Inter (Part-II) 2017

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 metals are good conductors?

Ans Metals are good conductors of heat. There are two reasons for this:

1. the close packing of the metal ions in the lattice.
2. the delocalized electrons can carry kinetic energy through the lattice.

(ii) What are amphoteric oxides? Give one example.

Ans A type of oxides show both acidic and basic properties are called amphoteric oxides. Al_2O_3 is an amphoteric oxide.

(iii) How gypsum is converted into plastic of paris?

Ans Calcium sulphate occurs in nature as gypsum $CaSO_4.2H_2O$. When it is heated above 100°C, it loses three quarters of its water of crystallization, giving a white powder called plaster of paris.

(iv) Why potassium super oxide is used in breathing equipments for mountaineers and in space crafts?

Ans Potassium super oxide (KO_2) has a special use as it can absorb CO_2. Because of this property, it is used in breathing equipments of the mountaineers and in the space crafts. It has the ability to absorb CO_2 while giving out oxygen at the same time.

(v) Give chemical reactions of orthoboric acid with ethyl alcohol and NaOH.

Ans Orthoboric acid reacts with ethyl alcohol forming ethyl borate.

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

After reaction with NaOH, it is partially neutralized by caustic soda to give borax.

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

(vi) What is meant by chemical garden?

Ans Chemical garden:

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

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(vii) Why does aqua regia dissolve gold?

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.

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

(viii) Ans **Give any two properties in which oxygen differs from sulphur.**

	Oxygen		Sulphur
1.	It does not react with alkalies.	1.	It reacts with alkali solution and forms sulphides and thiosulphate.
2.	It shows -2 oxidation state.	2.	It shows oxidation states of –2, +2, +4 and +6.

(ix) Ans **Write note on hydrosphere.**

The hydrosphere includes all water bodies, mainly oceans, rivers, streams, lakes; polar ice-caps, glaciers and groundwater reservoirs of environment.

(x) Ans **Why most of the transition elements form coloured compounds?**

Transition elements have partially filled d orbitals. We also know that when electrons jump from one orbital to another light is emitted due to which the compounds of transition elements seem to be coloured compounds.

(xi) What is role of chlorofluorocarbons in destroying ozone layer?

Ans **Role of Chloroflurocarbons (CEFCs) in Destroying Ozone:**

Chlorofluorocarbons used as refrigerants in air-conditioning and in aerosol sprays are inert in the troposphere but slowly diffuse into stratosphere, where they are subjected to ultraviolet radiation generating $Cl^{\cdot}$ free radicals. Chlorofluoro-carbons (CFCs) play an effective role in removing O_3 in the stratosphere due to following reactions:

$$CFCl_3 \longrightarrow CFCl_2 + Cl^{\cdot}$$

$$Cl^{\cdot} + O_3 \longrightarrow ClO^{\cdot} + O_2$$

$$ClO^{\cdot} + O \longrightarrow Cl^{\cdot} + O_2$$

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(xii) Name four components of environment.

Ans There are four components of environment:

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

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

(i) Perchloric acid is considered as valuable analytical reagent. Why?

Ans Perchloric acid is considered as valuable analytical reagent because it is a powerful oxidizer when hot, but its aqueous solutions up to approximately 70% by weight at room temperature are generally safe, only showing strong acid features and no oxidizing properties.

(ii) Why iodine has metallic lusters?

Ans Iodine shows excitation of electrons at room temperature. When excited electrons come back, they emit radiation of particular wavelength. Due to bigger size, electrons are excited at room temperature. So, iodine is a metallic-appearing shiny grayish-black solid.

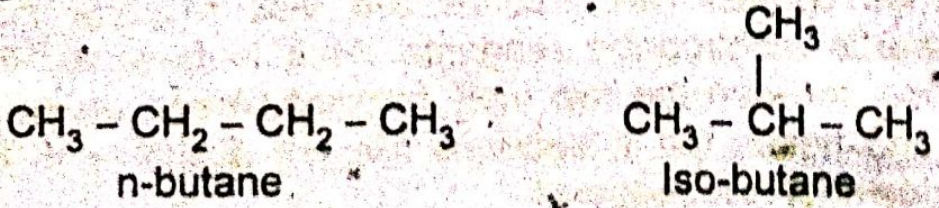
(iii) Define the following terms, giving one example for each:
(a) Position isomerism (b) Metamerism

Ans **Isomerism:**

The concept of isomerism is an important feature of organic compounds.

"Two or more compounds having the same molecular formula but different structural formulas and properties are said to be isomers and the phenomenon is called isomerism."

For example, butane molecule can have two different arrangements as represented by the following structures:

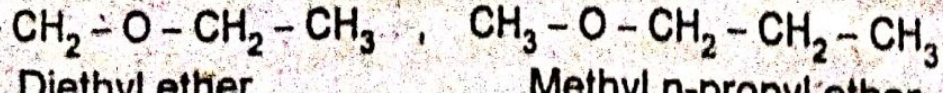


$CH_3 - CH_2 - CH_2 - CH_3$ (n-butane)

$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$ (Iso-butane)

Metamerism:

This is the type of structural isomerism. It 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.



