ZIAUDDIN UNIVERSITY
EXAMINATION BOARD

RESOURCES FOR

"HSC-II CHEMISTRY"

ZUEB EXAMINATIONS 2021

PREFACE:

The ZUEB examination board acknowledges the serious problems encountered by the schools and colleges in smooth execution of the teaching and learning processes due to sudden and prolonged school closures during the covid-19 spread. The board also recognizes the health, psychological and financial issues encountered by students due to the spread of covid-19.

Considering all these problems and issues the ZUEB Board has developed these resources based on the condensed syllabus 2021 to facilitate students in learning the content through quality resource materials.

The schools and students could download these materials from www.zueb.pk to prepare their students for the high quality and standardized ZUEB examinations 2021.

The materials consist of examination syllabus with specific students learning outcomes per topic, Multiple Choice Questions (MCQs) to assess different thinking levels, Constructed Response Questions (CRQs) with possible answers, Extended Response Questions (ERQs) with possible answers and learning materials.

ACADEMIC UNIT ZUEB:

1. Extended Response Questions (ERQs)

HOW TO ATTEMPT ERQs:

- Write the answer to each Constructed Response Question/ERQs in the space given below it.
- Use black pen/pencil to write the responses. Do not use glue or pin on the paper.

SECTION C (LONG ANSWER QUESTIONS)

1. **What is a covalent bond? Explain the types of covalent bond and their characteristics?**

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S#	ERQ	ANSWER	CL	DL
1.	**Define metallurgy. Explain the manufacture of 99.99% pure aluminum from bauxite ore containing impurities**	**METALLURGY OF METALS** Metallurgy is the art of extracting metals from their natural existing compounds. Except gold, platinum, silver, mercury etc, most of the metals occur in nature in the combined state. The compounds of metals which occur in nature are called "Minerals". The minerals from which metals can be economically extracted are known as 'Ores'. **METALLURGY OF ALUMINIUM** Aluminium does not occur free in nature, but it is widely distributed in combined state. **IMPORTANT ORES OF ALUMINIUM** (a) Silicates (i) Kaolin = $Al_2O_3.2SiO_2.2H_2O$ (ii) Potash felspar = $K_2O.Al_2O_3.6SiO_2$ (iii) Potash-mica=$K_2O.3Al_2O_3.6SiO_2.2H_2O$ b) Fluoride (i) Cryolite = Na_3AlF_6 c) Sulphate (i) Alunite = $K_2SO_4.Al_2(SO_4)_3.4Al(OH)_3$ d) Oxides (i) Bauxite = $Al_2O_3.nH_2O$ (ii) Gibbsite = $Al_2O_3.3H_2O$ (iii) Diaspore = $Al_2O_3.H_2O$ (iv) Corundum = Al_2O_3 **EXTRACTION** Aluminum is extracted from its bauxite ore ($Al_2O_3.nH_2O$). The extraction of Aluminum involves two steps: (a) Purification of bauxite to alumina (b) Electrolysis of pure Alumina **PURIFICATION OF BAUXITE** Bauxite usually contains ferric oxide (Fe_2O_3) and Silica (SiO_2) as Chief impurities. These impurities must be removed because these impurities make the metal brittle and liable to corrosion. The bauxite may be purified by any one of the following methods depending upon the nature of impurities present in it. **HALL'S METHOD** This method is used for the purification of Bauxite containing Fe_2O_3 and Silica (SiO_2) as impurities. Finally divided bauxite is fused with sodium carbonate (Na_2CO_3), it dissolves to form sodium aluminate, while the impurities Fe_2O_3 and SiO_2 are left unaffected. $Al_2O_3.nH_2O + Na_2CO_3 \longrightarrow 2NaAlO_2 + CO_2 + nH_2O$ The fused mass is extracted with water leaving behind both impurities. Sodium aluminate (NaAlO2) upto 50oC-60oC in the presence of CO2., the precipitates of aluminium hydroxide Al(OH)3 are formed. $2NaAlO_2 + 3H_2O+CO_2 \xrightarrow[50-60^oC]{} 2Al(OH)_3 + Na_2CO_3$ The precipitates of $Al(OH)_3$ are washed and ignited at about 1500^oC to get pure alumina. $2Al(OH)_3 \xrightarrow[1500^oC]{Heat} Al_2O_3 + 3H_2O$	K/ A	D

