

# Inter (Part-II) 2021

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)

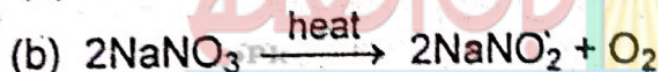
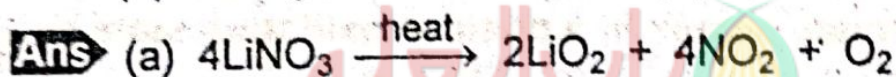
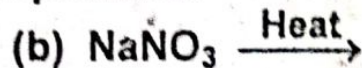
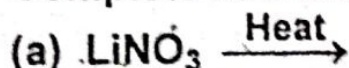
(i) Why the ionic radii of negative ions are larger than the size of their parent atoms?

**Ans** Neutral atoms that have gained an electron are called anions, and they are much larger than their respective atoms. As an additional electron occupies an outer orbital, there is increased electron-electron repulsion which pushes the electrons further apart.

(ii) Why the graphite is a good conductor?

**Ans** In the form of graphite, carbon is fairly good conductor of electricity because one of its four valence electrons is relatively free to move, or delocalised.

(iii) Complete and balance the equations:



(iv) Why the aqueous solution of  $\text{Na}_2\text{CO}_3$  is alkaline in nature?

**Ans** It is alkaline in nature because it contains sodium cations, which are strongly basic and carbonate anions which are weakly acidic. So, the basic ions win over acidic ions, making  $\text{Na}_2\text{CO}_3$  alkaline.

(v) Give the chemical formulae of: (a) Kaolin (b) Feldspar.

**Ans** (a) Kaolin:  $\text{H}_2\text{Al}_2(\text{SiO}_4)_2 \cdot \text{H}_2\text{O}$  or  $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$

(b) Feldspar:  $\text{KAlSi}_3\text{O}_8$  or  $\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$

(vi) Give the four differences of boron from other elements of group IIIA.

**Ans** Peculiar Behaviour of Boron:

Boron differs from other elements of group III-A in following aspects:

1. Boron is the only element in Group III-A, which is non-metallic in behaviour.
2. It is the only element with less than four electrons in the outermost shell which is not a metal.



3. Boron always uses all the three of its valence electrons for bonding purposes and its common oxidation states are +3 and -3.
4. One of the outstanding features of the chemistry of boron is its ability to form molecular addition compounds.

**(vii) Give 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.

**(viii) Give four similarities of sulphur and oxygen.**

**Ans** Following are four similarities of sulphur and oxygen:

1. Both oxygen and sulphur have same outer electronic configuration of  $ns^2np^4$ .
2. Both oxygen and sulphur are usually divalent.
3. Both oxygen and sulphur exhibit allotropic forms.
4. Both have polyatomic molecules. Oxygen has diatomic  $O_2$ , while sulphur has  $S_2$  and  $S_8$  molecules.

**(ix) Give four uses of sulphuric acid.**

**Ans** Following are four uses of Sulphuric Acid:

It is used:

1. in the manufacture of fertilizers like ammonium sulphate and calcium superphosphate.
2. in refining of petroleum to remove nitrogen and sulphur compounds.
3. in the manufacture of  $HCl$ ,  $H_3PO_4$ ,  $HNO_3$  and sulphates.
4. in the manufacture of many chemicals, dyes, drugs, plastics, disinfectants, paints, explosives, synthetic fibres, etc.

**(x) Mention any four 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) Give the composition of a good Portland cement.**

**Ans** A good Portland cement contains the mixture of lime (obtained from limestone), silica, iron oxide and alumina.

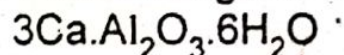
**(xii) Define the term 'setting of cement'. Also describe reactions taking place in first 24-hours.**

**Ans** Setting of Cement:

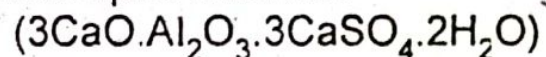


The use of cement is based on its property of setting to a hard mass when its paste with water is allowed to stand for sometime.

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,



2. This gel starts crystallizing slowly, reacts with gypsum having the formula ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) to give the crystals of calcium sulpho-aluminate



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

- (i) Oxidizing power of halogen depends upon which factors.

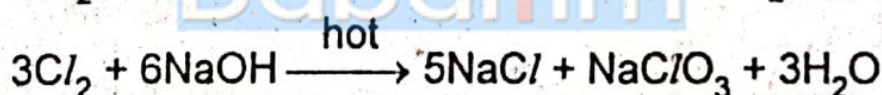
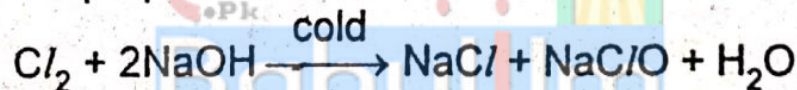
**Ans** The oxidizing power of halogens depends upon the following factors:

- (i) Energy of dissociation
- (ii) Electron affinity of atoms
- (iii) Hydration energies of ions
- (iv) Heats of vapourization (for  $\text{Br}_2$  and  $\text{I}_2$ )

- (ii) What do you know about disproportionation reactions? Give example.

**Ans** A reaction in which a species (molecule, atom or ion) is simultaneously oxidized and reduced, is called a "disproportionation reaction".

