

Metals

Metals are essential materials with unique properties, making them indispensable in construction, transportation, technology, and more.



1. Properties and Uses of Metals

Physical Properties:

Malleability: Can be hammered into thin sheets (e.g., aluminum).

Ductility: Can be drawn into wires (e.g., copper).

Conductivity: Excellent conductors of heat and electricity (e.g., silver, copper).

Luster: Shiny surface, often polished for aesthetic purposes.

High Melting and Boiling Points: Due to strong metallic bonds.



Chemical Properties:

Reactivity varies widely (e.g., potassium reacts violently with water, while gold is inert).

Tend to lose electrons to form positive ions (cations).

Uses:



Construction: Iron and steel for buildings, bridges.

Transportation: Aluminum for lightweight vehicle bodies.

Electronics: Copper and silver for wiring and circuits.

Jewelry: Gold, platinum for their aesthetic value and resistance to corrosion.

2. Reactivity Series and Displacement Reactions


Reactivity Series:

Definition: Ranks metals based on their reactivity with water, acids, and other substances.

Order (Examples):

Highly Reactive: Potassium (K), Sodium (Na), Calcium (Ca).

Moderately Reactive: Zinc (Zn), Iron (Fe), Tin (Sn).



K	potassium
Na	sodium
Ca	calcium
Mg	magnesium
Al	aluminium
Zn	zinc
Fe	iron
Pb	lead
H	hydrogen
Cu	copper
Ag	silver

Low Reactivity: Copper (Cu), Silver (Ag), Gold (Au).

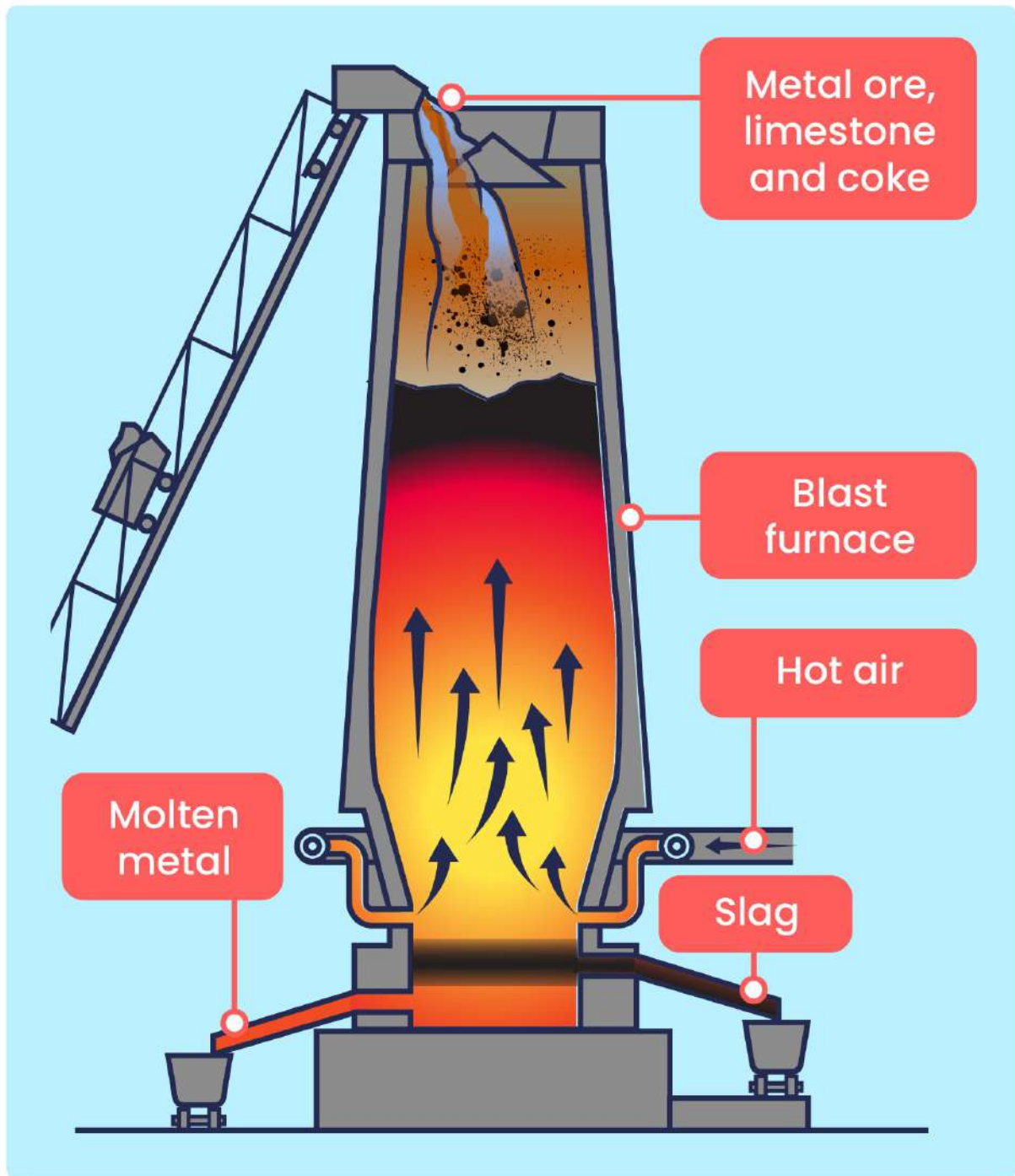
Displacement Reactions:

A more reactive metal displaces a less reactive metal from its compound.

