Chapter#3
Group IIIA and Group IVA Elements

1. Name the ores of boron. (Formulae of individual ores can be asked)

Ans: Following are the ores of boron:

Borax or Tincal	$Na_2B_4O_7.10H_2O$
Colemanite	$Ca_2B_6O_{11}.5H_2O$
Orthoboric Acid	H_3BO_3

2. Name the ores of aluminium. (Formulae of individual ores can be asked)

Ans: Following are the ores of aluminium:

Feldspar	$KAlSi_3O_8$ or $K_2O.Al_2O_3.6SiO_2$
Mica (Muscovite)	$KH_2Al_3(SiO_4)_3$
Kaolin (Clay)	$H_2Al_2(SiO_4)_2.H_2O$ or $Al_2O_3.2SiO_2.2H_2O$
Corundum	Al_2O_3
Emerald	AlF_2SiO_4
Gibbsite	$(Al_2O_3.3H_2O$ or $Al(OH)_3$
Bauxite	$Al_2O_3.2H_2O$
Cryolite	Na_3AlF_6
Diaspore	$Al_2O_3.H_2O$ or $AlO(OH)$

3. Why boron shows different behaviour as compared to rest of the group members?

Ans: The difference in the properties of boron and those of the other members of the series is mainly due to the large difference in their sizes and ionization energies.

4. Write any four points mentioning peculiar behaviour of boron.

Ans: Following are the points mentioning peculiar behaviour of boron:

1. Boron is the only element in Group IIIA which is non-metallic in behaviour

2. It is the only element with less than four electrons in the outermost shell which is not a metal

3. Boron always uses all the three of its valence electrons for bonding purposes and its common oxidation states are + 3 and -3

4. One of the outstanding features of the chemistry of boron is its ability to form molecular addition compounds

5. Mention the methods of preparation of borax.

Ans: 1. Formally borax was manufactured by treating a hot solution of boric acid with the proper amount of soda ash.

$$\underset{\text{Boric acid}}{4H_3BO_3\ (s)} + Na_2CO_3\ (s) \longrightarrow \underset{\text{Borax}}{Na_2B_4O_7\ (s)} + 6H_2O\ (l) + CO_2\ (g)$$

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

$$\underset{\text{Colemanite}}{Ca_2B_6O11\ (s)} + 2Na_2CO_3\ (s) \longrightarrow 2CaCO_3\ (s) + Na_2B_4O_7\ (s) + 2\ NaBO_2\ (s)$$

The clear solution from the top is taken off and is then allowed to crystallize, when crystals of borax separate out. To get more borax, CO_2 is blown through the mother-liquor, the sodium metaborate is decomposed into borax, which separates out in the form of fine crystals.

$$\underset{\text{Sodium metaborate}}{4NaBO_2\ (s)} + CO_2\ (g) \longrightarrow Na_2CO_3\ (s) + \underset{\text{Borax}}{Na_2B_4O_7\ (s)}$$

3. Borax may also be obtained from tincal ($Na_2B_4O_7.10H_2O$) by treating tincal with water and subsequently evaporating the clear solution, when crystals of borax separate out.

6. Why is the aqueous solution of borax alkaline in nature?

Ans: The aqueous solution of borax is alkaline in nature due to the formation of sodium hydroxide which is a strong base along with boric acid which is a weak acid. The overall solution is alkaline in nature due to the presence of a strong base.

$$Na_2B_4O_7\,(s) + 7H_2O\,(l) \longrightarrow \underset{\text{Strong alkali}}{2NaOH\,(aq)} + \underset{\text{Weak acid}}{4H_3BO_3\,(s)}$$

7. What is the effect of heat on borax?

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

$$Na_2B_4O_7.10H_2O\,(s) \xrightarrow{\Delta} \underset{\text{Glassy mass}}{Na_2B_4O_7\,(s) + 2NaBO_2\,(s) + B_2O_3\,(s)}$$

8. How borax reacts with HCl and H_2SO_4?

Ans:

$$\underset{\text{Borax}}{Na_2B_4O_7\,(s)} + 2HCl\,(aq) + 5H_2O \longrightarrow 2NaCl\,(aq) + \underset{\text{Boric acid}}{4H_3BO_3\,(s)}$$

$$Na_2B_4O_7\,(s) + H_2SO_4\,(aq) + 5H_2O\,(l) \longrightarrow Na_2SO_4\,(s) + 4H_3BO_3\,(s)$$