BAEYER'S METHOD

This method is used for the purification of ore containing excess of Fe_2O_3. Finely divided bauxite is treated with strong caustic soda (45%), the bauxite goes into the solution as sodium aluminate.

$$Al_2O_3.nH_2O + 2NaOH \xrightarrow{} 2NaAlO_2 + 2(n)H_2O$$

By heating sodium aluminate ($NaAlO_2$) upto 50^oC – 60^oC in the presence of CO_2, the precipitates of Al $(OH)_3$ are formed.

$$2NaAlO_2 + 3H_2O+CO_2 \xrightarrow{} 2Al\ (OH)_3 + Na_2CO_3$$

These precipitates of $Al(OH)_3$ are ignited at about 1500^oC to get pure alumina.

$$2Al(OH)_3 \xrightarrow[1500^oC]{Heat} Al_2O_3 + 3H_2O$$

SERPEK'S METHOD

This method is used for the purification of bauxite containing excess of SiO. Powdered bauxite is mixed with carbon and heated upto 1800^oC in the current of nitrogen produce aluminium nitride.

$$Al_2O_3.nH_2O\ +3C + N_2 \xrightarrow{1800^oC} 2AlN + 3CO +nH_2O$$

$$SiO_2 + 2C \xrightarrow{} Si+2CO$$

Aluminium nitride on hydrolysis with hot water produce the precipitates of aluminium hydroxides $Al(OH)_3$.

$$AlN + 3H_2O \xrightarrow{} Al(OH)_3 + NH_3$$

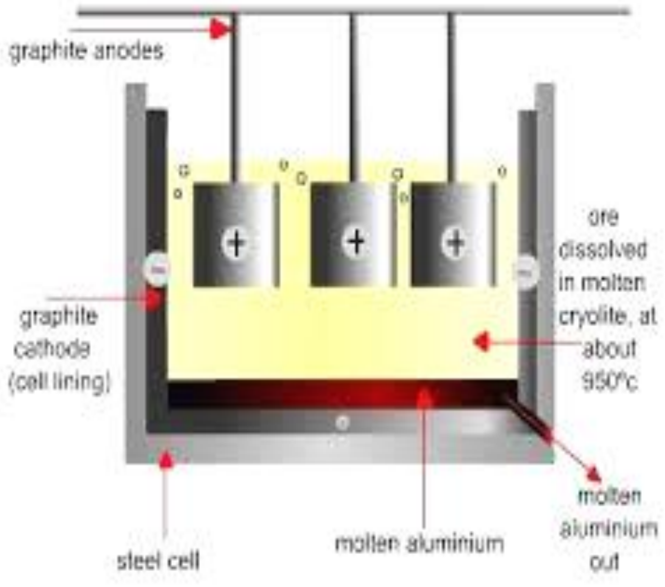
These precipitates now is filtered, dried and ignited to get pure alumina.

$$2Al(OH)_3 \xrightarrow[1500^oC]{Heat} \underset{alumina}{Al_2O_3} + 3H_2O$$

ELECTROLYSIS OF PURE ALUMINA (HALL'S PROCESS)

The pure and dry alumina from either of the above process now is electrolyzed. The electrolysis is carried out in a steel tank which is 8ft in length and 6ft in width lined with carbon (graphite) and serves as cathode where as carbon rods hanging in the molten mass used as anode.

The electrolyte consists of alumina dissolved in fused cryolite (Na_3AlF_6) and fluorspar (BaF_2). Cryolite lowers the melting point of alumina that is about 950^oC and fluorspar increase the fluidity of the melt, so that the liberated aluminum may sink at the bottom of electrolytic cell when electric current is passed through this mixture, then aluminum is obtained at cathode in liquid state, so, it sinks to bottom from where it is drawn periodically through the temping hole.



REFINING OF ALUMINIUM BY HOOP'S ELECTROLYTIC METHOD

The aluminum obtained by electrolysis of alumina is 99% pure which is further refined by hoop's electrolytic method. The electrolysis is carried out in an iron box which is lined with a carbon at the bottom. It contains three layers of fused mass. The lower layer consists of an alloy of impure aluminum with copper. This layer serves as Anode. The middle layer consist of a solution of Na_3AlF_6 and BaF_2. The upper layer consist of pure aluminum serves as cathode.

