INTERMEDIATE STAGE CHEMISTRY

BOOK TWO

FOR CLASS XII

For

Sindh Textbook Board, Jamshoro.

CONTENTS

Chapter 1

PERIODIC CLASSIFICATION

The Dalton's atomic theory was the bas of classification of the because according to the Dalton's atomic theory,

"The atoms of different elements have different atomic masses."

The arrangement of the elements according to the particular order is called as **Periodic classification.**

DOBEREINER'S LAW OF TRIAD:

The groups of three elements that have same chemical and physical properties are called as triad.
This law was presented by German scientist Dobereiner who tried to establish the relation between the atomic masses and the properties of the elements.

According to the law of triad,

"The atomic mass of the middle element of the triad is approximately equal to the arithmetic mean of the atomic masses of the remaining two elements."

FOR EXAMPLE:

Li = 7
Na=23
K=39
Now taking the arithmetic mean of the Li and K i.e.
7+39/2=46/2
23 and it is equal to the atomic mass of the middle element.

Now take another example:

S=32
Sc=79
Te=128
Now taking the arithmetic mean of the S and Te i.e.
32+128/2=160/2
80 and it is approximately equal to the atomic mass of the middle element that's Sc.

ADVANTAGES OF THE LAW:

It was easy to remember the elements according to the similarity of their physical and the chemical properties.

DISADVANTAGES OF THE LAW:

This is limited only to some elements and was not applicable on whole periodic table.

NEWLAND LAW OF OCTAVE:

According to the Newland law of octave,
"When all the atomic masses are arranged in a ascending order then the properties of every eight element have the similar properties starting from anywhere."

For example:

I	II	III	IV	V	VI	VII
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl

ADVANTAGE OF THIS LAW:

This law is used for the classification of the similar properties of the elements
This provides an idea to arrange all the elements in tabular form.

DISADVANTAGE OF THIS LAW:

This law is not applicable on all the elements.
This arrangement did not provide the place for Nobel gasses because they were not discovered at that time.
The heavier elements were not adjusted accordingly.

LUTHER MEYER'S CURVE LAW:

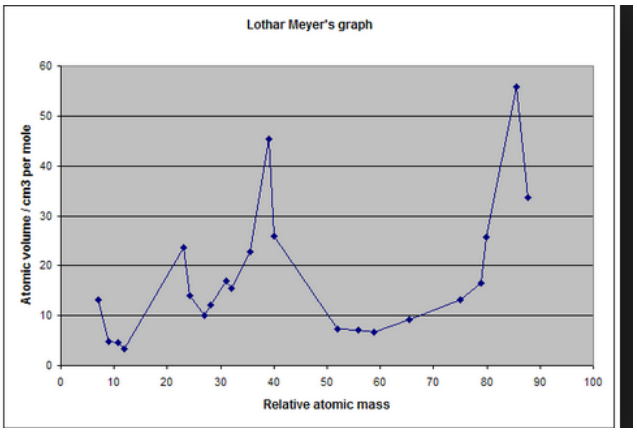
The German chemist Luther Meyer arranged the periodic table in a group from I to VIII and plotted the different values on the curve and come to the conclusion that,

"The elements with similar properties occupy the similar position of the curve."

DISADVANTES OF THIS LAW:

In this law the Luther focus on the physical properties only not on the chemical properties.

LUTHER MEYER'S GRAPH:



MENDELEEV'S PERIODIC LAW:

In this law the Mendeleev arrange the elements in increasing number and states that,

"The properties of the elements are the periodic function of their atomic masses."

ADVANTAGES OF THE LAW:

- When all the elements are arranged in the increasing atomic mass they indicate periodicity.
- The properties of the elements are co-related with their atomic masses.
- They have the similar gradation in their atomic masses.
- There is a space for the new discovered elements and predicted their properties that named as Eka boron, Eka Silicon and Eka Aluminum.
- Mendeleev corrects the atomic masses of the elements.

DISADVANTES OF THE LAW:

- He placed the elements according to their ascending atomic masses. Like Ar = 39.95 placed before K =39.10, Co=58.9 placed before Ni= 58.7,Te= 127.6 placed before 126.9
- Alkali and coinage metals (Cu, Ag, Au) are different in properties but they are placed in a same group.
- Lanthanides and Actinides elements were wrongly placed in Mendeleev's periodic table.
- It did not give the idea of the structure of the atoms.
- The difference of the consecutive two atomic masses is not constant.

MODERN PERIODIC LAW:

This law was presented by Mosley, In this law he stated that,

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

LONG FORM OF PERIODIC TABLE:

PERIODS:

The periodic table has seven horizontal rows and each row is called as period. The periodic number of an element is considered as the energy level in the element.

PROPERTIES OF THE PERIODS:

The physical and the chemical properties of the elements are the periodic function of their atomic numbers.

The Nuclear charge increase as the period increase
The atomic size decreases as the period increases.
In a period ionization potential increases.
The electro negativity increases in the period
The electro positivity decreases.
Each period start with alkali metal and end with a noble gas.

DESCRIPTION OF PERIODS:

FIRST PERIOD:

It is the shortest period and it contains only two elements named as Hydrogen and Helium.
They fill the K shell and its electronic configuration is 1 s^1 and $1s^2$

SECOND PERIOD:

It contains eight elements. It fills the K and L shell. In this period the electron covers the 2s and 2 p orbital. The period contains 2 elements from s Block and 6 from p block.

THIRD PERIOD:

It also contains eight elements and is known as second short period. It fills K, L and M shell. It contains 2 s-block and 6 P-block elements. In this period 3s and 3P orbital are being filled.

FORTH PERIOD:

It contains 18 elements having electronic configuration 4s1, 4s2, 3d10 4p6.

FIFTH PERIOD:

It also contains 18 elements having electronics configuration 5s1, 5s2,4d10, 5p6.

SIXTH PERIOD:

This period also contain 18 elements 6s1 6s2 4f14, 5d10, 6p6.

SEVENTH PERIOD:

It has 14 elements but yet it is not completed and its configuration starts from 7s1

PERIODIC TREND:

Second and third period are called as short period and they contain eight elements. And the forth and sixth period are considered as long period because they contain 18 elements.

PERIODICITY:

The recurrence of properties after specific interval of 2,8,8,,18,18,32 is called periodicity.

GROUP:

The vertical column of a periodic table is called as group.
There are 8 groups in periodic table.

CLASSIFICATION OF THE ELEMENTS ON THE BASIS OF ELECTRONIC CONFIGURATION:

S BLOCK ELEMENTS:

The elements having their valence electrons in their s shell is called as s block elements.
IA and IIA groups are included in this group.
Their electronic configuration is ns^{1-2}

P BLOCK ELEMENTS:

Elements having their valance electrons in p orbital are called as p block elements. The elements of group IIIA to VIIA is included in this block. Their general electronic configuration is called a ns^1 np^1

NOBLE OR INERT GASSES:

The elements having their completely filled valence shell are called as noble or inert gasses.
These gasses belong to p block elements except helium gas. Their general electronic configuration is ns^2 np^6

OUTER TRANSITION ELEMENT OR D BLOCK ELEMENTS:

Elements having their orbital in d block are called as d block elements. Their electronic configuration is ns^{1-2} $(n-1)d^{1-10}$.

INNER TRANSITION ELEMENT OR F BLOCK ELEMENTS:

Elements having their orbital in f block are called as f block elements. Their electronic configuration is ns^2 $(n-1)d^{10}$ $(n-2)f^{1-14}$.

Chapter 2

HYDROGEN CHEMISTRY

Hydrogen is the smallest element in the periodic table. It as many characteristics. We know that the hydrogen can loose electron, gain electron and share electron. Its properties resemble with the group of IA, IVA and VIIA. But its position is not fixed.

SIMILARTITIES OF HYDROGEN WITH GROUP IA:

1. It does belong to the s block elements same as the group IA elements.
2. The number of valence shell electron is 1 same as the group of IA.
3. Its valiancy is +1 same as group IA.
4. Like the Alkali metals (group IA elements) Hydrogen has electron positive character that means that it tends to loose one electron from outer most shell.
5. Like group IA elements the hydrogen can combine element of group VIIA that are high electro negativity elements.
6. Hydrogen atom is also considered as reducing agent same as the Alkali metals.

DIFFERENCES WITH GROUP IA:

1. Hydrogen is non metal but the elements of group IA are all the metals.
2. The alkali metals exist in mono atomic state (Li,Na) but hydrogen always exist in diatomic state like H2.
3. Hydrogen need only 1 electron to complete its outer most shell but all the alkali metals need 7 electrons to complete their outer most shell.
4. Alkali metals forms ionic bonds but hydrogen can form ionic and covalent bonds too.
5. Elements of group IA are all the solids but hydrogen is a gas.

SIMILARTITIES OF HYDROGEN WITH GROUP IVA:

1. The valence shell of group IVA is half filled. And we also know that the valence shell of electron is also half filled.
2. The IVA elements and Hydrogen both are non metals.
3. The hydrogen and elements of group IVA form the covalent bond with other elements.
4. Elements of group IVA and the hydrogen act as a reducing agent.

5. Electro negativity of group IV A elements and hydrogen is almost same.

DIFFERENCES WITH GROUP IVA:

1. We know that the hydrogen belongs to s block but IV A elements belong to p block.

2. The elements of IVA group are solid at the normal temperature but hydrogen is gas.

3. IV group elements have their 4 electrons in their valence shell and show their tetra valency but hydrogen has one electron and form the mono valency.

4. Hydrogen is diatomic but elements of group IVA are the mono atomic.

5. Elements of group IV A form covalent bond hydrogen form ionic and covalent bond both.

6. The oxides of hydrogen are neutral in nature but in case of IVA elements the oxides are acidic in nature.

SIMILARTITIES OF HYDROGEN WITH GROUP VIIA:

1. Elements of group VIIA require 1 electron to complete their outer most shell and same the hydrogen needs only 1 electron to complete their outer most shell.

2. The elements of group VII A are diatomic and hydrogen is also diatomic.

3. Hydrogen is non metals and the elements of group VIIA are also called non metals.

4. The hydrogen and the elements of group VII A both gain one electron. And get negative charge.

5. The halogens and the hydrogen react with the carbon and form tetravalent compounds.

6. In the electrolysis the Hydride ions and halide ions get discharge at anode.

DIFFERENCES WITH GROUP VIIA:

1. Hydrogen belongs to s block but VII A elements belong to p block.

2. Hydrogen has only 1 electron in its valence shell but the elements of group VIIA has 7 electrons in their valence shell.

3. Hydrogen is gas at normal room temperature but the fluorine and chlorine are gasses Bromine is liquid and Iodine is solid.

4. Halogen with carbon form polar covalent bond while Hydrogen with carbon form non polar molecule.

5. Halogens make covalent bond or ionic bond with negative charge. Hydrogen can also do that but it can form ion by loosing electron.

6. Hydrogen is a reducing agent and the halogens are oxidizing agent.

From the above discussion we come to the point that Hydrogen has some similarities or dissimilarities due to the smallest structure of 1 proton and 1 electron. Due to this reason the Hydrogen is misfit in IA IVA and VIIA. That's why Hydrogen is placed at the top of the periodic table.

INDUSTRIAL PREPARATION OF HYDROGEN:

Hydrogen can be prepared by the following methods.

BY THE ELECTROLYSIS OF WATER:

The water is an non electrolyte due to this reason the electrolysis of pure water is impossible. So to make the water electrolyte we have to add few drops of any acid or base then it will become electrolyte and allowed to pass the current.
When the electric current is passed through the water it dissociates in H+ and OH- ion these ions move toward the negative electrodes and get discharged.

EQUATION:

$$4H_2O \rightarrow 4H^+ + 4OH^-$$

AT CATHODE:

$$4H^+ + 4e^- \rightarrow 2H_2$$

AT ANODE:

$$4OH^- \rightarrow 4e^- + 2H_2O + O_2$$

Hydrogen gas is obtained at cathode and the oxygen gas is collected at anode. And the volume of the Hydrogen gas is double as compared to the oxygen gas. In this method 100% pure hydrogen gas is obtained but it consume must amount of electricity so we can say that it is a costly method.

BY STEAM AND NATURAL GAS:

When the steam is passed through natural gas at 900C in the presence of catalyst nickel then it will produce the mixture of the hydrogen and carbon mono oxide.
This mixture is called as water gas.

EQUATION:

$$CH_{4(g)} + H_2O_{(g)} \xrightarrow[900C]{Ni} CO_{(g)} + 3H_{2(g)}$$

SEPARATION OF HYDROGEN FROM WATER GAS:

Hydrogen gas can be separated from the water gas from the following method.

- Water gas is cooled down at -200C. Then the carbon mono oxide is converted in to the liquid and the hydrogen gas remains in gaseous state and then can be separated easily.