The reactions of chlorine with hot and cold  $\text{NaOH}$  are examples of "Disproportionation reactions".



- (iii) Give two uses of bleaching powder.

**Ans** Following are two uses of bleaching powder:

Bleaching powder is used:

- (i) It is used for the laboratory preparation of chlorine and oxygen. It is also used in the manufacture of chloroform.
- (ii) It is used as a disinfectant and in the sterilization of water.

- (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. Sometime they are also termed as interstitial alloys.

- (v) What is anode coating?

**Ans** Galvanizing or zinc coating is called anode coating. Galvanizing is done by dipping a clean iron sheet in a zinc

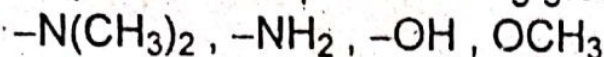


chloride bath and heating. The iron sheet is then removed, rolled into zinc bath and air cooled.

(vi) Give four examples of ortho-para directing groups.

**Ans** Ortho-para Directing Groups:

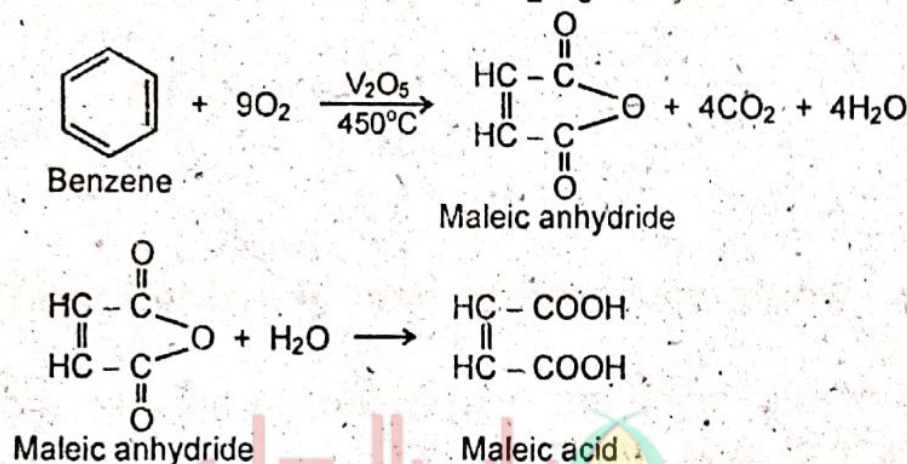
The examples of ortho-para directing groups are as follows:



(vii) Discuss catalytic oxidation of benzene.

**Ans** Catalytic Oxidation:

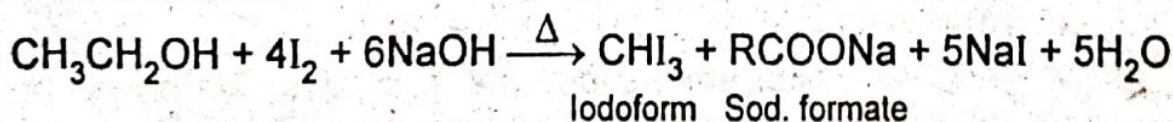
Benzene is not oxidized by  $\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$  at room temperature. The ring is destroyed when benzene is strongly heated with air in the presence of  $\text{V}_2\text{O}_5$  as a catalyst.



(viii) What is iodoform test? Give its uses.

**Ans** Iodoform Test:

The haloform reaction using iodine and aqueous sodium hydroxide is called the iodoform test. It results in the formation of water insoluble which is a yellow solid.



**Uses:**

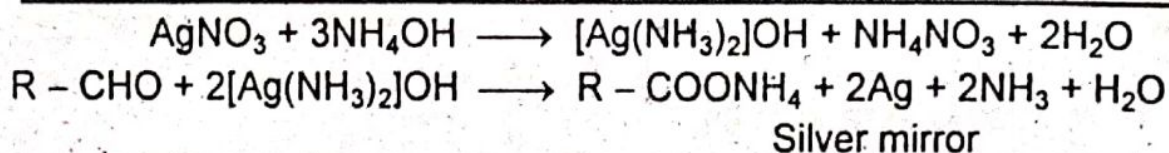
Iodoform test is used for distinguishing methyl ketones from other ketones. It is also used to distinguish ethanol from methanol and other primary alcohols. It can be used to distinguish acetaldehyde from other aldehydes.

(ix) What do you know about silver mirror test?

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

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

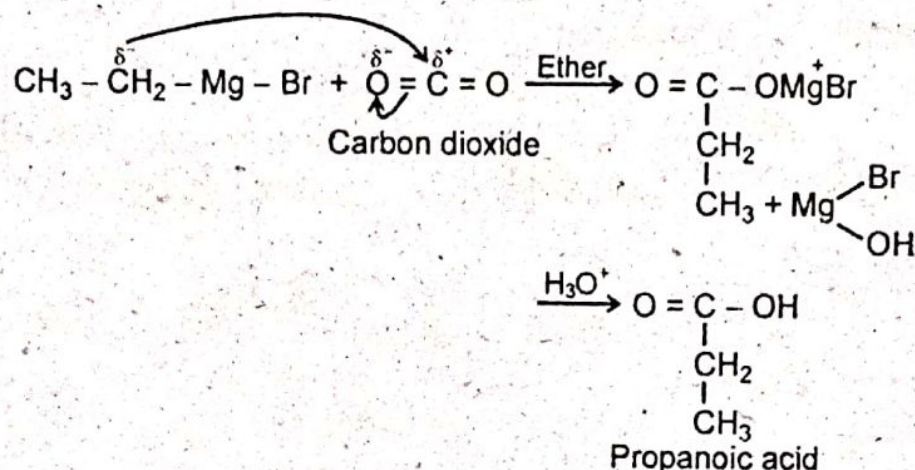




High quality mirrors are manufactured by using this principle. Ketones do not give this test.