On Electrolysis Al+3 ions from the middle layer migrate to the upper layer where they are reduced to aluminium. Equal number of Al+3 ions are produced in the lower layer. These Al+3 ions migrate to the middle layer. Therefore, in this way 99.99% pure aluminum is obtained.

$$Na_3AlF_6 \longrightarrow 3NaF + AlF_3$$

$$AlF_3 \rightleftharpoons Al_3^+ + 3F^-$$

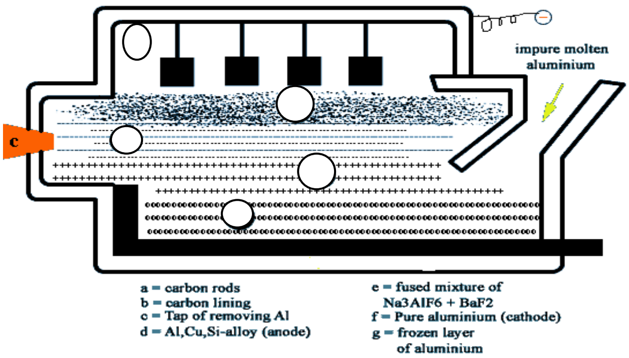
At cathode $Al^{3+} + 3e^- \longrightarrow Al$

At anode $Al \longrightarrow Al3^+ + 3\bar{e}$

(goes to molten cryolite)

OVERALL REACTION

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



2.	**What are binary compounds of hydrogen? Explain all types of hydrides**	**Hydrides** Those compounds of hydrogen made up of any two elements are called binary compounds of hydrogen. These binary compounds of hydrogen are called hydrides. **Classification of hydrides** Hydrides can be divided into the following groups in terms of the differences in their structures bonding and their properties. 1.Ionic hydrides or Saline hydrides 2.Covalent hydrides 3.Complex hydrides 4.Polymeric hydrides 5.Metallic hydrides 6.Borderline hydrides **Ionic or Saline hydrides (Salt like hydrides)** Those hydrides which are formed by the combination of alkali metals (Group IA) and alkaline earth metals (Group IIA) except of Be and Mg with hydrogen are called ionic hydrides or saline hydrides. These are the ionic compounds in which hydrogen is present as H^-ion of general formula MH^- and $M^{2+}H_2^-$ respectively. These hydrides possess salt like characters. Therefore, they are also called saline hydrides. **Preparation** Ionic hydrides are prepared by passing hydrogen gas over hot alkali metals and alkaline earth metals. $2Li + H_2 \xrightarrow{600^oC} 2LiH$ $2Na + H_2 \xrightarrow{200^oC} 2NaH$ **Properties** 1. These are colorless, non-volatile and salt like. 2. They have high melting points. 3. These hydrides are thermally very stable and don’t dissociate easily. 4. They act as dehydrating agent. 5. They react with water or with acids produce hydrogen $Na^+H + H_2O \longrightarrow NaOH + H_2$ $Na^+H^- + HCl \longrightarrow NaCl + H_2$ $Ca^{++} H_2^{2(-)} + 2H_2O \longrightarrow Ca(OH)_2 + 2H_2$ **Covalent hydrides** Hydrides of p-block elements are called covalent hydrides. The bonding in these hydrides is of electron sharing type. Due to their volatile nature they are also known as volatile hydrides. **Preparation** Covalent hydrides are prepared by direct or indirect combination of p-block elements with hydrogen.	**K/ A**	**M**

$$H_2 + Cl_2 \longrightarrow 2HCl$$
$$2H + O_2 \longrightarrow 2H_2O$$
$$H_2 + S \longrightarrow H_2S$$
$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$$
$$Al_4C_3 + 6H_2O \longrightarrow 2Al_2O_3 + 3CH_4$$
$$Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$$

Preparation

1. These hydrides are generally gases or liquid at room temperature.
2. They have low melting and boiling points.
3. These are volatile in nature.
4. They do not conduct electricity
5. Hydrides of Group III A and IVA are neutral, Group VA are basic and Group VIA and VIIA are acidic in nature.