9. How borax reacts with ammonium chloride?

Ans:

$$Na_2B_4O_7\,(s) + 2NH_4Cl\,(aq) \longrightarrow 2NaCl\,(s) + 2BN\,(s) + B_2O_3\,(s) + 4H_2O\,(l)$$

10. How borax is ionized?

Ans: Borax when dissolved in water ionizes as:

$$Na_2B_4O_7\,(s) \longrightarrow 2Na^{+}\,(s) + B_4O_7^{2-}\,(s)$$

Hydrolysis of $B_4O_7^{-2}$ occurs as follows:

$$B_4O_7^{2-}\,(s) + 7H_2O\,(l) \longrightarrow 4H_3BO_3\,(s) + 2OH^{-}\,(l)$$

So, a strong alkali (NaOH) is formed which is highly ionized. On the other hand, boric acid (H_3BO_3) is ionized to a little extent, because it is a weak acid. Hence, solution of borax as a whole is alkaline in nature.

11. Give chemistry of borax bead test.

Ans: 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, glasslike bead on the loop. Now put a few grains of the substance, under examination, on the beads and re-heat it first in the oxidizing flame and then in the reducing flame.

Chemistry of the Borax-bead Test:

Borax, when fused, is decomposed into sodium metaborate and boricanhydride.

$$Na_2B_4O_7\ (s) \longrightarrow 2NaBO_2\ (s) + B_2O_3\ (s)$$

The metallic oxide formed from the substance, under examination, combines with B_2O_3 giving the coloured metallic borates. With cupric oxide, the beads are coloured blue in the oxidizing flame because cupric borates are blue in colour.

$$CuO\ (s) + B_2O_3\ (s) \longrightarrow Cu\ (BO_2)_2\ (s)$$

12. Give uses of borax OR Give any two uses of borax OR Give any four uses of borax.

Ans: Following are the uses of borax:

1. It is used to prepare borate glass, which is heat resistant.
2. It is used in softening of water.
3. It is employed in borax bead test, for the detection of metallic cations.
4. It is used in metallurgical operations.
5. It is used as a flux in welding and in metallurgy.
6. It is employed in making washing powders.
7. It is used in leather industry for tanning and dyeing.

8. It is used in cosmetics, soaps, textiles, paints, medicine, match industry and as a preservative.

13. Name the important boric acids.

Ans: Following are the names and formulae of different boric acids:

(i) Orthoboric Acid, H_3BO_3

(ii) Metaboric Acid, HBO_2

(iii) Tetraboric Acid, $H_2B_4O_7$

(iv) Pyroboric Acid, $H_6B_4O_9$

14. What is boric acid?

Ans: Boric acid (H_3BO_3) is a white lustrous crystalline solid having a soft soapy touch, which is very slightly soluble in cold water but, fairly soluble in hot water. It is formed when water is added into metaboricacid (HBO_2)

$$\underset{\text{Metaboric acid}}{HBO_2} + H_2O \longrightarrow \underset{\text{Boric acid}}{H_3BO_3}$$

15. What are the products of hydrolysis of different boric acids?

Ans: The product of hydrolysis of all the boric acids is orthoboric acid, being the most stable one.

$$\underset{\text{Metaboric acid}}{HBO_2\ (s)} + H_2O\ (l) \longrightarrow \underset{\text{Boric acid}}{H_3BO_3(s)}$$

$$\underset{\text{Tetraboric acid}}{H_2B_4O_7\ (s)} + 5H_2O\ (l) \longrightarrow \underset{\text{Boric acid}}{4H_3BO_3\ (s)}$$

$$\underset{\text{Pyroboric acid}}{H_6B_4O_9\ (s)} + 3H_2O\ (l) \longrightarrow \underset{\text{Boric acid}}{4H_3BO_3\ (s)}$$

16. How is boric acid prepared on commercial level?

Ans: **From Colemanite**

On commercial scale, boric acid is prepared from a natural calcium borate called colemanite ($Ca_2B_6O_{11}.\ 5H_2O$) by suspending it in boiling water while, sulphur dioxide is passed through it.