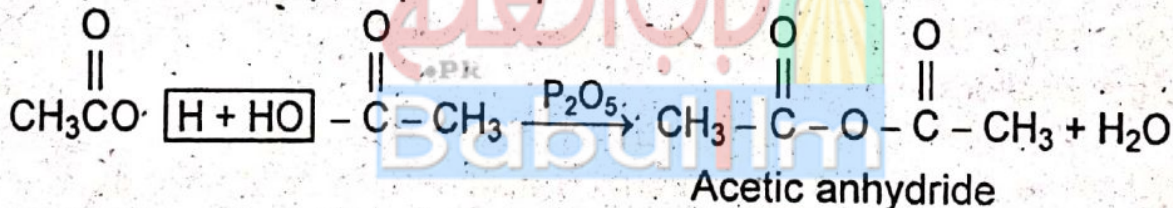
(x) How would you prepare carboxylic acids from Grignard Reagents?

**Ans**



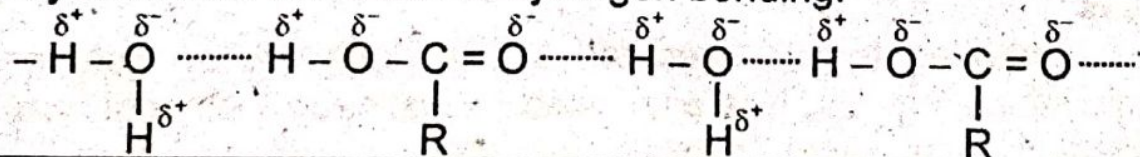
(xi) How would you prepare acid anhydride from acetic acid?

**Ans** Carboxylic acids are dehydrated on heating strongly in the presence of phosphorus pentoxide.



(xii) Why first four members of aliphatic acids are soluble in water?

**Ans** Among the aliphatic acids, the first four members are very soluble in water due to hydrogen bonding.



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

(i) What are homocyclic and heterocyclic compounds? Give one example of each.

**Ans** The compounds in which the ring consists of only carbon atoms are called homocyclic or carbocyclic compounds.

Example:





Benzene

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.

**Example:**

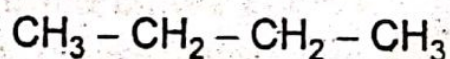


Pyridine

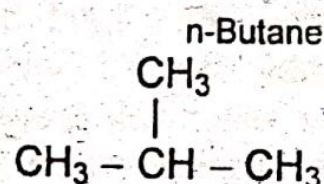
(ii) Write the structural formulas of two possible isomers of  $C_4H_{10}$ .

**Ans** The structural formulas of isomers of  $C_4H_{10}$  are as follows:

(a)



(b)

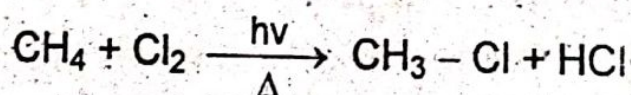


Isobutane

(iii) How is methane converted to ethane?

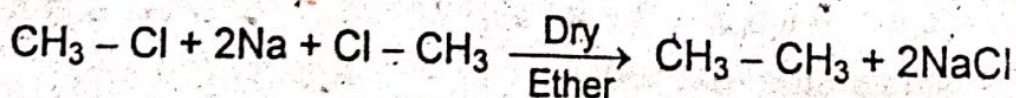
**Ans** Methane  $\rightarrow$  Ethane

(a) Chlorination:



Methane  
Methyl chloride

(b) Wurtz Synthesis:



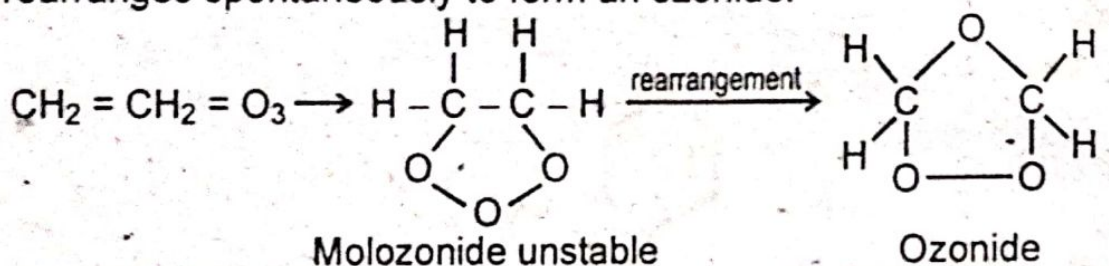
Ethane



(iv) Ozonolysis of alkene is used to locate the position of double bond, comment.

**Ans** Ozonolysis of alkene is used to locate the position of double bond.

Ozone ( $O_3$ ) is a highly reactive allotropic form of oxygen. It reacts vigorously with alkenes to form unstable molozonide. It rearranges spontaneously to form an ozonide.



