

CHAPTER – 3

SECTION – LONG QUESTIONS

GROUP III – A, AND GROUP IV – A ELEMENTS.

Q.1 Give the names, electronic configurations and occurrence of group- III-A elements of the periodic Table.

Ans: **Group III- A Elements:**

The elements of group III- A consist of boron, aluminium, gallium, indium and thallium.

Table Electronic Configuration of Group III – A elements.

Elements	Symbol	At.No.	Electronic Configuration
Boron	B	5	$1s^2, 2s^2, 2p^1$
Aluminium	Al	13	$1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
Gallium	Ga	31	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^1$
Indium	In	49	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^1$
Thallium	Tl	81	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^2, 4f^{14}, 5d^{10}, 6p^1$

Q.2 Write physical properties of group III – A Elements:

- Ans:
- Boron is non-metal while all other members are metals. Boron is non-metal due to its smaller size and high nuclear charge.
 - The abrupt increase in metallic character from B to Al is associated with the increased size of aluminium atom.
 - In a group, size of atom increases from top to bottom but this increase in size is not regular. Atomic sizes of both Al and Ga are almost similar. It is due to the behavior of 10 electrons present in d-orbitals. These electrons have poor shielding as compared to s and p electrons.
 - Increases in atomic size from In to Tl is also very small, due to the presence of $4f^{14}$ electron also have poor shielding.
 - Melting points of group III-A decrease downward in a group due to increase in the size of atoms.
 - First ionization energy decreases downward to group due to increased size of atom. However first IE also shows abnormal behavior from In to Tl due to the presence of f^{14} electrons. By poor shielding, the force of attraction between nucleus and electronic cloud increases.

Occurrence of Boron:

- Boron is not an abundant element; it occurs in traces in most soil and has been found to be essential in very small amounts for the proper growth of many plants.
- Boron is always found in nature combined with oxygen, usually as oxyborate ions. Boron occurs principally as salts of various polyboric acids.

Minerals of Boron	Chemical Formula
Borax or Tincal	$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$
Colemanite	$\text{Ca}_2\text{B}_4\text{O}_{13} \cdot 5\text{H}_2\text{O}$
Orthoboric Acid	H_3BO_3

Q.3 Give the names along with the formulas of three important ores of aluminium.

Ans **Occurrence of Aluminium:**

- Aluminium is very reactive element and does not exist in Free State.
- Aluminium is the most abundant element in the earth's crust. It is 8.13% of earth crust.
- It occurs primarily as aluminosilicate minerals found in the rocks of the outer portion of the earth.
- The other elements of group III-A gallium, indium and thallium are relatively rare and are obtained as by-products during the processing of other metals.

Name of Minerals of Aluminium	Chemical Formula
Feldspar	KAlSi_3O_8 Or $\text{K}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$
Mica	$\text{KH}_2\text{Al}_3(\text{SiO}_4)_3$
Kaoline(Clay)	$\text{H}_2\text{Al}_2(\text{SiO}_2 \cdot \text{H}_2\text{O})$ or $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$
Corundum	Al_2O_3
Emerald	$\text{Al}_2\text{F}_2\text{SiO}_4$
Gibbsite	$\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ or $\text{Al}(\text{OH})_3$
Bauxite	$\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
Cryolite	Na_3AlF_6
Diaspore	$\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ or $\text{AlO}(\text{OH})$

Q.4 Discuss any four the peculiar behavior of Boron with respect to the other members of Group-III –A elements.

MTN – 2015

Ans: Boron is the first member of the Group III –A, it shows many dissimilarities with the members of its own group. The difference in the properties of boron and those of the other member of the series is mainly due to the large difference in their sizes and ionization energies.

1. Boron is the only element in Group III A which is non-metallic in behavior.
2. It is the only element with less than four electrons in the outermost shell which is not a metal.
3. Boron always uses all the three of its valence electrons for bonding purposes and its common oxidation states are +3 and -3. For example in H_3BO_3 and B_2O_3 oxidation state of boron is +3.
4. Boron is black in colour while all other elements are silvery white.