- Water gas is reacted with NaOH and the sodium format (HCOONa) is obtained then hydrogen can be separated.

$$CO_{(g)} + H_{2(g)} + NaOH \rightarrow HCOONa_{l} + H_{2(g)}$$

- Steam is passed through water gas at 500C in the presence of FeO or mixture of Fe2O3 and Cr2O3. Then the carbon mono oxide will be oxidized and the hydrogen gas can be easily separated.

$$CO_{(g)} + H_{2(g)} + H_2O_{(g)} \xrightarrow[900C]{Ni} CO_{2(g)} + H_{2(g)}$$

BY COKE AND STEAM:

When the steam is passed through red coke at 1000C then water gas is produced. And then the hydrogen gas can be separated through using the above methods.

$$C_{(s)} + H_2O_{(g)} \xrightarrow{1000C} CO_{9(g)} + 3H_{2(g)}$$

BY THERMAL DECOMPOSTION OF METHANE:

When hydrocarbon like methane is heated upto 700C in the absence of air then carbon black and hydrogen gas are obtained.

$$CH_4 \xrightarrow[absenceofair]{700C} C_{(s)} + 2H_{2(g)}$$

BY THERMAL DECOMPOSITION OF AMMONIA:

The vaporization of liquid ammonia from a cylinder at 1500C in the presence of active catalyst and absence of air gives the mixture of nitrogen and hydrogen gasses.

$$2NH_3 \xrightarrow[absenceofair]{700C} N_{2(g)+3H_{2(g)}}$$

The mixture is cooled down upto -2000 and the nitrogen gas is liquefied at -196C hence the hydrogen gas is obtained.

ATOMIC HYDROGEN:

The Hydrogen obtained by the dissociation of the molecular hydrogen is called as atomic hydrogen.

THERMAL DECOMPOSTION:

The thermal decomposition of ordinary hydrogen gives atomic hydrogen.

$$H_{2(g)} \xrightarrow[104kcals]{5000C} 2[H]$$

BY ELECTRIC DISCHARGE:

The hydrogen breaks into atomic form at the 0.1 mm hg to 1.00mm hg pressure.

$$H_{2(g)} \xrightarrow[1.0-0.1mmhgpressure]{\text{electric current}} 2[\text{H}]$$

PROPERTIES:

Atomic hydrogen is more reactive then molecular hydrogen.

It has very short life and instantaneously combines to form molecular hydrogen.

$$2[\text{H}] \rightarrow H \ +104Kcals$$

Atomic hydrogen reacts with non metals.

$$P+3[H] \rightarrow PH_3$$
$$O_2+2[H] \rightarrow H_2O_2$$
$$S+2[H] \rightarrow H_2S$$
$$Cl_2+2[H] \rightarrow 2H\ Cl$$

Atomic hydrogen also reacts with metals to form hydrides.

$$Ca+2[H] \rightarrow CaH_2$$
$$Na+[H] \rightarrow NaH$$

Atomic hydrogen is a powerful reducing agent.

$$CuO+2[H] \rightarrow Cu+H_2O$$
$$HgO+2[H] \rightarrow Hg+H_2O$$
$$AgCl+[H] \rightarrow Ag+HCl$$

USES:

1. Atomic hydrogen is used to make the atomic hydrogen torch to attain the temperature of 4000C to 5000C
2. It is used in the welding of Aluminum, Chromium and nickel
3. It is used to cut the oxy hydrogen flame at 4000C

NESCENT HYDROGEN:

Hydrogen gas liberated during chemical reaction is always in atomic state, which is called as nascent hydrogen.

PREPARATION:

When Zn metal is reacted with diluted acid, Nascent hydrogen is obtained.

$$Zn+2HCl_{(dil)} \rightarrow ZnCl_2+2[H]_{Nascenthydrogen}$$

When Na metal is reacted with ethyl alcohol, Nascent hydrogen is obtained.

$$Na+C_2H_5OH \rightarrow C_2H_5ONa+[H]$$

When zn/Cu reacted with ethyl alcohol, Nascent hydrogen is obtained.

$$Zn/Cu + 2C_2H_5OH \rightarrow (C_2H_5O_2)Zn + 2[H] + Cu$$

BINARY COMPUND OF HYDROGEN:

BINARY COMPUND:

The compound formed by two elements are called binary compounds.
Such as FeS, Na2O and BeCl2.

HYDRIDES:

The compound in which hydrogen is present is called as hydrides. Like H2S, HCl and NaH etc

CLASSIFICATION OF HYDRIDES:

Binary compound of hydrogen are classified on the basis of their chemical bonding, properties the structure. They are classified as

Ionic Hydrides
Covalent Hydrides
Complex Hydrides
Metallic Hydrides
Polymeric Hydrides
Borderline Hydrides

IONIC HYDRIDES:

The hydrides formed due to the transfer of the electron from the metal of group IA to the group IIA to the hydrogen is called as ionic hydrogen. (Except Beryllium and Magnesium).

PREPARATION:

Ionic hydrides are prepared by passing the hydrogen to the metals of group IA and IIA.

$$2Na + H_2 \xrightarrow{200-400C} 2NaH$$

$$Ca + H_2 \xrightarrow{200-300C} CaH_2$$

PHYSICAL PROPERTIES:

They are colorless, crystalline and non volatile solids.
They have high boiling and melting point due to the presence of ionic bonding.
They are called as saline or salt like hydride.
They are soluble in water and insoluble in organic solvent.
They conduct electricity in fused and molten state.

CHEMICAL PROPERTIES:

They dissolve into the water and decompose into the liberated hydrogen.

$$NaH + H_2O \rightarrow NaOH + H_2$$

They react with acid and Alcohol and gives the hydrogen gas.

$$NaH + HCl \rightarrow NaCl + H_2$$
$$NaH + C_2H_5OH \rightarrow C_2H_5ONa + H_2$$

They conduct electricity in molten state.

$$NaH \xrightarrow{electrolysis} Na^+ + H^+$$

USES:

They are used as the reducing agent in metallurgical operation.
They are used as the dehydrating agent for organic solution.

COVALENT HYDRIDES:

These hydrides are formed by the sharing of electrons of elements of group IIIA to VIIA with hydrogen.

PREPARATION:

Covalent hydrides are prepared by direct action of non metals with hydrogen or by other suitable indirect methods.

EQUATION:

$$H_2 + Cl \xrightarrow{sunlight} 2HCl$$

INDIRECT METHODS EQUATION:

$$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$$

PROPERTIES:

They are colorless gasses.
They has low melting as well as boiling point
They are bad conductors of heat and electricity.
They elements of group IIIA and IVA is neutral the elements of group VA are basic in nature and the elements of group VIIA is acidic in nature.

COMPLEX HYDRIDES:

The hydrides that are formed by the reaction of electron deficient element of group IIIA with alkali metal hydrides are called as complex hydrides.

PREPARATION:

Complex hydrides are obtained by the reaction of IA hydrides with IIIA hydrides.

EQUATION:

$$NaH + BH_3 \rightarrow NaNH_4$$
$$LiH + AlH_3 \rightarrow LiAH_4$$

PROPERTIES:

They are like salt (white solid).
They are tetrahedral in structure
They are stable at 300C
They are stable in water and their hydrogen is powerful reducing agent.

METALLIC HYDRIDES:

The hydrides of transition elements are called as metallic hydrides.

PREPARATION:

We can prepare this kind of hydrides by the absorption of the hydrogen on the metal surface.

PROPERTIES:

They are solids in nature.
They do not fulfill the laws of chemical combination.
They are considered as good reducing agent.
They are good conductor of heat and electricity.
When we heat these hydrides the hydrogen gas is released.

POLYMERIC HYDRIDES:

The type of hydrides that are formed by the combination of Be and Mg with the hydrogen is called as polymeric hydrides.

PROPERTIES:

They are soluble in water but insoluble in organic solvent.
They are white solids.

BORDERLINE HYDRIDES:

They type of hydrides formed by the reaction of metals of IB IIB and IIIA groups.

PROPERTIES:

They are metallic in nature.
They have intermediate properties of metallic and covalent hydrides.

ISOTOPES OF HYDROGEN:

ISOTOPES:

The atoms having same atomic number but different atomic masses are called as isotopes.

ISOTOPES OF HYDROGEN:

Hydrogen has three isotopes named as protium, deuterium and tritium.

PROTIUM:

It has one electron, one proton but no neutron.

DEUTRIUM:

The atom having 2 electron one proton and one neutron is called as deuterium is also called as heavy hydrogen.

TRITIUM:

The atom having one electron one proton and two neutrons is called as tritium.

Chapter 3

s- BLOCK ELEMENT

s- BLOCK ELEMENTS:

The electron having their valence electron in the s orbital is called as s block elements. These elements consists of group IA and group IIA.

ALKALI METALS:

The metals whose oxides and hydroxides are soluble in water are called as alkali metals.

EXAMPLE:

Li, Na, K, Rb, Cs, Fr.

ALKALINE EARTH METALS:

The metals that have their oxides in their earth crust and they are also soluble in water and produce alkaline solution are called as alkaline earth metals.

EXAMPLE:

Be, Mg, Co, Sr, Ba, Ra

DIAGONAL RELATIONSHIP:

Some elements of 2^{nd} represent the similar behavior to the elements of the 3^{rd} group then this type of relation is called as diagonal relation.

EXAMPLE:

Li and Mg are similar in electro positivity, ionization, carbonates, phosphates.

NATURE OF METALS:

The metals of this block are soft in nature and they can easily cut by knife. But the Li, Be, Mg are hard metals.

METALLIC LUSTRE:

When the elements of s block cut by knife then they give luster. All the alkali metals give grey luster and alkaline earth metals give white luster. But all these lusters disappear in the normal atmosphere because they are very reactive metals.

ELECTRONIC CONFIGURATION:

All the member of group IA has 1 electron in their valence shell and their electronic configuration is ns^1. Similarly the elements of group IIA have 2 electrons in their valence shell so there electronic configuration becomes ns^2. Where n represents the number of periods.

IONIZATION POTENTIAL:

They have low ionization power because their electrons are weak in bonding and they can be removed easily.
We know that the ionization of the group decrease as the atomic sioze of the atom increases.

ELECTRONEGATIVITY:

They are positive in nature because they have low electro negativity.
We know that the electro negativity decreases as the number of atomic size increase.

ATOMIC SIZE:

They have large atomic size in the periodic table.
They are directly proportional to the number of the electron.

HYDRATION ENERGY:

The amount of energy released in the formation of one mole of a substance is called as hydration energy.

CHEMICAL PROPERTIES OF S BLOCK ELEMENTS:

CHEMICAL REACTIVITY:

We know that Alkali metals and Alkaline metals are very reactive. They tend to form the ionic bonding with electronegative elements.

REACTION OF OXYGEN:

These elements directly react with oxygen to form different type of oxides such as normal oxides, per oxides and super oxides.

ALKALI METALS:

$$4Li + O_2 \rightarrow 2Li_2O$$
$$2Na + O_2 \rightarrow Na_2O_2$$
$$M + O_2 \rightarrow MO_2$$

ALKALINE METALS:

$$2M + O_2 \rightarrow 2MO$$
$$M + O_2 \rightarrow MO_2$$

METALLURGY OF SODIUM:

We can obtained Sodium by Down's process.

PRINCIPLE:

The electrolysis of molten sodium chloride provides the sodium.

CONSTRUCTION:

This system is made up of iron graphite in the center that is used to collect the chlorine gas. And the cathode is made up of circular bar that is made up of the Cu or Fe, They both are separated by the iron guaze to prevent Na+ nd Cl-.

METHOD:

We mixed the two elements Na Cl and CaCl2. Then the electric current is passed through the electrolyte and the Na is collected at cathode.
Cl is obtained at anode.
The sodium rise up and store in molten state. The 99.9% pure sodium obtained through this procedure.

IONIZATION:

$$NaCl \rightarrow Na^{+} + Cl^{-}$$

CATHODE:

$$2Na^{+} + 2e^{-} \rightarrow 2Na$$

ANODE:

$$2Cl^{-} \rightarrow Cl_2 + 2e^{-}$$

ADVANTAGES OF DOWN'S CELL:

It has following advantages.

1. The by product Cl is obtained.
2. Liquid sodium can be obtained easily at 600C

SODIUM CHLORIDE:

Sodium chloride is also called as common salt. We can obtained this from sea water or rock salt.

FROM SEA WATER:

We know that the sea water contain 3% NaCl. To obtained the NaCl we put the sea water in large tanks and then the water is evaporated by solar heat.
But the advantage is that this type of NaCl has come kind of impurities.
And these impurities can be removed by sodium carbonate and sodium hydroxide.

$$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaCl$$
$$MgCl_2 + 2NaOH \rightarrow Mg(OH) + 2NaCl_2$$

FROM ROCK SALT:

This type of salt can be obtained from the underground as a saturated solution.

USES:

Salt is necessary for our diet.
It is used to prepare the chemicals.
The salt is used to make the soap.
It is used to preserve the food.

SODIUM CARBONATE BY AMMONIA SOLVAY PROCESS:

Na2CO3 can be obtained by the solvay process.

STEP NO 1:

The brine is pumped from the underground and passed the ammonia gas through it.
Then brine mixed with this ammonia gas and called ammoniac brine.

STEP NO 2:

Then we enter the stream of CO2 and then they all react together.

STEP NO 3:

Then the participate of NaHCO3 is removed by vacuum filtration and washed out to separate NH4CL.