Ozonides are unstable compounds and are reduced directly by treatment with zinc and  $H_2O$ . The reduction produces carbonyl compounds (aldehydes or ketones).

(v) Why is sigma bond inert?

**Ans** The unreactivity of alkanes can also be explained on the basis of inertness of a  $\sigma$ -bond. In a  $\sigma$ -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  $\sigma$ -bond can neither attack on any electrophile nor a nucleophile can attack on them. Both these facts make alkanes less reactive.

(vi) Give four differences between  $S_N1$  and  $S_N2$  reactions.

**Ans**

- | $S_N2$  | $S_N1$   |
|---|--|
| (i) The $S_N$ -reaction in which breaking and formation of bonds take place simultaneously is called $S_N2$ reaction. It is a single-step reaction. | (i) The $S_N$ -reaction in which breaking and formation of bonds do not take place at a time is called $S_N1$ reaction. It is a two-step reaction. |
| (ii) In $S_N2$ reaction, the direction of attacking nucleophile is opposite to that of leaving group.   | (ii) In $S_N1$ reaction, the attacking nucleophile can attack from both directions easily.   |

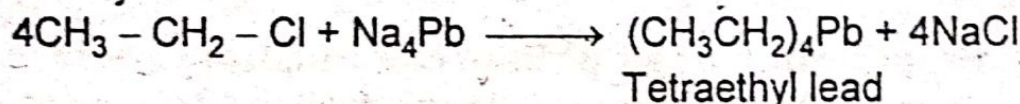


- (iii) In  $S_N2$  reaction, the configuration of alkyl halide is 100% inverted.
- (iv) Rate of  $S_N2$  reaction depends upon both the concentration of alkyl halide and attacking nucleophile.

Rate =  $K [\text{Alkyl halide}][\text{Nucleophile}]$

(vii) How is tetraethyl lead prepared? Give its one application.

**Ans** Ethyl chloride reacts with sodium lead alloy giving tetraethyl lead.



**Application:**

Tetraethyl lead is important anti-knock agent and is used in gasoline.

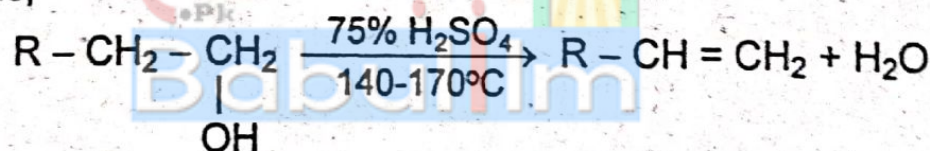
(viii) Ethanol reacts with conc.  $\text{H}_2\text{SO}_4$  and gives different products at different temperatures, comment.

**Ans** Ethanol gives different products at different temperatures with conc.  $\text{H}_2\text{SO}_4$ .  $\text{H}_2\text{SO}_4$  is dehydrating agent.

The ease of dehydration of various alcohols is in the order:

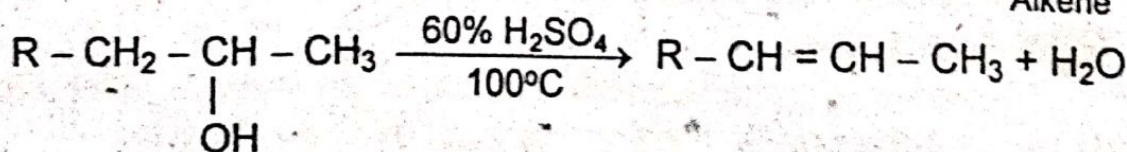
Ter. alcohol > Sec. alcohol > Pri. alcohol

Thus,



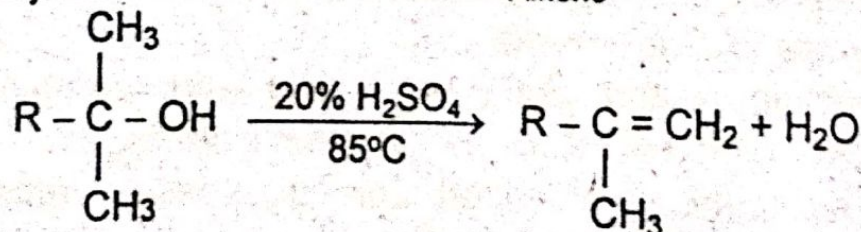
Primary

alcohol



Secondary alcohol

Alkene



Tertiary alcohol

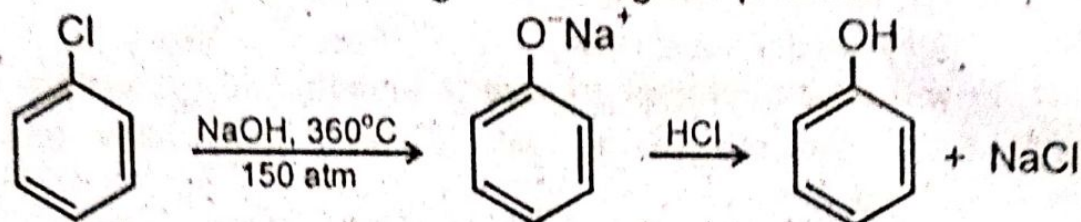


(ix) Write any two methods of preparation of phenol.