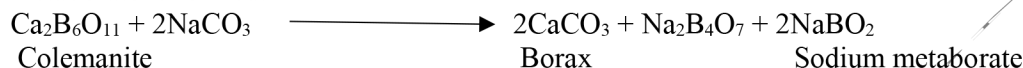
GRW-2014,15, LHR,MTN-2015, MTN-2018

1. From orthoboric Acid:

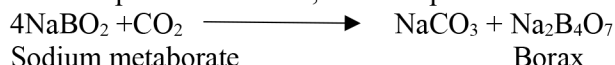
$$4\text{H}_3\text{BO}_3 + \text{Na}_2\text{CO}_3 \longrightarrow \text{Na}_2\text{B}_4\text{O}_7 + 6\text{H}_2\text{O} + \text{CO}_2$$

Boric Acid Borax

Now-a-days broax is almost exclusively obtained from calcium borate. Finely powered colemanite is boiled with Na_2CO_3 solution, when CaCO_3 precipitates out and a mixture of borax and sodium metaborate is formed.



The clear solution from the top is taken off and is then allowed to crystallize, when crystals or borax Separate out. To get more borax, CO₂ is blown through the mother-liquor, the sodium metaborate is decomposed into borax, which separates out in the form of fine crystals.



Borax may also be obtained from tincal by treating natural tincal with water and subsequently evaporating the clear solution, when crystals of borax separate out.

D GK , LHR - 2015

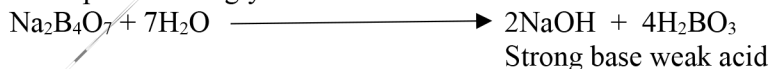
1. Borax is a white crystalline solid.

2. It is sparingly soluble in cold water but more soluble in hot water. In 100 g of water at 10 °C only 3g of borax is soluble but at 100 °C its solubility is 99.3 grams.

3. If a saturated solution of borax be allowed to crystallize above 62 °C, octahedral crystals of pentahydrate $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$ separates out, but if temperature is below 62 °C decahydreaes crystals $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ are formed.

BWP - 2015

Aqueous solution of borax is alkaline in nature due to hydrolysis. Hydrolysis is prevented in the presence of glycerin.

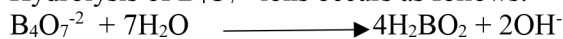


- Aqueous solution of borax turns red litmus to blue due to the presence of alkali.
- Borax when dissolved in water ionizes as.

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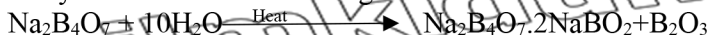
- Hydrolysis of $\text{B}_4\text{O}_7^{2-}$ ions occurs as follows:



So a strong alkali (NaOH) is formed which is highly ionized.

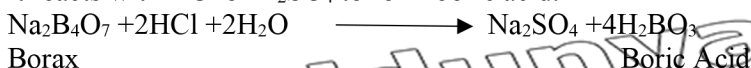
- On the other hand boric acid ionizes to a little extent so it is a weak acid, Hence, solution of borax as a whole is alkaline in nature.

When borax is heated, it loses water and swells up into a white porous mass due to the evolution of water. On further heating it melts into a clear transparent glass, which dissolves, metallic oxides forming coloured beads. This reaction forms the basis of borax bead test.



3. **Reaction with Acids:**

It reacts with HCl or H₂SO₄ to form boric acid.



4. **Reaction with ammonium chloride:**

When borax is heated with ammonium chloride, boron nitride is produced, BN is also called Borazole or inorganic graphite.



Q.6 Write down the reactions of boric acid with:

BWP- 2015, DGK - 2016

Ans: (a) Ethyl alcohol (b) Water (c) Na₂CO₃ (d) NaOH

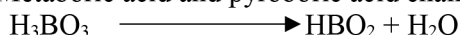
(a) **Ethyl Alcohol:**

(a) Boric acid reacts with ethyl alcohol forming ethyl borate.



(b) **Water:**

Metaboric acid and pyroboric acid changes to orthoboric acid when dissolved in water.