Complex hydrides

Those hydrides which are formed by the combination of hydrides of alkali metals (Group IA) with Boron-family (Group IIIA) are called complex hydrides. These hydrides have complex nature possessing all the three types of chemical bonds. The general formula of complex hydrides is ABH_4 where 'A' is univalent metal and 'B' is trivalent posture ion of Group IIIA.

Preparation

Complex hydrides are prepared by combining ionic hydrides of alkali metals and covalent hydrides of Group IIIA.

$$LiH + AlH_3 \longrightarrow Li^{+1} Al^{+3} H_4^{-1}$$
$$NaH + BH_3 \longrightarrow Na^{+1}B^{+3}H_4^{-1}$$

Properties of Complex hydrides

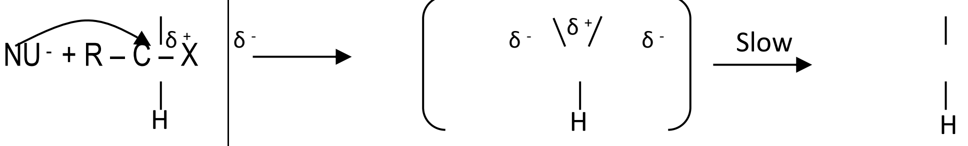
1. These are salt like solids and stable upto 300°C
2. They are soluble in water
3. They are used as catalyst.
4. These are reducing agents
5. They react with water and produce hydrogen gas with basic of monovalent and trivalent cation.

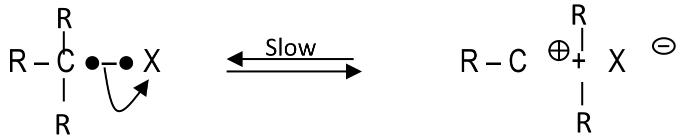
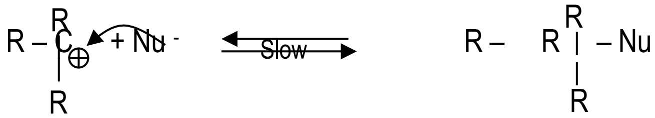
$$NaBH_4 + 4H-OH \longrightarrow NaOH + B(OH)_3 + 4H_2$$
$$LiAlH_4 + 4H-OH \longrightarrow LiOH + Al(OH)_3 + 4H_2$$

