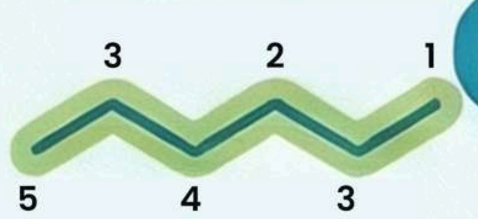
Nomenclature of Organic Compounds and Isomerism

IUPAC NOMENCLATURE: NAMING ORGANIC COMPOUNDS

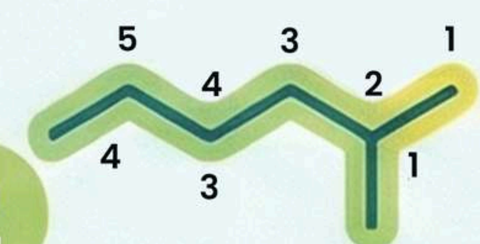
Systematic rules for naming based on structure, chain length, branches, and functional groups.

HOW TO NAME BRANCHED ALKANES (STEP-BY-STEP)



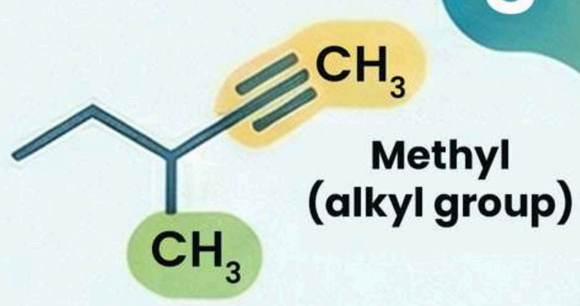
1 **Find the Main Chain**

Identify the longest continuous chain. This forms the base name (eg. 8 carbons = pentane).



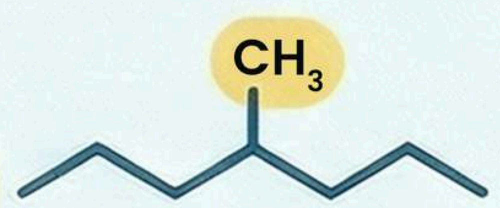
2 **Number the Carbon Atoms**

Number the main chain to give the branch the lowest possible number.



3 **Name the Branch**

Branches are alkyl groups. Names end in-yl (eg one-carbon is 'methyl).

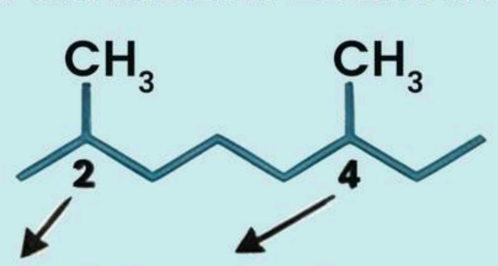


4 **Assemble the Full Name**

2-Methylpentane

Combine in order: [Position]-[Name of branch] [Name of main chain).

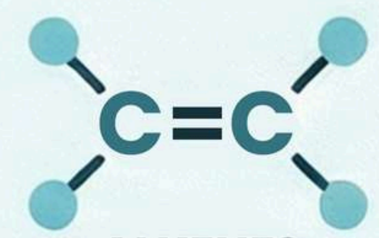
RULE FOR MULTIPLE BRANCHES



2,4-Dimethylhexane

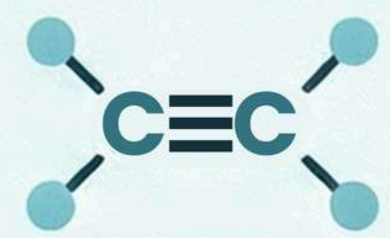
Use prefixes like 'dl', 'tri' and list all positions, separated by commas.

