Inter (Part-II) 2019

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

SECTION-I

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

(i) What is hydration energy? Give an example.

Ans It is the amount of heat absorbed or evolved when one mole of gaseous ions dissolve in water to give infinitely dilute solution.

Example:

When one mole of gaseous hydrogen ions are dissolved in water to give an infinitely dilute solution, then 1075 kJ of energy is evolved. This is called hydration energy of $H^{\oplus}$ ion.

$$H^+_{(g)} + H_2O \longrightarrow H_3O^+_{(aq)} \qquad \Delta H_h = -1075 \text{ kJ mol}^{-1}$$

(ii) Why diamond is a non-conductor but graphite is a fairly good conductor?

Ans Diamond and graphite are the allotropic forms of carbon. Diamond has a compact structure. All the electrons are busy in sigma framework due to sp^3-sp^3 overlapping. Electrons are not free, so diamond is bad conductor of electricity while graphite is good conductor because it contains delocalised (free) electrons. These ēs are free to move through the structure of graphite.

(iii) How are lime and sand used to make glass?

Ans The ability of lime to react with sand at high temperature forming Calcium silicate ($CaSiO_3$) serves as an important basis for glass manufacture.

(iv) How does orthoboric acid react with:
(a) Sodium hydroxide (b) Ethyl alcohol

Ans **(a) Sodium hydroxide:**

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

(b) Ethyl alcohol:

$$H_3BO_3 + 3C_2H_5OH \xrightarrow{H_2SO_4} (C_2H_5)_3\,BO_3 + 3H_2O$$

(v) Why is CO_2 a gas at room temperature while SiO_2 is a solid?

Ans Because CO_2 is a non-polar molecule, so the forces of attraction in CO_2 are very weak, hence it occurs in gas form at room temperature. While SiO_2 is a solid because in its structure, one Si atom combines with four oxygen atoms and one oxygen atom combines with two Si atoms. The repetition occurs throughout its structure and forces of attraction become more prominent than CO_2.

(vi) Why are borate glazes preferred over silicate glazes?

Ans Boric acid is used in pottery as glaze because borate glazes are more fusible, than silicate glazes and possess a higher coefficient of expansion.

(vii) H_2SO_4 is a powerful dehydrating agent. Prove it giving two examples.

Ans H_2SO_4 acts as dehydrating agent as follows:

1. With oxalic acid, it forms CO_2 and CO.

$$\begin{matrix}COOH\\|\\COOH\end{matrix} \xrightarrow{\text{Conc. } H_2SO_4} CO_2 + CO + H_2O$$

2. With formic acid, CO is formed.

$$H-\overset{\overset{O}{\|}}{C}-OH \xrightarrow{\text{Conc. } H_2SO_4} CO + H_2O$$

3. With ethyl alcohol, it forms ethylene.

$$C_2H_5OH \xrightarrow[100^\circ C]{\text{Conc. } H_2SO_4} C_2H_4 + H_2O$$

(viii) 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.

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

(ix) Write two similarities of oxygen and sulphur.

Ans Following are two similarities of oxygen and sulphur:

1. Both are typical non-metals.
2. They are usually divalent.

(x) What do you mean by prilling of urea?

Ans The molten urea is sprayed at the prilling tower by means of prilling bucket where it is cooled by the air rising upward. Molten droplets solidify into the form of prills.

(xi) State the reactions that take place during first 24 hours by the setting of cement.

Ans

1. After a short time of the paste formation, tri-calcium aluminate absorbs water. This is called the hydration. It forms a colloidal gel of composition,

   $3Ca \cdot Al_2O_3 \cdot 6H_2O$

2. This gel starts crystallizing slowly, reacts with gypsum having the formula ($CaSO_4.2H_2O$) to give the crystals of calcium sulpho-alminate

   $(3CaO \cdot Al_2O_3.3CaSO_4 \cdot 2H_2O)$

(xii) How are detergents threat to aquatic animal life?