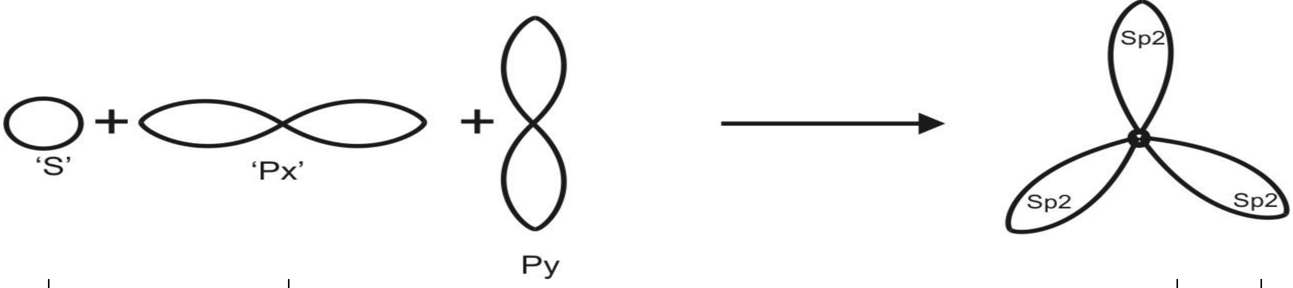
Polymeric hydrides

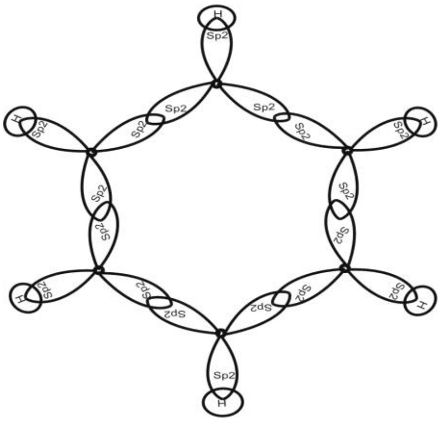
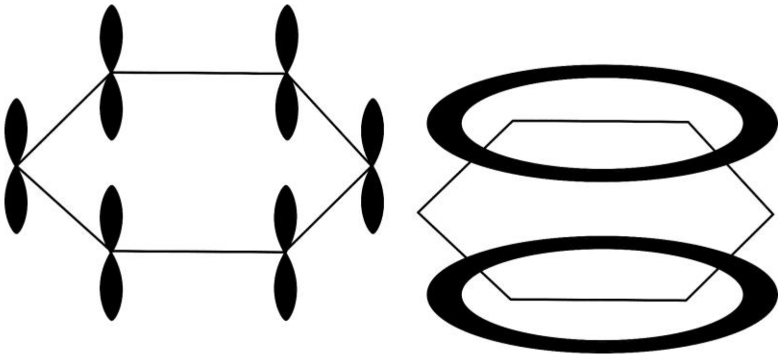
Hydrides of 'Be' and 'Mg' are called polymeric hydrides. Having formulae $(BeH_2)_n$ and $(MgH_2)_n$. Hydrides of these elements are polymeric not ionic due to their small size and high charge density. These hydrides are so called polymeric hydrides because small units of BeH_2 and MgH_2 are polymerized and attach through hydrogen bridge.

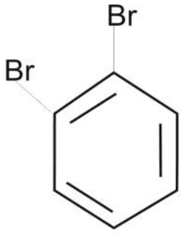
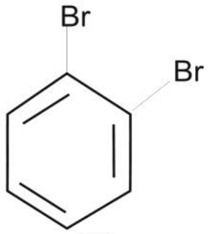
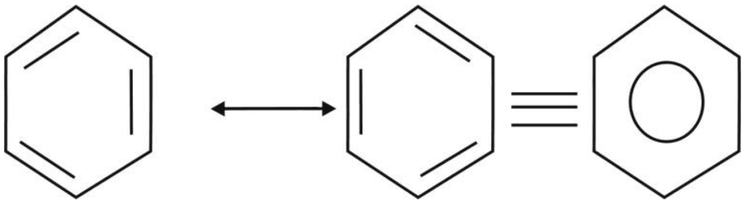
		Properties 1. These are white solids and volatile in nature. 2. Their properties are intermediate between those of ionic and covalent hydrides. **Metallic Hydrides / Interstitial hydrides:** These are the binary compound of hydrogen with the transition elements (d-block) including Lanthanides' and Actinides. With the transition metals, hydrogen forms these hydrides of intermediate composition by penetrating the crystal lattice structure of these metals therefore, they are named as metallic hydrides. These hydrides are also called interstitial spaces on the surface of transition metals. **Properties** 1. These are hard solid having metallic luster. 2. They conduct electricity. 3. They have magnetic properties. **Borderline Hydrides** Hydrides of some elements like copper, Zinc and Indium of Group IB, IIB and IIIA are called Borderline hydrides. The formulae of these hydrides are CuH_2, ZnH_2, InH_2. **Properties** The properties of Borderline hydrides are intermediate those of metallic and covalent hydrides.		
3.	**Explain the types of elements based on electronic configuration**	**TYPES OF ELEMENTS BASED ON ELECTRONIC CONFIGURATION** The periodic table has been divided into s, p, d and f-block elements on the basis of electronic configuration. 1. The Noble Gases (or) Inert elements. 2. Representative elements (or) Typical elements. 3. Outer transition elements (or) d-block elements. 4. Inner transition elements (or) f-block elements. **THE NOBLE GASES:** Those elements which are found at the end of periodic table in VIII A group called noble gases. These elements consist of He, Ne, Ar, Kr, Xe, Rn. These are colorless gases and chemically unreactive and diamagnetic in nature that's why named as inert gases. These are monoatomic gases of general valence shall configuration ns^2, np^1 to ns^2, np^6 except of Helium of configuration Is^2. **REPRESENTATIVE ELEMENTS:** All those elements which are found in sub groups 'A' called Representative or Typical elements. These elements consist of metals, non-metals and metalloids. They are paramagnetic and some are diamagnetic in nature. These elements include 's' and 'p'-blocks.	**K/ A**	**M**