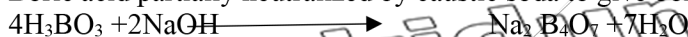
(c) **Na₂CO₃**

Formally borax was manufacture by treating a hot solution of boric acid with the proper amount of Soda Ash.



(d) **NaOH**

Boric acid partially neutralized by caustic soda to give borax.



Q.7 Explain the chemistry of borax bead test.

Ans: **Borax bead test:**

(i) **Significance:**

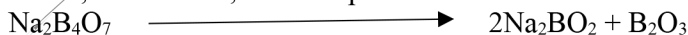
The test is used for the identification of coloured ions of the salt, i.e. Cu²⁺, Fe⁺², Mn²⁺, Co⁺², Cr³⁺, Fe³⁺ and Ni²⁺

(ii) **Procedure:**

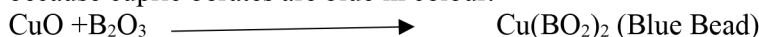
Prepare a loop at the end of a platinum wire. Heat the wire and take a little powdered borax on the hot loop. Heat again, borax first swells up and then melts into colourless, glass like beads on the loop. Now put a few grains of the substance, under examination on the beads and re-beat it first in the oxidizing flame and then in the redacting flame. Note the color of the beads.

(iii) **Chemistry of Borax bead test:**

Borax, when fused, is decomposed into sodium metaborate and boric anhydride.



The metallic oxide formed from the substance, under examination, Comines with B₂O₃ giving the colored metallic borates. With cupric oxide, the beads are coloured blue in the oxidizing flame because cupric borates are blue in colour.



Q.8 What is Boric Acid. Give properties and uses of boric acid.

Ans: **Orthoboric Acid or Boric Acid. (H_3BO_3):**

LHR – 2010

It is white crystalline chemical substance (triclinic), sparingly soluble in cold water (2.6% at 40°C) but dissolves readily in hot water (37% at 107°C). This temperature variation in solubility forms the basis for its separation and purification.

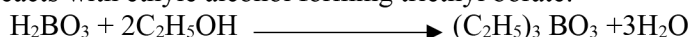
Uses of Boric Acid:

SGD – 2015, LHR - 2016

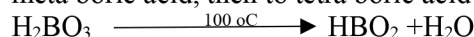
1. Boric acid is used in medicines as an antiseptic, e.g. dusting powder, and boric ointment and boric solution is used as an eye-wash.
2. It is used in pottery as a glaze because borate glazes are more fusible than silicate glazes and possesses a higher coefficient of expansion.
3. It is also used in candle industry for stiffening of wicks.

Properties of Boric Acid:

1. Boric acid is a white lustrous crystalline solid having a soft soapy touch, slightly soluble in cold water but fairly soluble in hot.
2. It is volatile in steam.
3. It reacts with ethyle alcohol forming triethyl borate.



4. When heated strongly. It a wells to frothy mass losing water molecules. It is first converted into meta boric acid, then to tetra boric acid and finally to boric anhydride.



Metaboric Acid

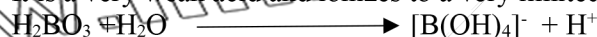


Tetraboric Acid



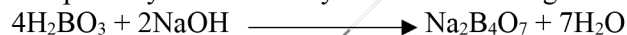
Boric anhydride

5. It is a very weak acid and ionizes to a very limited extent mainly as a mono basic acid.



6. Its solution has no effect on methyl orange although it turns blue litmus red.

7. It is partially neutralized by caustic soda and gives borax.



8. Boric acid being a weak acid, cannot be titrated with alkalis in the usual manner. In the presences of glycerol, however, it can be titrated against a standard alkali using phenolphthalein as an indicator in the presence of glycerol it act as much stronger acid as compared to pure H_2BO_3 .

Q.9 How and under what conditions does aluminium react with the following?