STEP NO 4:

The solid sodium bi carbonate is dried and heated to get anhydrous sodium carbonate, commonly known as soda ash.

USES:

The sodium is used in manufacture of sodium hydro oxide.

The soda ash is used in preparation of glass, water glass, soap.

The washing soda is used to soft the water.

SODIUM HYDROGEN CARBONATES:

PREPARATION:

It is usually known as baking soda.
We can obtained it by reacting the Na2CO3 with CO2 and H2O.

USES:

It is used in baking.
It is used to make the CO2.
It is used to reduce hyperacidity of body.

SODIUM HYDROXIDE OR CAUSTIC SODA:

PREPARATION:

We can prepare this by the Castner Kellener's process

CONSTRUCTION OF CELL:

This cell is consists of steel trough with lined ebonite. The titanium plates are available and used as anode and the condensation of the mercury is considered as cathode.

WORKING OF CELL:

In this process when the electric current is passed through the brine the NaCl get ionized. The Cl ions get oxidized and become Cl2 gas and the Na+ ions turns into form the sodium amalgam. After that this sodium amalgam react with water to give the sodium hydroxide.

CHEMICAL REACTION IN CELL:

ELECTROLYSIS:

$$2NaCl \rightarrow 2Na^{+} + Cl^{-}$$

ANODE:

$$2Cl^{-} \rightarrow Cl_2 + 2e^{-}$$

CATHODE:

$$2Na^{+} + 2e^{-} \rightarrow 2Na$$

ADVANTAGES:

This method is cheaper because the raw material used is the cheaper.
The complete pure product is obtained.
The NaOH and Cl2 both obtained at different chambers.

DISADVANTAGES:

It used excess amount of electricity.
The steam of mercury pollutes the environment.

PHYSICAL PROPERTIES:

It is a white solid.
It is translucent.
It absorbs the moist.

USES:

It is used in soap industry.
It is used in the manufacturing of rayon.
It is used in petroleum products.
It is used in textile industry.

BLEACHING POWDER:

It is called as calcium hypochlorite.

PREPARATION:

It is prepared in Hasenclever plant at large scale by reacting the chlorine gas with slaked lime.

$$Ca(OH)_2 + Cl_2 \rightarrow Ca(OCl)Cl + H_2O$$

PROPERTIES:

It smells like chlorine.
It reacts with water or acid to produce chlorine.

Chapter 4

p- BLOCK ELEMENT

p- BLOCK ELEMENTS:

The electron having their valence electron in the p orbital is called as p block elements. These elements consists of group IIIA and group IVA. Their electronic configuration is ns2 np4to ns2 to np6.

ATOMIC RADII:

Its radii increases down the group with the increase in the atomic numbers.

ELECTRONEGATIVITY:

It's electro negativity decreases down the group except the group IIIA because we know that electro negativity is inversely proportional to the atomic size.

TYPE OF BORIC ACID:

There are three types of boric acids.

Orthoboric Acid
Metaboric Acid
Pyroboric Acid

ORTHOBORIC ACID:

It is a crystalline solids that are formed to infinite layers of the boric acid. The week vander walls forces between these layers.

$$Na_2B_4O_7 + H_2SO_4 \text{--------} > 4H_3BO_3 + 5H_2O + Na_2SO_4$$

PROPERTIES:

It is white silky, transparent odorless crystalline solid.
It is slightly soluble in cold water.
It is fairly soluble in hot water.
It is a very weak mono basic acid.

USES:

It's solution is used to wash the eyes.
It is used to preserve the milk and other eatables.
It is used in the manufacturing of enamel.

BORAX:

The chemical name of the Boron "Sodium tetra borate decahydrate (Na2B4O7.10H2O). It is also called as suhaga or tincal.

PREPARATION:

It can be obtained by the chemical reaction of orthoboric acid and sodium hydroxide

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

It can be obtained by the chemical reaction of orthoboric acid and sodium carbonate.

$4H_3BO_3 + Na_2CO_3 \longrightarrow Na_2B_4O_7 + 7H_2O$

It is prepared by hot sodium carbonate and colemanite.

$Ca_2B_6O_{11} + Na_2CO_3 \longrightarrow Na_2B_4O_7 + 2NaBO_3 + 2CaCO_3$

It can be obtained by passing the CO_2 through sodium metaborate.

$4NaBO_2 + CO_2 \longrightarrow Na_2B_4O_7 + Na_2CO_3$

PROPERTIES:

It is a colorless crystalline solid.
It is slightly soluble in cold water but completely soluble in hot water.
Its melting point is 20C.

USES:

It is used as a flux
It is used in manufacturing of the glass.
It is used as glazes in tiles.

ALUMINIUM METAL:

The aluminum is the third most important element on the earth.
It is found approximately 8.3% in the universe.

OCCURRENCE:

OXIDE ORES:

Bauxite	$Al_2O_3.2H_2O$
Corundum	Al_2O_3
Diaspore	$Al_2O_3.H_2O$
Gibbisite	$Al_2O_3.3H_2O$

Corundum usually found in the stones. These stones are very much expensive.
For example
Rubi
Sapphire
Topaz
Emerald

SILICATE ORES:

Kaolin	$Al_2O_3.2SiO_2.2H_2O$
Meca	$K_2O.3AlO_3.6SiO_2.2H_2O$
Feldspar	$K_2O.Al_2O_3.6SiO_23$

FLOURIDE ORE:

Cryolite	Na_3AlF_6

SULPAHTE ORE:

Alumite K2SO4. Al(SO4)3. 4Al(OH)3

EXTRACTION OF ALUMINUM:

It is commonly extracted from its bauxite ore.
It has three major steps.

1. Purification of bauxite ore
2. Electrolysis of aluminum
3. Refining and purification of aluminum.

PURIFICATION OF BAUXITE:

Bauxite ore contain impurities like ferric oxide and silica. To purify bauxite we can use several methods.
These methods are

HALL'S METHOD:

Hall's method is used for the purification of bauxite if it contains both Fe_2O_3 and SiO_2 in excess.
In this method the bauxite is treated with aqueous solution of Na2CO3 so the sodium aluminate is obtained.
When finely divided bauxite is fused with sodium carbonate it dissolved to form sodium aluminate, while the impurities of Fe_2O_3 and SiO_2 are left unaffected

$$Al_2O_3.nH_2O + Na_2CO_3 \text{----------} \rightarrow 2NaAlO_2 + CO_2 + (n)\ H2O$$

Sodium aluminate is then reacted with CO2 and produces

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

Then the aluminum hydroxide is heated upto 1500 and produces pure aluminum

$$2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$$

BAEYER'S METHOD:

This method is good for the purification of bauxite if it contains excess of iron oxide (Fe_2O_3).
It is reacted with strong caustic soda.

$$Al_2O_3.nH_2O + 2NaOH \rightarrow 2NaAlO_2 + 2(n)H_2O$$

Insoluble Fe2O3 settle down in the form of red mud. So the sodium aluminate heated upto 50-6.C with CO2 and then it produces.

$$2NaAlO_2 + 3H_2O + CO_2 \rightarrow 2Al(OH)_3 + Na_2CO_3$$

The precipitates of $Al(OH)_3$ are washed to remove Na_2CO_3, dried and ignited at about 1500°C to get pure alumina.

$$2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$$

SERPEK'S METHOD:

This method is used for the purification of bauxite if it contains excess amount of silica (SiO_2).
In this method the powdered bauxite is mixed with carbon and heated up to 1800°C and a current of nitrogen is passed, so we obtained aluminum nitride.

$$Al_2O_3.nH_2O + 3C + N_2 \rightarrow 2AlN + 3CO + (n)H_2O$$

After that Silica is converted in to silicon (Si).

$$SiO_2 + 2C \rightarrow Si + 2CO$$

Aluminum nitride on hydrolysis with hot water produces precipitates of $Al(OH)_3$.

$$AlN + 3H_2O \rightarrow Al(OH)_3 + NH_3$$

The precipitates of $Al(OH)_3$ are washed to remove Na_2CO_3, and we obtained pure aluminum.

$$2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$$

ELECTROLYSIS OF ALUMINUM:

The electrolysis of aluminum is carried out in a steel tank lined inside with graphite that serves as a cathode. And the hanged molten mass is considered to be anode.
When the electric current is passed through the solution it is dissociated with their ions. The aluminum metal is obtained at cathode in liquid state and sinks to the bottom. The oxide ions are reacted with anode and converted into carbon di oxide.

IONIZATION OF ALUMINUM:

$$2Al_2O_3 \rightarrow 6O^{-2} + 4Al^{+3}$$

AT CATHODE:

$$4Al^{+3} + 12e^- \rightarrow 4Al$$

AT ANODE:

$$6O^{-2} \rightarrow 3O_2 + 12e^-$$
$$C + O2 \rightarrow CO_2$$

REFINING OF ALUMINUM METAL:

Aluminum is produced by the electrolysis of alumina and it is 99% pure but it also contains impurities of Fe, Si and Al_2O_3. Aluminum is further refined by hoop's method.

HOOP'S METHOD:

This is an electrolytic process. Electrolytic cell is made of up iron, which is lined with carbon at the bottom. It contains three layers. The lower layer consists of an alloy of impure aluminum with copper. This layer serves as anode. The middle layer consists of a solution of cryolite (Na_3AlF_6) and barium fluoride. The upper layer consists of pure aluminum and serves as cathode. These three layers are separated from each other due to difference in specific gravity.
During electrolysis Al^{+3} ions from the middle layer move to the upper layer where they are reduced to aluminum by gaining 3 electrons. Equal numbers of Al^{+3} ions are produced in the lower layer. These ions then transfer to the middle layer. Pure aluminum is obtained by this method.This method will produce pure aluminum that is 99.99%.

OVERALL REACTION:

$$AlF_3 \rightarrow Al^{+3} + 3F^-$$

AT CATHODE:

$Al^{+3} + 3e^{-} \rightarrow Al$

AT ANODE:

$Al \rightarrow Al^{+3} + 3e^{-}$

PHYSICAL PROPERTIES:

It is a good conductor of heat and electricity.
It is a ductile.
It is a soft white metal.
It has resistance to corrosion.

CHEMICAL PROPERTIES:

REACTION WITH OXYGEN:

When it is reacted with oxygen it produces a thin oxide layer.

$$4Al + 6O_2 \longrightarrow 2Al_2O_3$$

REACTION WITH ACIDS:

When it reacts with dilute HCL and sulphuric acid then it produces H2 gas.

$$2Al + 6H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3H_2$$

REACTION WITH HALOGEN:

On heating aluminum produces halides.

$$2Al + 3Cl_2 \longrightarrow 2AlC_3$$

REACTION WITH NITROGEN:

When it reacts with nitrogen and 700C then it produces aluminum nitrate.

$$2Al + N_2 \xrightarrow{700C} 2AlN$$

REACTION WITH CARBON:

When it reacts with nitrogen and 2000C then it produces aluminum carbonate.

$$4Al + 3C \xrightarrow{2000C} Al_4C_3$$

REACTION WITH ALKALIS:

When it reacts with alkalis then it produces the aluminates and the H2 gas.

$$Al + 2NaOH \rightarrow NaAl_2O + H_2$$
$$Al + 2KOH \rightarrow KAl_2O + H_2$$

THERMITE PROCESS:

The reducing property of aluminum powder in which a huge amount of heat is liberated and produces pure aluminum is called as thermite process.

It is very useful for the welding. In this process the powdered aluminum reacts with iron oxide or chromium oxide, a large amount of heat is released durind the reaction and about a temperature of 3500oC is attained which is enough to weld broken metallic parts.
Its chemical equation is.

$$2Al + Fe2O3 \text{----------} \rightarrow Al2O3 + 2Fe$$
$$2Al + Cr2O3 \text{----------} \rightarrow Al2O3 + 2Cr$$

USES:

It is used as a heat exchange in the industries.
It is used to jam the radar.
It has tensile strength so it is used in transport industry.
It is used in navigational equipments.
It is a good reducing agent so it can be used in chemical industry.
It is also used for the manufacturing of petrol and milk tanks.

ALUM:

The double sulphate salts of monovalent and trivalent metals having 24 molecules of water is called as alum. It is usually called as phitkari.
It's examples are

Potsh alum $K_2SO_4.Al_2(SO_4)_3.24H_2O$
Ferric alum $(NH_4)_2SO_4.Fe_2(SO_4)_3.24H_2O$
Chrome alum $K_2SO_4.Cr_2(SO_4)_3.24H_2O$

PREPARATION:

It can be prepared by mixing equal molecules of potassium sulphate and aluminum sulphate. And then we cooled this mixture so the crystalline solid is obtained is called as alum.

PROPERITES:

It is a white crystalline solid.
It is soluble in water.
It is used for the purification of the water
It melting point is 92C.

ALLOTROPIC FORM OF CARBON:

Existence of an element in more than one physical form in the same physical state is called allotropy. And if the element is in different physical form so they are referred to as ALLOTROPES.
Allotropes of an element are differing in physical properties but they have same chemical properties. Carbon exists in two allotropic forms.
Crystalline form
Amorphous form

CRYSTALLINE FORMS:

There are two crystalline forms of carbon.
Diamond
Graphite

There are following amorphous forms of carbon
Coal
Coke
Charcoal
Carbon black etc.