Boric acid crystallizes out from the solution while, the other product $CaSO_3$ remains in the solution.

$$\underset{\text{Colemanite}}{Ca_2B_6O_{11}.5H_2O\ (s)} + 2SO_2\ (g) + 4H_2O\ (l) \longrightarrow 2CaSO_3\ (aq) + 6H_3BO_3\ (s)$$

From Borax

A hot concentrated solution of borax is treated with a calculated quantity of conc. H_2SO_4. On cooling, crystals of boric acid formed separate out.

$$\underset{\text{Borax}}{Na_2B_4O_7\ (s)} + H_2SO_4\ (aq) + 5H_2O\ (l) \longrightarrow Na_2SO_4\ (s) + \underset{\text{Boric acid}}{4H_3BO_3\ (s)}$$

17. How boric acid reacts with ethanol?

Ans: It reacts with ethyl alcohol forming ethyl borate.

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

18. What is the effect of heat on boric acid?

Ans: When heated strongly, it swells to frothy mass losing water molecules. It is first converted into metaboric acid, then to tetra boric acid and finally to boric anhydride.

$$H_3BO_3\ (s) \xrightarrow{100\ ^oC} \underset{\text{Metaboric acid}}{HBO_2\ (s)} + H_2O\ (l)$$

$$4HBO_2\ (s) \xrightarrow{140\ ^oC} H_2B_4O_7\ (s) + H_2O\ (l)$$

$$H_2B_4O_7\ (s) \xrightarrow{\text{Red hot}} \underset{\text{Boric anhydride}}{2B_2O_3\ (s)} + H_2O\ (l)$$

19. How is the boric acid ionized? OR Show that H_3BO_3 is a monobasic acid.

Ans: It is a very weak acid and ionizes to a very limited extent mainly as a monobasic acid.

$$H_3BO_3\ (s) + H_2O\ (l) \longrightarrow [B(OH)_4]^-\ (s) + H^+$$

It releases only one H^+ ion in solution. From this it can be easily evident that H_3BO_3 is a mono basic acid.

20. How boric acid reacts with sodium hydroxide? OR How will you convert boric acid into borax and vice versa?

Ans: Boric acid is partially neutralized by caustic soda to give borax.

$$4H_3BO_3\ (aq) + 2NaOH\ (aq) \longrightarrow Na_2B_4O_7\ (aq) + 7H_2O\ (l)$$

A hot concentrated solution of borax is treated with a calculated quantity of conc. H_2SO_4. On cooling, crystals of boric acid formed separate out.

$$\underset{\text{Borax}}{Na_2B_4O_7\ (s)} + H_2SO_4\ (aq) + 5H_2O\ (l) \longrightarrow Na_2SO_4\ (s) + \underset{\text{Boric acid}}{4H_3BO_3\ (s)}$$

21. How boric acid reacts with soda ash (Na_2CO_3)?

Ans: When boric acid is neutralized by soda ash (Na_2CO_3), borax is obtained.

$$4H_3BO_3\ (aq) + Na_2CO_3(aq) \longrightarrow \underset{\text{Borax}}{Na_2B_4O_7\ (s)} + 6H_2O\ (l) + CO_2\ (g)$$

22. How does borax serve as a water softening agent?

Ans: Hardness in water is because of Ca^{2+} and Mg^{2+}. Borax has ability to remove Ca^{2+} and Mg^{2+} ions from water as calcium tetra-borate and magnesium tetra-borate and hence borax can be used as a water softening agent.

$$\underset{(aq)}{Ca^{2+}} + \underset{(aq)}{Na_2B_4O_7} \longrightarrow \underset{(s)}{CaB_4O_7} + \underset{(aq)}{2Na^+}$$

$$\underset{(aq)}{Mg^{2+}} + \underset{(aq)}{Na_2B_4O_7} \longrightarrow \underset{(s)}{MgB_4O_7} + \underset{(aq)}{2Na^+}$$

23. What are the uses of boric acid?

Ans: Following are the uses of boric acid:

1. Boric acid is used in medicines as an antiseptic, e.g. dusting powder, 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 possess a higher coefficient of expansion.