$CH_3 - CH_2 - O - CH_2 - CH_3$ Diethyl ether

$CH_3 - O - CH_2 - CH_2 - CH_3$ Methyl n-propyl ether

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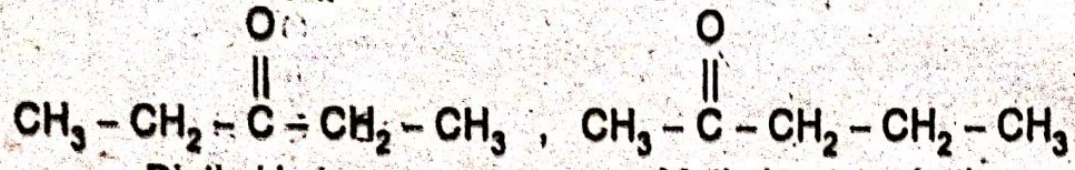
For a ketonic compound having the molecular formula $C_5H_{10}O$, the following two metamers are possible:

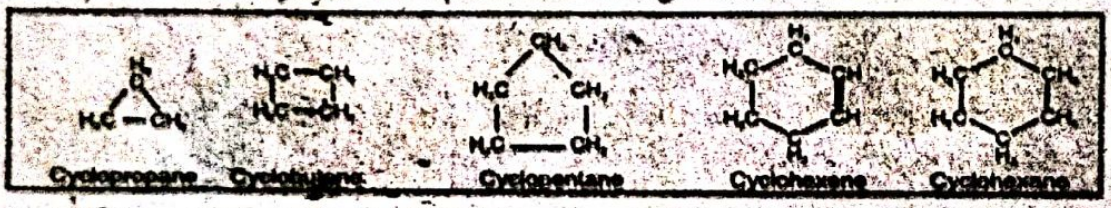


Diethyl ketone Methyl n-propyl ether

(iv) What are alicyclic organic compounds? Give two examples.

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 C_nH_{2n}. Typical examples of alicyclic compounds are given below:



One or more hydrogen atoms present in these compounds may be substituted by other group or groups.

(v) What is Baeyer's test?

Ans When alkenes are treated with mild oxidizing reagent like dilute alkaline $KMnO_4$ solution, it is Baeyer's test at low temperature.

Use: It is a test for presence of unsaturation in the molecule.

(vi) Why alkynes are less reactive than alkenes towards electrophilic reagents?

Ans Alkynes contain two π-bonds are less reactive than alkenes towards electrophilic reagents. This is because the bond distance between the two triple bonded carbon atoms is very short and hence the π-electrons are not available to be attacked by electrophilic reagents.

(vii) How will you prove that, benzene has cyclic structure?

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_nH_{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.

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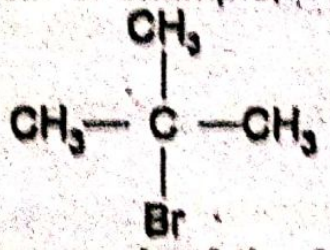
Conclusion: Thus it is proved that benzene molecular formula C_6H_6 does not correspond to straight chain alkane, alkene or alkynes. Rather it is an unsaturated cyclic hydrocarbon.

(viii) What is general pattern of reactivity of benzene towards electrophile?

Ans Meta-directing groups withdraw the electrons of the benzene ring towards themselves, thereby reducing their availability to the electrophiles.

(ix) Define tertiary alkyl halides, give one example.

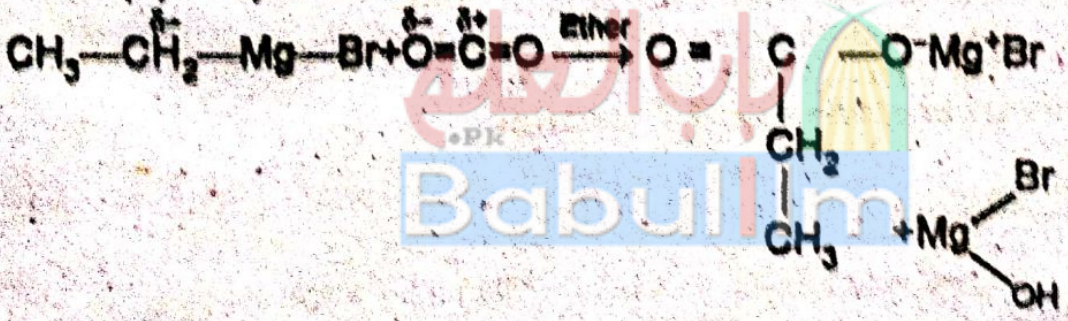
Ans Alkyl halides containing tertiary C-atom are called tertiary alkyl halides. For example,