**Ans** Preparation of Phenol:

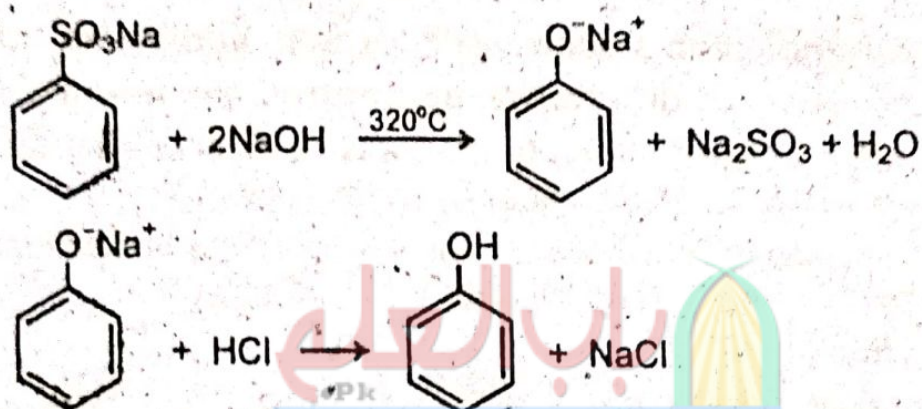
(a) **Dow's Method:**

In this method, chlorobenzene is treated with 10% NaOH at  $360^{\circ}\text{C}$  and 150 atmospheres pressure. Sodium phenoxide is produced which on treating with HCl gives phenol.



(b) **From Sodium Salt of Benzene Sulphonic Acid:**

Sodium salt of benzene sulphonic acid reacts with NaOH at  $320^{\circ}\text{C}$  to give sodium phenoxide which on treatment with HCl gives phenol.



**SECTION-II**

**NOTE: Attempt any Three (3) questions.**

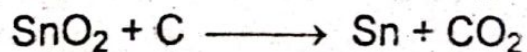
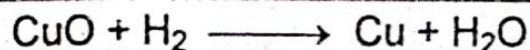
**Q.5.(a) Discuss position of hydrogen with carbon family giving similarities and dissimilarities. (4)**

**Ans** Similarities:

Some of the characteristic properties of hydrogen resemble with those of group IV-A elements such as C and Si, etc.

1. Valence shell of hydrogen is half-filled like those of group IV-A elements.
2. Hydrogen and group IV-A elements combine with other elements through covalent bonding.
3. Like carbon, hydrogen also possesses remarkable reducing properties.





### Differences:

Hydrogen also shows marked differences with carbon and rest of the group members. For example:

- (i) Carbon and silicon form long chain compounds, when their atoms combine with each other, while hydrogen does not form such compounds.
- (ii) Carbon can simultaneously form bonds with more than one elements, whereas hydrogen due to having only one electron can combine with only one element at a time.

**(b) Write down any eight properties of lithium in which it behave differently from its group members. (4)**

### **Ans** Peculiar Behaviour of Lithium:

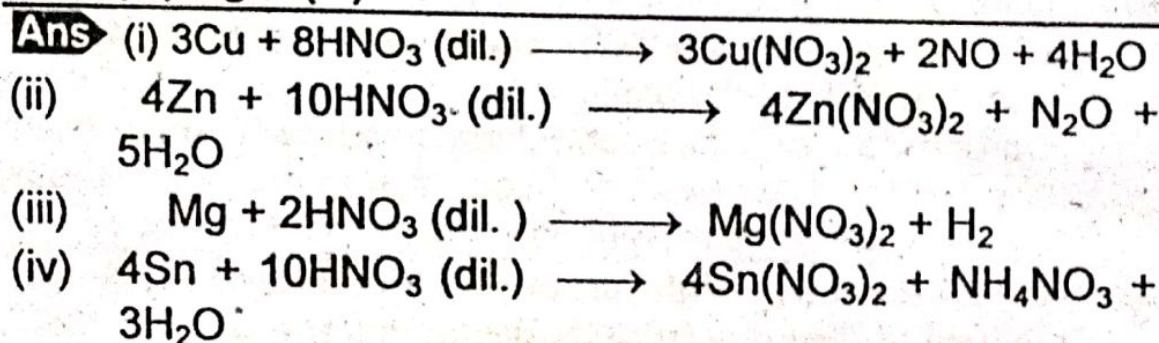
Some of the more important differences of lithium from other alkali metals are listed below:

1. Lithium is much harder and lighter than the other alkali metals.
2. The lithium salts of anions with high charge density are generally less soluble in water than those of the other alkali metals, e.g.,  $\text{LiOH}$ ,  $\text{LiF}$ ,  $\text{Li}_3\text{PO}_4$ ,  $\text{Li}_2\text{CO}_3$ .
3. Lithium forms stable complex compounds, although complex formation generally is not a property of alkali metals. One of the stable complexes formed by lithium is  $[\text{Li}(\text{NH}_3)_4]^+$ .
4. Lithium reacts very slowly with water, while other alkali metals react violently.
5. Lithium salts of large polarizable anions are less stable than those of other alkali metals. Unlike other alkali metals, lithium does not form bicarbonate, triiodide or hydrogen sulphide at room temperature.
6. When burnt in air, lithium forms only normal oxide, whereas the others form peroxides or superoxides.
7. Lithium hydride is more stable than the hydrides of other alkali metals.



8. Lithium compounds are more covalent, that is why its halides are more soluble in organic solvents and the alkyls and aryls of lithium are more stable than those of other alkali metals.