Ans Detergents are excessively used in industries and household as cleaning agents. The amount of disposed detergents in waste water is increasing day-by-day. This water when discharged in river or sea, greatly affects the aquatic animal life. The detergents mobilize the bound heavy metal ions like Pb, Cd and Hg from sediments into water. These metal particles are very toxic.

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

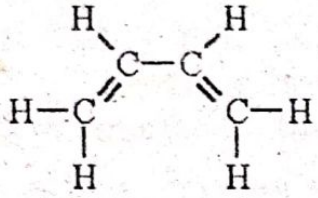
(i) How coal is produced from remain of trees?

Ans Coal in nature was formed from the remains of the trees buried inside the earth crust some 500 millions years ago. Due to the bacterial and chemical reactions on wood, it got converted into peat. Then, as a result of high temperature and high pressure inside the earth crust, peat got transformed into coal.

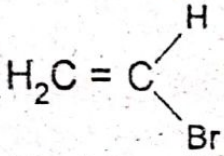
(ii) Write structural formulas of:

(a) 1,3-Butadiene (b) Vinyl bromide

Ans **(a) 1,3-Butadiene:**



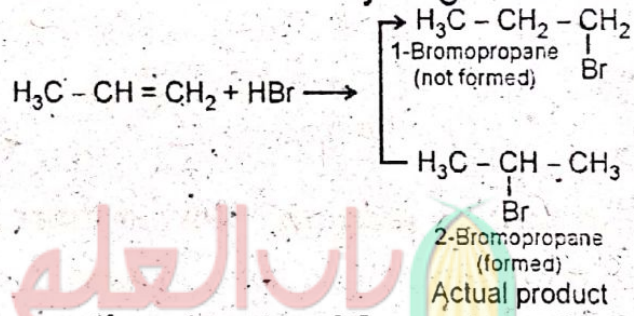
(b) Vinyl bromide:



OR $CH_2 = CH - Br$

(iii) State Markownikov's rule and give an example.

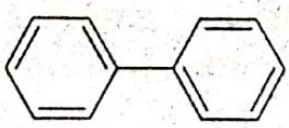
Ans This rule states that: In the addition of an unsymmetrical reagent to an unsymmetrical alkene, the negative part of the adding reagent goes to that carbon, constituting the double bond, which has least number of hydrogen atoms. *e.g.*,



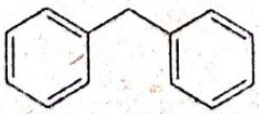
(iv) Write down the structural formulas of:

(a) Biphenyl (b) Diphenylmethane

Ans **(a) Biphenyl:**



(b) Diphenylmethane:



(v) How the cyclic structure of benzene got verified?

Ans Molecular formula of benzene C_6H_6 is not in relation with straight chain hydrocarbons like alkanes C_nH_{2n+2} and alkenes $C_n.H_{2n}$ or alkynes C_nH_{2n-2}.

For six carbon:

C_6H_{14} (alkane), C_6H_{12} (alkene), C_6H_{10} (alkynes).

This six carbon containing alkane, alkene or alkyne has no relation with benzene.

Conclusion:

Thus it is proved that benzene molecular formula C_6H_6 does not correspond to straight chain alkane, alkene or alkynes. Rather it is an unsaturated cyclic hydrocarbon.

(vi) Write down any two methods of preparation of alkyl halides.

Ans Following are some important methods for the preparation of alkyl halides:

1. From alcohols:

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.

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

2. Alcohols also react with thionyl chloride in pyridine as a solvent to give alkyl chlorides. This method is especially useful since by-products (HCl, SO_2) are gases, which escape leaving behind the pure product.

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

(vii) What is Grignard's reagent? How is it prepared?

Ans The organometallic compounds, in which an atom of Mg is connected with a halogen atom and alkyl groups, are called Grignard's reagent.