LEAD PIGMENT:

The compound of lead is oxides, carbonate and chromate. They are used as pigment in paint.

NITRIC ACID:

Nitric acid is a strong acid. It is a mono-basic acid. It is a strong oxidizing agent and can oxidize metals and nonmetals easily. It is used in the manufacture of fertilizers, silk industry, and explosive materials.

PREPARATION:

It can be prepared from the following methods at industrial level.

- BRIKLAND-EYDE's METHOD
- OSTWALD' s METHOD

OSTWALD'S METHOD:

INGREDIANT'S REQUIRED
Ammonia gas
Oxygen gas
Water
Platinum as a catalyst

STEP NO 1:

The mixture of ammonia gas and oxygen is passed at the presence of catalyst platinum at 600C. The ammonia is gets oxidized into nitric acid. It is an exothermic and reversible reaction.

$$4NH_3 + 5O_2 \xrightarrow{Pt} 4NO + 6H_2O \Delta H = 24.8 kcal / mole$$

STEP NO 2:

The gas obtained by the oxidation process of ammonia is very hot. In order to cool down its temperature , it is passed through a heat exchanger where the temperature of nitric oxide is reduce to 150°C. Nitric oxide after cooling is transferred to another oxidizing tower where at about 50° c it is oxidizing to NO2.

$$2NO + O_2 \rightarrow 2NO_2$$

STEP NO 3:

Nitrogen dioxide is passed through the chamber and then the water is showered

on it. It absorbs some water. And by this absorption nitric acid is obtained.

$$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$$

STEP NO 4:

To increase the concentration of nitric acid, it passed from the fumes of h2sO4 and the sulphuric acid absorbs its all water vapors and increase its concentration.

HYDROGEN SULPHIDE GAS:

Hydrogen sulphide is a colorless gas. It has a rotten egg smell. It is widely used in qualitative analysis.

PREPARATION:

FROM SULPHUR:

$$H_2 + S \rightarrow H_2S$$

FROM ZINC SHULPHIDE:

$$ZnS + 2HCl \rightarrow ZnCl_2 + H_2S$$

PHYSICAL PROPERTIES:

It smells like rotten eggs.
It is a colorless gas.
It is soluble in water.
It is a toxic gas.

SULPURIC ACID:

sulphuric acid can be prepared by the following two methods at industrial level.

1. Contact process
2. Lead chamber process

CONTACT PROCESS:

The sulphuric acid is prepared through contact process these days.
The Sulphuric acid is obtained by the following steps.

STEP NO 1:

First we obtained the SO2 by burning sulphur or by heating the iron pyrite

$S + O_2$ ---------→SO_2

STEP NO 2:

The Sulphur contained the impurities like the dust particles, Arsenous oxide, vapours, sulphur etc
The SO2 is passed through the dust catcher which removes the dust particles.

After cooling it is passed to the washing tower and here the soluble impurities are removed.
Then the gas is dried by the drying tower and then the conc H2SO4 removed the moist from SO2.

STEP NO 3:

The washed and dried SO_3 is taken into the contact chamber and then it is treated with air or oxygen from sulphuric trioxide.

$2SO_2 + O_2$ --------→ $2SO_3$

STEP NO 4:

SO3 absorbs in sulphuric acid to form oleum. This is done when the SO2 is directly absorb in water then acid forg is produced and explosion may occur

$SO_3 + H_2SO_4$----------→ $H_2S_2O_7$

STEP NO 5:

Then the oleum dissolved in water and sulphuric acid is formed.

$H_2S_2O_7 + H_2O$----------→$2H_2SO_4$

PHYSICAL PROPERTIES:

It's melting point is 10.5C
It is soluble in water.
It cause the burns or pain
It is colouless odourless or viscous

USES OF SULPHURIC ACID:

It is usd as a reagent.
It is a labortary agent
It is used as a dehydrating agent.
It is used as an industries like cotton or paper.
It is used as in the preparation of explosives.

CHLORINE GAS:

It is a gas that is greenish in color. It has pungent smell.

PREPARATION OF GAS:

Nelson cell consist of u shaped perforated cathode. This cell is filled with brine.

WORKING OF CELL:

The cell is dissociated as follows,
2NACL----→2Na+Cl
In this way sodium hydro oxide is collected at the bottom of the cell through perforated cathode but the hydrogen is collected on the top of the cell. Cl ion moves toward anode and get oxidized to give chlorine gas.

PHYSICAL PROPERTIES:

It is a yellow greenish gas
It is soluble in water and its solution is called as chlorine water.
It has pungent smell.

USES:

It is used as sterilizer of drilling water
It is used in the production of dyes and drugs
It is used in the preparation of bleaching powder.

Chapter 5

d-BLOCK ELEMENTS

The elements having partially filled d-orbitals either ground state or in one or more of their ions, are called as d-block elements or outer transition elements. Their properties are intermediate between s-block elements and p-block elements. They have more electropositivity than p-block elements but they are less electropositive than s-block elements. They are all metals and have electronic configuration ns^2, $(n-1)d^{1 \text{ to } 10}$

FIRST SERIES:

From $_{21}Sc$ to $_{30}Zn$

SECOND SERIES:

From $_{39}Y$ to $_{43}Cd$

THIRD SERIES:

From $_{57}La$, $_{72}Hf$ to $_{50}Hg$

f-BLOCK ELEMENTS:

Elements having their valence electron in f orbital are called as f block elements or inner transition elements.

This series belongs to the f orbital and called as 4f series. It has fourteen elements from $_{58}Ce$to $_{70}Lu$

This series belongs to 5f orbital and also called as 5f series. It has fourteen elements from $_{90}Th$ to $_{103}Lr$

ELECTRONIC CONFIGURATION OF FIRST SERIES:

For first series (Sc z=21) to (Zn z=30)
Sc (z=21): $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$.
Ti (z=22) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^2$.
V (z=23) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^3$.
Cr (z=24) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$.
Mn (z=25) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$.
Fe (z=26) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^6$.
Co (z=27) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^7$.
Ni (z=28) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^8$.
Cu (z=29) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$.
Zn (z=30) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}$.

METALLIC CHARATECTER:

All the transition elements are metallic in nature.

ATOMIC SIZE:

The atomic size of d-block elements decreases from Sc to Zn due to increase in nuclear charge. Their atomic sizes are smaller than that of s-block elements.

IONIZATION POTENTIAL:

The ionization potential of these elements is intermediate between those of s-block and p-block elements. This means that they are more electropositive than p-block elements and less reactive than s-block elements.

OXIDATION STATE:

These type of elements have variable state oxidation. They have very small energy differences due to this reason they have variable oxidation state. Variation in oxidation state is related to their electronic configuration.
For example:-
Ti : +2, +3, +4.
Cr : +1, +2, +3, +4, +5, +6.
Mn : +2, +3, +4, +6, +7.
Fe : +2, +3.
Cu : +1, +2.

MELTING POINT AND BOILING POINT:

Thye have high melting and boiling point (except Zn). These higher values are due to small atomic radii of these elements which provides greater inter atomic forces of attraction. Due to this reason they are very hard to melt.

CONDUCTIVITY:

The transition elements are good conductor or heat as well as good conductor of electricity.

COLORS:

The transition elements are colorless due to the presence of the unpaired electrons except the zinc that is colored.

COPPER:

Copper occur in a free or combined state. It is mainly found in sulphide and oxide ores.

TYPES OF ORES:

Copper pyrite $CuFeS_2$
Chalocite Cu_2S
Malachite $CuCO_3.Cu(OH)_2$
Azurite $2CuCO_3.Cu(OH)_2$

EXTRACTION OF COPPER:

The copper is usually extracted from its sulphide or copper pyrite that contain 6% copper.
Extraction of copper contain following steps.

STEP 1: CONCENTRATION OF ORE (FROTH FLOATING PROCESS):

The ore is broken into small pieces and take in large tank containing oil and water. The ore is agitated with compressed air and then after that the particles of ore are wetted and then get from the tank in the form of forth.

Then this forth comes on the upper surface and we skimmed off that surface.

STEP 2: ROASTING OF ORE:

The concentration of ore is then roasted in an open furnace in the presence of air. The impurities like sulphur and iron are removed in the form of their oxide.

$2CuFeS_2 + O_2 \dashrightarrow Cu_2S + 2FeS + SO_2$

STEP 3 SMELTING OF ORE:

The roasted ore is mixed with coke and silica sand (SiO_2) and is introduced in to a blast furnace. The hot air is blasted and FeO is converted in to ferrous silicate ($FeSiO_3$).

$FeO + SiO_2 \dashrightarrow FeSiO_3$
$Cu_2O + FeS \dashrightarrow Cu_2S + FeO$

MATTE:

The molten mass comprise of cuprous sulphate and ferrous sulphide is called as matte.

STEP 4: BASSEMERIZATION

Copper metal is extracted from molten matte through bessemerization. The matte is introduced in to Bessemer converter which uphold by tuyers. The air is blown through the molten matte. Blast of air converts Cu_2S partly into Cu_2O which reacts with remaining Cu_2S to give molten copper.

$2Cu_2S + 3O_2 \dashrightarrow 2Cu_2O + 2SO_2$
$2Cu_2O + Cu_2S \dashrightarrow 6Cu + SO_2$

STEP 5: PURIFICATION OF COPPER

Blister copper contain impurities like iron, zinc, lead gold and silver. These impurities reduces the conductivity of copper metal through blister copper needs to be refined or purified.

SILVER NITRATE:

Silver nitrate is commonly called as Lunar caustic

The silver nitrate is prepared by dissolving silver metal by diluting nitric acid when the crystal of the silver nitrate is obtained then long crystal like stick are formed.

$3Ag + 4HNO_3 \dashrightarrow 3AgNO_3 + NO + 2H_2O$

PROPERTIES:

It is colorless
It is soluble in water
It is also soluble in organic solvent
It's melting point is 290C

USES:

It is used in laboratory to find the halides
It is used in the preparation of hair dyes.
It is used in the silvering the mirror.
It is used in the photography.
It is used in medicine.

COPPER SULPHATE:

It is called as blue vitriol.

PREPARATION:

We can obtained it by the reaction of cupric oxide or cupric carbonate with the diluted sulphuric acid followed by the evaporation.

$CuO+H_2SO_4 \longrightarrow CuSO_4+H_2O$

And on the industry level we can get it by, dissolving metallic copper in hot H_2SO_4 in the presence of air oxygen.

$2Cu+2H_2SO_4+O_2 \longrightarrow 2CuSO_4+2H_2O$

PROPERTIES:

It is soluble in water but insoluble in alcohol.
It formed blue color of water in crystallization.

USES:

It is used in the process of electroplating
It is used to make the green pigments.
It is used to kill the fungus by mixing it in the milk of lime.

POTASSIUM CHROMATE:

PREPARATION:

There are three methods to prepare $K_2Cr_2O_4$.
When a trivalent chromium compound is treated with the oxidizing like br in the presence of the alkali metals This the potassium chromate is produced

$2KCrO_2+3Br_2+3KOH \longrightarrow 2Kr_2CrD_4+6KBr$

Bromine is acting as an oxidizing agent in the basic medium and chromate can be produced in the dry method. In this method the Cr_2O_3 is used with an alkali in the presence of the $KClO_3$

$Cr_2O_2+4KOH+KCIO_3 \longrightarrow 2K_2CrO_4+KCI+2H_2O$

Bromide is strongly heated with $K_2C_2O_3$ in the presence of fuse state and this can be extracting by water.

$4FeCrO_3+3K_2CO_3+9O_2 \longrightarrow 8K_2CrO_4+2Fe_2O_3+3CO_2$

PHYSICAL PROPERTIES:

i. All the chromate are yellow in color.
ii. K2CrO4 is also yellow crystalline solid.
iii. Its melting point is 975C.

USES:

It is used in the manufacturing of pigment.
It is used as a corrosion inhibitor.
It can be used in the dyeing and tanning of leather.
It can also be used in the AgNO3 titration as a indicator.

POTASSIUM DICHROMATE:

When K2CrO4 is reacted with the acid then the K2CrO4 is get crystallized on cooling. Then this compound is purified by doing crystallization again.

$$2K_2CrO_4 + H_2SO_4 \rightarrow K_2Cr_2O_4 + K_2SO_4 + H_2O$$

It can be prepared by reaction sodium dichromate in HCL.

$$Na_2Cr_2O_7 + 2KCl \rightarrow K_2Cr_2O_7 + 2NaCl$$

PHYSICAL PROPERTIES:

It is soluble in water.
It's melting point is 396C
It is a red orange crystalline solid.

CHROMYL CHLORIDE TEST:

When we heat the potassium dichromate with KCl in the presence of H2SO4 as a catalyst. It will give reddish brown fumes of chromyl chloride.

USES:

It is used as a dyer of many substance.
It is used as an oxidizing agent
It is used to manufacture the chromium compound.

SILVERING OF THE MIRROR:

To deposit a coating of pure silver on a glass sheet or a glass plate is called as silvering of mirror. This process converts a plane glass sheet into a mirror.