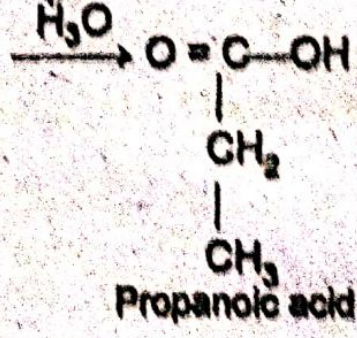


(x) Prepare each of the following compounds from ethyl magnesium bromide:

(a) Propanoic acid **(b) 1-Propanol**

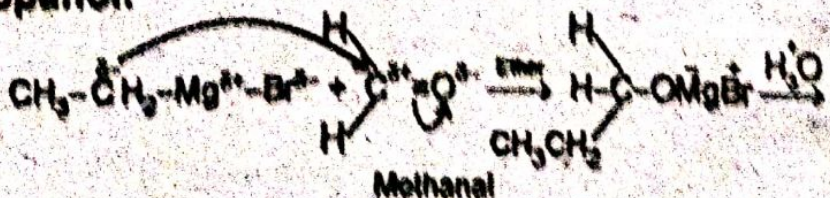
Ans (a) Propanoic acid:





Propanoic acid

(b) 1-Propanol:



Methanal

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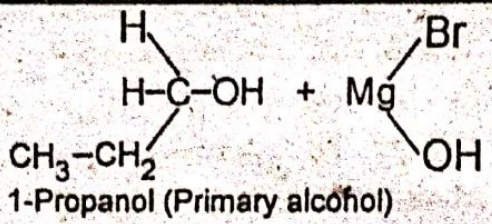


1-Propanol (Primary alcohol)

(xi) Absolute alcohol cannot be prepared by fermentation. Why?

Ans Actually, lime is often employed as a dehydrating agent in the preparation of absolute alcohol, therefore, it cannot be prepared by fermentation process.

(xii) How will you distinguish ethanol from methanol?

Ans Ethanol gives iodoform with iodine in the presence of NaOH. Formation of yellow crystals indicate that the alcohol is ethanol. Methanol does not give iodoform test.

$$C_2H_5OH + 4I_2 + 6NaOH \longrightarrow \underset{\text{Iodoform}}{CHI_3} + HCOONa + 5NaI + 5H_2O$$

$$CH_3OH + I_2 + NaOH \longrightarrow \text{No yellow ppt}$$

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

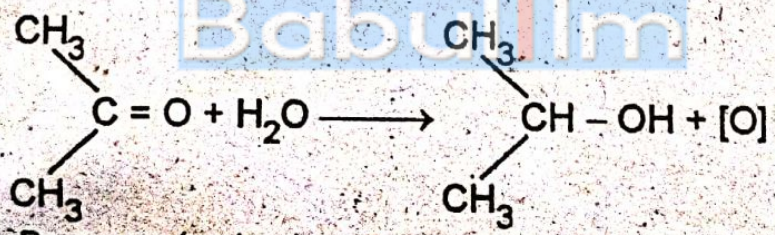
(i) Write four uses of formaldehyde.

Ans **Uses of formaldehyde:**

1. It is used in processing of anti-polio vaccine.
2. It is used in manufacturing of dyes.
3. It is used as decolorizing agent in vat dyeing.
4. It is used in silvering of mirror.

(ii) Convert acetone into 2-Propanol.

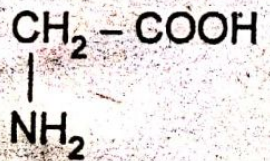
Ans



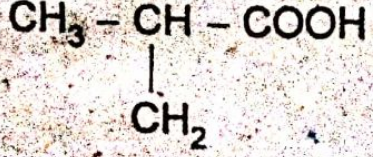
Propanone (acetone) (2-Propanol)

(iii) Write the formulas of : (a) Glycine. (b) Alanine.

Ans **(a) Glycine:**



(b) Alanine:



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(iv) What happens when sodium formate and soda lime is heated?

Ans When sodium formate and soda lime is heated:

$$2H-\overset{\overset{O}{\|}}{C}-ONa \xrightarrow{\text{Soda lime}} H_2 + Na_2CO_3$$

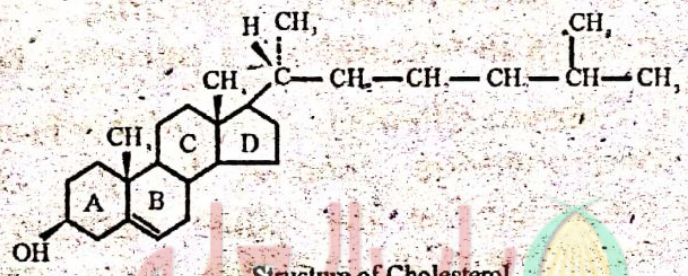
(v) Give four properties of enzymes.