		(A) s-BLOCK ELEMENTS Those elements which involves s-orbitals in their electronic configuration as valence orbitals are called “s-block elements”. s-block elements consist of IA and IIA group. The general valence shell configuration of s-block element is $ns^1 – ns^2$. Those elements are metals. Elements of IA group are called “Alkali metals” while that of IIA group are called “Alkaline earth metals”. **(B) p-BLOCK ELEMENTS** Those elements which involve p-orbitals in their electronic configuration as valence orbitals are called p-block elements. Those elements consist of IIIA to VIIIA groups where VIII A group elements are Noble gases. The valence shall configuration of p-block element is ns^2, np^1 to ns^2, np^6. This block consists of metals as well as non-metals. **d-BLOCK ELEMENTS (OR) OUTER TRANSITION ELEMENTS** Those elements in which d-orbitals involved in their electronic configuration as valence orbitals are called “d-block elements”. This block consists of eight groups, IIIB to VIIIB, IB and IIB. These elements are transition metals the general valence shell configuration of d-block element is ns^2 $(n-1)d^1$ to ns^2 $(n-1)d^{10}$. There are four series of outer transition elements. **f-BLOCK ELEMENTS (OR) INNER TRANSITION ELEMENTS** Those elements in which the last electron enters into (n-2)f orbitals are called f-block elements. These elements consist of two series called “Lanthanide Series” and “Actinide Series”. The general valence shell configuration of these elements is $ns^{2,}$ $(n-1)d^{1,}$ $(n-2)f^{1-14}$.		
4.	**Explain the mechanism of SN_1 and SN_2 reaction**	**MECHANISM OF NUCLEOPHILIC SUBSTITUTION REACTIONS** In nucleophilic substitution reactions may proceed by two different mechanism and are accordingly classified as: 1) **SN^2 reactions (It occurs in one step)** 2) **SN^1 reactions (It occurs in two steps)** **MECHANISM OF SN^2 REACTIONS (OR) BIOMOLECULAR NUCLEOPHILIC SUBSTITUTION REACTIONS** In SN^2 reactions attacking of nucleophile and leaving of halogen group takes place simultaneously. This bond breaking and forming go through a transition state. As the bond making and bond breaking process occur simultaneously, it is also “Rate determining or slow step of the reaction i.e., it determines the overall rate of reaction” such a reaction in which two molecules participate in the rate determining step is called a biomolecular reaction”SN^2 stands for substitution Nucleophilic biomolecular. 	**K/ A**	**M**

		The rate of SN^2 reaction depends on the concentrations of both the attacking nucleophile (Nu) and primary Alkyl halide. $R \alpha$ [RX] [Nu] **MECHANISM OF SN^1 REACTION OR UNIMOLECULAR NUCLEOPHILIC SUBSTITUTION REACTION** The mechanism of SN reactions consists of two steps. In the first step the bond breaks between carbon atom and the halogen group produce carbon ion.  In the second step, nucleophile attacks on carbonium ion produce the substitution product.  In this mechanism first step is rate determining step which is shown in nature since the rate of reaction depends upon the concentration of only alkyl halide (one molecule). That’s why called SN^1 reaction SN^1 stands for substitution nucleophilic unimolecular. **RATE EXPRESSION FOR SN^1 REACTIONS $R \alpha$ [RX]** 2^o or secondary alkyl halide may react by SN^1 or SN^2 mechanism depending on the nature of solvent. In polar solvent in nonpolar solvent, it undergoes SN^2 mechanism.		
5.	**Explain the molecular orbital treatment of benzene**	**MOLECULAR ORBITAL TREATMENT OF BENZENE** The molecular formula of benzene is C_6H_6 in which each carbon atom is Sp^2 hybridized i.e one ‘s’ orbital and two ‘p’ orbitals of each carbon atoms now overlap produce three sp^2 hybrid orbitals having same energy.	**K/A**	**D**