3. It is also used in candle industry for stiffening of wicks.

24. Give reaction of aluminium with air.

Ans: When a piece of aluminium sheet is exposed to moist air it acquires a thin, continuous coating of aluminium oxide, which prevents further attack on the metal by atmospheric oxygen and water under normal conditions. Because of this aluminium sheets are said to be corrosion-free. However, if the aluminium powder is heated to 800°C and above, the metal will react with air to form aluminium oxide, Al_2O_3, and aluminium nitride, AIN. The reaction is accompanied by the evolution of heat and intense white light. This property of aluminium is made use of in flash light photography.

$$4Al\ (s) + 3O_2\ (g) \longrightarrow 2Al_2O_3\ (s)$$

$$2Al\ (s) + N_2\ (g) \longrightarrow 2AlN\ (s)$$

25. Why is aluminium not found as a free element?

Ans: Aluminium does not exist in free state because it is a highly reactive metal. It is third most abundant element of earth crust and mostly found in the form of alumino-silicates.

26. How aluminium reacts with non-metals?

Ans: Heated aluminium combines with the halogens, sulphur, nitrogen, phosphorus and carbon, accompanied by the evolution of heat.

$$2Al\ (s) + 3Cl_2\ (g) \longrightarrow 2AlCl_3\ (s)$$

Aluminium on heating with hydrogen forms aluminium hydride.

$$2Al\ (s) + 3H_2\ (g) \longrightarrow 2AlH_3\ (s)$$

27. Give reactions of aluminium with acids and alkalies.

Ans: Aluminium is amphoteric. It dissolves in both acids and bases with the liberation of hydrogen gas. Aluminium reacts slowly with dilute acid and more rapidly with concentrated hydrochloric acid to displace hydrogen.

$$2Al\ (s) + 6HCl\ (aq) \longrightarrow 2AlCl_3\ (aq) + 3H_2\ (g)$$

Aluminium does not react with dilute sulphuric acid. However, it is oxidized by hot concentrated sulphuric acid to liberate sulphur dioxide gas.

$$2Al\ (s) + 6H_2SO_4\ (aq) \longrightarrow Al_2(SO_4)_3\ (aq) + 6H_2O\ (l) + 3SO_2\ (g)$$

Aluminium does not react with nitric acid at any concentration, probably because of the formation of protective layer of aluminium oxide. The acid is said to render the aluminium passive. Nitric acid is, therefore, frequently transported in aluminium containers. Aluminium dissolves in both sodium and potassium hydroxides to form a soluble aluminate, with the evolution of hydrogen.

$$2Al\ (s) + 2NaOH\ (aq) + 6H_2O\ (l) \longrightarrow 2NaAl(OH)_4\ (aq) + 3H_2\ (g)$$

28. Give uses of aluminium OR Give any four uses of aluminium.

Ans: 1. Aluminium is very-light (nearly three times less dense than iron) but possesses high tensile strength. These properties account for its extensive use in the transport industries, in the construction of aircrafts, ships and cars.

2. It is an excellent conductor of both electricity and heat. Thus, it is used as heat exchanger in chemical, oil and other industries. Heavy duty electrical cables are made of aluminium metal.

3. Aluminium is an excellent reflector of radiant energy. For this reason, it is commonly used to insulate buildings. Aluminium foil is also used to jam radar.

4. It is non-magnetic and is thus used in navigational equipment.

5. It is a good reducing agent and can thus be used for this purpose in the chemical and steel industries.

6. It is non-toxic and can be used for making food and brewing equipments and in packaging.

7. Aluminium readily forms alloys with other metals like copper, magnesium, nickel and zinc.

8. At homes, aluminium is found in the form of cooking utensils, window frames and kitchen foil.

9. Aluminium is used for making petrol and milk storage tanks because it reflects heat and prevents them of being over heated in the sun.

29. How Al finds its uses in metallurgy and photoflash bulbs?

Ans:

Use in metallurgy

Aluminum being highly reactive is used in the extraction of chromium and manganese from their oxides. Al reduces oxides of these metals.

$$Cr_2O_3 + 2\ Al \longrightarrow 2Cr + Al_2O_3$$

$$3Mn_3O_4 + 8\ Al \longrightarrow 9\ Mn + 4Al_2O_3$$

Use in photoflash bulbs

Photoflash bulbs are made up of glass containing a thin filament or foil of Aluminum. Bulb is filled with oxygen at low pressure. The foil is ignited using electricity. Oxygen atmosphere increases the brilliance of the flash.