LHR -2015, AJK-2016, GRW-2018

- i) Oxygen ii) Hydrogen iii) Halogens iv) Acids v) Alkalis

Ans: **Aluminium:**

(1) **Reaction with air:**

(a) Corrosion free aluminium:

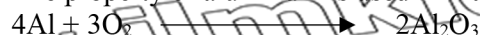
When a piece of aluminum sheet is exposed to moist air it acquires a thin continuous coating of aluminium oxides, which further prevent attack on the metal by atmospheric oxygen and water under normal conditions. Because of this, aluminium sheets are said to be corrosion free.

(b) Reaction with O_2 :

Aluminium burns in air at 800°C temperature. The reaction is accompanied with the evolution of heat and intense white light.

Significance:

The property of aluminum is used in Flash light photography.



(c) Reaction with N_2 :

When aluminium is burnt in air, the product is a mixture of the oxide and equally white aluminium nitride.

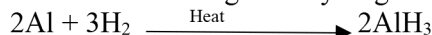


Significance:

- Because of the ability to combine with both oxygen and nitrogen, the metal is often used to **remove air bubbles** from molten metals.
- Salt solutions corrode aluminium badly so aluminum and aluminum alloys are not suitable for marine use.

2. Reaction with non-metals:

- (i) Aluminium on heating with hydrogen forms aluminum hydride.



- (ii) When halogens are passed over heated aluminium, powdered aluminum halides are produced.



Reaction with Acids:

- (i) Aluminium does not react with nitric acid at any concentration. It is passive due to the formation of a protective layer of Al_2O_3 . Nitric acid is said to render the aluminum passive. Nitric acid is, there fore frequently transported in aluminium containers.
- (ii) Aluminium reacts slowly with dilute acids and rapidly with concentrated HCl giving out hydrogen gas.

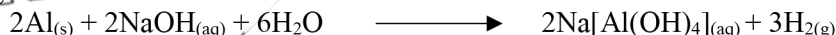


- (iii) Aluminium does not react with dilute sulphuric acid. However it reacts with concentrated acid and SO_2 gas is evolved.



Reaction with Alkalis:

Aluminium dissolves in both sodium and potassium hydroxides to form a soluble aluminate, with the evolution of hydrogen gas.



Uses of Aluminium:

MTN - 2015

1. It is very light metal but possess high tensile strength. Due to these properties, it is used in the transport industries, in the construction of aircrafts, ships and cars.
2. It is good conductor of heat and electricity. It is used as heat exchanger in chemical industry, oil industry and many other industries.
3. Its smooth surface reflects the radiations. For this reason it is commonly used to insulate buildings, and telescope mirrors. Aluminium foil is also used to wrap radar.
4. It is non-magnetic and used in **Navigational equipment's**.
5. It is good reducing agent and thus is used in chemical and steel industry.
6. It is non-toxic and can be used to make food and brewing equipment's and packing materials.
7. Aluminium readily forms alloys with other metals like copper, magnesium, nickel, cobalt and zinc.
8. Aluminium, due to its conductivity and luster, is used for making cooking utensils, window frames and kitchen foil.
9. Aluminium is used for making petrol and milk storage tanks because it reflects radiations and prevents them from being over-heated in the sun's radiations.

Q.10 Give the names electronic configuration and occurrence of Group IV –A, elements of the Periodic Table.

Ans: **Group IV – A Elements:**

Elements of group IV –A consist of carbon, silicon, germanium, tin and lead.

The electronic configuration of group IV-A, element are given below in the table.

Elements	Symbol	At.No.	Electronic Configuration
Carbon	C	6	$1s^2, 2s^2, 2p^2$
Silicon	Si	14	$1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
Germanium	Ge	32	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^2$
Tin	Sn	50	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^2$
Lead	Pb	82	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^2, 4f^{14}, 5d^{10}, 6p^2$

General Trend of Properties in Group IV – A.

There is a marked change of properties from carbon to lead. Due to this gradation of properties there are few similarities between extreme members carbon and lead.

1. Metallic Characters:

Carbon is nonmetal, silicon and germanium are semi-metals and tin and lead are good metals. metallic characters increase from top to bottom in a group.

2. Atomic radii:

Atomic radii increase from top to bottom in a group, but this increase is very small from Si to Ge due to the presence of d-electrons. d^{10} electrons have poor shielding and hold of nucleus on valence electron increase.