NAMING ALKENES & ALKYNES (DOUBLE & TRIPLE BONDS)



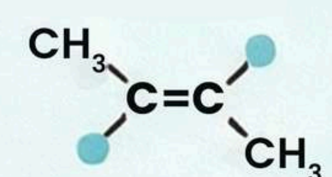
ALKENES (Unsaturated)

At least one carbon-carbon double bond. Name format [Word Root]-[Position]-one



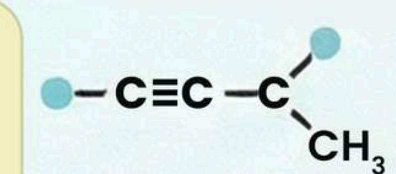
ALKENES (Unsaturated)

At least one carbon-carbon triple bond. Name format [Word Root]-[Position]-one



But-1-ene

THE #1 RULE: Prioritize the Bond.
Always start numbering to give the double/triple bond the lowest possible position number.



But-1-yne

MEET THE FUNCTIONAL GROUPS

A functional group is an atom or group of atoms that gives a compound its specific chemical and physical properties.

Functional Group	Structure	Class	Naming Rule (Suifts/Preits)	Example
Carboxyl	-COOH	Carboxylic Acid	Ends in-oic acid'	Ethanolc acid
Aldohyde	-CHO	Aldehyde	Ends in-al	Ethanol
Keto	-CO-	Ketone	Ends in-one'	Propanone
Halo	-F-Cl, Br,-1	Halo Compound	Prefix Tluoro-Chloro-etc	1-Chloropropane
Alkexy	-O-R	Ether	'Alkoxy'+'alkane	Methoxyethane

UNDERSTANDING ISOMERISM

Compounds with the same molecular formula but different structural arrangements.

What Are Isomers?

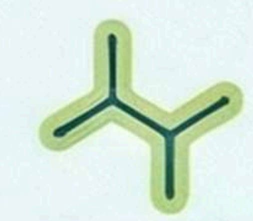
Isomers are compounds that have the exact same molecular formula but different structural arrangements, leading to different properties.

THE 4 TYPES OF STRUCTURAL ISOMERISM

1. CHAIN ISOMERISM

Same molecular formula, different carbon chain structure.

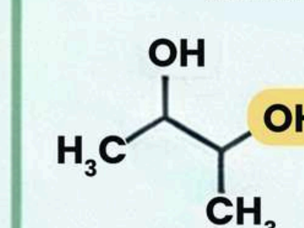
Pentane



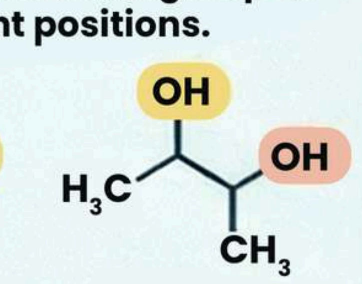
2-Methylbutane

2. POSITION ISOMERISM

Same carbon chain and functional group, but functional group at different positions.



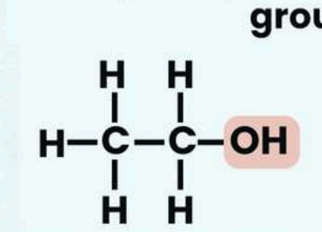
Propon-1-ol



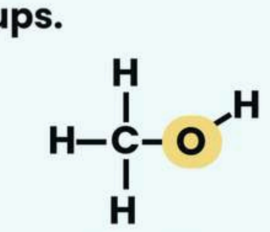
Propon-2-ol

3. FUNCTIONAL ISOMERISM

Some molecular formula, completely different functional groups.



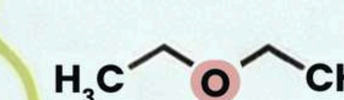
Ethanol (Alcohol)



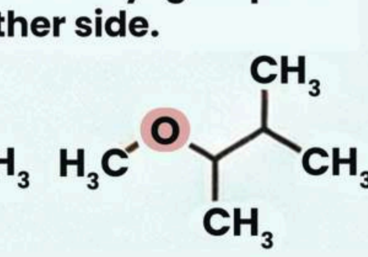
Methoxymethane (Ethor)

4. METAMERISM

Same functional group, different arrangement of alkyl groups on either side.