Ans Following are the four properties of enzymes:

1. Enzymes are specific in their action which means that an enzyme will act on only one substrate or a group of closely related substrates.
2. Enzymes with few exceptions are protein in nature.
3. Most enzymatic reactions are reversible.
4. They catalyze the same reaction but are chemically and physically distinct from each other.

(vi) Write down the structure formula of cholesterol.

Ans



Structure of Cholesterol

(vii) Give two differences between fats and oils.

Ans

	Fats	Oils
1.	The glycerides in which long-chain saturated acid compounds predominate tend to be solid or semi-solid and are termed as fats.	Oils are glycerol esters which contain higher proportion of unsaturated fatty acids components.
2.	Its structural formula is: $CH_2-O-\overset{\overset{O}{\|}}{C}-(CH_2)_{16}-CH_3$ $\vert$ $CH-O-\overset{\overset{O}{\|}}{C}-(CH_2)_{16}-CH_3$ $\vert$ $CH_2-O-\overset{\overset{O}{\|}}{C}-(CH_2)_{16}-CH_3$	Its structural formula is: $CH_2-O-\overset{\overset{O}{\|}}{C}-(CH_2)_7-CH=CH-(CH_2)_7-CH_3$ $\vert$ $CH-O-\overset{\overset{O}{\|}}{C}-(CH_2)_7-CH=CH-(CH_2)_7-CH_3$ $\vert$ $CH_2-O-\overset{\overset{O}{\|}}{C}-(CH_2)_7-CH=CH-(CH_2)_7-CH_3$

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(viii) Write 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.

(ix) What do you mean by setting of cement?

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

SECTION-II

NOTE: Attempt any Three (3) questions.

Q.5.(a) Define Mendeleev's periodic law. Discuss improvements in Mendeleev's periodic table. (4)

Ans In 1871, Russian Chemist, Dmitri Mendeleev, gave a more useful and comprehensive scheme for the classification of elements. He presented the first regular periodic table in which elements of similar chemical properties were arranged in eight vertical columns called Groups. The horizontal rows of the table were called Periods. Mendeleev also started by arranging the elements in ascending order of their atomic masses and found that elements having similar chemical properties appeared at regular intervals. This significant observation was called Periodic Law.

Improvements in Mendeleev's Periodic Table:

In order to make the periodic table more useful and accurate, a few improvements were made in Mendeleev's periodic table. After the discovery of atomic number by Moseley, in 1911, it was noticed that elements could be classified more satisfactorily by using their atomic numbers, rather than their atomic masses. Hence, the periodic table was improved by arranging the elements in ascending order of their atomic numbers instead of their atomic masses. This improvement rectified a number of confusions present in the old periodic table. The modern Periodic Law states that: "if the elements are arranged in ascending order of their atomic numbers, their chemical properties repeat in a periodic manner."

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Another improvement was the addition of an extra group (group VIIIA) at the extreme right of the periodic table. This group contains noble gases, which had not been discovered in Mendeleev's time.

Another confusion in Mendeleev's table was that elements like Be, Mg, Ca, Sr, Ba and Zn, Cd, Hg were placed in a single vertical group, while according to their properties they belonged to two different categories. The same was true for so many other elements placed in the same vertical group. In modern periodic table, the confusion was removed by dividing the elements in two types of vertical groups, A and B. In modern periodic table, Be, Mg, Ca, Sr and Ba are placed in group IIA and Zn, Cd, Hg in group IIB.

(b) Describe the commercial preparation of sodium by Down's cell. What are the advantages of this process? (4)

Ans **Down's Cell:**

Raw Material: Molten NaCl.

Source of Energy: Electrical energy.

Construction:

This cell is made up of steel tank. It is lined inside with acid resisting material. Two rods of iron are introduced into the tank through the side walls. These iron rods act as cathode.

The anode is made up of graphite. It is introduced to the bottom of the tank at the top end. This upper thicker part of the anode is covered by a sheet iron hood. A wire gauze is suspended from this hood. This wire gauze separates the cathode and anode region in cell.

Procedure:

NaCl is melted. It is kept in the molten state by the heat produced by the resistance of the cell. The melting point of NaCl is decreased up to 600°C by adding $CaCl_2$.

The anode and cathode are immersed in the molten NaCl. Powdered solid NaCl is sprinkled on the upper surface of the melt. This will protect the molten mass from the effects of the air. Moreover, heat lost is reduced.

Chemical reaction:

Ionization $NaCl \rightleftharpoons Na^{\oplus} + Cl^{\ominus}$

At cathode $2Na^{\oplus} + 2e^{\ominus} \longrightarrow 2Na$ (metal)

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At anode $2Cl^{\ominus} - 2e^{\ominus} \longrightarrow Cl_2$

Collection of sodium:

Na metal which is produced is in the molten state. It is lighter than the molten NaCl. It rises upwards and gets collected in the hood.