PRINCIPLE:

When the aldyhydes are heated with ammonical silver nitrate in a glass tube then a think layer of metallic silver is obtained on a glass sheet.

PROCEDURE:

Clean the glass sheet carefully. And then react with that solution and it will converted into the glass mirror.

$AgNO_3 + NH_4OH \text{ ----------} \rightarrow AgOH + NH_4NO_3$ (white ppt.)
$AgOH + 2NH_4OH \text{----------} \rightarrow [Ag(NH_3)_2]OH + 2H_2O$
$2[Ag(NH_3)_2]OH \text{ ----------} \rightarrow Ag_2O + H_2O + 4NH_3$

TIN PLATING:

The process of depositing a think layer on base metal to protect against the corrosion is called as tin plating. There are two methods of tin plating

ELECTROLYTIC METHOD:

The mixture of SnCl and Hcl is used in this process. We placed the material that is used for tin plating is dipped and used as a cathode in that electrolytic solution. When the current is passed then a think layer deposit on the iron cathode and the iron sheet is get plated

$SnCl_2 \text{----} \rightarrow Sn^{+2} + 2Cl^-$

MECHANICAL METHOD:

This is the cheapest method of tin plating. The iron sheets are dipped into the warm shulphuric acid and then these iron sheets passed through the hot rollers to give the uniform coating on the iron sheets.

PHOTOGRAPHY:

The agNO3 and NH4Br are mixed together in a solution of gelatin. And this mixture is then placed in dark room so the ppt of theagBr produces.

Then the film is put in the camera and exposed to the light. Then silver bromide is reduced to the metallic silver due to the light exposure.

Then this film is taken out in a dark room and dipped into the water then it is dipped into the alkaline solution. Then the image is taken on the photographic plate and then this film is immersed in the solution of Na2S2O3 to remove the excess of AgBr.

CORROSION:

The rusting of the metallic surface is called as rusting.

FACTORS RESPONSIBLE FOR CORROSION:

The presence of the moisture in the air is the main reason of the corrosion in the metallic surface. This is due to the large amount of the moist in the air.

The presence of carbonic acid also fastens the process of corrosion. The acidic vapors corrode the iron very fast.

The rate of corrosion also depends on the metal nature. For example the iron corrodes more quickly as compared to the aluminum and gold do not corrode.

PREVENTION OF CORROSION:

These metals like iron or steel can be prevented by coating another metal on it.

We can electroplate the metal to stop the corrosion.

We can get rid of corrosion by mixing the other metal in it.

And it can also prevent from corrosion by using non-metallic substances. Like paints, Greece, and plastic emulsion.

STAINLESS STEEL:

The type of iron based alloys that show resistance to the corrosion is called as stainless steel.
We can obtain it by the addition of chromium and nickel in steel.

PREPARATION:

First we have to remove all the impurities that are present in the iron pig by blowing pure oxygen.

$C+O_2$ --------→ CO_2

There are following types of the stainless steel having different percentage of the base metals.
Containing 13% of cr. And 0.47% of C
Containing 17% of cr. And 2% of Ni
Containing 18% of cr. And 6% of Ni

USES:

It is used in the automobiles.
It is used in the ships.
It is used in the manufacturing of surgical instrument.
It is used in the manufacturing of household and decoration.

Chapter 6

INTRODUCTION OF ORGANIC CHEMISTRY

HOMOLOGOUS SERIES:

They type of organic compound that have same functional group but different from adjacent members by (-CH_2) group in their structure and molecular formula is called as homologous series.

CHARACTERISTICS OF HOMOLOGOUS SERIES:

GENERAL FORMULA:

Members of a homologous series can be represented by a general formula.

ALKANE : CnH2n+1
ALKENE : CnH2n
ALKYNE : CnH2n-2
ALCOHOL : CnH2n+1 OH
ETHERS : CnH2nO

STRUCTURAL FORMULA:

Member of the homologous series have same structural formula.

MOLECUALR FOLRMULA:

Molecular formula of different members of a homologous series differs from previous and next member by CH_2.

NATURE:

They have similar nature.

FUNCTINAL GROUP:

All the members of homologous series contain same functional group.

MOLECULAR FORMULA:

Molecular mass of any two consecutive members differ by 14 units.

CHEMICAL PROPERTIES:

The members of a homologous series have same chemical properties because they have same functional group.

PHYSICAL PROPERTIES:

All the member of homologous series have different physical properties due to the increase in atomic weight.

PETROLEUM:

A complex mixture of hydrocarbons and different compounds for example sulphur, oxygen and nitrogen in small amounts. Usually it contains alkanes, alkenes, cyclo alkanes, aromatic hydrocarbons etc are called as petroleum.

REFINING OF PETROLEUM:

It consists of mixture of large number of the compounds of different boiling points. And the process of dividing these compounds into fractions by providing 400C and then all the fractions get apart and get free from impurities is called as refining of petroleum.

FRACTIONAL DISTILLATION:

The process of separating the material into the series of fraction by supplying certain amount of temperature is called as fractional distillation of the petroleum.

More than 500 compounds can be obtained through the process of this fractional distillation

Boiling point	**Number of C atoms**	**Nature of the compound**
Below 20C	C1 to C4	Natural gas, bottled gas
20C-60C	C5 to C6	Petroleum ether
60C-120C	C6 to C7	Ligroin
40-200	C5 to C10	Gasoline
175-325	C12 to C18	Kerosene oil, Jet fuel
250C-400	C12 – higher	Gas oil, fuel oil, diesel oil
Non volatile liquid	C20 – higher	Grease, lubricants
Non volatile liquid	C20 – higher	Wax, asphalt, tar

GASOLINE:

The term Gasoline usually called as petrol and it is a mixture of n-hexane and n-heptanes. When we process the petroleum then it is collected at the chamber of the tower.

OCTANE:

Octane is a type of number that is a standard which determines the knocking ability and quality of the gasoline. Higher is the number of octane of a gasoline, lower is the knocking it produces.
Octane number can be increased by the following two methods:
Reforming
By adding TEL (tetraethyl lead)

KNOCKING:

It is a pointed metallic sound produced in the internal combustion engine. Knocking is caused by the low octane number of gasoline.

REFORMING OF PETROLEUM:

The conversion of straight chain hydrocarbon into branched chain hydrocarbon is called as reforming of petroleum.

MONOMERS:

The single repeating chains of large molecules that are combined to form polymers are called as monomers.

POLYMERS:

The high molecular mass compound that is consists of the repeating unit of molecules is called as polymers.

POLYMERIZATION:

A type of a chemical reaction in which a number of simple molecules or monomers are joined to form a very large set of molecules is called polymerization.

OR

A type of reaction in which monomers are converted into polymers are called as polymerization.

TYPES OF POLYMERIZATION:

There are two types of polymerization.

1. Addition polymerization
2. Condensation polymerization.

ADDITION POLYMERIZATION:

When many monomers are joined together to form a large polymer that means that it is an addition polymerization.
The empirical formula for the monomer and the polymer will be same.

CONDENSATION POLYMERIZATION:

In this type of polymerization molecules join together and lose small molecules as by-products such as water or methanol, as opposed to addition polymers (that involve the reaction of unsaturated monomers).

CATENATION:

Carbon has ability to form bonds successively to other C-atoms to form chains of varying lengths, structures and shapes. This property of carbon is called as catenation.
It is responsible for the variety and a large number of organic compounds.
Due to catenation carbon forms long chains, branched chains, rings, ring and chain structured compounds.

ISOMERISM:

The type of compound that have same molecular formula but different structural formula and having different physical and the chemical properties are called as isomers and the process is called as isomerism.

TYPE OF ISOMERISM:

There are different types of isomerism

CHAIN ISOMERISM:

Two or more different compounds that having the same molecular formula but having different carbon chains structure are considered to be chain isomers and this type of isomerism is called as chain isomerism.

EXAMPLE:

Butane (C_3H_{10}) has two isomers.

POSITION ISOMERSIM:

The type of isomers having the relative position that means that they are having the different position in the functional groups are called as position isomerism.

FUNCTINAL ISOMERISM:

The type of compounds that are having same molecular formula but different functional group are called as functional group.

METAMERISM:

The compounds that are having same functional group but different alkyl group attached to the atom is called as metamerism.

FUNCTIONAL GROUP:

An atom or group of atom that gives the molecules some characteristics and chemical properties are called as functional group.

Functional group	Functional group representation	Homologous series	General type	Example
Alkyl group	C_nH_{2n+1} or R	Alkane	C_nH_{2n}	Ethane
Olefanic double bond		Alkene	C_nH_{2n}	Ethene
Acetylenic triple bond		Alkyne	C_nH_{2n-1}	Ehyne
Halo group	-X (X=F,Br,Cl, I)	Alkyl halides	X or RX	Chloro ethane
Hydroxyl group	-OH	Alcohol	R-OH	Phenol
Etheric group	-O-	Ethers or alkoxy group	R-O-R	Methoxy methane

Aldehydic group	-CHO	Aldehydes		Ethanol
Ketonic group		Ketones		Butanone
Carboxyl group	-COOH	Carboxylic acid	R-COOH	Ethanoic acid
Alkoxy group		Alkyl alkoanate	R-COOR	Ethyl ethanoate
Acyl group		Acid hilides		Acetyl chloride

TYPE OF ORGANIC COMPOUNDS:

The organic compounds are divided into the following types.

Open chain compounds
Closed chain compounds

OPEN CHAIN COMPOUNDS:

The types of compounds that are open structure is called as open compounds.

CLOSED CHAIN COMPOUNDS:

The types of compounds that have closed structure of carbon is called as closed compounds.

TYPES OF HOMOCYCLIC COMPOUNDS:

There are two types of homocyclic compounds

ALICYCLIC COMPOUND:

They type of compounds that do not contain the benzene group is called as alicyclic compounds.

AROMATIC COMPOUND:

The type of compounds that contain the benzene ring is called as aromatic compound.

CRACKING:

When we provide high temperature to the long chain of the alkanes then it decompose into the smaller alkanes , alkenes and hydrogen is called asw cracking.

TYPES OF CRACKING:

There are two types of cracking

Thermal cracking
Caralytic cracking

CATALYTIC CRACKING:

A catalyst like the silica or aluminum is used.

THERMAL CRACKING:

The type of cracking due to the presence of heat energy.

INDUSTRIAL APPLICATIONS OF CRACKING:

The cracking can be used in the following ways
Galsoline production
Fuel gas production
Synthetic production

TYPE OF CARBON ATOM:

There ate three types of carbon atom.

PRIMARY CARBON ATOM:

The type of carbon atom that is directly attached to the one carbon atom is called as primary carbon atom.

SECONDRY CARBON ATOM:

The type of carbon atom that is directly attached to the two carbon atom is called as primary carbon atom.

TERTIARY CARBON ATOM:

The type of carbon atom that is directly attached to the three carbon atom is called as primary carbon atom.

AMINES:

The type of organic compound that contain amino group is called as amines.

Chapter 7

HYDROCARBONS

SATURATED HYDROCARBONS:

The type of hydrocarbons in that all the valencies of carbon atoms are fully utilized by single covalent bonds are called as saturated hydrocarbons.

UNSATURATED HYDROCARBONS:

The type of Hydrocarbons in that all the valencies of carbon atoms are not fully utilized by single covalent bonds are called as unsaturated hydrocarbons. They contain at least one double or triple bond in their structure.
Alkenes, Alkynes

REACTIVITY OF SATURATED HYDROCARBON:

The saturated hydrocarbons are saturated in the respect to chemical combination with the other compounds and elements. Saturated hydrocarbons are chemically inert to some extent.
e.g. Alkanes (methane, ethane, propane etc.)

REACTIVITY OF USSATURATED HYDROCARBON:

They are very reactive hydrocarbons. Their high reactivity is due to the presence of pi-bond in their structure.
Alkenes, Alkynes

CHARACTERISTIC REACTIONS OF SATURATED HYDROCARBONS:

Characteristic reactions of saturated hydrocarbons are called as substitution reaction. They do not undergo the addition reaction in any circumstances.

REACTIVITY OF UNSATURATED HYDROCARBON:

They are very reactive hydrocarbons. Their high reactivity is due to the presence of pi-bond in their structure.

CHARACTERISTIC REACTIONS UNSATURATED HYDROCARBONS:

Their characteristic reactions are addition reactions. They may undergo the substitution reactions.

ALKANES:

The open chain saturated hydrocarbons (aliphatic hydrocarbons) in which all carbon atoms are bonded to each other by single covalent bond is called as alkanes. Each carbon is tetrahedrally surrounded by H-atoms . Since all the valencies of carbon atoms are fully utilized by sigma bond with H-atoms.

GENERAL FORMULA:

C_nH_{2n+2}

where,
n=number of Carbon atoms
EXAMPLES:
methane , ethane, propane , butane etc.

ALKENES:

Alkenes are open chain unsaturated hydrocarbons in which a carbon-bond is a double covalent bond.

GENERAL FORMULA:

C_nH_{2n}
Where n= number of carbon atoms and n is greater than 1.

There are very reactive organic compounds due to the presence of pi-bond. They are also called as

EXAMPLES :

Ethene, propene etc.

ALKYNES:

The open chain unsaturated hydrocarbons in which one bond between any two carbon atoms is a triple covalent bond is called as alkynes.