Example:

Zinc displaces copper in copper sulfate solution:

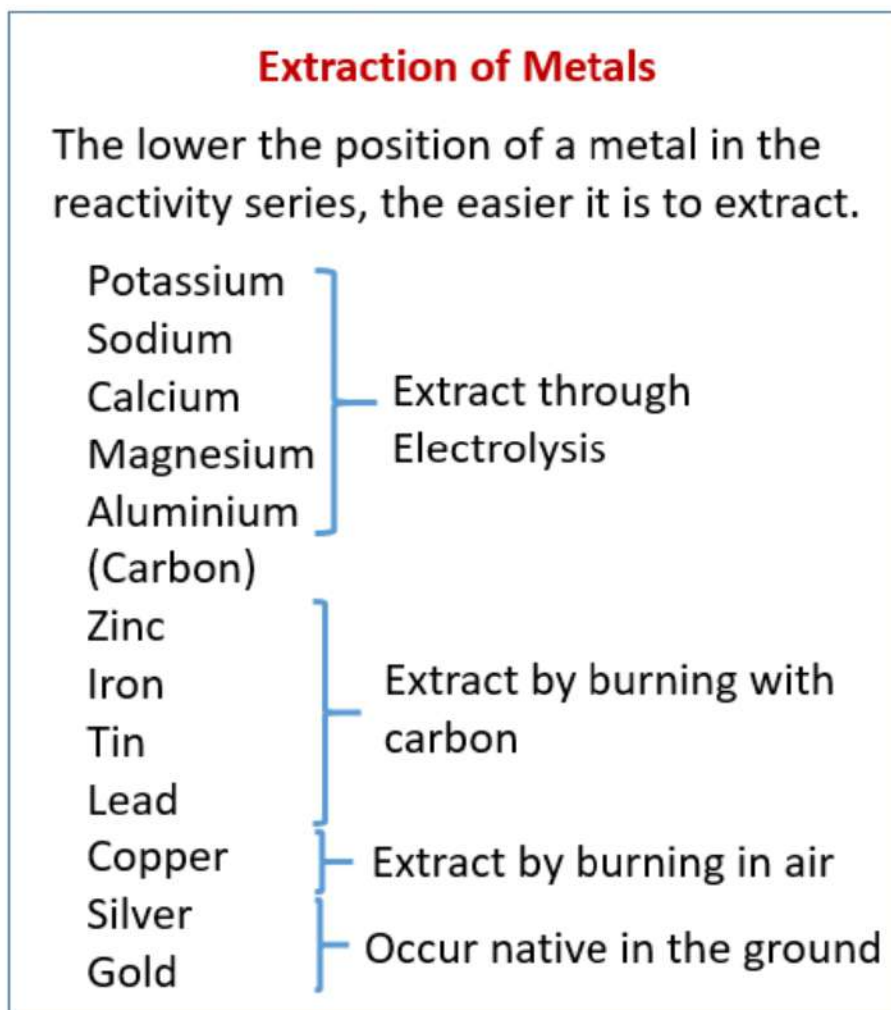
3. Extraction of Metals from Ores



Stages of Extraction:

1. Mining: Extracting ores from the earth.
2. Concentration: Removing impurities from the ore.

3.Reduction: Extracting metal using heat or electricity.



Methods:

Electrolysis: For highly reactive metals like aluminum.

Example: Extraction of aluminum from bauxite.

Reduction with Carbon: For moderately reactive metals like iron.

Example: Iron extraction in a blast furnace:

Thermal Decomposition: For some less reactive metals.

Example: Decomposition of mercury(II) oxide:

4. Alloys and Their Importance

Definition:

Alloys are mixtures of metals or metals with non-metals, designed to improve properties such as strength, durability, and corrosion resistance.

Examples:

Steel: Iron with carbon; used in construction.

Bronze: Copper and tin; used in statues and coins.

Brass: Copper and zinc; used in musical instruments and decorative items.

Importance:

Enhanced Properties: Improved hardness, resistance to wear and corrosion.

Tailored Applications: Specific alloys for different industries, such as aerospace (lightweight titanium alloys) and automotive (durable aluminum alloys).

Alloy	Composition	Use
Brass	Copper and zinc	Machine bearings, jewellery, electrical objects, metallic parts of door furniture, water pipes.
Bronze	Copper and tin	Machine parts, ornaments e.g. necklaces, castin.
Solder	Lead and tin	Connecting electrical wiring
Duralumin	Aluminium, copper and magnesium	Aircraft construction, bicycle parts and small boats.
Magnalium	Alluminium and magnesium	Aircraft construction, small boats
Alnico (ferromagnetic)	Aluminium, nickel and cobalt	Generators, electric motors, mass spectrometer
Pewter	Lead, tin and small amount of antimony	Plates, ornaments and drinking mugs.
Stainless steel	Iron, chromium and nickel	Cutlery, kitchen sinks, surgical instruments
Hard steel	Iron and carbon	Cutting tools, razor blades, chisels
Tungsten steel	Iron and tungsten	Edges of high speed cutting tools

Conclusion

Electrochemical Cells: These devices demonstrate the intricate relationship between electricity and chemical reactions, enabling advancements in energy storage, industrial processes, and material refinement. Metals: Metals and their alloys are foundational to modern civilization due to their diverse properties, reactivity, and applications. From infrastructure to technology, they continue to shape industries and scientific progress.

Understanding these concepts bridges the gap between fundamental chemistry and practical applications, emphasizing their significance in both academic and industrial contexts.