30. Mention the peculiar behaviour of carbon.

Ans: Carbon differs from the remaining members of Group IV-A in the following respects:

1. Carbon and silicon are nonmetals while the other members of the family are metalloids or metals.

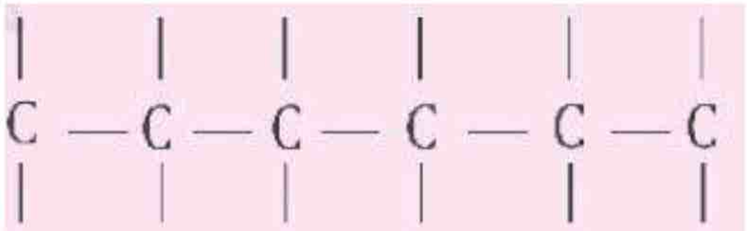
2. Catenation or self linkage. Carbon has a tendency to form long chains of identical atoms. The type of linkage of identical atoms with each other is called catenation or self-linkage. The property of catenation decreases on moving down the group from carbon to lead.

31. ***How are carbon and silicon different from rest of the group members? OR Mention points of similarity between carbon and silicon.***

Ans: Carbon and silicon are the only non-metals in Group IVA. Carbon has the peculiar property of forming long carbon chains, silicon forms long chains of alternating silicon and oxygen atoms.

1. Carbon and silicon both form acidic oxides, whereas the oxides of germanium, tin and lead are amphoteric in nature.

2. Both carbon and silicon form covalent bonds. Their oxides are acidic and both form hydrides and chlorides.



Carbon and Carbon Linkages

Silicon and Oxygen Linkages

32. What is inert pair effect?

Ans: The pair of valence electrons that do not readily take part in chemical combination is termed as inert pair. The inert pair effect is most marked in the element of highest atomic mass, namely lead.

33. Mention the common properties of group IVA elements.

Ans:

1. All the elements of this group show a valency of four.
2. All of them form hydrides, MH_4
3. They form tetrachlorides, MCI_4
4. They also form the dioxides, MO_2

34. How does carbon exist in nature?

Ans: Carbon occurs naturally in the two states. One is crystalline (graphite, diamond) form and the other is amorphous (coal, charcoal) form.

Limestone (calcite) $CaCO_3$

Dolomite	$MgCO_3.CaCO_3$
Magnesite	$MgCO_3$

35. Name the ores of silicon. (Formulae of individual ores can be asked)

Ans: Following are the ores of silicon:

Analcite (a zeolite)	$NaAl(SiO_3)_2.H_2O$
Asbestos	$CaMg_3(SiO_3)_4$
Kaolin (pottery clay)	$H_2Al_2(SiO_4)_2.H_2O$ or $Al_2O_3.2SiO_2.2H_2O$
Zircon	$ZrSiO_4$
Talc (or soapstone)	$H_2Mg_3(SiO_3)_4$

36. Name the oxides of carbon.

Ans: Three oxides of carbon are known:

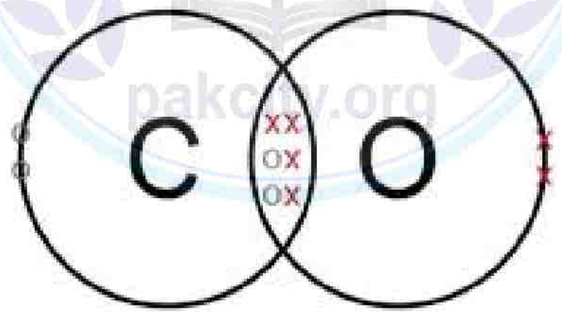
(i) Carbon monoxide, CO

(ii) Carbon dioxide, CO_2

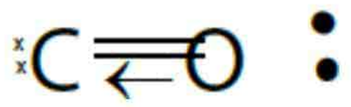
(iii) Carbon suboxide, C_3O_2

37. Tell about the structure of carbon monoxide.

Ans: Carbon monoxide is diatomic molecule having triple bond between the two atoms. It is very slightly polar. The electronic structure of carbon monoxide can be represented as

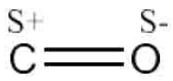


It is usually written as:



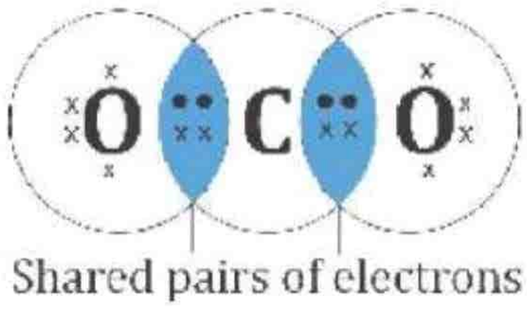
It might appear from the above structure that the molecule should have a large dipole moment, but

in fact the molecule has a small dipole moment (0.112D).