GENERAL FORMULA:

C_nH_{2n-2}

Where, n= number of C-atoms and n is greater than 1.
Alkynes are more unsaturated hydrocarbons then alkenes. They are also very reactive compounds.

TYPE OF REACTIONS:

Characteristic reactions of alkynes are "addition reactions".

EXAMPLES :

Ethyne, propyne etc.

CHEMISTRY OF METHANE:

Molecular formula = CH_4
Molecular mass = 16
Empirical formula = CH_4
Empirical formula mass = 16
State: Gas at room temperature.
Occurrence: marsh, stagnant ponds.
It is the major constituent of natural gas. Natural gas contains 94.6% methane.

ORBITAL STRUCTURE OF METHANE:

COMPOSITION:

Methane molecule consists of one carbon and four hydrogen atoms (CH_4).

NATURE:

It is Sp_3-hybridized. One s-orbital and three p-orbitals ($2p_x$,$2p_y$,$2p_z$) of carbon atom undergo Sp_3-hybridization to produce four Sp_3-hybrid orbitals. These Sp_3-hybrid orbitals are 109.5^o a part.

SIGMA BOND:

Each Sp_3-hybrid orbital overlaps 1s-orbital of H-atoms. In this way four **s**-bonds are produced between C and four H-atoms.

GEOMETRY OF METHANE:

It is tetrahedral in structure in which the carbon atom is central atom and for atoms are surrounding it.

BOND ANGLES:

It's length is 109.5C

BOND LENGTH:

It's bond length is 1.09A.

PHYSICAL PROPERTIES:

It is colorless, poisonous and odorless
It is lighter than air.
Its molecules are symmetrical.

ETHANE:

Molecular formula = C_2H_4
Molecular mass = 30
Empirical formula = CH_3
Empirical formula mass = 17
State: Gas at room temperature.
Occurrence: Ethane occurs along with methane in natural gas and gases from oil-wells. It is also present in coal gas in very small quantity.

ORBITAL STRUCTURE OF ETHANE:

COMPOSTION OF ETHANE MOLECULE:

It has two carbon atoms and six hydrogen atoms.

NATURE OF HYBRIDIZATION:

In ethane each C-atom is Sp^3-hybridized containing four Sp^3-hybrid orbitals. One s-orbital and three p-orbitals undergo Sp^3-hybridization to produce four Sp^3-hybrid orbitals for each carbon atom.

SIGMA BOND:

One Sp^3-hybrid orbital of one C-atom overlaps with one s-orbital of H-atom to produce three sigma bond and the last overlaps with one Sp^3-orbital of other C-atom to produce a sigma bond between two C-atoms.

GEOMETRY OF ETHANE:

These molecules are arranged in tetrahedral geometry in which central carbon atoms are surrounded by Hydrogen atoms in three dimensions.

PHYSICAL PROPERTIES:

It is colorless gas
It is partially soluble in water.
Its boiling point is -89C.

ETHENE:

Molecular formula = C2H4
Empirical formula = CH2
Molecular mass = 28
Empirical formula mass = 14
Homologous series = alkene.

ETHYNE:

Molecular formula = C_2H_2
Empirical formula = CH
Molecular mass = 26
Empirical mass = 13
Common name = Acetylene
Homologous series = Alkynes

COMPOSITION OF ETHYNE MOLECULE:

Ethyne molecule consists of two Carbon atoms and two Hydrogen atoms (C_2H_2).

NATURE OF HYBRIDIZATION:

In these molecules, each carbon atom is Sp-hybridized. Due to Sp-hybridization. These Sp-orbital are arranged in linear geometry and 180^o apart. Remaining py and pz unhybrid orbitals of each carbon atom lie perpendicular to the plane of Sp-orbitals.

SIGMA BOND:
One Sp-hybrid orbital of each carbon atom overlaps to produce one sigma bond between two Carbon atoms. The remaining one Sp-orbital of each Carbon atom overlaps with one Hydrogen atom to produce sigma bond.

STRUCTURE OF BENZENE:

Benzene has outstanding characteristics so it is difficult to know from which group it is belongs.
It has the characteristics of the saturated as well as unsaturated hydrocarbons.

BENZENE AS A MEMBER OF ALKANE:

The molecular formula of benzene is C6H6. But according to the general formula of the alkane it must be C6H14. So it does not belong to the alkane family.

BENZENE AS A MEMBER OF ALKENE:

The molecular formula of benzene is C6H6. But according to the general formula of the alkene it must be C6H12. So it does not belong to the alkene family too.

BENZENE AS A MEMBER OF ALKYNE:

The molecular formula of benzene is C6H6. But according to the general formula of the alkyne it must be C6H10. So it does not belong to the alkyne family too.

From the above discussion we can say that the benzene are not open chain hydrocarbons.

KEKULE'S STRUCTURE FOR BENZENE:

According to the Kekule:
It has 6 carbon atoms and six corners of the regular hexagone.
Each carbon atom is attached the hydrogen atom.

AROMATICITY:

These type of compounds containing alternate double and single bonds in a cyclic structure and resemble benzene in chemical behaviour. They undergo substitution reactions rather addition reactions. The characteristic behavior is called as aromatic character.

STATBILITY OF BENZENE RING:

We know that in benzene ring the pi-molecular orbital is in a state of vibration and because of the this vibration the resonance is produced. This resonance tries to stable the benzene ring. The difference in energy content of benzene compared with that of a formal written structure is called as the resonance.
The Kekule's structure requires localization of 2p-electrons as specific pi-bonds alternately between particular Carbon atoms. The actual resonance hybrid structure has these electrons delocalized spread over the whole ring. Hence, pi-electrons of benzene are not present at their fixed positions as in alkenes, and due to this reason the reactivity of benzene ring is also affected by the presence of nucleophile attack. Thus electrophilic substitution is more common in benzene but for a powerful electrophile reagent.

ORIENTATION IN BENZENE:

All the hydrogen atoms are equivalent in the benzene rings. When an electrophile enters in the benzene group then it occupy the space to the 5 places of the hydrogen atom.

Chapter 8

ALKYL HALIDES

ALKYL HALIDES

When one hydrogen (H) – atom of an alkane is substituted by a halogen atom (X = F, Cl, Br, I), a new organic compound is formed which is known as an "alkyl halide". An alkyl halide is represented as "R – X" and its general formula is "CnH2n+1X".

HALO ALKANES:

When one or more hydrogen atoms are substituted by the helogen atom a new organic compound is formed and this is called as halo alkane

It has three types

MONO HALO ALKANE (ALKYL HALIDES):

If H atom of alkene or alkyne is substituted by the so the compounds are unsaturated and mono halo alkane or alkyl halides.

DI HALO ALKANE:

The halo aklane molecules in which the two halogens are atom attached with the carbon atoms.

POLY HALO AKLANE:

The halo aklane molecules in which the more than two halogens are atom attached with the carbon atoms.

CLASSIFICATION OF ALKYL HALIDES:

PRIMARY ALKYL HALIDES:

When halogen is attached to the primary carbon then it is known as primary alkyl halides.

SECONDRY ALKYL HALIDES:

When the halogen atom is bonded to the secondary carbon atom then it is called as secondary alkyl halide.
For example 2 chloro propane

TERTIARY ALKYL HALIDES:

When the halogen atom is bonded to the tertiary carbon atom then it is called as tertiary alkyl halide.
For example: 2-methyl -2- chloro propane

PREPARATION OF ALKYL HALIDES:

REACTION OF ALKENES:

When the alkyl halides react with an alkene we get the alkyl halides.
$H2C = CH2 + HCl \rightarrow H3C - CH2 - Br$ (Ethyle Bromide)

BY THE HALOGENATION OF ALKANES:

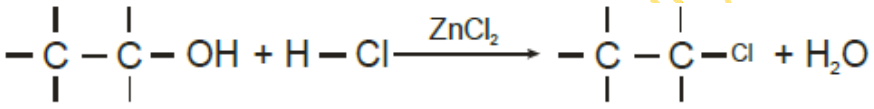
When the alkanes react with cl2 and Br2 in the presence of the sunlight so we obtain the alkyl halides
For example:

$H_3C - CH_3 + Cl_2 \rightarrow H_3C - CH_2 - Cl + HCl$

FROM ALCOHOLS:

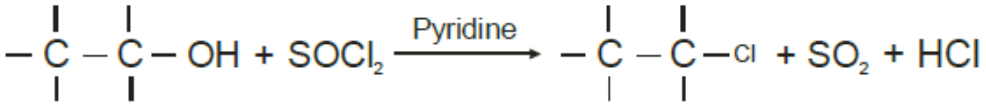
REACTION OF ALCOHOLS WITH HALOGEN ACID:

When the alcohol is reacted with the halogen acid in the presence of ZnX2 then the alkyl halides can be obtained.



REACTION OF ALCOHOLS WITH THIONYL CHLORIDE:

When the alcohols reacted with the thionyl chloride



Ethyl alcohol Ethyl chloride

DIFFERENCES BWTWEEN SN2 AND SN1:

SN2	SN1
This reaction always occurs in primary alkyl halides.	This reaction always occurs in secondary alkyl halides.
The rate of reaction is directly proportional to the alkyl halides and as well as nucleophilic substitution reaction.	The rate of reaction is directly proportional to the alkyl halides only
It always completed in first step.	It always completed in two step.
The overall order of the reaction is 2.	The overall order of the reaction is 1.
Primary and secondary alkyl halides perform this mechanism in the presence of non polar solvent.	Tertiary alkyl halides perform this mechanism in the presence of polar solvent.

The formation of a new bond and the breaking of the old bond take place simultaneously.	The previous bond first break and then new bond established
100% inversion product is obtained in this reaction.	Inversion and retention product is obtained.
The attacking nucleophile, attack the carbon atom from the side which is opposite to leaving group.	The attacking nucleophile can attack on the carbon atom from any side.

β – ELIMINATION REACTION:

When the removal of halogen and the beta hydrogen take place simultaneously then this reaction is called as beta elimination.

BIMOLECULAR ELIMINATION REACTION:

The type of a reactions in which the rate of reaction depends upon the concentration of two molecules and that completes in a single step, is called as E2 Mechanism or reaction.

UNIMOLECULAR ELIMINATION REACTION:

The type of a reactions in which the rate of reaction depends upon only one molecules and that completes in a two steps, is called as E1 Mechanism or reaction.
In first step, the alkyl halide loses the halogen atom. The hybridization of the carbon atom, attached with halogen atom, changes from SP3 to SP2. This is a slow step.
In second step, the attacking nucleophile attacks on the β – H forming an alkene. This is a fast step. E1 reactions usually occur in tertiary alkyl halides.

DIFFERENCES BETWEEN SUBSTITUTION AND ELIMINATION REACTION:

SUBSTITUTION REACTION	ELIMINATION REACTION
	The elimination reaction can be done by
Weaker bases.	Strong bases
Less stable carbonium ion.	Stable carbonium

GRIGNARD REAGENT:

They are organo metallic compounds, they are alkyl magnesium halide.

PREPARATION:

The alkyl halide is reacted with magnesium in anydrous ether. Then it is kept in ether solution because it is too reactive that can react with atmospheric water.

REACTIONS OF GRIGNARD'S REAGENT:
OR
ALKANE FORMATION:

Grignard's reagent reacts with so many compounds and produce alkanes. For example:

a) With Water: It reacts with water in the presence of ether to form an alkane. For example:

CH3 – Mg – Cl + H – OH CH4 + Mg

b) With Ammonia: when reacts with NH3 in the presence of ether, we get an alkane. For example:

CH3 – Mg – Cl + H – NH2 CH4 + Mg

c) With Halogen Acid: When it is reacted with a halogen acid, an alkane is obtained. For example:

C2H5 – Mg – Cl + H – Cl C2H6 + MgCl2

d) With an Alcohol: When G.R. reagent reacts with an alcohol in the presence of ether, we get an alkane. For example:

C2H5 – Mg – Br + CH3 – CH2 – O – H C2H6 + Mg

Chapter 9

CARBON COMPOUNDS WITH OXYGEN CONTAINING FUNCTIONAL GROUP

ALCOHOLS:
When one or more Hydrogen atoms of a hydrocarbon are replaced by hydroxyl groups or OH, the resulting compound is called as an alcohol.

TYPES OF ALCOHOLS:

MONO HYDRIC ALCOHOL:

The type of alcohol that contains only one OH group is called as mono hydric alcohol.

DIHYDRIC ALCOHOLS:

The type of alcohol that contains two OH groups is called as Dihydric alcohol.

TRIHYDRIC ALCHOLS:

The type of alcohol that contains three OH groups is called as trihydric alcohol.

POLYHYDRIC ALCHOLS:

The type of alcohol that contains more than three OH groups is called as polyhydric alcohol.

METHANOL:

It is commercially called as wood sprit. It was obtained in 1661 by the Boyle.

PREPARATION OF METHANOL:

Methanol is prepared commercially from a mixture of carbon monoxide and hydrogen. This mixture is treated at 200 atmospheres and then passed over heated in the presence of the mixture of the both catalyst of ZnO and Cr2O3 that treated at the temperature of 400O C to 450O C. This reaction results the formation of methanol vapours which are then condensed to liquid state.

