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1. General Information

- Symbol: Si
- Atomic Number: 14
- Atomic Mass: 28.09 u
- Group: 14 (Carbon Group)
- Period: 3
- Block: p-block
- Electron Configuration: $1s^2 2s^2 2p^6 3s^2 3p^2$
- Valence Electrons: 4
- Phase at Room Temperature: Solid

2. Isotopes of Silicon

| Isotope | Protons | Neutrons | Abundance | Notes |
|------------------|---------|----------|-----------|----------------|
| ^{28}Si | 14 | 14 | 92.23% | Most abundant. |
| ^{29}Si | 14 | 15 | 4.67% | Stable. |
| ^{30}Si | 14 | 16 | 3.1% | Stable. |

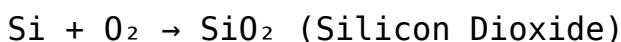
3. Physical Properties

- Color: Gray with metallic luster
- Odor: Odorless
- Density: 2.33 g/cm³
- Melting Point: 1,414°C
- Boiling Point: 3,265°C
- State at STP: Solid
- Hardness: Brittle, crystalline structure (like glass).

4. Chemical Properties

- Moderately Reactive:
 - Forms silicon dioxide (SiO_2) in air.
 - Resists corrosion by water and acids but reacts with halogens.
- Forms Covalent Bonds:
 - Tetravalent (can form four bonds).
- Semiconductor Properties:
 - Conducts electricity better than non-metals but worse than metals.

Reaction with Oxygen (Oxidation):



Reaction with Hydrofluoric Acid:



5. Occurrence and Abundance

- Second most abundant element in Earth's crust (after oxygen).
- Found in:
 - Rocks and Sand: Quartz, granite, feldspar.
 - Silicates: Form the majority of Earth's minerals.
- Not found in Free State: Always in compounds (e.g., SiO_2).

6. Industrial Production of Silicon

- Extracted from Quartz (SiO_2):
 $\text{SiO}_2 + 2\text{C} \rightarrow \text{Si} + 2\text{CO}$ (Reduction with carbon in electric arc furnaces)
- Refined Further for Electronics:
 - Zone Refining: Produces ultra-pure silicon.

7. Uses of Silicon

| Application | Description |
|------------------------|--|
| Semiconductors | Microchips, transistors, solar cells. |
| Construction | Concrete, glass, and bricks. |
| Alloys | Aluminium-silicon alloys for automotive parts. |
| Cosmetics and Sealants | Silicone-based products. |
| Glass and Ceramics | Silica (SiO_2) used in glassmaking. |
| Aerospace and Defense | High-strength silicon carbide (SiC). |
| Medical Implants | Silicone for surgical implants. |

8. Important Silicon Compounds

| Compound | Formula | Use |
|-----------------------|----------------------------|--|
| Silicon Dioxide | SiO_2 | Glass, sand, concrete. |
| Silicones | $(\text{R}_2\text{SiO})_n$ | Lubricants, sealants, medical devices. |
| Silicon Carbide | SiC | Abrasives, cutting tools. |
| Silicon Tetrachloride | SiCl_4 | Optical fibers, semiconductors. |
| Sodium Silicate | Na_2SiO_3 | Detergents, water treatment. |

9. Biological Importance of Silicon

- Trace Element in Humans and Plants:
 - Supports bone strength and connective tissue.
 - Promotes plant growth and cell wall strength.
- Essential for Diatoms: Microscopic algae use silica to form protective shells.

10. Silicon in Technology

- Key Material in Electronics:
 - Used in transistors and microchips for computers and phones.
- Solar Panels:
 - Photovoltaic cells are made from silicon wafers.
- Silicon Valley:
 - Named after the use of silicon in the tech industry.

11. Environmental Role of Silicon

- Rock Cycle:
 - Forms minerals that shape Earth's crust and geological processes.
- Silica Dust:
 - Can cause lung diseases (silicosis) if inhaled.

- Sustainable and Abundant:
 - Silicon-based materials are widely recyclable.

12. Safety and Hazards

- Inert in Pure Form:
 - Does not pose direct health risks.
- Silica Dust (SiO_2):
 - Prolonged exposure can lead to respiratory issues.
- Silicon Compounds:
 - Some are corrosive (e.g., SiCl_4 reacts with moisture to form HCl).

Handling Precautions:

- Ventilation when working with silica dust.
- Use respirators and safety goggles during cutting or grinding.

Fun Facts About Silicon:

- Named after the Latin word “silex” meaning flint or hard stone.
- Silicon makes up 27% of Earth’s crust.
- Silicon-based life forms are a common science fiction trope!
- The first transistor was made from silicon and germanium.