Ethoxyethane

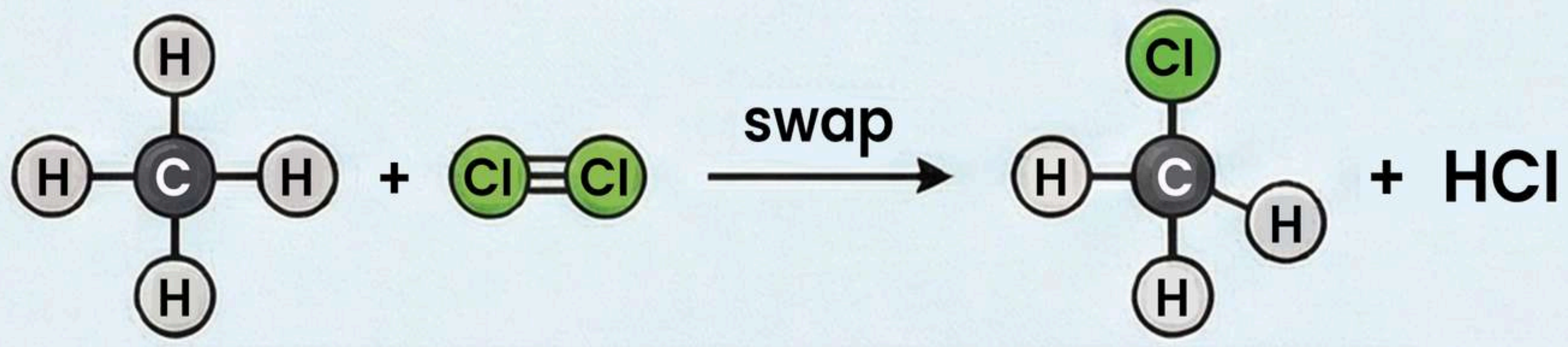


Methoxymethane

Chemical Reactions of Organic Compounds

SUBSTITUTION REACTIONS: Swapping Atoms

One atom (or group) is replaced by another.

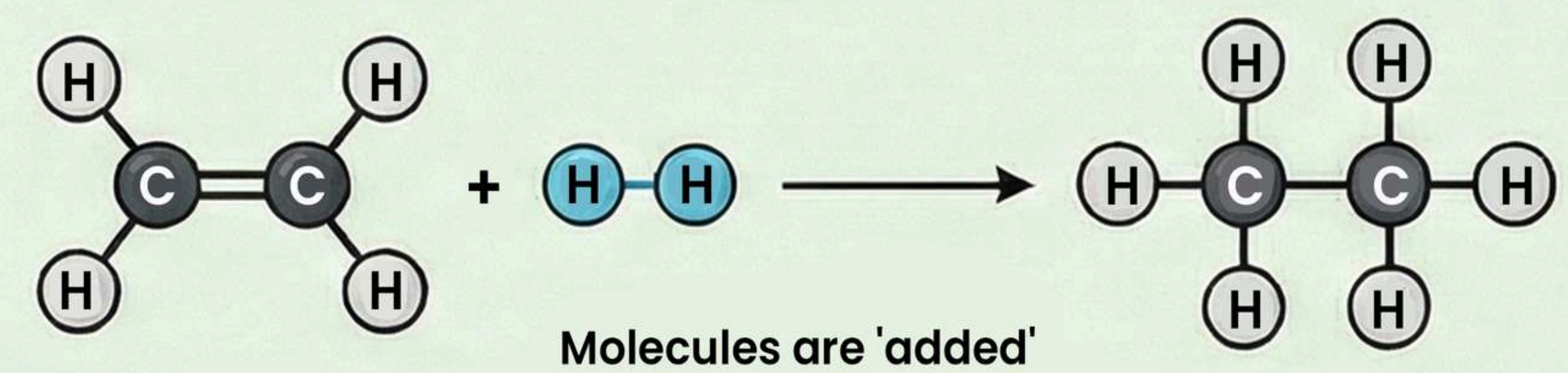


Like a 'substitute' player in a game, an atom is swapped.