$CO + 2H_2 \longrightarrow CH_3\text{-}OH$

PHYSICAL PROPERTIES:

It is a colorless and volatile.
It is less viscous
It is a poisonous liquid.
It has burning taste.

CHEMICAL PROPERTIES:

Methanol gives three type of the chemical reactions.
Oxidation reaction
Easterfication reaction
Substitution of the OH group by the halogens.

OXIDATION REACTION:

Methanol is oxidized to the methanol with the mixture of the K2Cr2O7 and concentrated H2SO4.

$CH_3\text{-}OH + [O] \dashrightarrow HCHO + H_2O$

EASTERFICATION:

The reaction between the alcohol and the carboxylic acid and produces the easter and the water.

$CH_3\text{-}OH + CH_3COOH \dashrightarrow CH_3\text{-}COO\text{-}CH_3 + H_2O$

SUBSTITUTION OF THE OH GROUP BY THE HALOGENS:

The methyl halide is produced by the combination of methanol and the halogens.

$CH_3\text{-}OH + HCl \dashrightarrow CH_3\text{-}Cl + H_2O$

USES:

It is used to make the methylated sprit.
It is used to prepare the anti-freeze solution.
It is used in the manufacturing of the dyes and the perfumes
It is used to prepare the drugs.

ETHANOL:

It IS called as alcohol and it is largely produced by the process of the fermentation.

PREPARATION:

Fermentation produces the gentle bubbling and the carbon di oxide escape from the gas in the form of bubbles and this process is called as fermentation.
The starch is cooked to form the pulp and the malt is added to that enzyme diastase may hydrolyze starch to sugar maltose.

Then the sugar is converted into the glucose by the reaction of maltase and yeast.

Then the glucose is converted into the ethanol and carbon dioxide by 14 enzymes present in the living cells.

Then the ethanol is separated from the water and the other impurities through distillation as its boiling point is 78.5C

FROM FERMENTATION OF MOLASSES:

The thick dark brown syrup left after the isolation of crystalline cane is called as molasses.
This molasses is mixed with yeast which secrets the enzyme sucrose and convert that sugar into the glucose.

Then this glucose and fructose reacted with zymase and produced ethanol and carbondioxide.

FROM FERMENTATION OF GLUCOSE:

Different kind of sugar can be fermented to produce the different alcoholic beverages.
For example the glucose and sucrose is converted into the ethanol and carbon dioxide by the action of the zymase that is present in the yeast.

PHYSICAL PROPERTIES:

It is colorless, volatile with the sweet smell.
It is soluble in water due to the presence of hydroxyl group.
It's boiling point is 78.5C

CHEMICAL PROPERTIES:

It gives following types of the reactions.
Oxidation
Displacement of hydroxyl group
Easter formation
Esterfication
Dehydrogenation

OXIDATION:

Ethanol is oxidized to ethanol with K2Cr2O7 in the presence of Conc. Sulphuric acid.

DISPLACEMENT OF OH GROUP:

REACTION WITH HALOGENS:

Ethaol reactes with HCl in the presence of the ZnCl2 to form chlro ethane.

ESTERFICATION:

Ethanol like other alcohols reacts with acetic acid forming ester.
Ethanol losses hydrogen and acid losses hydroxide to give water.
Esterfication is linked with neutralization, but it is different as in the neutralization H+ and OH- are lost in the ionic form where as in esterfication in covalent form.

USES:

It is used as a raw material for synthesis of organic compounds for example ethanol esters.
It is used in the base form of ethanol.
It is use in the anti freeze in automobile radiators.
It is used in the beverages, bears, wines.

PHENOLS:

The aromatic compound contains OH group directly attached to the rings carbon atom are called as phenols.

NAPTHALONE:

Compounds having the hytryl oxyl attached to the naphthalene ring is called as napthalone.

PREPARATION OF PHENOLS:

Chloro benzene on heating with 10% NaOH forms sodium phenoxide which on further heating give phenols.

FROM BENZENE SULPHONATE:

The benzene sulphonate is fused with NaOH at 25 C and gives sodium phenoxide which on further heating produces phenol.

PHYSICAL PROPERTIES:

It is colorless, crystalline and poisonous solid.
It is peculiar in odor.
It is soluble in water.

CHEMICAL PROPERTIES:

REACTIVITY:

Phenol are weak acids it gives H ion and stable phenolate ion.

REACTION WITH ALKALIES:

Phenols dissolve in alkalies and yield salt and water.

REACTION WITH ZINC DUST:

When phenol vapour are passed over red hot zinc dust it is reduced to the zinc.

USES:

It is used as an antiseptic.
It is a chief active agent in many of the coalter dips.
It is used in the manufacturing of the soaps, plastic dyes, sprays.
It is used in the preparation of the drugs like asparin
It is used as an ink preservative.

ETHERS:

Ethers are the functional group of mono hydric alcohol.

CLASSIFICATION OF ETHERS:

SYMMETRICAL ETHERS:

If two alkyl groups are present in the ethers are similar then they are said to be symmetrical ethers.

UNSYMMETRICAL ETHERS:

If two different alkyl groups are present in the ethers are similar then they are said to be symmetrical ethers.

PREPARATION:

FROM ETHYL ALCOHOL:

When the ethyl alcohol is treated in the presence of the sulphuric acid it produces diethyl alcohol.

FROM ETHYL CHLORIDE:

When ethyl chloride is heated with the dry silver then it produces diethyl alcohol.

PHYSICAL PROPERTIES:

It is a colorless liquid
It has low boiling point.
It is highly inflammable.
It is a good solvent.

CHEMICAL PROPERTIES:

REACTIVITY:

It is not very much reactive compound. Their chemical inactivity makes them good solvent to dissolve many organic to dissolve many organic compounds like fats, oil and gums.

OXONIUM ION:

Oxygen atom of ether posses two lone pair of electrons can accept proton or donate electronic pair to form oxonium ion.

ALDEHYDES:

Aldehydes are the compounds having carboxyl group whose one valency is satisfied by hydrogen and other is satisfied by an alkyl group.

PREPARATION OF FORM ALDEHYDE:

BY DEHYDROGENATION OF METHANOL:

Methanol vapors and air is over heated with catalyst.
For equation see book.

BY OXIDATION OF METHANOL:

Methanol is oxidized to methanol by heating methanol with the mixture of K2Cr2O7.

CHEMICAL PROPERTIES:

Form aldehyde or methanol has an active hydrogen atom directly associated with carbonyl group which can be easily oxidized.

KETONES:

They are the molecules having the carbonyl group.

CLASSIFICATION OF KETONES:

SYMMETRICAL KETONES:

If two alkyl groups are present in the ketones are similar then they are said to be symmetrical ethers.

UNSYMMETRICAL ETHERS:

If two different alkyl groups are present in the ketone are similar then they are said to be symmetrical ethers.

CHEMICAL PROPERTIES:

Carbonyl group of ketones is also polarized like aldehydes with carbon partial positive and oxygen partial negative.

OXIDATION REACTION:

The acetone is oxidized to the acetic acid in the presence of the oxidizing mixture of K2Cr2O7 and H2SO4.

REDUCTION REACTION:

Acetone is reduced to the secondry propyl alcohol on heating in the presence of catalyst pd.

CARBOXYLIC ACID:

Organic compounds that having carboxyl group are called as carboxylic acids.

CLASSIFICATION OF CARBOXYLIC ACID:

MONO CARBOXYLIC ACID:

Carboxylic acid contains only one carboxyl group is called as mono carboxylic acid.

DI CARBOXYLIC ACID:

Carboxylic acid contains two carboxyl group is called as mono carboxylic acid.

TRI CARBOYLIC ACID:

Carboxylic acid contains three carboxyl group is called as mono carboxylic acid.

CHEMICAL PROPERTIES:

REACTIVITY:

The chemical reactivity of carboxylic acids depend mainly on the carboxylic group that is obtained from combination of carboxyl group and hydroxyl group.

ESTER:

Alkyl derivatives of carboxylic acids are called ester.

USES:

It is liquid with pleasant smell.
It is used as a solvent for paints.

Chapter 10

CHEMISTRY OF LIFE

BIOCHEMISTRY:

The branch of chemistry, that deals with the study of chemical and physical processes occur inhuman life to maintain the organized structure and activities. Like carbohydrates, proteins, lipids, vitamins and mineral that are transformed into one another by the cell.
Main area of study of biochemistry is food and nutrition. Selection of food groups, their digestion, assimilation, enzymes and their functions are all studied in biochemistry.

FOOD:

The group of naturally occurring chemicals that take part in life of living organisms sustaining processes is called as food.

NUTRIENTS OF BALANCE FOOD:

Nutrients are made from these classs.
Carbohydrates
Proteins
Fats
Minerals
Vitamins
Water

PURPOSE OF FOOD:

We eat food for the following reasons.
It gives energy to work.
It helps to grow the tissues of the body.
It helps to regulate the process of the body.

CARBOHYDRATES:

These are polyhydroxy aldehydes or the type of the substance that produces such compounds when they hydrolyzed.
Glucose, Fructose, Sucrose starch e.t.c

SOURCES OF THE CARBOHYDRATES:

Maize
Cereals
Sugar
Potato
Fruit
Honey
sugar cane

CLASSIFICATION OF THE CARBOHYDRATES:

It is classified into two groups.
Sugars
Non sugars

SUGAR:

The type of carbohydrate having the sweet taste are called as the sugars. They are crystalline and soluble in the water.

NON SUGAR:

The type of carbohydrate have no taste are called as the non-sugars. For example starch or cellulose

TYPES PF SUGARS:

There are two types of sugars
Reducing sugar
Non-reducing sugar

REDUCING SUGAR:

Sugars that can reduce Tollen's reagent and Fehling's solution are called as reducing sugars. They contain free aldehydes or ketonic group

For example glucose and fructose

NON-REDUCING SUGARS:

Sugars that do not reduce Tollen's reagent and Fehling's solution are called as reducing sugars. They do not contain free aldehydes or ketonic group.

For example:
Sucrose

CLASSIFICATION OF THE CARBOHYDRATES ACCORDING TO THE MOLECULAR STRUCTURE:

Monosaccharides
Oligo saccharides
Poly saccharides

AMINES:

The amino acids are bi functional compounds containing both the carboxylic group and amino group. They are the building blocks of the proteins.
They are joined together by peptide bond.

TYPE OF AMINO ACIDS:

According to the molecular structure
These acids can be divided into three types.

ALPHA AMINO ACIDS:

Amino acids having (-NH2) group attached to the alpha carbon atom are called α-Amino acids.

BETA AMINO ACIDS:

Amino acids having (-NH2) group attached to the beta carbon atom are called β-Amino acids.

GAMMA AMINO ACIDS:

Amino acids having (-NH2) group attached to the gamma carbon atom are called γ

CLASSIFICATION OF THE AMINO GROUP ACCORDING TO THE ANTURE:

NEUTRAL AMINO GROUP:

The type of amino group that contain one acid group (-COOH) and one basic amino group (-NH2) are known as neutral amino acids.

BASIC AMINO GROUP:

Amino group that contain once acid group (-COOH) more than the basic group (-NH2) are called as basic amino group are called as basic amino group.

ACIDIC AMINO GROUP:

The type of amino group that have one more basic group (-NH2) more than the acidic group (-COOH) is called as acidic amino group.

PEPTIED BOND:

Amino acids in protein are linked together through acid amide group and this type of bond is called as peptide bond.

PROTEIN:

They are the most important compound that are found in the body.
They are the essential constituent of our body.
Generally the proteins are build from large number of the amino acids that are interlinked with peptide bond.

CLASSIFICATION OF THE PROTEIN:

SINGLE PROTIENS:

The type of proteins that are made form the simple amino acids is called as single proteins.

CONJUGATED PROTEINS:

The type of proteins that are composed by joining the chian of simple proteins with a non-proteinous substance. The non-proteinous substance called as prosthetic group or cofactor.

DERIVED PROTEINS:

This type of proteins are not naturally occurring proteins and are obtained from simple proteins by the action of enzymes and chemical agents.

SOURCES OF PROTEINS:

EGG
Meat
Pulses
Lentils
Peas
Nuts

FUNCTION OF PROTEIN:

They are the most essential part of the diet.they help in the growth of animal body. Proteins helps in the nervous defence, metabolic regulation, biochemical catalyst and oxygen support. They help the body to build new tissues and maintain already present tissues.

LIPIDS:

They are naturally accruing organic compounds. They are generally fat like compound and they contain carbon hydrogen and oxygen.

TYPE OF LIPIDS:

Simple lipids
Compound lipids
Steroids

SIMPLE LIPIDS:

The naturally occurring fats, oil and waxes are called as simple lipids.

FATS AND OIL:

They are the esters of long chain carboxylic acids normally 10 to 12 carbon chain.

ENZYMES:

The class of protein that catalyze all type of thebio chemical reactions like metabolism digestion, respiration in the living organisms are called as enzymes.

VITAMINS:

The organic substances which are necessary food factors required in small amounts to regulate energy transformation and metabolism are called as vitamins.