		These Sp^2 orbitals of each carbon atom now overlap with each other and with one 's' orbital of hydrogen atom produce internal, planner hexagonal structure of benzene.  'Pz' orbital of each carbon atom did not involve in the hybridization and perpendicular to the plane therefore, these Pz orbitals now overlap at the same time and produce π cloud by delocalized π bonding which surround the whole molecule of benzene undergoes electrophilic substitution reaction rather addition reactions. 		
6.	**What was Kekule's Structure of benzene? What was objection raised against Kekule's Structure? How Kekule modified it?**	**KEKULE'S STRUCTURE OF BENZENE** Benzene was first isolated by Farady and in 1834 Mitscherlich give the molecular formula of benzene C_6H_6.This molecular formula showed that Benzene contains high percentage of carbon as well as it should have the ring structure. Many proposals had been given about the structure of Benzene. In 1865, Kekule's proposed the structure of Benzene that was most appropriate main points of this proposal are being described below. i) It is hexagonal in shape. ii) It had ring structure. iii) It contains conjugate π bonds i.e π bonds at alternate position.	**K/ A**	**M**

		iv) The nature of each carbon and valency of carbon and involve in the resonance i.e rotate at alternate position. The above proposal shows the Kekule's structure of benzene as under: **OBJECTION RAISED ON KEKULE STRUCTURE** The following two objections were raised on Kekule's structure. i) The nature of each carbon in not same by existing two ortho isomers of Benzene by $FeBr_3$ which are found at the carbon attached with single and double bond. ii) kekule's structure failed to explain that benzene did not involve in addition reactions with HBr or Br_2 like alkenes although it contains conjugate π bonds.  (A)  (B) **REMOVAL OF OBJECTIONS** Kekule removed these objections by giving the resonance idea about conjugate π bonds of benzene. According to this concept conjugate π bonds are not fixed between two carbon atoms, they rotate at alternate position and exist a mixture of two possible structure of benzene. 		
7.	**Write A short note on Isomerism**	**ISOMERISM** Those compounds that have the same molecular formula but they have different structures are called 'Isomers' and the phenomenon is called Isomerism'. **TYPES OF ISOMERISM** There are two different types of Isomerism: **Structural Isomerism** **Stereo Isomerism** **STRUCTURAL ISOMERISM** Structural isomerism is further classified as: 1) **Chain or skeletal Isomerism** 2) **Position Isomerism** 3) **Functional Groups Isomerism** 4) **Metamerism**	**K/ A**	**M**

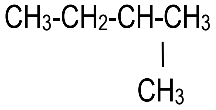
1) **CHAIN (OR) SKELETAL ISOMERISM**

Those structural isomers that have different structures due to the different chains of carbon atoms are called chain or skeletal isomerism.

(i) $CH_3-CH_2-CH_2-CH_2-CH_3$

Normal Pentane

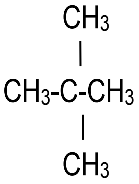
(ii)



$CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

ISO-Pentane

(iii)



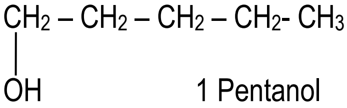
$CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-CH_3$

Neo Pentane

2) **POSITION ISOMERISM**

Those structural isomers that have different structures due to the position of a substituent are called “Position Isomers”.

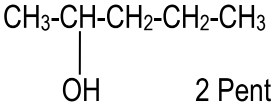
i)



$\underset{\displaystyle OH}{\underset{|}{CH_2}} - CH_2 - CH_2 - CH_2- CH_3$

1 Pentanol

ii)



$CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CH_2-CH_3$

2 Pentanol

Similarly,

i) $CH_2=CH-CH_2-CH_3$

ii) $CH_3-CH=CH-CH_3$

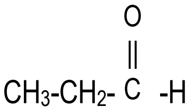
1 butene 2 butene

3) **FUNCTIONAL GROUP ISOMERISM**

Those structural isomers that have different structures due to the presence of different functional group are called Functional Group Isomers.