Preparation:

Grignard's reagents are prepared by the reaction of Mg metal with alkyl halides in the presence of dry ether.

$$R - X + Mg \xrightarrow{Ether} R - Mg - X$$

$$CH_3CH_2 - Br + Mg \xrightarrow{Ether} CH_3CH_2 - Mg - Br$$

All reactants must by dry and pure.

(viii) Absolute alcohol cannot be prepared by fermentation process. Give justification.

Ans 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.

(ix) How can you distinguish between methanol and ethanol?

Ans Ethanol reacts with I_2 in the presence of NaOH to give yellow crystalline ppt. of iodoform while methanol does not give this reaction.

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

(Iodoform Yellow ppt)

$$CH_3OH + I_2 + NaOH \rightarrow \text{No Yellow ppt.}$$

(x) What are essential and non-essential amino acids?

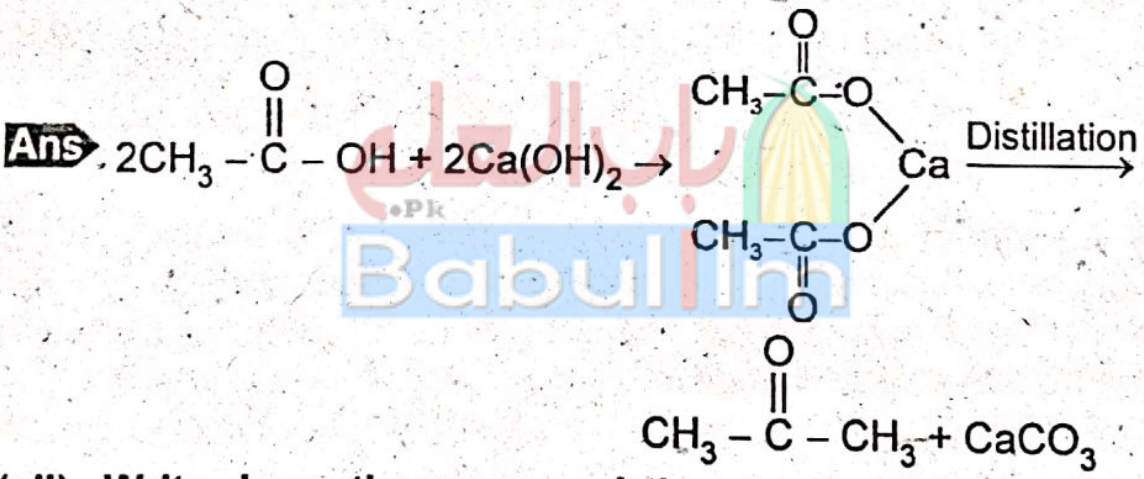
Ans The amino acids, which the body is not able to synthesize are called essential amino acids. These are supplied to our body by our diet, their deficiency may cause diseases.

The amino acids which the body can synthesize are called non-essential amino acids.

There are 20 amino acids which are required for protein synthesis. Human body can synthesize only 10 amino acids. It means that 50% of the total amino acids are essential and 50% are non-essential.

(xi) How will you carry out following conversion: Acetic acid into acetone.

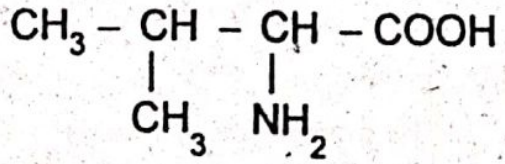
Ans



$$2CH_3-\overset{\overset{O}{\|}}{C}-OH + 2Ca(OH)_2 \rightarrow \left[CH_3-\overset{\overset{O}{\|}}{C}-O\right]_2Ca \xrightarrow{\text{Distillation}} CH_3-\overset{\overset{O}{\|}}{C}-CH_3 + CaCO_3$$

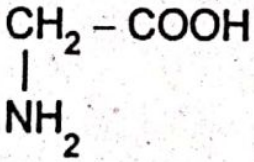
(xii) Write down the name and the structural formulas of two acidic amino acids.