CLASSIFICATION OF VITAMINS:

WATER SOLUBLE VITAMINS:

Vitamin B- complex , Vitamin C

FAT SOLUBLE VITAMINS:

Vitamin A, Vitamin D,Vitamin E and Vitamin K

SOURCES OF VITAMIS:

Egg
Carrot
Butter
Cheese
Green vegetable
Milk

SYMPTOM OF DEFFICIENCY:

Night blindness
Infectious disease

VITAMIN B1 THIAMIN:

FOOD SOURCES:

Liver
Kidney
Cereal
Nuts
Egg yolk
Legumes
Fish
Meat
fruits etc.

FUNCTION:

It helps the body to convert the carbohydrates into the energy
It helps the heart to function properly.
It helps to function the brain properly.
And to provide healthy nerve cells.

DISEASE:

Beri Beri
heart failure
Loss of weight
digestive disturbance
weakness
nerve damage
constipation

VITAMIN B2 RIBOFLAVIN:

FOOD SOURCES:

Green leafy vegetables
Eggs
Milk

Soyabean
Wheat
Fruits
Yeast

FUNCTIONS:

It helps in body growth and red cell production.

DISEASE:

poor general health
Dry & cracked skin
inflammation on mouth
anemia
eye diseases
Scales on nails.

Chapter 11

CHEMICAL INDUSTRIES IN PAKISTAN

FERTILIZERS:

The chemical compound that contains nitrogen, phosphorus, sulphur and sodium for the growth and the development of the crops is called as fertilizers.

NEED OF FERTILIZERS:

They are used to stimulate the metabolism in plants.
To increase the content of plants.
To Maintain P^H of soil in between 7.00 to 8.00.

PROPERTIES OF FERTILIZERS:

They are soluble in water and weak organic acids.
They are not injurious for the plants.
They enhance the quality of the plants.
They maintain the ph of the soil
They increase the quantity of the oil and sugar.

TYPES OF FERTILIZERS:

ORGANIC FERTILIZERS:

The type of fertilizer that are obtained through the excretion of the animals like peat, straw is called as organic fertilizers. They are also called as natural fertilizers.

MINERAL FERTILIZERS:

They fertilizers obtained from the mineral are called as mineral fertilizers.

1. Nitrogenous fertilizers
2. Potassic fertilizers
3. Phosphatic fertilizers

NITROGENOUS FERTILIZERS:

The type of fertilizers having the nitrogen as essential element is called as nitrogenous fertilizers.

EXAMPLES:

Ammonium sulphate $(NH_4)_2SO_4$
Ammonium nitrate (NH_4NO_3)
Ammonium phosphate $(NH_4)_3PO_4$

UREA (NH_2-CO-NH_2)

POTASSIC FERTILERS:

Fertilizers that contain the potassium as the essential element are called as potassic fertilizers.

EXAMPLES:

Potassium nitrate
Potassium sulphate

PHOSPHATES SULPHATE:

Phosphates are best fertilizers. The type of fertilizers having the phosphates as essential element is called as phosphates fertilizers.
The presence of phosphorus in the soil is vital for successful propagation of plant. There are two important phosphoric fertilizers.

Examples:

Ammonium phosphates
Diammonium hydrogen phosphates
Super phosphates
Triple phosphates

DETERGENTS:

They are soap less compounds that is used cleaning purpose. They are organic compound with long chain that can soluble in water that can remove the stain and dirt.
They are the salt of alkyl benzene sulphonic acid or sodium salts of long chain of alkyl hydrogen sulphate. But soap are salts of long chain carboxylic acids.

STRUCTURE OF DETERGENT:

It consists of two type of part

Hydrophobic part water repelling
Hydrophilic part water attracting

HYDROPHOBIC PART:

It is the long hydrocarbon chain that is non polar and it attracts non polar substances like oil or grease.

HYDROPHILC PART:

They are sodium salt and it is soluble in water. And attract the polar part of the dirt.

CLEANING ACTION:

When the greasy cloth is put into the detergent the hydrophilic part dissolve in water and the hydrophobic part become active and remove the stain of the cloth.

DIFFERENCES BETWEEN SOAPS AND DETERGENT:

SOAPS	DETERGENT
Soaps are the salt of the long chain carboxylic acids.	They are the salt of alkyl benzene sulphonic acid or sodium salts of long chain of alkyl hydrogen sulphate.
It can be obtained by the natural resources.	They are the synthetic materials.
They produce the scum in hard water.	Hard water do not effect its cleaning
Calcium and magnesium salts of soap are water.	Calcium and magnesium salts are soluble in water.

GLASS:

Glass is an organic compound. They are artificial silicate. It has no definite melting point and it also have high viscosity that prevents crystallization.

CHEMICAL DEFINITION:

It HAS random atomic structure that can be obtained by the sand, the oxides f alkali metals and alkaline earth metals and other materials.

FORMATION OF GLASS:

It is formed by the allowing the molten silicates to settle down and cool.

TYPES OF GLASS:
There are several types of glass.
Soda glass
Pyrex glass
Crystal glass
Colored glass

SODA GLASS:

This type of glass can be formed by the mixture of the silica Na2CO3 and CaCO3 in a furnace treating at the temperature 1400C

$Na_2CO3+CaCO_3+6SiO_2$----------→ $Na_2O.CaO.6SiO_2 + 2CO_2$

PROPERTIES:

It is easy to work on it
It is expensive type of glass.
It breaks easily.

USES:

We can use these type of glasses in bottles, windows and glass sheets.

BOROSILICATE OR PYREX GLASS:

The glass formed by the boron oxide is called as borosilicate

PREPARATION:

It is the mixture of borosilicate.
We can prepared it by using silica, Boron oxide (B_2O_3), Aluminum oxide (Al_2O_3) and sodium oxide (Na_2O)

PROPERTIES:

It has high softening temperature. It bears high temperature.

USES:

This type of glass can be used in the laboratory wares, beakers, test tube, flask etc.

CRYSTAL GLASS:

PREPARATION:

It is prepared by silica,lead oxide(PbO) Potassium carbonate and $CaCO_3$.

PROPERTIES:

It is very expensive
It is a heavy glass

USES:

They are uses in the decorative show pieces.

COLORED GLASS:

PREPARATION:

They can be prepared by mixing many gasses in the molten state. These compounds give the particular color to the gas.

For example:

Cu_2O
Cr_2O_3
CoO

WATER GLASS:

Na_2SiO_3 is known as water glass.

PREPARATION:

It can be prepared by the silica and sodium carbonate.

USES:

It is used to manufacture the fire proofing material.

SILICA:

When an acid is added to a solution of water glass, it turns into a jelly like substance called as gel ($SiO_2.H_2O$) on heating the Gel dehydrates and forms a hard porous material which is called as silica Gel.

PLASTIC:

Plastic are the polymer that contract on heat and then cast into moulds.

TYPES OF PLASTIC:

There are following types of plastic.

THERMOPLASTIC:

The type of plastic that become contract on heating and can be moulded again and again is called as thermoplastic.
They are called as addition polymers.

EXAMPLES:

Polyethane
Nylon
PVC
PVA

THERMOSETTING PLASTIC:

The type of plastic that can be softened on heating but they become hard on cooling is called as thermosetting plastic. They can not be remoulded again and again. They are in soluble in organic as well as inorganic or inorganic substances.

EXAMPLES:

Bakelite
Urea aldehydes
Silicons

RAW MATERIAL OF PLASTIC:

PLASTICIZERS: They enhance the softening property of the plastic, decrease brittleness and workability of plastics. They are organic substances in nature.

STABLIZERS: They prevent chemical degradation of plastic and they are anti oxidants.

FILLERS: They increase the tensile strength of plastic.

REINFORCING AGENT: They increase its mechanical strength.

PIGMENT: They are used to add the color in the plastic.

PVC:

PVC stands for poly vinyl chloride it is a polymer of vinyl chloride. It is prepared by heating the vinyl chloride at 60C in the presence of hydrogen peroxide.

USES OF PVA:

It is used to chewing gum.
It is sued for water proofing.
It is used to textile industry.

SCIENTIFIC REASONS

Q1: Why modern classification is better classification?

Answer: Modern classification was prepared on the logical and scientific grounds. It corrected the position of some elements that were wrongly placed in previous periodic table. It used the empirical approach to express to periodicity of the elements with increasing atomic number.

Q2: Why was Mendeleev's periodic law modified?

Answer: Mendeleev's periodic law was modified because.

- It doesn't have position of isotopes.
- It has alkali and coinage metals in same group.
- There was no regular difference in atomic masses of two consecutive elements.
- Lanthanides and Actinides were assigned wrong positions.

Q3: Why every period starts from ns1 and ends at ns2 np6?

Answer: In modern periodic table, s-block elements are placed on left side and p-block elements are on right side. s-block has general electronic configuration of ns1-2 and p-block has ns2 np1-6. So we can say that every period starts from ns1 and ends at ns2 np6.

Q4: Why Ionic hydrides are true hydrides?

Answer. Hydrides are binary compound of hydrogen. Ionic hydrides are only one in which hydrogen has negative charge (H).

Q5: Why position of hydrogen in modern periodic table is difficult to choose?

Answer: The position of hydrogen in modern periodic table is a puzzle because of the limitation of first electrons shell causing controversial properties of loosing, gaining and sharing of electrons. Due to the fact, its position is not definite. However, in most periodic tables, it is placed at the top of the periodic table.

Q6: Why the elements of a group in the periodic table has same valence shell configuration?

Answer: In a group of the periodic table, elements of similar characteristics are kept such as valency, number of outer most electrons, chemical characteristic etc. hence they have same valence shell configuration too.

Q7: Why Be and Mg don't form Ionic hydrides?

Answer: Because we know that Be and Mg are smaller in size they have large charge density and has intermediate properties of Ionic and covalent. Due to this reason their molecule gets polymerized and don't form fully Ionic hydrides. These have partially Ionic and partially covalent properties.

Q8: Why alkali and alkaline earth metals easily form cations?

Answer: Alkali and alkaline earth metals (elements of IA and IIA) groups easily form cations because they have,
a: Large size
b: Low ionization potential
c: Low electron affinity

Q9: Why heavy water is heavy?

Answer: Heavy water has heavier isotope of hydrogen i.e. Deuterium that's why its is called as heavy water It has formula D2O.

Q10: Why Li and Be markedly differ from other members of their respective groups?

Answer: Li and Be are,
i: Are smaller in size.
ii: Having higher charge densities causing strong polarizing effects on their ions.
iii: Have high heat of hydration.
Due to these facts, they are markedly differ from their congeners.

Q11: Why nascent or atomic hydrogen is more reactive than molecular hydrogen?

Answer: Nascent hydrogen (newly born) occurs in atomic state has greater energy and needs to be stabilized by decreasing energy. That's why it remains ready to react with those substance which are not reacted by molecular hydrogen (already stabled).

Q12: Why the elements of group IA are called "Alkali Metals"?

Answer: The name Alkali is derived from the Arabic word means "ashes". These metals are present in the ashes of plants and produce strong alkaline solution in water. That's why they are called "Alkali Metals".

Q13: Why the elements of group IIA are called "Alkaline Earth Metals"?

Answer: These metals are present produce Alkaline solution in water and widely distributed in earth's crust. That's why they are called "Alkaline Earth Metals".

Q14: Why alkali metals have largest covalent radii?

Answer: In a period nuclear charge increases subsequently atomic size or covalent radii decreases. Alkali metals are on left most side in periodic table therefore they have largest covalent radii.

Q15: Why the first Ionization Enthalpies of alkali and alkaline earth metals are generally low. However, Ionization Enthalpies of IIA group elements are higher than IA group elements?

Answer: Ionization enthalpies of s-block elements are generally low as their outer electron is effectively shielded from nucleus by inner electrons. However, i.e. of IIA group is higher due to increase in nuclear charge and decrease in size than IA group in the same period.

Q16: Why Ionization Potential decreases from Li to Cs?

Answer: Ionization Potential is inversely proportional to atomic size. In a group atomic size increases that's why I.P. decreases.

Q17: Why alkali metals are powerful reducing agents?

Answer: Alkali metals get easily oxidized and form cations because they have,
i: Large size
ii: Low ionization potential
iii: Low electron affinity
Hence they are more powerful reducing agents.

Q18: Why alkali metals are highly reactive?

Answer: Alkali metals are highly reactive than alkaline metals because alkali metals have low ionization potential energy, greater size less nuclear charge as compared to the corresponding alkaline earth metals.

Q19: Why electronic configuration of Cr is 4s1, 3d 5 instead of 4s2, 3d4 while that of cu is 4s1, 3d10 istead of 4s2, 3d9?

Answer: In Cr and Cu one electron from 4s orbital jumps to 3rd orbital in order to gain the extra stability of lower energy orbital and single spin electron. Hen Cr has configuration of 1s2, 2s2, 2p6,3s2,3p6, 4s1, 3d5 and copper have 1s2, 2s2, 2p6,3s2,3p6, 4s1, 3d10

Q20: Why diamond is the hardest substance?

Answer: It is the hardest substance because its 4 valence electrons are strongly bonded due to the sp3 hybridization it has high refractive index as well as M.P too.