Collection of Cl_2 gas:

The hood which is covering the graphite anode is narrower at the top. The Cl_2 gas rises through this narrow path and is collected.

Advantages of Down's cell:

(a) Metallic fog is not produced.
(b) Liquid Na can be easily collected at 600°C.
(c) The material of the cell is not attacked by the products which are formed during electrolysis.

Q.5.(a) Write systematic name of the following complexes: (4)

(i) $[Co(NH_3)_6]Cl_3$ (ii) $Na_3[COF_6]$
(iii) $[pt(OH)_2(NH_3)_4]SO_4$ (iv) $K_2[pt\ Cl_6]$

Ans (i) $[Co(NH_3)_6]Cl_3$

Hexa-aminecobalt (III) chloride

(ii) $Na_3[COF_6]$

Sodium Hexafluoro caboltate (III)

(iii) $[pt(OH)_2(NH_3)_4]SO_4$

Tetra-amine hydroxo platinum (II) sulphate

(iv) $K_2[pt\ CL_6]$

Potassium Hexachloroplatinate (IV)

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

Ans The Effects of Polluted Air on Environment

Acid Rain:

Acid rain which nowadays is termed as acid deposition, was discovered by Angus Smith in Great Britain in the mid-seventeenth century but this phenomenon gained importance as a serious environmental problem in 1950s. Initially, it was referred to the precipitation which was more acidic than natural rain. Due to the presence of CO_2 in the atmosphere, the natural rain itself forms carbonic acid:

$$CO_{2(g)} + H_2O_{(aq)} \longrightarrow H_2CO_{3(aq)}$$

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The pH of unpolluted rain water should be 5.6. The rainwater has pH less than 5 is considered truly acidic.

In the atmosphere, SO_x and NO_x are transformed by reactions with oxygen and water into H_2SO_4 and HNO_3, respectively. These acids get mixed with rain. The acid deposition includes both wet (rain, snow, fog) and dry acidic deposition.

$$SO_2 + 1/2\ O_2 + H_2O \xrightarrow{\text{(hydrocarbon, smoke, metal oxides)}} H_2SO_4$$

In some countries, due to release of HCl by volcanic eruption, there is temporary acid rain.

Acidification of the soil and rocks can leach metals like aluminium, mercury, lead and calcium and discharges them into water bodies. These heavy metals are accumulated in the fishes and are health hazards for humans and birds as they eat these fishes. The elevated concentration of aluminium is harmful for fish as it clogs the gills thus causing suffocation. Acidification of the soil can also leach nutrients thus damaging leaves and plants and growth of forest. It also damages building materials such as steel, paint, plastic, cement, masonry work and sculptural materials, especially of marble and limestone.

Q.7.(a) Define cracking and explain its type with examples. (4)

Ans **Cracking of Petroleum:**

The fractional distillation of petroleum yields only about 20% gasoline. Due to its high demand, this supply is augmented by converting surplus supplies of less desirable petroleum fractions such as kerosene oil and gas oil into gasoline by a process called cracking. It is defined as breaking of higher hydrocarbons having high boiling points into a variety of lower hydrocarbons, which are more volatile (low boiling). For example, a higher hydrocarbons $C_{16}H_{34}$ splits according to the following reaction:

$$C_{16}H_{34} \xrightarrow[700^\circ]{\text{Heat}} C_7H_{16} + CH_2{=}CH_2 + CH_3{-}CH{=}CH_2$$

Alkane

This is the process in which C-C bonds in long chain alkane molecules are broken, producing smaller molecules of both alkanes and alkenes. The composition of the products depends on the condition under which the cracking takes place. Cracking is generally carried out in the following ways:

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1. Thermal Cracking:

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 ethane and propene.

2. Catalytic Cracking:

Higher hydrocarbons can be cracked at lower temperature (500°C) and lower pressure (2 atm), in the presence of a suitable catalyst. A typical catalyst used for this purpose is a mixture of silica (SiO_2) and alumina (Al_2O_3). Catalytic cracking produces gasoline of higher octane number and, therefore, this method is used for obtaining better quality gasoline.

3. Steam Cracking:

In this process, higher hydrocarbons in the vapour phase are mixed with steam, heated for a short duration to about 900°C and cooled rapidly. The process is suitable for obtaining lower unsaturated hydrocarbons.

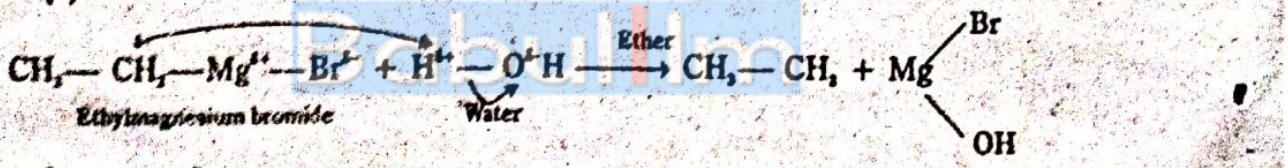
Besides increasing the yield of gasoline, cracking has also produced large amounts of useful by-products, such as ethene, propene, butene and benzene. These are used for manufacturing drugs, plastics, detergents, synthetic fibres, fertilizers, weed killers and important chemicals like ethanol, phenol and acetone.