EXAMPLES

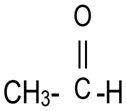
i)



$CH_3\text{-}CH_2\text{-}\overset{\overset{O}{||}}{C}\text{-}H$

Propanal

ii)



$CH_3\text{-}\overset{\overset{O}{||}}{C}\text{-}H$

Propanone
(C_3H_6O)

4) **METAMERISM**

Those structural isomers (in esters. Ethers and carbonyl compound) that have different structure due to attachment of different alkyl radical are called 'Metamers'.

i) $CH_3\text{-}CH_2\text{-}O\text{-}CH_2\text{-}CH_3$

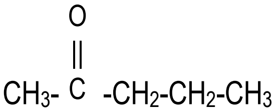
ii) $CH_3\text{-}O\text{-}CH_2\text{-}CH_2\text{-}CH_3$

Diethyl ether

Methyl-n-propylether

($C_4H_{10}O$)

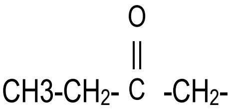
i)



$CH_3\text{-}\overset{\overset{O}{||}}{C}\text{-}CH_2\text{-}CH_2\text{-}CH_3$

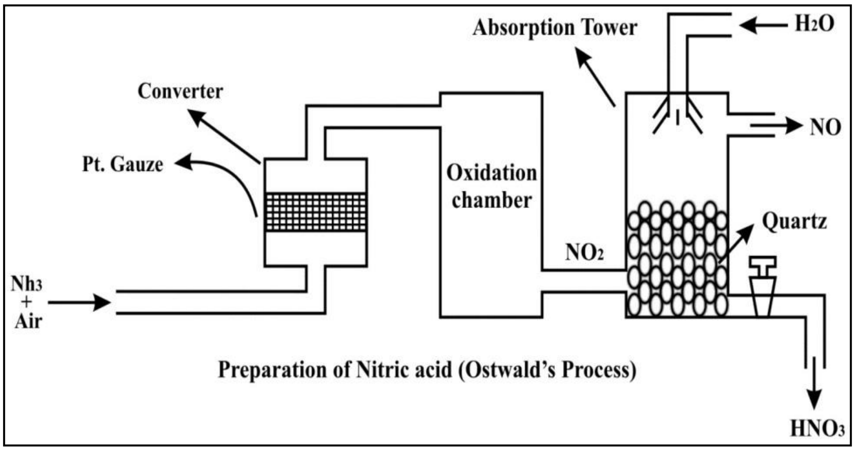
Methyl-n-propylketone

ii)



$CH3\text{-}CH_2\text{-}\overset{\overset{O}{||}}{C}\text{-}CH_2\text{-}CH_3$

Di-ethyl Ketone

8.	**INDUSTRIAL PREPARATION OF NITRIC ACID (HNO_3)) BY “OSTWALD’S PROCESS**	**INDUSTRIAL PREPARATION OF NITRIC ACID (HNO_3)) BY “OSTWALD’S PROCESS”** On industrial scale, it is prepared by the oxidation of ammonia by Ostwald’s process. During this method ammonia is oxidized to NO at 600oC in the presence of Platinum. NO now combines with oxygen of air to produce NO_2 that is dissolved in water to produce HNO_3.  Preparation of Nitric acid (Ostwald’s Process) $4NH_3+5O_2 \underset{600}{\overset{pt}{\rightleftharpoons}} 4NO + 6H_2O$ $2NO+O_2 \rightleftharpoons 2NO_2$ $3NO_2+H_2O \longrightarrow 2HNO_3+NO$ **DETAILS OF THE PROCESS** Following three steps are involved during the preparation of nitric acid by Ostwald’s process. 1. **OXIDATION OF AMMONIA** Ammonia (NH_3) 1 part by volume is mixed with 8 parts by volume of air in the converter containing platinium gauze and heated to a temperature of 600°C in the beginning, about 95% of NH3 is oxidized to NO. $4NH_3+5O_2 \xrightarrow[600^oC]{Pt} 4NO+6H_2O$ 2. **OXIDATION OF NO TO NO_2** NO with the air now introduced in the oxidation chamber, where it is oxidized by lowering the temperature and produce NO_2. $2NO+O_2 \longrightarrow 2NO_2$ 3. **FORMATION OF HNO_3** NO_2 gas obtained by oxidation chamber now it is introduced into the absorption tower where it is absorbed by the water sprayed from the top of the tower and produced nitric acid which is very dilute in the beginning and recycled to get the maximum saturation by absorbing more NO_2 gas HNO_3 is obtained during this process is 68 – 70% pure. $3NO_2+H_2O \longrightarrow 2HNO_3+NO$	**K/ A**	**E**