3. Ionization Energy:

Ionization energy usually decreases in a group from top to bottom, in this group, ionization energy value increases from Si to Ge due to poor shielding of d^{10} electrons. This abnormality is also present in Sn to Pb due to poor shield of f^{14} electrons.

4. Variable oxidation state:

The elements of group IV-A have four electrons in their valence shell as ns^2, np^2 , Carbon and silicon use their four electrons for bonding and have four oxidation state Ge, Sn and Lead have oxidations $+2$ and $+4$. Lower oxidations states ($+2$) ends with –ous e.g. Germinous, Stannous and Plumbous. Higher oxidation states ($+4$) ends with –ic e.g. Germinic, stannic and Plumbic.

5. Electropositive characters:

The electro positivity or the tendency to lose electron increases downward in group IV A. This trend is due to the increase in the atomic mass and metallic characters.

Common properties of the elements of group IVA.

1. The elements of Group IV A have four electron in their valence shells and their valency in four or elements show four oxidations states in their compounds. e.g CO_2 , SiO_2 , $PbCl_4$ etc.
2. All the members of group IV A form hydrides of formula XH_4 e.g. methane CH_4 , Silane SiH_4 , Germane GeH_4 etc.
3. All the members of group IV A form tetra halides e.g. CCl_4 , CF_4 , $SiCl_4$, $GeCl_4$, $SnCl_4$, $PbCl_4$.
4. Members group IV A form dioxides, e.g. CO_2 , SiO_2 , GeO_2 , and PbO_2

Oxides of Silicon:

Silicon dioxide (SiO_2):

Silicon dioxide, SiO_2 called silica, is probably the most common and the most important compound of silicon, IN silica, every silicon atom is attached tetrahedral to four oxygen atoms and each oxygen atom has two close silicon neighbors.

Quartz:

The common crystalline form of silicon dioxide is a hard, brittle, refractor, colourless solid which very markedly from carbon dioxide.

Structure of Silica:

In the interior of silica network each silicon atom is linked with four oxygen atoms in tetrahedral arrangement. Each oxygen atom is covalently bonded with two silicon atoms. It is a three dimensional network covalent bond.

Due to this continuous arrangement, a giant silicon oxygen network extends out to give a massive silicon dioxide crystal because each oxygen atom is attached with two silicon atoms it has no molecular formula. We can only write the simplest ratio of atoms of silicon and oxygen, which is 1:2 or SiO_2 . Silicon-oxygen bond is very strong bond and atoms are firmly placed at their places.

High surface activity:

SiO_2 does not exist in the form of single molecules like CO_2 . It is a macromolecule. Atoms of silicon and oxygen have their complete valence shells and are satisfied but those atoms of Si and O which are present at the surface are not satisfied, Due to this reason silicon has high surface activity.

Structure of different polymorphic species of silica:

In each of the various crystalline forms of silica, there is a special pattern which is repeated throughout the crystal in a regular definite crystal lattice. The regular tetrahedral arrangement of four oxygen atoms around each silicon persists in each crystalline form but the Si-O-Si bond angles and the rotation about each Si-O bonds are different in the different polymorphic species.

Vitreous Silica or Silica Glass:

Preparation:

At 1600°C , silica or quartz melts to give a viscous liquid with a random internal structure. On the average still many molecules of silicon are attached with four oxygen and one oxygen is attached with two silicon atoms. When this liquid silica is cooled, it does not crystallize readily, but usually it under-cools tremendously and eventually becomes rigid without having undergone orientation into a regular crystal pattern. This rigid, highly under-cooled liquid is called vitreous silica or silica glass.

Proportion of Vitreous silica:

Vitreous silica possesses the following interesting and useful properties:

1. High transparency to light.
2. Very refractory does not soften below 1500 to 1600°C .
3. Very low thermal expansion.
4. Excellent insulator.
5. Hard, brittle, and elastic.
6. Insoluble in water and inert toward many reagents.
7. It is resistant towards all acids except HF .

Q.11 Why is CO_2 a gas at room temperature while SiO_2 is a solid?