(b) Write reactions of the Grignard reagent with the following: (4)

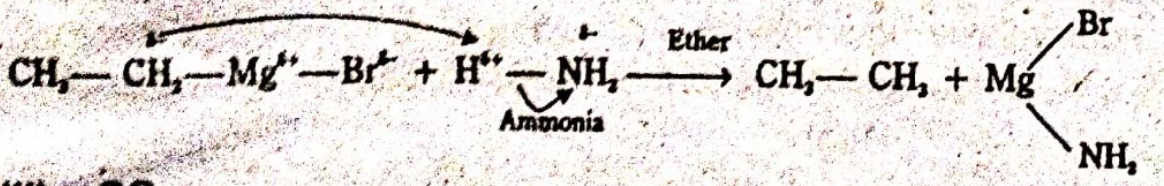
(i) Water (ii) Ammonia

(iii) CO_2 (iv) Alcohol

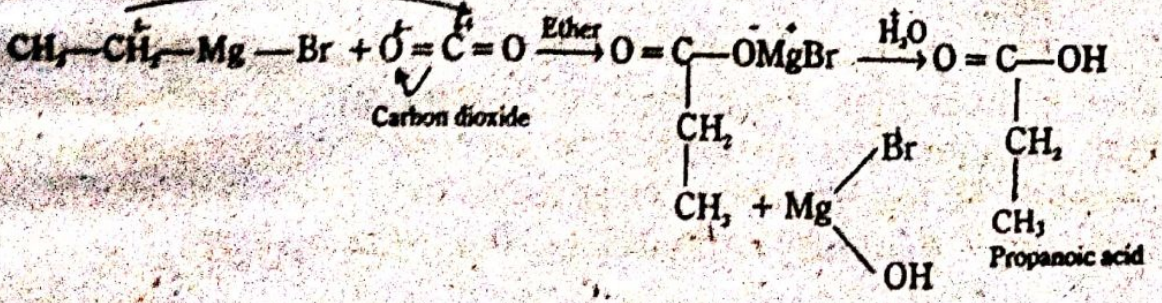
Ans (i) Water:



(ii) Ammonia:



(iii) CO_2:



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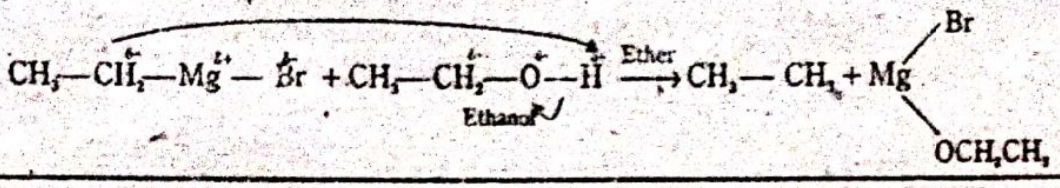
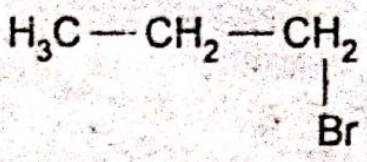
(iv) **Alcohols:**

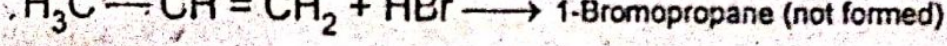


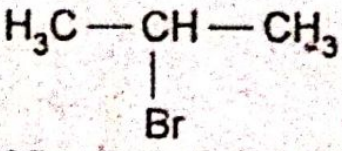
Q.8.(a) How will you make the following conversions from an alkene: (4)

(i) 2-Bromopropane (ii) 2-Bromo-2-methylpropane
(iii) 2-propanol (iv) Propylene oxide

Ans **(i) 2-Bromopropane**

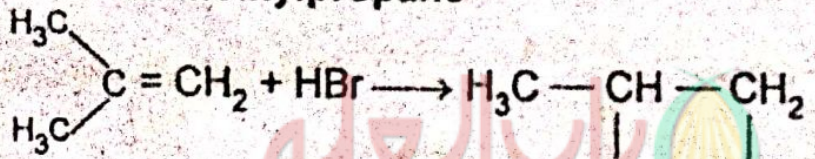


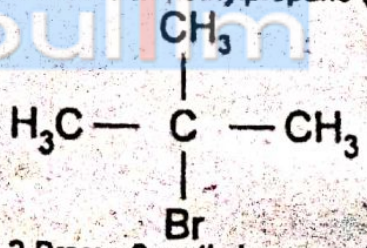




2-Bromopropane (Actual Product)