38. Tell about the structure of carbon dioxide OR How CO_2 is non-polar?

Ans: Carbon dioxide exists in the gaseous state as linear molecules. The observed C-O bond distance is 115 pm. Solid CO_2 has a face-centered cubic structure. Being linear its dipole moment is zero.



39. How CO_2 is acidic in nature?

Ans: Carbon dioxide is a non-metal oxide so when it is dissolved in water it changes into carbonic acid. Hence, it is acidic in nature.

$$CO_2\,(g) + H_2O\,(l) \longrightarrow H_2CO_3\,(aq)$$

40. Mention the properties of vitreous silica.

Ans: 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.

41. Both carbon and silicon have four electrons in their valence shells and both also form four

covalent bonds. So, why should there be a big difference between CO_2 and SiO_2? OR Why CO_2 is a gas while SiO_2 is a solid?

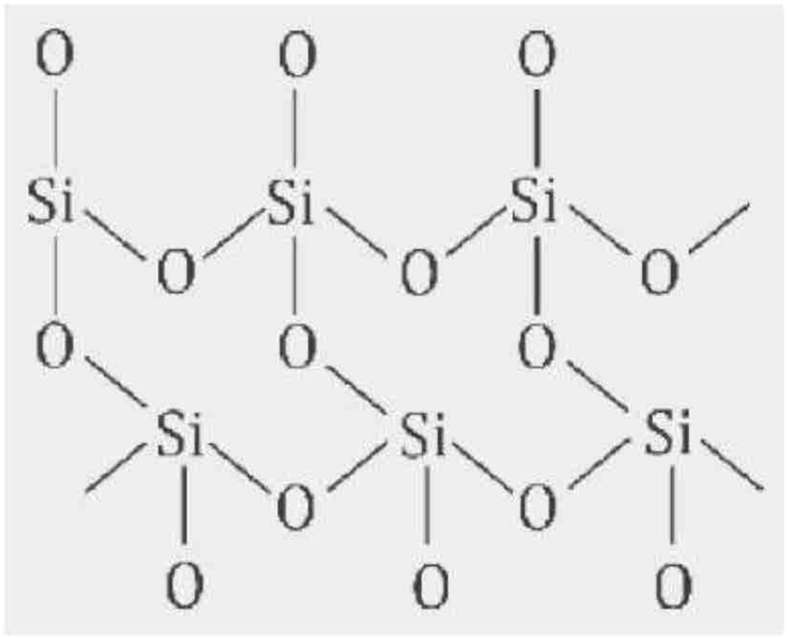
Ans: Silicon atoms are much larger than carbon atoms and thus tend to surround themselves with more oxygen neighbours; silicon forms only single bonds to oxygen atoms whereas carbon may form double bonds. Carbon, in fact, forms double bonds to each of the two oxygen atoms to produce a small, symmetrical, linear molecule CO_2, which is volatile and reasonably reactive.

42. Tell about the structure of silicon dioxide.

Ans: The silicon atom can be approached closely by four oxygen atoms and forms a single bond to each at tetrahedral angles. This structure can be continued in three dimensions to produce a continuous giant silicon oxygen network extending out to give the massive silicon dioxide crystal. In the interior of the silica network every silicon atom is bonded tetrahedrally to four oxygen atoms and every oxygen atom is bonded to two silicon atoms. The overall ratio of silicon to oxygen atoms is 1:2 and the simplest formula for silica therefore is SiO_2.

The silicon oxygen bonds are strong and keep the atoms firmly in place. It is not the molecular formula for silica but the whole chunk of silica must be considered to be essentially one molecule. The atoms of silicon and oxygen at the surface of the chunk do not have all their valence forces satisfied, as is shown by the high surface activity of silica.

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 bond are different in the different polymorphic species.



43. What is silica glass?

Ans: When crystalline silica is heated sufficiently it melts to give a viscous liquid having a random structure, presumably with the silicon atoms still on the average close to four oxygen atoms and the oxygen atoms close to two silicon atoms. When this liquid silica is cooled it does not crystallize readily, but usually it under supercools tremendously and eventually becomes rigid without having undergone orientation into a regular crystal pattern. This rigid, highly under super cooled liquid is called vitreous silica or silica glass.

