Chapter 4: Silicon

C4

1. Write a note on occurrence of silicon.

Silicon is the 2nd most abundant element in the earth's crust. It is widely distributed in sand, various forms of silicon dioxide (silica) or silicates. It is the chief constituent of semi-precious stones like garnet, zircon, topaz and opal.

2. Write the electronic configuration of silicon

The atomic number of silicon is 14 and its mass number is 28. Its electronic configuration is $1s^2$, $2s^2$ $2p^6$, $3s^2$ $3p^2$

3. Name the two allotropic forms of silicon.

a) Amorphous silicon

b) Crystalline silicon

4. Briefly explain the extraction of amorphous silicon.

Finely powdered silica (sand or quartz) is mixed with magnesium powder and heated in a fire clay crucible. Magnesium oxide and silicon are formed.

$SiO2 + 2Mg \xrightarrow{Heat} Si + 2MgO$

The product is washed with dilute hydrochloric acid to dissolve magnesium oxide.

Then it is washed with hydrofluoric acid to remove unreacted silica.

The powder left behind is amorphous silicon.

5. What is the role of the following in the extraction of amorphous silicon?

a) Hydrochloric acid b) hydrofluoric acid

a) Hydrochloric acid is used to dissolve magnesium oxide

b) Hydrofluoric acid is used to remove unreacted silica.

6. How is crystalline silicon prepared?

Crystalline silicon is prepared by reducing silica with coke.

When excess of silica is heated with coke in an electric furnace in the absence of air, dark grey coloured silicon in its crystalline form is obtained.

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

7. Compare the properties of amorphous and crystalline silicon

Amorphous silicon	Crystalline silicon
It is a brown powder	It is a dark grey crystalline solid and rough. It resembles the structure of diamond
It does not conduct electricity at low temperatures.	Slightly conducts electricity
It is more reactive than crystalline silicon	It is less reactive than amorphous silicon
When heated in air, it oxidizes at the surface level & catches fire	It does not burn in air even when heated

8. What happens when amorphous silicon is heated?

When amorphous silicon is heated in air, it oxidizes at the surface level & catches fire.

9. What happens when silicon is burnt in air?

Silicon burns brilliantly in air and vigorously in oxygen to form silicon dioxide. It is an exothermic reaction.

$Si + O_2 \longrightarrow SiO_2$

10. What is an exothermic reaction?

A chemical reaction in which heat is liberated is called exothermic reaction.
Ex: Dissolution of sodium hydroxide, calcium oxide, sulphuric acid and combustion of fuel.

11. How does red hot silicon react with steam?

Silicon is insoluble in water. It slowly decomposes with steam. When silicon is in red hot state, it reacts with steam liberating hydrogen.

$Si + \underset{\text{(Steam)}}{2H_2O} \longrightarrow SiO_2 + H_2$

12. Give reason: Even though silicon is a non-metal it resembles metals in its properties.

When red hot silicon reacts with steam, it liberates hydrogen. Even when metals like hot iron, zinc or magnesium react with steam, they liberate hydrogen with their respective metal oxides. Hence silicon resembles metals in some properties.

13. How is silicon carbide formed?

OR

What happens when silicon and coke are heated?

When a mixture of silicon and coke is heated in an electric furnace, silicon carbide is formed. It is an endothermic reaction.

$Si + C \longrightarrow SiC$

14. What is an endothermic reaction?

A chemical reaction in which there is absorption of heat is called endothermic reaction.
Ex: Dissolution of ammonium chloride, common salt and sugar in water, cooking of rice

15. What is carborundum? How is it prepared?

Carborundum is chemically silicon carbide. When a mixture of silicon and coke is heated in an electric furnace, silicon carbide is formed.

$Si + C \longrightarrow SiC$

16. Mention some uses of silicon compounds.

a) Quartz is used in modern clocks.
b) Zircon, topaz are used to make ornamental objects.
c) Sand is used in buildings to make concrete mix.
d) Sand is used in preparation of glass.
e) Silicon carbide is used in cutting and grinding tools, polishing.
f) Zeolite is used in removal of hardness of water and in chromatography.
g) Silicon is used as raw material in the production of silicones.

h) Silicones are used in water proofing treatments, moulding compounds, insulating material for electric motors and other electrical appliances.
i) Silica gel is used in chromatography.
j) It is used in manufacture of transistor, diodes and integrated circuits (IC).
k) Silica is used in manufacture of emery paper or sand paper.
l) It is used as sand bath during roasting and in laboratory to carry out chemical reaction.