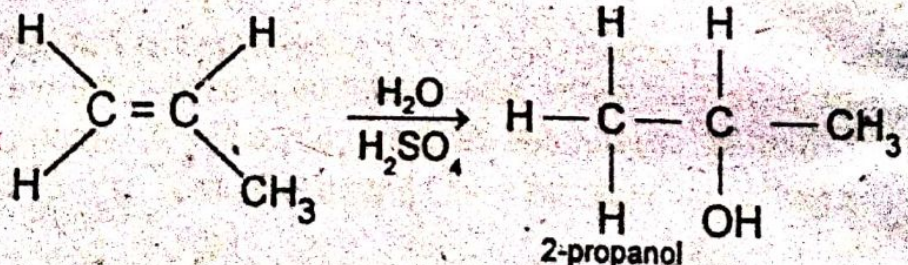
(ii) 2-Bromo-2-methylpropane





2-Bromo-2-methylpropane (Actual Product)

(iii) 2-propanol



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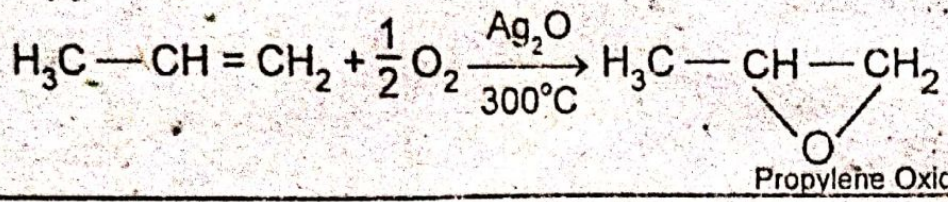
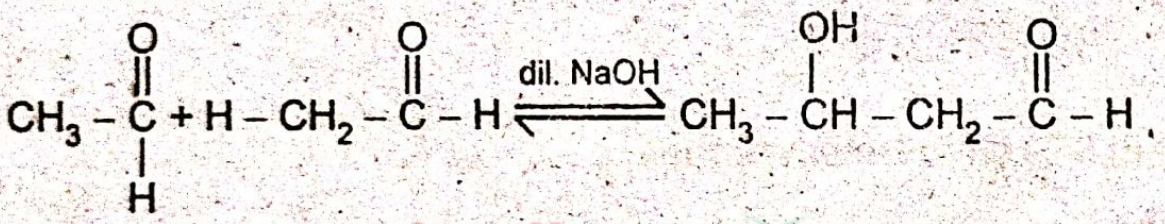
(iv) Propylene oxide



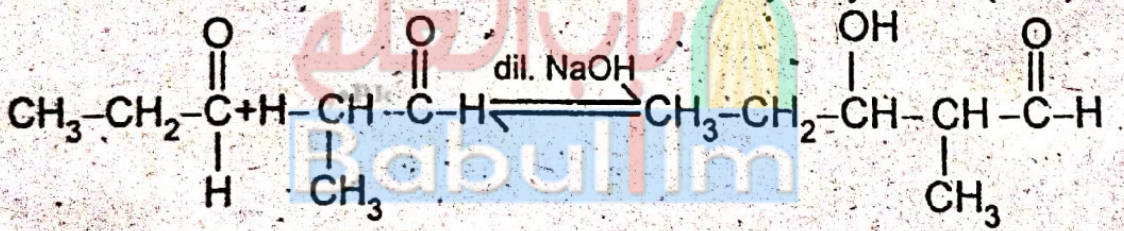
(b) Define and explain aldol condensation with reaction mechanism. Why formaldehyde does not give this reaction? (4)

Ans Aldol Condensation:

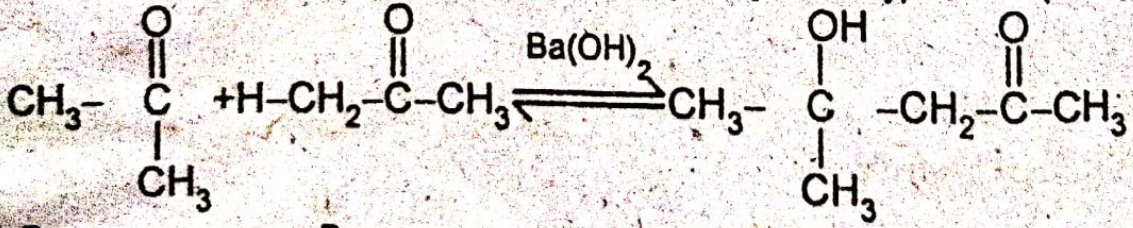
Aldehydes and ketones possessing α-hydrogen atoms areact with a cold dilute solution of an alkali to form addition products known as aldols. The name 'aldol' is given to the product because it contains both aldehyde and alcohol functional groups. Note that the name aldol condensation is reserved for 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)

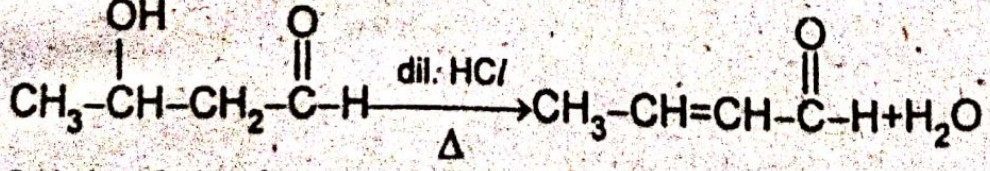


Propanal Propanal 3-Hydroxy-2-methypentanal (aldol)



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.



