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## 1. General Information

- Symbol: Ca
  - Atomic Number: 20
  - Atomic Mass: 40.08 u
  - Group: 2 (Alkaline Earth Metals)
  - Period: 4
  - Block: s-block
  - Electron Configuration:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
  - Valence Electrons: 2
  - Phase at Room Temperature: Solid
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## 2. Isotopes of Calcium

Isotope	Protons	Neutrons	Abundance	Notes
<sup>40</sup> Ca	20	20	96.9%	Most abundant, stable.
<sup>42</sup> Ca	20	22	0.65%	Stable.
<sup>43</sup> Ca	20	23	0.14%	Stable.
<sup>44</sup> Ca	20	24	2.08%	Stable.
<sup>48</sup> Ca	20	28	0.19%	Rare, used in nuclear research.

### 3. Physical Properties

- Color: Silvery-white
- Odor: Odorless
- Density: 1.55 g/cm<sup>3</sup>
- Melting Point: 842°C
- Boiling Point: 1,484°C
- State at STP: Solid
- Soft Metal: Can be cut with a knife.

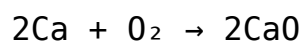
### 4. Chemical Properties

- Moderately Reactive:
  - Reacts readily with water to form calcium hydroxide (Ca(OH)<sub>2</sub>) and hydrogen gas (H<sub>2</sub>).
  - Reacts with oxygen to form a thin layer of calcium oxide (CaO).
- Forms Alkaline Solutions in water.
- Burns with a Bright Orange-Red Flame.

#### Reaction with Water:



#### Reaction with Oxygen:



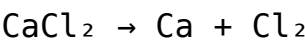
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## 5. Occurrence and Abundance

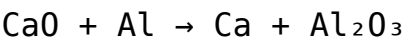
- 5th most abundant element in Earth's crust.
  - Found in:
    - Minerals: Limestone ( $\text{CaCO}_3$ ), Gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ), Fluorite ( $\text{CaF}_2$ ).
    - Bones and Teeth: Makes up 99% of body calcium in humans.
  - Seawater: Contains calcium ions ( $\text{Ca}^{2+}$ ).
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## 6. Industrial Production of Calcium

- Electrolysis of Molten Calcium Chloride ( $\text{CaCl}_2$ ):



- Thermal Reduction:



## 7. Uses of Calcium

Application	Description
Construction	Limestone and gypsum used in cement and plaster.
Steel Production	Removes impurities as a flux.
Chemical Manufacturing	Produces calcium compounds (e.g., $\text{CaCl}_2$ , $\text{Ca(OH)}_2$ ).
Pharmaceuticals	Supplements and antacids.
Glass and Ceramics	Calcium carbonate ( $\text{CaCO}_3$ ) strengthens glass.
Fertilizers	Calcium nitrate ( $\text{Ca(NO}_3)_2$ ) enriches soil.

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## 8. Important Calcium Compounds

Compound	Formula	Use
Calcium Carbonate	$\text{CaCO}_3$	Chalk, limestone, antacids.
Calcium Oxide (Quicklime)	$\text{CaO}$	Cement, steel, and paper.
Calcium Hydroxide	$\text{Ca(OH)}_2$	Plaster, water treatment.
Calcium Chloride	$\text{CaCl}_2$	De-icing roads, food preservative.
Calcium Nitrate	$\text{Ca(NO}_3)_2$	Fertilizer.
Calcium Sulfate	$\text{CaSO}_4$	Plaster of Paris, drywall.

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## 9. Biological Importance of Calcium

- Essential for Life:
    - Builds bones and teeth (hydroxyapatite).
    - Regulates nerve function, muscle contractions, and blood clotting.
  - Cellular Function:
    - Calcium ions ( $\text{Ca}^{2+}$ ) play a role in cell signaling and enzyme activation.
  - Daily Requirement:
    - Adults: 1,000–1,200 mg/day.
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## 10. Calcium in Environmental Chemistry

- Water Hardness:
    - Calcium ions cause hard water, forming scale in pipes.
  - Carbonate Cycle:
    - Calcium carbonate in oceans helps regulate  $\text{CO}_2$  levels through the carbon cycle.
  - Soil Health:
    - Calcium enhances soil structure and plant growth.
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## 11. Safety and Hazards

- Reacts with Water:
  - Generates heat and hydrogen gas, which can ignite.
- Irritant:
  - Calcium hydroxide (slaked lime) can cause skin and eye burns.
- Non-Toxic in Small Quantities:
  - Excessive intake can cause hypercalcemia (calcium buildup in the body).

### Handling Precautions:

- Store in dry environments to prevent reactions with moisture.
  - Use protective gear (gloves, goggles) when handling calcium compounds.
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### Fun Facts About Calcium:

- Calcium was isolated in 1808 by Sir Humphry Davy.
- Calcium carbonate forms stalactites and stalagmites in caves.
- Calcium ions are essential for the “glow” in fireflies.
- Bone fossils and shells are primarily composed of calcium minerals.