Ans **(i) Alanine:**



$$CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{NH_2}{|}}{CH}-COOH$$

(ii) Glycine:



$$CH_2(NH_2)-COOH$$

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

(i) Which halogen sublimes as violet vapours?

Ans Iodine is such a solid halogen which can sublime. When it is heated, it is directly converted into violet vapours.

(ii) Write reaction of Cl_2 with cold and hot NaOH.

Ans The reactions of chlorine with hot and cold NaOH are examples of "Disproportionation reactions".

$$Cl_2 + 2NaOH \xrightarrow{\text{cold}} NaCl + NaClO + H_2O$$

$$3Cl_2 + 6NaOH \xrightarrow{\text{hot}} 5NaCl + NaClO_3 + 3H_2O$$

(iii) Halogens act as oxidizing agents, justify.

Ans Loss of electrons is called oxidation.

Halogens are electronegative elements. They have tendency to gain the electrons. They oxidize the other substances and get themselves reduced. The metals and non-metals react with halogens. The reacting element acquires the positive oxidation state in the halides formation.

(iv) Give systematic name of $Na_3[CoF_6]$.

Ans The systematic name of $Na_3[CoF_6]$ is Sodium hexafluorocobaltate.

(v) Write Fehling's solution test.

Ans Aliphatic aldehydes form a brick-red precipitate with Fehling's solution. To an aldehyde solution, add Fehling's solution and boil. A brick red precipitate of cuprous oxide is formed. Ketones do not give this test.

$$R - CHO + 2Cu(OH)_2 + NaOH \longrightarrow R - COONa + \underset{\text{Brick-red ppt}}{Cu_2O} + 3H_2O$$

(vi) How will you distinguish between ethanal and propanal?

Ans Ethanal gives iodofom test which propanal does not.

$$\underset{\text{Acetaldehyde}}{CH_3-\overset{\overset{O}{\|}}{C}-H} + \underset{\text{Iodine}}{3I_2} + 4NaOH \longrightarrow \underset{\substack{\text{Iodoform}\\(\text{yellow ppt})}}{CHI_3} + \underset{\text{Sod. Formate}}{HCOONa} + 3NaI + 3H_2O$$

$$H-\overset{\overset{O}{\|}}{C}-H + 3I_2 \longrightarrow \text{No ppt.}$$

(vii) What are polysaccharides?

Ans The polysaccharides are carbohydrates of high molecular mass which yield many monosaccharide molecules on hydrolysis. Examples are starch and cellulose both of which have molecular formula, $(C_6H_{10}O_5)n^+$.

Polysaccharides are amorphous solids, insoluble in water and tasteless, and are called 'non-sugars'.

(viii) Glycogen is called animal starch, give reason.

Ans It occurs mainly in the liver and muscles where it represents the main storage polysaccharide in the same way as starch functions in plant cells. Glycogen is, therefore, also called animal starch.

(ix) What is meant by denaturation of protein?

Ans The structure of proteins can be disrupted easily of protein by heat, by change of pH or by using strong oxidizing and reducing reagent. Under such conditions, the proteins undergo denaturation. The most familiar example of denaturation is the change that takes place in albumin, the principal component of egg white, when it is cooked. In this particular case, the change is irreversible.

SECTION-II

NOTE: Attempt any Three (3) questions.

Q.5.(a) Write similarities and differences of halogens with hydrogen. (4)

Ans **Similarities:**

(i) Hydrogen is a gas at room temperature like most of the halogens (F_2, Cl_2, etc.).

(ii) Hydrogen and halogens are non-metals.

(iii) Hydrogen and halogens need one electron to complete their valence shells.

(iv) Hydrogen and halogens exist in diatomic states as H_2, F_2, Cl_2, Br_2, I_2.

Differences:

(i) Hydrogen has only one electron in its valence shell, while halogens have seven electrons in their valence shell.

(ii) Hydrogen is a gas at room temperature, but Br_2 and I_2 are liquids and solids, respectively.

(iii) Hydrogen is s-block element, but halogens are p-block elements.

(iv) Hydrogen always shows the valency of one, but halogens show the variable valencies.