3-Hydroxybutanal Crotonaldehyde

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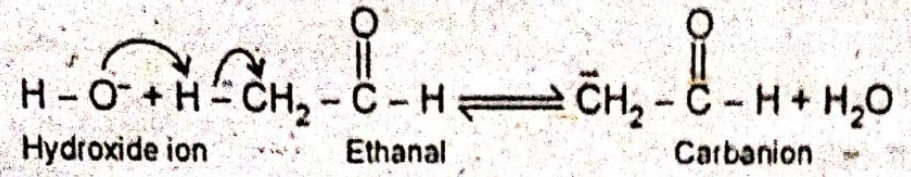
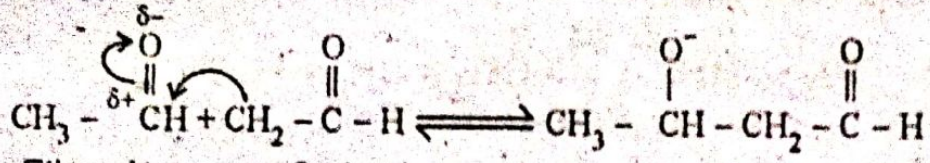
Mechanism of Aldol Condensation:

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.



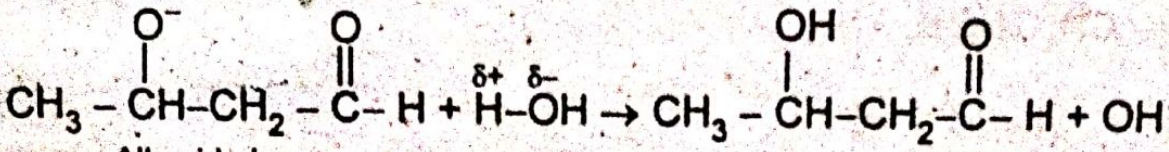
Hydroxide ion — Ethanal — Carbanion

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.

Q.9.(a) Explain structure of benzene by atomic orbital treatment. (4)

Ans **Modern Concepts About the Structure of Benzene**

Atomic Orbital Treatment of Benzene:

The hexagonal framework of benzene can be conveniently explained using hybridization approach. According to this, each carbon in benzene is sp^2 hybridized. The three sp^2 hybrid orbitals on each carbon are utilized to form three σ-bonds, two with adjacent carbon atoms and one with hydrogen. The unhybridized $2p_z$ orbitals remain at right angle to these sp^2 orbitals. Since all the sp^2 orbitals are in the same plane, therefore, all the carbon and hydrogen atoms are coplanar. All the angles are of 120° which confirms the regular hexagonal structure of benzene.

The unhybridized $2p_z$ orbitals partially overlap to form a continuous sheath of electron cloud, enveloping, above and below, the six carbon-carbon sigma bonds of the ring. Since each $2p_z$ orbital is overlapped by the $2p_z$ orbitals of adjacent

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carbon atoms, therefore, this overlapping gives, 'diffused' or 'delocalized' electron cloud.

(b) How does ethyl alcohol react with following reagents: (4)

(i) Conc. H_2SO_4 (ii) Na

(iii) CH_3COOH (iv) $SOCl_2$

Ans **(i) Conc. H_2SO_4**

For ether formation:

$$2CH_3—CH_2—OH \xrightarrow[140^\circ C]{H_2SO_4} CH_3—CH_2—O—CH—CH_3 + H_2O$$

For ethene formation:

$$2CH_3—CH_2—OH \xrightarrow[180^\circ C]{H_2SO_4} CH_2 = CH_2 + H_2O$$

(ii) Na

$$2CH_3—CH_2—OH + 2Na \longrightarrow 2CH_3—CH_2—ONa^+ + H_2$$

(iii) CH_3COOH

$$CH_3—CH_2—OH + CH_3—\overset{\overset{O}{\|}}{C}—OH \xrightarrow{H^+} CH_3—\overset{\overset{O}{\|}}{C}—OC_2H_5 + H_2O$$

(iv) $SOCl_2$

$$CH_3—CH_2OH + SOCl_2 \xrightarrow{\text{Pyridine}} CH_3—CH_2—Cl + SO_2 + HCl$$

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