**Q.6.(a)** How does  $\text{HNO}_3$  (dil.) react with: (i) Cu (ii) Zn (4)  
(iii) Mg (iv) Sn



**(b)** Describe following general characteristics of transition elements: (4)  
(i) Binding energies (ii) Paramagnetism

**Ans** (i) **Binding Energies:**

Transition metals show good mechanical properties. They are tough, malleable and ductile. The toughness of these metals indicates strong metallic binding. This is because, apart from s-electrons of the outermost shell, the electrons of underlying half-filled d-orbitals also participate in binding.

In moving from left to right in any transition series, the number of unpaired electrons increases up to groups VB and VIB, after that pairing takes place and number of unpaired electrons goes on decreasing until it becomes zero at group IIB.

Therefore, binding is stronger up to group VIB and weakens progressively up to group IIB. In the first transition series, the general increase in binding energy ends at vanadium. This is due to changes in metallic structure, e.g., Mn. In the third transition series, the increase in binding energy ends at tungsten when all the 5d electrons contribute to binding.

**(ii) Paramagnetism:**

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



Paramagnetic behaviour is caused by the presence of unpaired electrons in an atom, molecule or ion because there is a magnetic moment associated with the spinning electron. It increases with increase in the number of unpaired electrons.

When the electrons are paired in an orbital, then magnetic moments are cancelled out and the substances become diamagnetic.

The paramagnetic behaviour is the strongest for  $\text{Fe}^{3+}$  and  $\text{Mn}^{2+}$  and decreases on both sides of the first transition series. The reason is that both  $\text{Mn}^{2+}$  and  $\text{Fe}^{3+}$  have 5 unpaired electrons each. The number of unpaired electrons decreases gradually to zero on both sides.

**Q.7.(a) Explain any four types of structural isomerism by giving one suitable example in each. (4)**

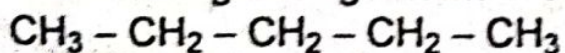
**Ans** **Structural Isomerism:**

The structural isomerism is not confined to hydrocarbons only. In fact, all classes of organic compounds and their derivatives show the phenomenon of structural isomerism.

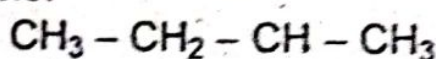
The structural isomerism arises due to the difference in the arrangement of atoms within the molecule. The structural isomerism can be exhibited in five different ways. These are:

**(i) The Chain Isomerism:**

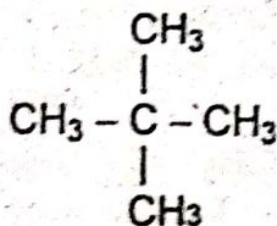
This type of isomerism arises due to the difference in the nature of the carbon chain. For example, for pentane ( $\text{C}_5\text{H}_{12}$ ), the following arrangements are possible:



n-Pentane



Isopentane



Neopentane

**(ii) Position Isomerism:**

This type of isomerism arises due to the difference in the position of the same functional group on the carbon chain.

The arrangement of carbon atoms remains the same.



For example,

- (a) Chloropropane can have two positional isomers given below:

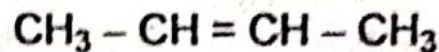
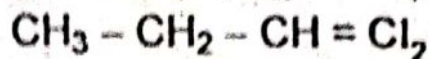


1-Chloropropane



2-Chloropropane

- (b) Butene ( $\text{C}_4\text{H}_8$ ) can have two positional isomers.



1-Butene

2-Butene

### (iii) Functional Group Isomerism:

The compounds having the same molecular formula but different functional groups are said to exhibit functional group isomerism. For example, there are two compounds having the same molecular formula  $\text{C}_2\text{H}_6\text{O}$ , but different arrangement of atoms.



Dimethyl

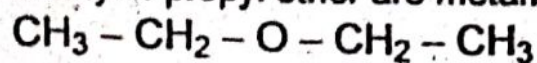


ether

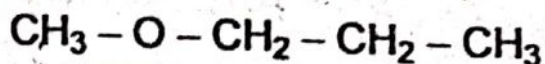
Ethyl alcohol

### (iv) Metamerism:

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.

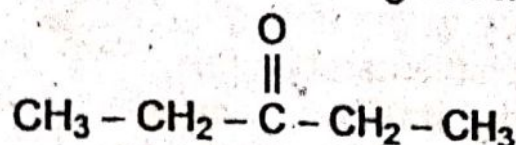


Dimethyl ether

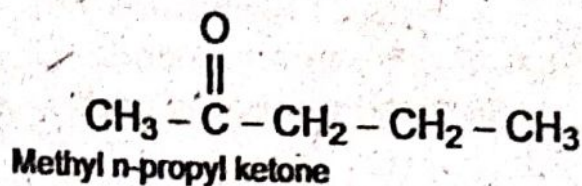


Methyl n-propyl ether

For a ketonic compound having the molecular formula  $\text{C}_5\text{H}_{10}\text{O}$ , the following two metamers are possible.