RWP - 2015

Ans: Both carbon and silicon are the members of group IV A and have four electrons in their valence shell. Size of carbon atom is smaller than the size of silicon atom. In CO_2 each carbon atom forms two double bonds with two oxygen atoms. CO_2 is an independent molecule.



In case of SiO_2 , each silicon atom is covalently bonded with four oxygen atoms and each oxygen atom is attached with two silicon atoms. This networking of bonds is due to bigger size of silicon than carbon. SiO_2 has three dimensional regular arrangement of silicon and oxygen. Due to this network of strong covalently bonded atoms of Si and oxygen are present at their fixed position and it exists as solid at room temperature.

Silicates and Their uses:

The compounds derived from silicic acid H_2SiO_3 are known as silicates.

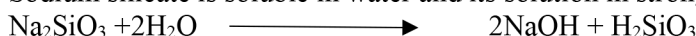
(a) Sodium silicate (Na_2SiO_3):

This is sodium salt meta silicic and H_2SiO_3 . It is known as water glass or soluble glass. It is prepared by fusing sodium carbonate with pure sand. The process is carried out in a furnace called **reverberatory furnace**.



Properties:

Sodium silicate is soluble in water and its solution is strongly alkaline due to hydrolysis.



Uses of sodium silicate:

1. it is used as a filler for soap in soap industry.
2. It is used in textile as fire proof.
3. It is used as furniture polish.
4. It is also used in calico printing. Calico printing is a special printing at cotton fabrics.

Chemical Garden:

When crystals of soluble coloured salts like nickel chloride, ferrous sulphate, copper sulphate or cobalt nitrate, etc. are placed in 1M solution of sodium silicate, they produce a very beautiful growth, like plants, which is called chemical garden.

(b) Aluminium Silicates:

Chemical Weathering of Rocks:

Aluminium silicates are formed by the chemical weathering of the rocks. Clay is an example of aluminium silicate. Clay is formed by disintegration and weathering of rocks.

The melting and freezing of water in the rocks, and the chemical action of water and carbon dioxide, convert these compounds into potassium carbonate, sand and clay. The following reaction explains the weathering of potassium feldspar:



Properties of kaolin or Pure Clay:

1. Pure clay which has the formula $\text{Al}_2\text{O}_3 \cdot (\text{SiO}_2)_2 \cdot 2\text{H}_2\text{O}$ is white and is called kaolin.

Uses:

It is used to make porcelain and china wares. Ordinary clay contains compounds of iron and other metals and it has a yellow or reddish yellow colour.

2. Impure clays:

Impure clays can be more easily fused because they contain oxides of iron, calcium, magnesium and other metals which form easily fusible silicates with sand.

Uses:

Such clays are used to make bricks, tiles, and stone wares. Due to the presence of ferric oxide, the articles of this clay turn reddish when heated in a kiln.

3. Glazing of Stone ware:

Stoneware is usually glazed to give it a less porous surface by throwing salt upon the articles while they are hot. This treatment produces sodium aluminate Na_2AlO_2 and sodium aluminium silicate, which melts readily and covers the entire surface. When the article cools, the covering solidifies, producing a compact, smooth waterproof surface. China wares are made from a mixture of **Kaolin, bone ash, and feldspar** the mixture fuses when heated and fills the pores between the grains of kaolin.

Plasticity of Clay:

The use of clay in making pottery and other ceramic articles depends upon the Plasticity of the paste. When soaked in water, the clay progressively hydrates and the paste becomes more plastic. When the clay is heated, the water of hydration is lost and a hard rock like mass is formed.

Q.12 What are silicates? Describe the important uses of Silicates.

Ans: **Define:** *Silicate are the compounds which are derived from meta silicic acid e.g. talc, asbestos.*

Different silicates are used for the following purposes.

1. Sodium silicate (Na_2SiO_2):

Sodium silicate is used as a filter in soap, preservative for eggs, fire proof in textile, furniture polish, calico printing.

2. Aluminium silicate (Kaolin) ($\text{Al}_2\text{O}_3 \cdot (\text{SiO}_2)_2 \cdot 2\text{H}_2\text{O}$):

Aluminium silicate is used in Porcelain and chinaware, making pottery and ceramic materials, glazing of tiles, making of tiles and bricks, etc.