44. What are silicates?

Ans: The compounds derived from silicic acids are termed as silicates. For example, sodium silicate, aluminium silicate, talc or soapstone and asbestos.

45. How sodium silicate is prepared?

Ans: This is sodium salt of metasilicic acid 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.

$$Na_2CO_3\ (s) + SiO_2\ (s) \longrightarrow \underset{\text{Sodium silicate}}{Na_2SiO_3\ (s)} + CO_2\ (g)$$

46. Mention the uses of sodium silicate.

Ans: Following are the uses of sodium silicate:

1. It is used as a filler for soap in soap industry.

2. It is used in textile as a fire proof.

3. It is used as furniture polish.

4. It is also used in calico printing.

47. What is chemical garden?

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

48. How is aluminium silicate obtained? OR How weathering phenomenon converts potassium feldspar into clay?

Ans: Many important silicate rocks contain aluminium. The weathering of these rocks results in the disintegration of the complex silicates which they contain. The boiling 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.

$$K_2O.Al_2O_3.6SiO_2\ (s) + H_2CO_3\ (aq) + H_2O\ (l) \rightarrow K_2CO_3\ (s) + 4SiO_2\ (s) + Al_2O_3.(SiO_2)_2.2H_2O\ (s)$$

49. What is glazing?

Ans: 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 and sodium aluminium silicate, which melt readily and cover the entire surface. When the article cools, the covering solidifies, producing a compact, smooth, waterproof surface.

50. Borate glazes are better than silicate glazes. Explain.

Ans: Borate glazes are used in potteries which are more fusible than silicate glazes and possess higher co-efficient of expansion. In this way, borate glazes are better than silicate glazes.

51. What is China ware?

Ans: 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.

52. What is talc or soapstone?

Ans: The magnesium silicate, $Mg_3H_2(SiO_3)_4$, is commonly known as talc or soapstone. It is physically greasy to touch. Therefore it is used in making cosmetics. It is also used in making household articles.

53. What is asbestos?

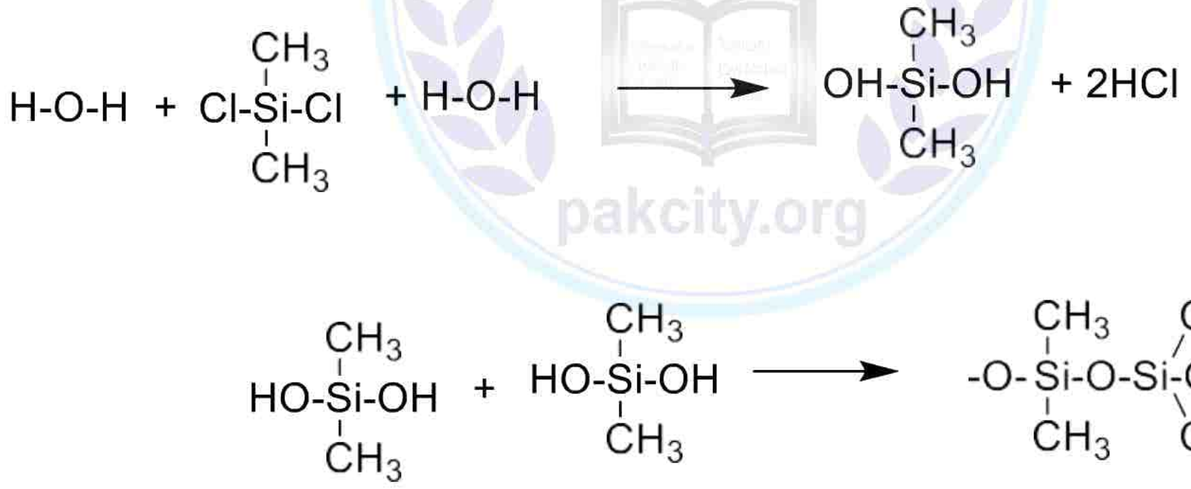
Ans: Asbestos is hydrated calcium magnesium silicate $CaMg_3(SiO_3)_4$. It is commonly used in making incombustible fabrics and hardboard, etc.

54. How acidic soil is treated?

Ans: Large quantities of calcium oxide are used in agriculture for neutralizing acidic soils.

55. What are silicones?

Ans: If a compound of silicon containing chlorine atoms and methyl groups, $SiCl_2(CH_3)_2$, is allowed to react with water, hydrogen chloride (HCl) comes out, and the silicon atoms join together through oxygen atoms.