Diethyl ketone



Methyl n-propyl ketone



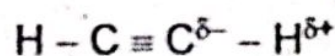
(b) What is aldol condensation? Give its mechanism. (4)

**Ans** For Answer See Paper 2020, Q. 7(b).

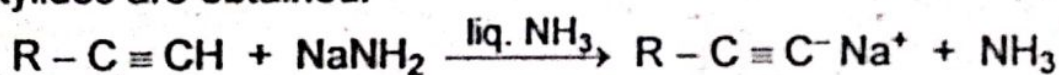
**Q.8.(a)** Explain acidic nature of alkynes in detail by giving two examples. (4)

**Ans** **Acidic Nature of Alkynes:**

In ethyne and other terminal alkynes like propyne, the hydrogen atom is bonded to the carbon atom with sp-s overlap. An sp hybrid orbital has 50% s-character in it and renders the carbon atom more electronegative than sp<sup>2</sup> and sp<sup>3</sup> hybridized carbons. As a result, the sp hybridized carbon atom of a terminal alkyne pulls the electrons more strongly making the attached hydrogen atom slightly acidic.

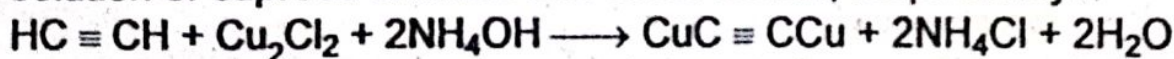


When 1-alkyne or ethyne is treated with sodamide in liquid ammonia or passed over molten sodium, alkynides or acetylides are obtained.

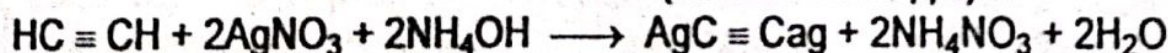


Disodium acetylide

Sodium acetylide is a very valuable reagent for chemical synthesis and is essentially ionic in nature. Acetylides of copper and silver are obtained by passing acetylene in the ammoniacal solution of cuprous chloride and silver nitrate, respectively.

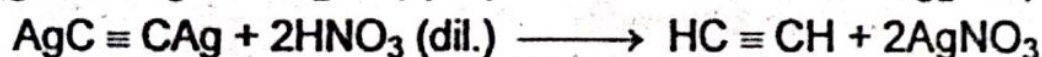
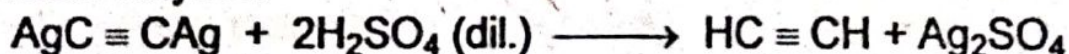


Dicopperacetylide  
(Reddish-brown ppt.)



Disilver acetylide  
(white ppt.)

Silver and copper acetylides react with acids to regenerate alkynes.



These alkynides are used for the preparation, purification, separation and identification of alkynes.

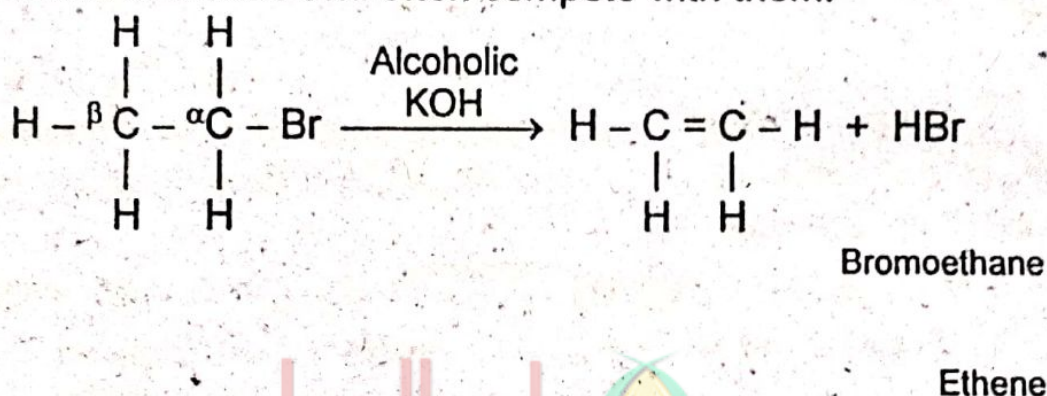


(b) What are  $\beta$ -elimination reactions? Differentiate between E1 and E2 reactions. (4)

**Ans**  $\beta$ -Elimination Reactions:

During nucleophilic substitution reactions, the attacking nucleophile attacks the electrophilic carbon atom of the alkyl halide. There is another site present in the alkyl halide molecule where the nucleophile can attack at the same time. Such a site is an electrophilic hydrogen atom attached to the  $\beta$ -carbon of the alkyl halide. When the attack takes place on hydrogen, we get an alkene instead of a substitution product. Such a type of reactions are called elimination reactions.

These reactions take place simultaneously with substitution reactions and often compete with them.



**Difference Between E1 and E2 Reactions**

E1 Reactions	E2 Reactions
1. E1 reactions follow unimolecular mechanism.	1. E2 reactions follow bimolecular mechanism.
2. In E1 reactions, 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.	2. In E2 reactions, the nucleophile attacks and the leaving group leaves at the same time with a formation of carbon-carbon double bond.
3. Tertiary alkyl halides follow E1 reactions.	3. Primary alkyl halides undergo E2 reactions.
4. The rate of E1	4. The rate of E2



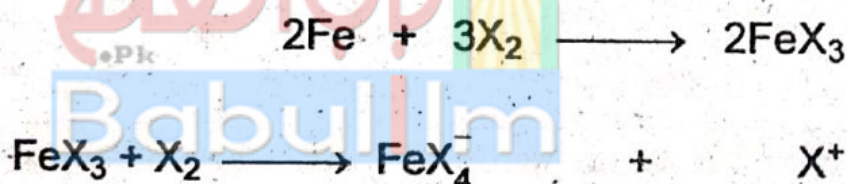
reactions depends upon the concentration of alkyl halide molecule only.

reactions depends upon the concentrations of alkyl halide as well as attacking nucleophile.