3. Talc or soap stone (Magnesium silicate):

Magnesium silicate is commonly known as talc or soapstone. Due to weak forces in these layers, they can slide over one another and have a slippery touch. Talc is used as bath powder or talcum powder. It is used to make cosmetics. It is also used in making household articles.

4. Asbestos (Calcium magnesium silicate):

Asbestos is hydrated calcium magnesium silicate. It has a fibrous nature. Due to its fibrous nature, it is used to make reinforcing fillers in brakes and clutch linings. Because it is fireproof. It is spun and woven into fabrics used in making incombustible fabrics and hardboards. It is used in insulations and sealers in cars, trucks and planes.

Q.13 What are silicones? Give properties of Silicones. Write uses of silicones.

Ans: **GRW- 2010, SWL-2014, AJK, DGK-2015, SGD, SWL-2015, SGD-MTN-2016, SGD-MTN, RWP-2018**

"These are polymeric chain compounds consisting of a backbone of alternately linked silicon and oxygen atoms and alkyl or aryl groups are attached to the silicon atoms."

Properties of Silicones:

1. Low molecular mass silicones are liquid and used as lubricants.
2. High molecular mass silicones are solid and mostly used as rubber.
3. Small change in viscosity takes place by changing temperature in silicones.
4. They are excellent insulators and water repellent.

Uses of Silicones:

1. As lubricants:

- Some methyl silicones are only liquid and become more viscous on increasing chain length, are used as lubricants. They are also used in hydraulic backs and other hydraulic systems.
- Very small change in viscosity takes place by changing the temperature of silicones. In this respect, silicones are better lubricants than mobile oils.
- If the temperature is dropped from 100°C to 0°C , the viscosity of petroleum oil may increase about one hundred folds, whereas that of silicones oil will increase less than four folds.
- In the presence of air or oxygen at temperature as high as 300°C , silicone oils remain free from acid formation, oxidation and similar phenomena, which frequently limit the usefulness of petroleum products and other synthetic organic liquids.

2. **As rubber:**

Methyl silicones of high molecular mass, resemble rubber and are used in making rubber like tubing and sheets.

3. **Electrical Insulator:**

Silicones molecules can be made in such a way that bridges or cross linkages, bind one long molecule to another, at several points along the chain. These compounds have resinous properties and are extensively used in electrical insulation.

4. **Water repellent:**

Another interesting and important application of silicones is their use in the treatment of various surfaces to make them water repellent. A silicones film covers the surface, and repels water like a grease film. Much of the leak of electricity through moisture film on ceramic electrical insulators can be prevented by a silicone film cloth, plastics, asbestos, glass, leather, and paper, oven filter paper and blotting paper become strongly water repellent when covered with silicone film.

Q.14 Define semi-conductors. Give example, Write two properties and two uses of semi-conductors. **FBD-2016**

Ans: **Define:** *"A semiconductor is a solid, crystalline material with an electrical conductivity intermediate between that of metals and insulators.*

Or

A semiconductor is substance which has different resistances for the the passage of electrical current under different circumstances.

Both elements and compounds can act as semiconductors.

Elements as semiconductors:

(i) Germanium (ii) Selenium (iii) Silicon

Compounds As semiconductors:

(i) Lead sulphide (PbS) (ii) Silicon carbide (SiC) (iii) Cadmium sulphide (CdS)
(iv) Lead telluride (PbTe) (v) Gallium arsenide (GaAs) (vi) Indium antimonide (InSb)

Why are they called Semiconductors?

Semiconductors are better conductors than insulators, but they are bad conductors than metal. For this reason, they are called half conductors or semiconductors.

Effect of temperature on semiconductors:

The electrical conductivity of semiconductors depends upon the temperature. When a metal is heated its resistance increase and conductivity decreases. When a semiconductor is heated, its resistance decreases and conductivity increases. Similarly, when the semiconductor absorbs the light, then electrons become more mobile and conductivity increases.