Such a compound is called a silicone; this one is a methyl silicone. Other alkyl groups may also be substituted for the methyl groups and the molecular chain can be made of various lengths.

56. Why silicone oil is preferred over ordinary lubricant?

Ans: 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 silicone 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.

57. Mention any four uses of silicones OR Mention any two uses of silicones.

Ans:1. Some of the methyl silicones are oily liquids and they become more viscous as the chain length increases. They are used as lubricants, either incorporated in greases or as oils, in bearings, gears, etc. They are also used in hydraulic brakes and other hydraulic systems.

2. The outstanding physical attribute of silicone oil is its very small change in viscosity with change in temperature, compared with the behaviour of other oils of similar viscosity. 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 silicone 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.

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

4. Silicone 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.

5. Another interesting and important application of silicones is their use in the treatment of various surfaces to make them water repellent. A silicone film covers the surface and repels water like a grease film. Much of the leak of electricity through the moisture film on ceramic electrical

insulators can be prevented by a silicone film; cloth, plastics, asbestos, glass, leather, and paper, even filter paper and blotting paper become strongly water repellent when covered with a silicone film.

58. What are semiconductors? Give examples.

Ans: A semiconductor is a substance that has different resistances to the passages of an electric current under different circumstances. Semiconductors include the elements germanium, selenium and silicon, and the compounds lead sulphide, silicon carbide, cadmium sulphide, lead telluride, gallium arsenide and indium antimonide.

59. What is the effect of increase of temperature on semiconductors?

Ans: In semiconductors flow of electricity increases by increasing temperature because as the temperature increases the number of free moving electrons increase in case of semiconductors, thereby, increasing the flow of electricity.

60. Name the lead compounds used in paints.

Ans: Following are the lead compounds used in paints:

i. Lead suboxide Pb_2O

ii. Lead Monoxide (Litharge, Massicot) PbO

iii. Triplumbic Tetraoxide, (red lead, minium), Pb_3O_4

iv. Lead Dioxide, PbO_2

v. White Lead $2PbCO_3.Pb(OH)_2$

vi. Lead Chromate ($PbCrO_4$)

61. Tell about lead chromate. Give uses.

Ans: 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 is also used as yellow pigments.

62. Tell about white lead. Give uses.

Ans: Basic lead carbonate $2PbCO_3.Pb(OH)_2$ is an amorphous white pigment. It mixes readily with linseed oil and has a good covering power. If improperly prepared, it becomes crystalline and its covering power is reduced. White lead is not suitable for use as a good pigment since it is darkened by the hydrogen sulphide which is frequently present in the atmosphere.

63. Tell about lead dioxide. Give uses.

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

$$Pb_3O_4\ (s) + 4HNO_3\ (aq) \longrightarrow 2Pb\ (NO_3)_2\ (s) + PbO_2\ (s) + 2H_2O$$

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

64. Tell about triplumbic tetraoxide. Give uses.

Ans: When lead is heated in air at about 340°C, it absorbs oxygen and forms a bright scarlet crystalline powder of read lead or minium.

$$3Pb\ (s) + 2O_2\ (g) \longrightarrow \underset{\text{Triplumbic tetraoxide}}{Pb_3O_4\ (g)}$$

It decomposes at 470°C

$$2Pb_3O_4\ (s) \longrightarrow 6PbO\ (s) + O_2$$

Red lead is used for a variety of purposes. Its principal uses are in the manufacture of storage batteries, as a pigment in paints applied to steel and iron to retard corrosion, and as an ingredient in the manufacture of flint glass, matches and ceramic glazes.

65. Tell about lead monoxide. Give uses.

Ans: Litharge varies in colour from pale yellow to reddish yellow, possibly owing to the existence

of two forms, a rhombic (yellow) and a tetragonal (red). It is slightly soluble in water. It is usually used in preparing flint glass and paints. If litharge is boiled with water and olive oil, lead oleate which is a sticky adhesive mass is formed and glycerin passes into solution. Litharge is used in preparing oils and varnishes and in the manufacturing of flint glass.

66. Tell about lead suboxide. Give uses.

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

$$2PbC_2O_4\ (s) \xrightarrow{\Delta} Pb_2O\ (s) + 3CO_2\ (g) + CO\ (g)$$

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