17. What are silicones?

Silicones are rubbery compounds of silicon, oxygen and hydrocarbons.

18. Give reason: Silicones used as insulating materials.

Unlike common organic polymers, silicones do not catch fire. Hence they are used in fire proof suits and insulating material.

19. Give reason: Silicon is used widely even through Germanium is a better semiconductor material.

Silicon is the second most abundantly available material and it can be used at higher temperature. Hence it widely used than Germanium.

20. Give reason: Carbon is not a semiconductor inspite of it's group being 14.

Conductivity increases as you go down a group, so carbon, at the top of its group, is usually described as a resistor and silicon and germanium are described as semi-conductors. Continuing down the group, tin and lead are conductors.

21. Give reason: Sand is used during roasting and as sand bath in chemical reactions.

As silicon has high thermal and non combustible property.

22. Give reason: Silicon compounds have water repelling property.

Due to the absence of porosity in the polymer of silicon. The structure is so compact that water cannot enter.

23. Mention the biological significance of silicon.

a) Diatoms, radiolarian and siliceous sponges use biogenic silica as a structural material to construct skeletons.
b) Paddy needs silicon for its growth.

24. What are the hazards of silicon?

Miners and stone breakers, in asbestos factory, glass factory some times suffer from a professional hazard.

25. What is silicosis? How is it caused?

Silicosis a professional disease which affects miners and stone breakers. Silica particles suspended in air in the mining area enters into lungs of workers and causes silicosis.

26. Give reason: Workers in mines, glass factory, asbestos factory and stone breakers often suffer from silicosis.

Silica particles suspended in air in the mining area enters into lungs of workers and causes silicosis.

27. **Give reason: Workers in mines, glass factory and asbestos factory must be provided with gas masks.**

Because long exposure to silica particles suspended in air enter lungs of workers and causes silicosis.

Fill in the blanks:

1. The chemist who produced crude silicon from silicon dioxide was **Berzelius**.
2. The chemist who proved that sans is a compound and not an element was **Berzelius**.
3. Silicon is derived from the Latin word **Silicium** which means **stone or flint**.
4. The atomic number of silicon is **14** and its mass number is **28**.
5. The electronic configuration of silicon is **$1s^2, 2s^2\ 2p^6, 3s^2\ 3p^2$**.
6. The two allotropic forms of silicon are **amorphous** and **crystalline**.
7. Amorphous silicon is obtained by heating silica with **magnesium powder**.
8. During preparation of amorphous silicon, product is washed with **dilute hydrochloric acid** to dissolve **magnesium oxide**.
9. During preparation of amorphous silicon, the product is washed with **hydrofluoric acid** to **remove unreacted silica**.
10. Crystalline silicon is obtained by reducing **silica** with **coke**.
11. A chemical reaction in which heat is liberated is called **exothermic reaction**.
12. The gas liberated when red hot silicon reacts with steam is **hydrogen**.
13. A chemical reaction in which there is absorption of heat is called **endothermic reaction**.
14. Carborundum is chemically silicon carbide.
15. **Carborundum** is prepared heating a mixture of **silicon** and **coke** in an electric furnace.
16. The compound of silicon used in modern clocks is **quartz**.
17. The compound of silicon used in making ornaments is **Zircon / Topaz**.
18. The compound of silicon used in building construction is **sand**.
19. The compound of silicon used in cutting & grinding tools is **silicon carbide/carborundum**.
20. The compound of silicon used in preparation of glass is **sand**.
21. The compound of silicon used in removing hardness of water is **Zeolite**.
22. The compound of silicon used in water proof treatment is **silicone**.
23. The compound of silicon used as insulating material for electric motors/appliances is **silicone**.
24. Silicon is a **semiconductor**.
25. The rubbery compound of silicon, oxygen and hydrocarbons is called **silicone**.
26. The compound of silicon used in chromatography is **silica gel**.
27. The element of used in making integrated circuits is **silicon**.
28. The element used in manufacture of transistor, diodes and integrated circuits is silicon.
29. The compound used in manufacture of emery paper or sand paper is **silica**.
30. An example of an organism which uses biogenic silica as a structural material to construct skeletons is **Diatoms, radiolarian and siliceous sponges**.
31. A professional disease formed which affects miners and stone breakers is **silicosis**.