dry silver oxide to form ethers:

$$2C_2H_5Br + Ag_2O \longrightarrow C_2H_5OC_2H_5 + 2AgBr$$

Q.9.(a) How does ethyl magnesium bromide react with: (4)

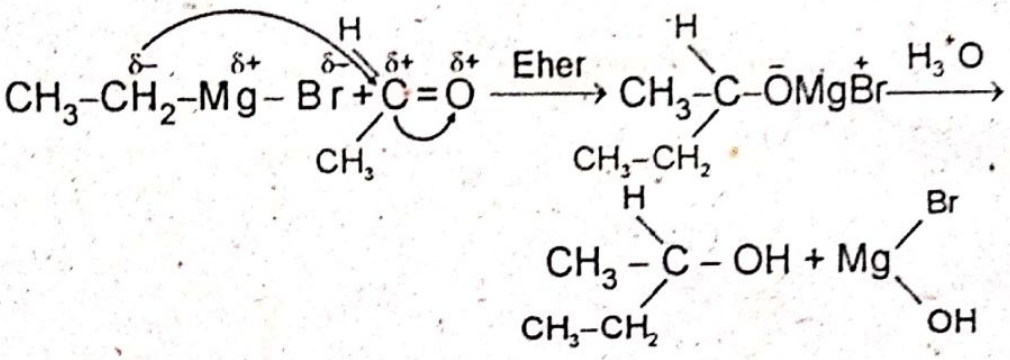
(i) CO_2 **(ii) $H_3C - CHO$**

(iii) H_2O **(iv) CH_3OH**

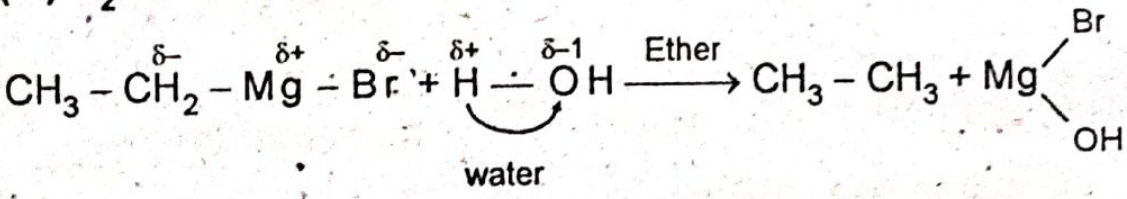
Ans (i) CO_2:

For Answer see Paper 2015 (Group-II), Q.7.(b)(i).

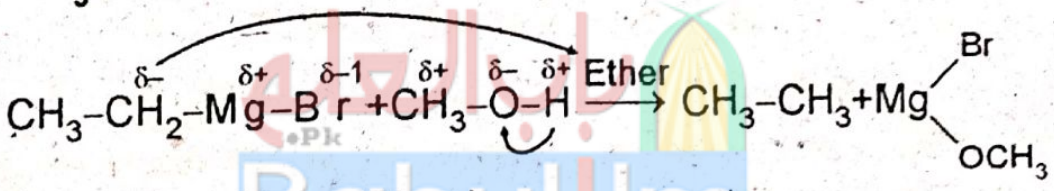
(ii) $H_3C - CHO$:



(iii) H_2O:



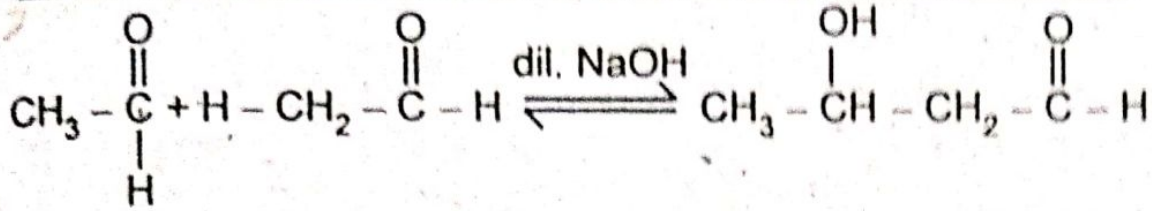
(iv) CH_3OH:



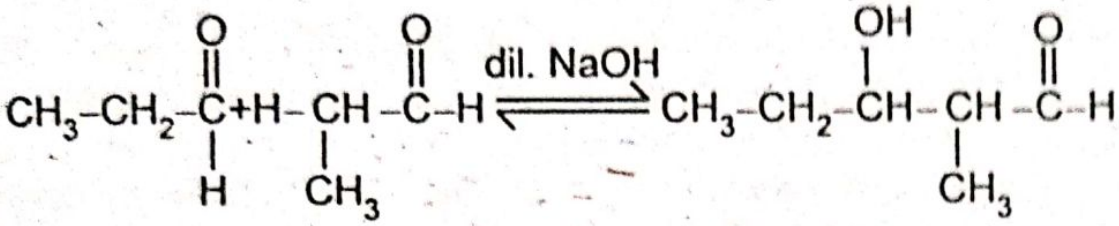
(b) Describe with mechanism aldol condensation reaction. (4)

Ans Aldol Condensation:

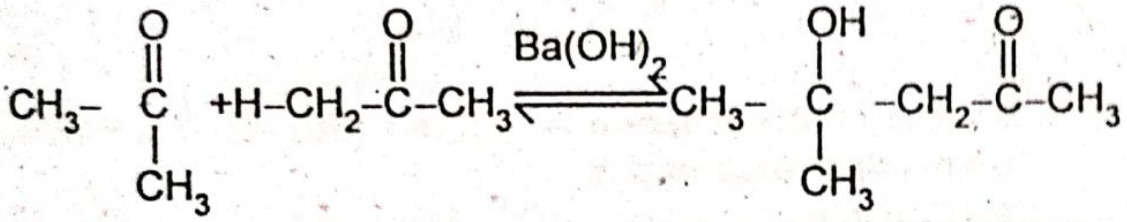
Aldehydes and ketones possessing α-hydrogen atoms react with a cold dilute solution of an alkali to form addition products known as aldols. The name 'aldol' is given to the product because it contains both aldehyde and alcohol functional groups. Note that the name aldol condensation is reserved for the reaction that starts with two identical carbonyl compounds. Two molecules of the same carbonyl compound condense to form an aldol.



Ethanal Ethanal 3-Hydroxybutanal (aldol)



Propanal Propanal 3-Hydroxy-2-methylpentanal (aldol)



Propanone Propanone 4-Hydroxy-4-methyl-2-pentanone

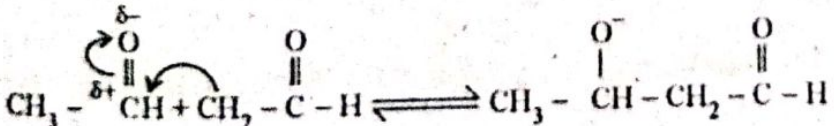
The aldol compound readily loses water on heating in the presence of dilute acid to form an unsaturated carbonyl compound. A carbon-carbon double bond is formed between the α-and β-carbon atoms.

Mechanism:

The hydroxide ion acts as a base. It removes a proton from α-carbon of one molecule of the carbonyl compound to form a carbanion.

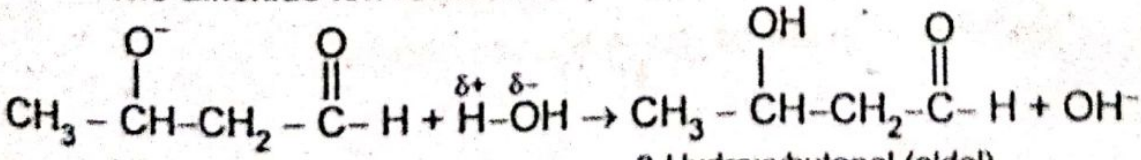
Hydroxide ion Ethanal Carbanion

The carbanion acts as a nucleophile. It attacks the electrophilic carbonyl carbon atom of the unchanged second molecule to form an alkoxide ion.



Ethanal Carbanion An alkoxide ion

The alkoxide ion removes a proton from water to form aldol.



Alkoxide ion 3-Hydroxybutanal (aldol)

The basic catalyst hydroxide ion is regenerated.