

## CHAPTER NO. 12

### CARBON, SILICON AND THEIR COMPOUNDS

Q1. Write down the introduction and occurrence of carbon and silicon.

#### INTRODUCTION:

1. Carbon and silicon belong to group IV -A in the periodic table.
2. Both elements contain 4 electrons in their last shell or valence shell.
3. Carbon is pure non metal.
4. Silicon is a metalloid.

#### OCCURRENCE:

Carbon is the sixteenth most abundant element in the earth crust. Carbon occurs in the free state as well as in the combined stated in the earth's crust.

#### SILICON:

Silicon is the second most abundant element in the earth crust after oxygen. Silicon does not occur in the free state although silicon is widely distributed in nature.

Q2. Draw a table to show the formation of coal with carbon contents and energy values.

#### FORMATION OF COAL WITH CARBON CONTENTS AND ENERGY VALUES:

S.N O.	FUELS	CARBON CONTENT	ENERGY VALUE (KJ/Kg)
1.	Wood	50.0%	19800 KJ/Kg
2.	Peat	59.9%	18700 KJ/Kg
3.	Lignite	61.8%	20900-25700 KJ/Kg
4.	Bitumen	78.7%	32100 KJ/Kg
5.	Anthracite	91.0%	32600 KJ/Kg

Q3. Write down the crystalline and amorphous forms of carbon.

#### CRYSTALLINE FORMS:

The crystalline forms of carbon are:

- i. Diamond
- ii. Graphite
- iii. Bucky balls

#### AMORPHOUS FORMS:

- i. Lamp black
- ii. Wood charcoal
- iii. Animal charcoal
- iv. Gas carbon
- v. Coal

Q4. What is allotropy? Write down the solid allotropic forms of carbon along their properties.

#### ALLOTROPY:

*"The existence of two or more different forms of the same element in the same state is called allotropy and the different forms are known as allotropic modifications or allotropes."*

Solid allotropic forms of carbon:

Solid allotropic forms of carbon are:

- i. Diamond
- ii. Graphite
- iii. Bucky balls

#### 1. DIAMOND:

- i. It is the hardest natural substance known.
- ii. Its density is about 3.51 gm/cm<sup>3</sup>.
- iii. It is a bad conductor of electricity.
- iv. It has very high melting point about 3500°C.

## 2. GRAPHITE:

- It is soft and greasy to feel.
- It is a good conductor of electricity.
- Its density is less than diamond which is  $2.2 \text{ gm/cm}^3$ .
- It has high melting point about  $3000^\circ\text{C}$ .

## 3. BUCKY BALLS:

- Bucky balls exactly like a soccer ball and has a high symmetric structure.
- It can be dissolved in organic solvents.

Q5. Write down the differences between diamond and graphite.

S.NO	DIAMOND	GRAPHITE
1.	It is transparent and bright in pure state.	It is of dark grey color and dull metallic lusture.
2.	It is hardest substance known in nature.	It is soft substance and greasy to feel.
3.	Its density is $3.5 \text{ g/cm}^3$ .	Its density is $2.2 \text{ g/cm}^3$ .
4.	Its melting point is $3500^\circ\text{C}$	Its melting point is $3000^\circ\text{C}$
5.	It is a bad conductor of electricity.	It is a good conductor of electricity.

Q6. Write down the uses of diamond, graphite and bucky balls.

### USES OF DIAMOND:

- It is used as precious stone.
- Colored diamond are used as gems in jewellery.
- Bort or carborado (Black diamond) is used for drillings and boring of rocks.

### USES OF GRAPHITE:

- Graphite is a good conductor of electricity, therefore it is used in the preparation of electrodes.
- Graphite is used as black pigments in paints.
- It leaves black mark on paper so it is used in the manufacture of lead pencils (Graphite + Clay)

### BUCKY BALLS:

- The carbon atoms are joined as making pentagons and hexagons which are used in making footballs.
- It is used as semi-conductors in the construction of electric circuits.
- It dissolved in organic solvents which are used for many purposes.

Q7. Write down the physical and chemical properties of carbon.

### PHYSICAL PROPERTIES OF CARBON:

- All the different carbon allotropes are black or grayish black solids except diamond.
- All the allotropic forms of carbon are odourless and tasteless.
- All the allotropic forms of carbon have high melting point above  $3000^\circ\text{C}$ .