(v) Combining with oxygen, hydrogen forms very stable oxides while halogens lack this property.

(b) Complete and balance the following equations: (4)

(i) $Mg(NO_3)_2 \xrightarrow{Heat}$ **(ii)** $Ca(OH)_2 + SiO_2 \rightarrow$

(iii) $Be + O_2 \rightarrow$ **(iv)** $Be + NaOH \rightarrow$

Ans

(i) $2Mg(NO_3)_2 \xrightarrow{Heat} 2MgO + 4NO_2 + O_2$

(ii) $Ca(OH)_2 + SiO_2 \longrightarrow CaSiO_3 + H_2O$

(iii) $2Be + O_2 \longrightarrow 2BeO$

(iv) $Be + 2NaOH \longrightarrow Na_2BeO_2 + H_2$

Q.6.(a) How will you prepare steel by Bessemer's process? (4)

Ans Bessemer's Process:

The furnace used in the process is called Bessemer's converter which is a pear-shaped vessel made of steel plates. At the bottom, the converter is provided with a number of holes through which hot air can be introduced. The converter is held on a central axis so that it can be tilted in any desired position for feeding and pouring out the finished materials.

Molten pig or cast iron (25 to 30 tons) from the blast furnace is fed into the converter and hot air blast is injected through the perforated base.

This oxidizes C, Si and Mn:

$$C + \frac{1}{2}O_2 \longrightarrow CO$$

$$Si + O_2 \longrightarrow SiO_2$$

$$2Mn + O_2 \longrightarrow 2MNO.$$

These oxides form a slag of $MnSiO_3$. The heat evolved during the oxidation is enough to keep iron in the molten state.

$$MnO + SiO_2 \longrightarrow MnSiO_3.$$

CO produced burns at the mouth of the converter with a blue flame. Iron is partly oxidized to ferric oxide (Fe_2O_3).

$$4Fe + 3O_2 \longrightarrow 2Fe_2O_3$$

$Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$

Within 10 to 15 minutes, the flame due to CO subsides indicating that the carbon is completely oxidized. At this stage, ferromanganese is added to correct the proportion of carbon to obtain the desired qualities. A blast of air is continued for a moment to ensure thorough mixing. The addition of Mn imparts increased hardness and tensile strength.

In order to remove entrapped bubbles of gases, such as O_2, N_2, CO_2, a little aluminium or ferro-silicon is also added.

Aluminium removes nitrogen as nitride.

$2Al + N_2 \rightarrow 2AlN$

At the end of the operation, the molten steel is poured out into moulds for casting. Such casting are free from any defect.

(b) What is acid rain? How does it affect our environment? (4)

Ans For Answer see Paper 2017 (Group-I), Q.6.(b).

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

Ans Hybridization is a process of mixing of orbitals of nearly equal energy to form new orbitals of exactly equal energies. These orbitals are arranged around the central atom in a regular manner.

Explain sp hybridization:

The structure of alkynes can be explained by yet another mode of hybridization called sp hybridization. In this type, one 2s and one 2p orbitals of the carbon atom mix together to give rise to two degenerate sp hybridized atomic orbitals. These orbitals have a linear shape with a bond angle 180°.

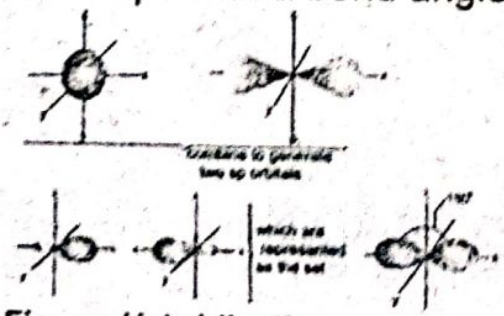


Fig. sp-Hybridization of carbon.

The two unhybridized atomic orbitals, $2p_y$ and $2p_z$, are perpendicular to these sp hybridized orbitals.