Effect of Light:

Semiconductors are semiconductors depends upon the temperature. When a metal is heated its resistance increases and conductivity decreases. When a semiconductor is heated, its resistance decreases and conductivity increases. Similarly, when the semiconductor absorbs the light, then electrons become more mobile and conductivity increases.

Use in Transistors:

Another special property of semiconductors is the way they behave when they are joined to another material, which may be a metal or a different semiconductor. The junction between the different materials forms a boundary. It allows electricity to pass more properly and is used in transistors. Transistors are much smaller and less complicated than old fashioned electronic tubes. They are used in radio, Television, Computers and calculators.

Q.15 What is the importance of oxides of lead in paints?

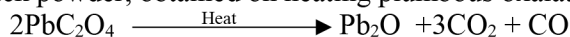
MTAN - 2016

Ans: **Uses of Lead Compounds in Paints:**

Different oxides of lead, basic lead carbonate and lead chromate are used in paints.

1. **Lead sub oxide Pb_2O :**

It is black powder, obtained on heating plumbous oxalate in the absence of air.



Pb_2O is decomposed by heat into Pb and PbO. Oxidation state of lead is +1. Other than pigment, it is also used in the manufacture of lead storage batteries.

2. **Lead monoxide (Litharge, Massicot, PbO):**

Litharge varies in colour from pale yellow to reddish yellow, possibly due to the existence of two forms, a rhombic and a tetragonal. It is slightly soluble in water.

Uses of lead monoxide:

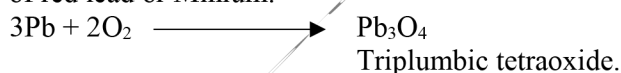
1. It is usually used in preparing flint glass and paints.
2. If litharge is boiled with water and olive oil, lead oleate is formed which is a sticky adhesive mass.
3. A paste of litharge and glycerin harden on standing and yield a cement that is stable towards water and is often employed to seal drain pipes of sinks.
4. It is also used as glaze for decorating ceramic objects.

3. **Triplubic tetroxide or Red lead Or Minium (Pb_3O_4):**

It is a combination of plumbous and plumbic oxide. ($PbO \cdot PbO_2 \cdot PbO$)

Preparation:

When lead is heated in air at about $340^\circ C$, it absorbs oxygen and forms a bright scarlet crystalline powder of red lead or Minium:



It decomposes at $470^\circ C$



Uses:

1. It is used for manufacture of lead storage batteries.
2. It is used as red pigment in paints.
3. Mixture of linseed oil and red lead is applied to steel and iron to prevent corrosion.
4. It is an important ingredient for the manufacture of flint glass, matches and ceramic glazes.

4. **Lead dioxide, plumbic oxide, PbO_2 :**

When red lead is treated with concentrated nitric acid, it is decomposed into lead nitrate and lead dioxide.



Lead dioxide is a reddish brown powder. It is slightly soluble in water, but it does dissolve in alkaline water to yield soluble plumbates. It is not affected by dilute acids.

5. **White lead $2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$:**

- Basic lead carbonate $2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$ is an amorphous white pigment.

- If improperly prepared, it becomes crystalline and its covering power is reduced.

Disadvantages:

White lead is not suitable for use as a good pigment since it is darkened by the hydrogen sulphide.

6. Lead Chromate, PbCrO_4 :

- It is used as a pigment under the name of **chrome yellow**.

- Orange or red basic lead chromates are formed when lead chromate is boiled with dilute alkali hydroxide and are used as pigments.

- The stable yellow modification of lead chromate is monoclinic.

- Mixture of lead chromate with lead sulphate or barium sulphate are also used as yellow pigment

Q.16 Write formula of the followings.

LHR - 2008

(a) Talc (b) Red Lead (c) White lead (d) Cryolite

Ans: (a) Talc $\text{Mg}_3\text{H}_2(\text{SiO}_3)_4$

(b) Red Led Pb_3O_4

(c) White Lead $2\text{PbCO}_3 \cdot \text{Pb(OH)}_2$

(d) Cryolite Na_2AlF_6

(d) Cryolite Na_2AlF_6

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