### CHEMICAL PROPERTIES OF CARBON:

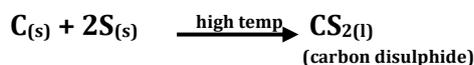
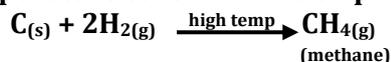
#### 1. COMBUSTION:

All forms of carbon burn in excess of air ( $\text{O}_2$ ) to produce carbondioxide. ( $\text{CO}_2$ ) gas.



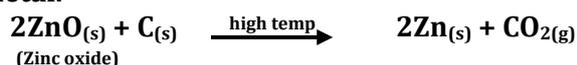
#### 2. COMBINATION REACTION:

Carbon combines directly with other elements such as hydrogen, sulphur, calcium, aluminium at very high temperature to form addition products.



#### 3. CARBON AS A REDUCING AGENT:

Carbon is a powerful reducing agent because it has greater affinity for oxygen. It reduces many metal oxides into free metal.



#### 4. REACTION WITH STRONG OXIDIZING AGENTS:

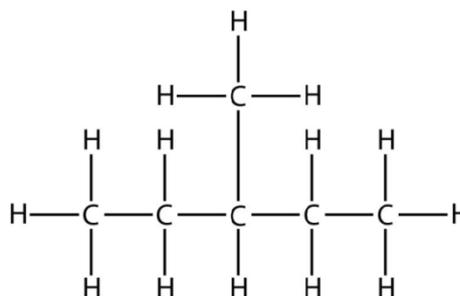
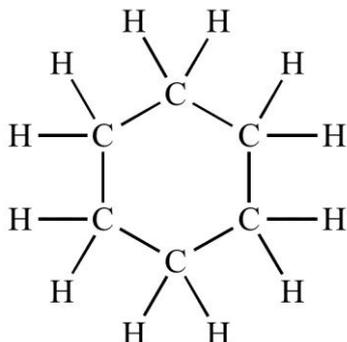
Carbon reacts with strong oxidizing agents like hot concentrated nitric acid (HNO<sub>3</sub>) and concentrated sulphuric acid (H<sub>2</sub>SO<sub>4</sub>) and get oxidized on heating to liberate CO<sub>2</sub> gas.



#### Q8. Define Catenation.

CATENATION:

*“Catenation is the ability of the atoms of carbon to bond itself forming long chains and ring also to form compounds containing chains and rings together.”*



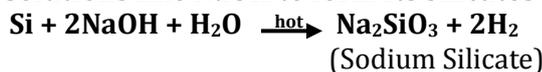
#### Q9. Draw a table to show some common natural silicates along their formula and uses.

S.NO.	NAME OF SILICATE	FORMULA	USES
1.	Feldspar	K <sub>2</sub> O.Al <sub>2</sub> O <sub>3</sub> .6SiO <sub>2</sub> or KAlSi <sub>3</sub> O <sub>8</sub>	Ceramics, glass, pottery and abrasive
2.	Kaolin (china clay)	Al <sub>2</sub> O <sub>3</sub> .SiO <sub>2</sub> .2H <sub>2</sub> O Hydrated	Crockery
3.	Mica	K <sub>2</sub> O.3Al <sub>2</sub> O <sub>3</sub> .6SiO <sub>2</sub> .2H <sub>2</sub> O or KAl <sub>3</sub> Si <sub>3</sub> O <sub>10</sub> Hydrated	Electrical insulator resistance to high temp.
4.	Talc (Soapstone)	3MgO.4SiO <sub>2</sub> .H <sub>2</sub> O hydrated	Ceramics
5.	Asbestos	CaO.3MgO.4SiO <sub>2</sub> Or Ca MgSi <sub>4</sub> O <sub>12</sub>	Heat insulation, fire-proofing

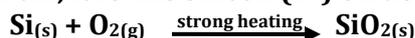
#### Q10. Write down the physical properties and uses of silicon.

PHYSICAL PROPERTIES AND USES OF SILICON:

- Amorphous silicon is brown in color which crystalline silicon is grey in color.
- Its melting point is about 1410°C and boiling point is 2600°C.
- It is insoluble in most of the common solvent like water but it dissolve in hydrofluoric acid (HF).
- It is poor conductor of electricity at room temperature.
- Silicon dissolves in hot alkali solutions like NaOH to form its silicates with the evolution of H<sub>2</sub> gas.