Ethyne molecule is formed when two sp hybridized carbon atoms join together to form a σ-bond by sp-sp overlap. The other sp orbital is utilized to form a σ-bond with 1s orbital of hydrogen atom.

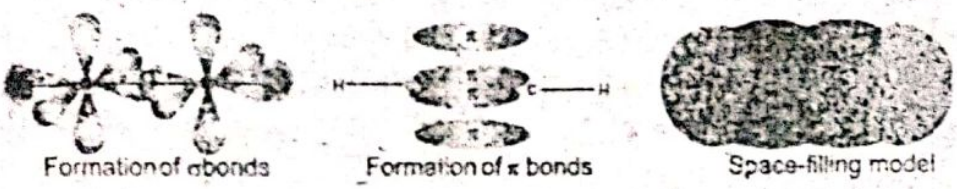
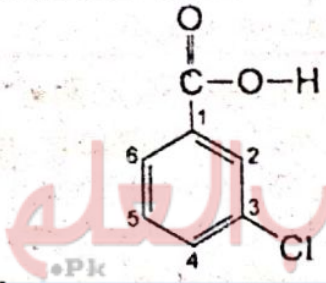


Fig. Formation of ethyne.

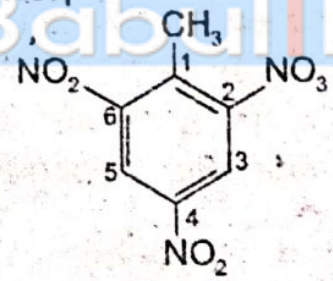
The two unhybridized p orbitals on a carbon atom will overlap separately with the p orbitals of the other carbon atom to give two π-bonds both perpendicular to the σ-framework of ethyne. The presence of a σ and two π-bonds between two carbon atoms is responsible for shortening the bond distance.

(b) Draw structural formulae for the following compounds: (4)
(i) m-Chlorobenzoic acid (ii) 2,4,6-Trinitrotoluene
(iii) p-Dibenzylbenzene (iv) p-Nitroaniline

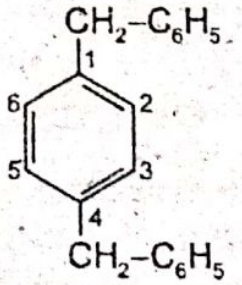
Ans (i) m-Chlorobenzoic acid:



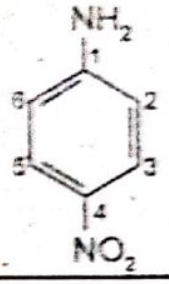
(ii) 2,4,6-Trinitrotoluene:



(iii) p-Dibenzylbenzene:



(iv) p-Nitroaniline:



Q.8.(a) How would you prepare alkanes from carbonyl compounds? (4)

Ans The carbonyl groups of aldehydes or ketones are reduced to methyl or methylene group, respectively by either Clemmensen or Wolf-Kishner's reduction. In the former reaction, a ketone is reduced to an alkane using zinc amalgam and hydrochloric acid whereas in the latter, an aldehyde is reduced to alkane with hydrazine in the presence of KOH.

$$H_3C-\overset{\overset{O}{\|}}{C}-CH_3 + 4[H] \xrightarrow{Zn\text{-}Hg\ /\ HCl} H_3C-CH_2-CH_3 + H_2O$$

$$H_3C-\overset{\overset{O}{\|}}{C}-H + 4[H] \xrightarrow[200°C]{N_2H_2\ /\ KOH} H_3C-CH_3 + H_2O$$

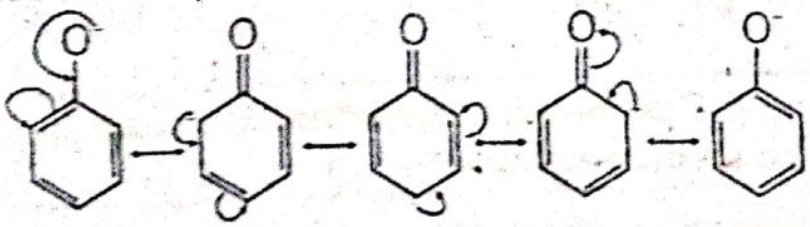
(b) Discuss the acidic behaviour of phenol. (4)

Ans **Acidic Behaviour of Phenol:**

Phenol is much more acidic than alcohols but less acidic than carboxylic acids. It dissolves readily in alkalies but it is too weak to affect the litmus paper or to evolve CO_2 from carbonates. Its dissociation constant (K_a) is 1.3×10^{-10}.