**Q.9.(a) Discuss the general pattern of reactivity of benzene towards electrophile with reference to halogenation. (4)**

**Ans** **General Pattern of Reactivity of Benzene:**

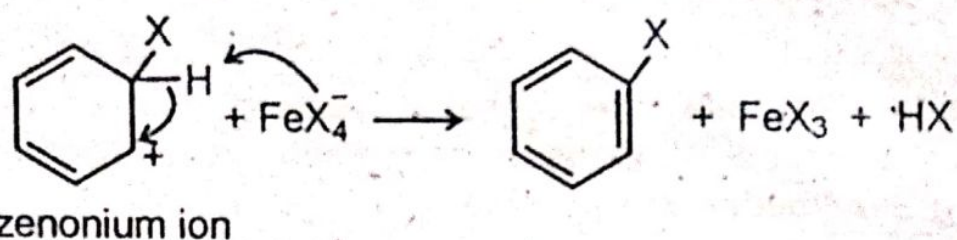
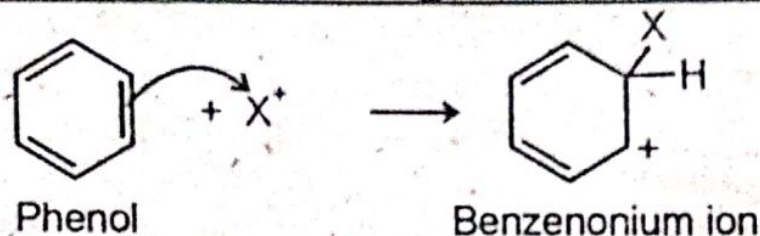
The highly stable, delocalized electrons of benzene ring are not readily available for the nucleophilic attack like the electrons of alkenes. Therefore, the electrons of benzene ring do not assist in the attack of weak electrophiles. It means that more powerful electrophiles are required to penetrate and break the continuous sheath of electron cloud in benzene, e.g., substitution of halogen in benzene requires iron or corresponding ferric halide as a catalyst. In fact, iron too is first converted into  $\text{FeX}_3$  which further reacts with halogen molecule to produce a powerful electrophile.



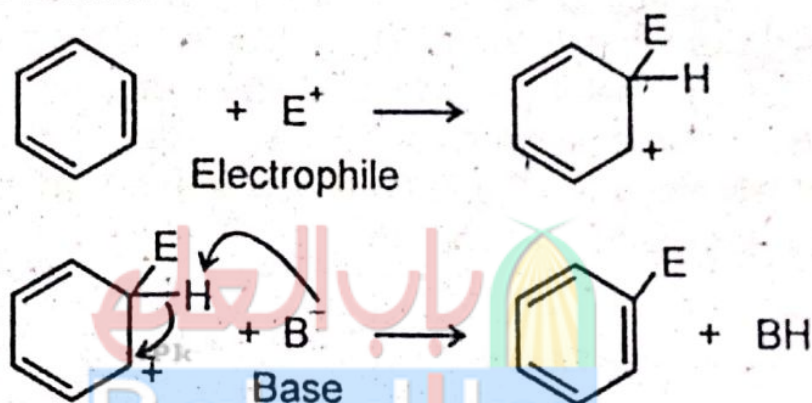
Tetra haloferrate ion (III)      Halogenation

The halogenonium ion  $\text{X}^+$  thus produced attacks as a powerful electrophile on the electrons of benzene ring.





The addition product is not favourable because in its formation the characteristic stability of benzene is lost. The only possible product is the substitution product in which the stability of benzene is retained. Therefore, the general pattern of the chemical reactivity of benzene towards electrophiles can be shown as follows:

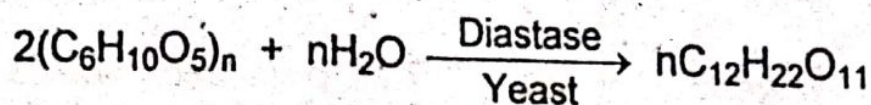


(b) What is fermentation? How ethanol is prepared from starch? (4)

**Ans** Ethanol is prepared on industrial scale world over, by the process of fermentation. Fermentation is a biochemical process which occurs in the presence of certain enzymes secreted by microorganisms such as yeast. Optimum temperature for this process of fermentation is  $25-35^\circ\text{C}$ . Moreover, proper aeration, dilution of solution and the absence of any preservative are essential conditions for fermentation.

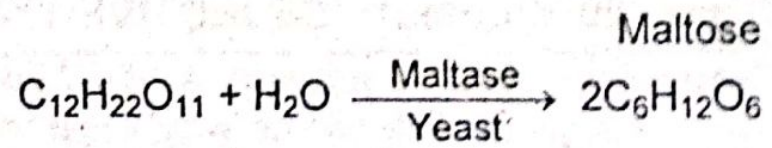
In Pakistan, ethanol is prepared by the fermentation of molasses, starch grains or fruit juices.

**From Starch:**





Starch



Glucose