- When silicon is heated strongly in air, it forms silicon (IV) oxide i.e. silica (SiO<sub>2</sub>)



USES:

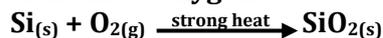
- Silicon is used in bronze and steel alloys to increase their tensile strength.
- Very pure silicon is used in making semi-conductors which are of great importance in computers, transistors, solar cells and electronic industries.
- It is also used for making silicones which are rubber like liquids.
- They are used as lubricants, water-repellent electric insulators and are also used in paints, varnishes and polishes.

Q11. Write down the preparation, properties and uses of silica (Silicon (IV) oxide); SiO<sub>2</sub>.

**SILICA (SILICON (IV) OXIDE); SiO<sub>2</sub>:**

**Preparation:**

Silica is prepared by heating silicon in air or oxygen.



**PROPERTIES:**

1. Silica (SiO<sub>2</sub>) exist in a colorless crystalline form when pure.
2. It is a macromolecular compound.
3. It is non-volatile and hard.
4. Its melting point is about 1500°C.

**USES:**

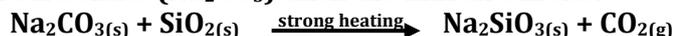
1. Sand (SiO<sub>2</sub>) is used in making mortar, cement, concrete, glass and refractory silica bricks.
2. Fused silica (Quartz glass) is used in making optical lenses and prisms.
3. Very fine threads of fused silica are used to suspend component parts in electrical instruments.
4. It is also used in medicines for making dry antiseptic dressings.

Q12. What is sodium silicate or water glass (Na<sub>2</sub>SiO<sub>3</sub>) ? Write down its preparation and uses.

**SODIUM SILICATE OR WATER GLASS (Na<sub>2</sub>SiO<sub>3</sub>):**

**Preparation:**

Sodium silicate is prepared by heating strongly two parts by mass of silica i.e. sand (SiO<sub>2</sub>) with one part by mass of sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) until the mixture melts.



It is obtained as colorless glass like liquid with melting point 1090°C.

**Water Glass:**

Sodium silicate dissolve in hot water under pressure to form a viscous liquid which is known as water glass because it looks like ordinary glass.

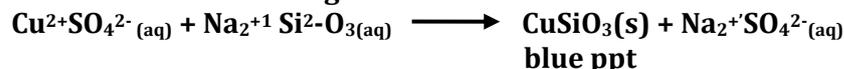
**USES:**

1. It is used for sizing of paper for fire proofing of wood and textile and for making glue.
2. It is also used as a filler in soap industries.
3. Eggs are preserved by immersing eggs in a solution of water glass.
4. A dilute solution of sodium silicate can be used for making chemical garden.

Q13. What is chemical garden? Show by equation.

**CHEMICAL GARDEN:**

Make a dilute solution of water glass (Na<sub>2</sub>SiO<sub>3</sub>) in a glass through. Add some crystals of colored salts such as cobalt chloride, nickel sulphate, copper sulphate etc. Leave them for few days without touching the through. You will find your chemical garden grows with colorful plants of chemical. This is because of the formation of insoluble metal silicate e.g.



Q14. What is silica jel? Write it uses.

**SILICA JEL:**

When an acid is added in a solution of water glass. It turns into a jelly like substance known as jel. The formula for this jel is SiO<sub>2</sub>. nH<sub>2</sub>O. on complete dehydration of this jel by heating, a hard porous material is obtained known as silica jel.

**Uses:**

1. Small bags of silica jel are kept in medicine packing to prevent the medicines being spoiled by water vapours.
2. It is also used to recover valuable vapours from industrial effluents and in the refining of petroleum.

Q15. What is coal, coke and charcoal? Write down their uses.

**COAL:**

The major resource of carbon is coal. Coal is complicated mixture of chemical substance containing carbon, compounds of carbon with hydrogen, oxygen, nitrogen, sulphur and many other elements.

**COKE:**

Coke is formed when coal is heated strongly about 1300 °C in the absence of air.

**CHARCOAL:**

**Wood charcoal:-**

Wood charcoal is formed when wood is heated strongly in the absence of air.

**Animal charcoal:-**

Animal charcoal is formed when bones of animals are heated strongly in the absence of air.

**USES OF COAL AND COKE:**

1. Coal and coke are important fuel and source of energy for homes and industries.
2. Coke is a powerful reducing agent and is used in the extraction of metals from their oxides.

**USES OF CHARCOAL:**

1. Charcoal is mainly used a domestic fuels.
2. It is also used for decolorization of petroleum jelly.
3. Animal charcoal is used for decolorizing brown color sugar in sugar mills.

Q16. Draw the structures of diamond and graphite.