Phenol is partially soluble in water and its solution has a pH of around 5 or 6. This makes phenol different from aliphatic alcohols.

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 π-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.



Q.9.(a) Write a note on oxidation of aldehydes and ketones. (4)

Ans **Oxidation of Aldehydes:**

Aldehydes are easily oxidised by mild oxidising agents like Tollen's reagent, Fehling's solution and Benedict's solution. They are oxidised to carboxylic acids by strong oxidising agents such as $K_2Cr_2O_7/H_2SO_4$, $KMnO_4/H_2SO_4$ and dilute nitric acid. The hydrogen atom attached to the carbonyl group in aldehydes is oxidised to OH group.

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

Acetic acid

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

Proplonic acid

Oxidation of Ketones:

Ketones do not undergo oxidation easily because they require breaking of strong carbon-carbon bond. They give no reaction with mild oxidising agents. They are only oxidised by strong oxidising agents such as $K_2Cr_2O_7/H_2SO_4$, $KMnO_4/H_2SO_4$ and conc. HNO_3. In oxidation of ketones, only the carbon atoms adjacent to the carbonyl group are attacked. The carbon atom joined to the smaller number of hydrogen atoms is preferentially oxidised. In case of symmetrical ketones, only one carbon atom adjacent to the carbonyl group is oxidised and a mixture of two carboxylic acids is always obtained.

$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 + 3[O] \xrightarrow{K_2Cr_2O_7/H_3SO_4} CH_3-\overset{\overset{O}{\|}}{C}-OH + HCOOH$$

Acetone — Acetic acid

However, in case of unsymmetrical ketones, the carbon atom joined to the smaller number of hydrogen atoms is preferentially oxidised and the carbonyl group remains with the smaller alkyl group.

$$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_3 + 3[O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3-\overset{\overset{O}{\|}}{C}-OH + CH_3-\overset{\overset{O}{\|}}{C}-OH$$

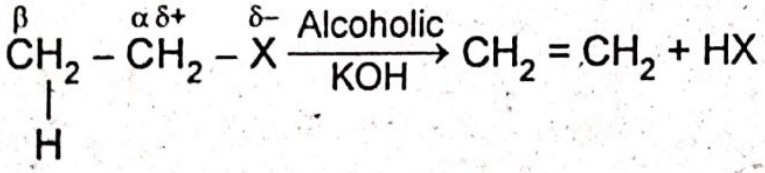
Butanone — Acetic acid

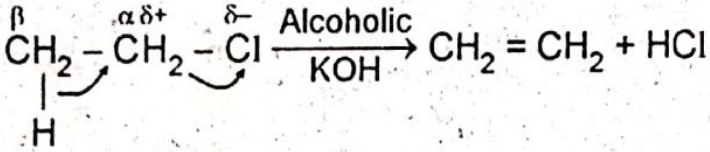
(b) Define β-Elimination reactions. Discuss in detail E1 reaction with mechanism. (4)

Ans **β-Elimination Reaction:**

When alkyl halides are reacted with alcoholic KOH, alkenes are produced. Actually, halogen is removed from the α-carbon and H from β-carbon. In this way, double bond is created between C – α and C – β.

This reaction is known as dehydrohalogenation and is used for preparation of alkenes.





In E1 mechanism, like S_N1 mechanism, the first step is the slow ionization of the substrate to give a carbocation. In the second step, the nucleophile attacks on hydrogen to give an alkene as a product.