$$CH_4 + Cl_2 \xrightarrow{\text{(sunlight)}} CH_3Cl + HCl$$

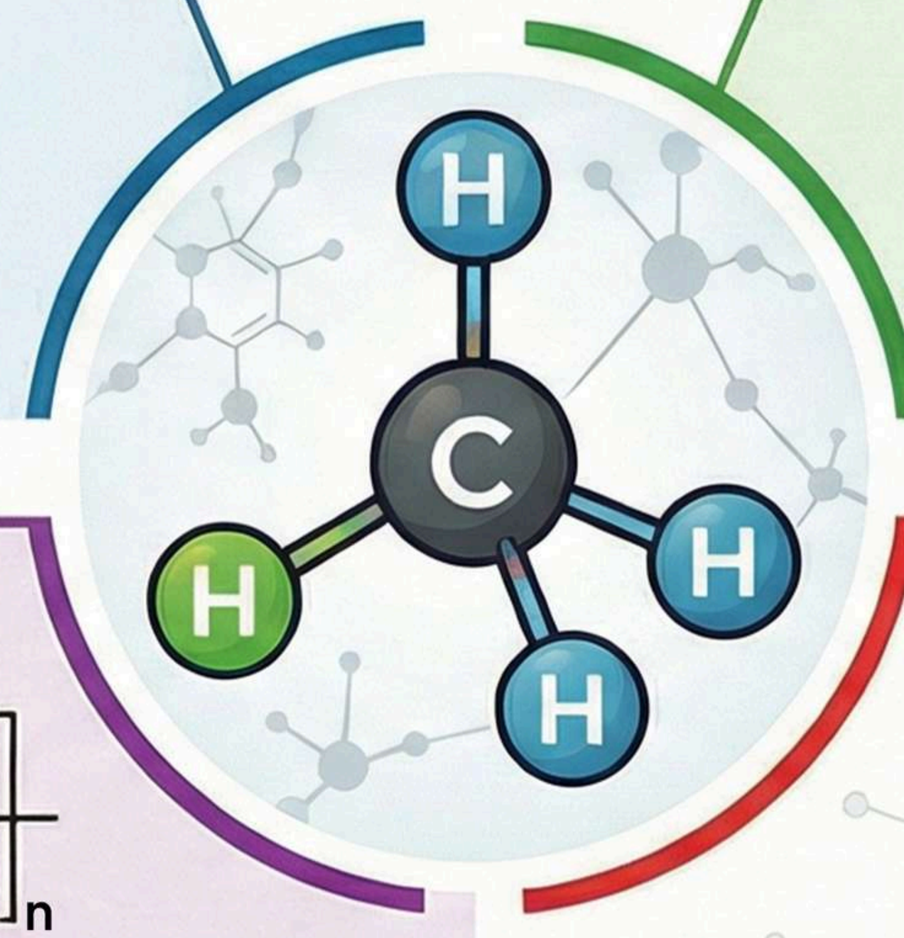
ADDITION REACTIONS: Breaking Double Bonds

Unsaturated compounds become saturated.



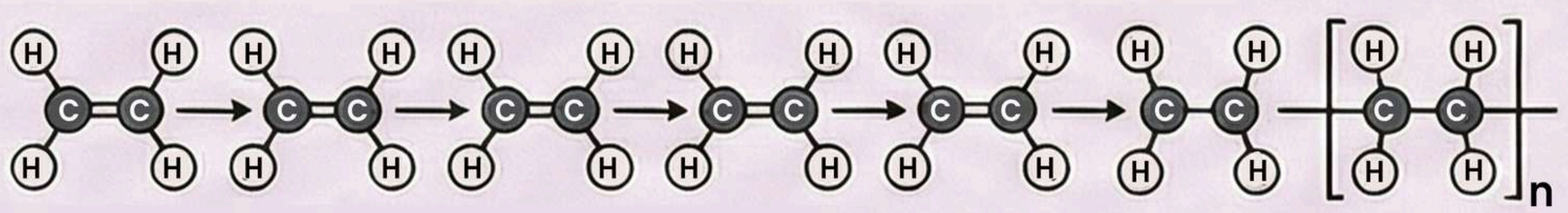
Molecules are 'added' across a double bond, converting it into a single bond.

$$CH_2{=}CH_2 + H_2 \xrightarrow{\text{(Ni catalyet)}} CH_3{-}CH_3$$



POLYMERISATION: Making Long Chains

Small molecules join to form giant molecules.



Monomers link to form a very long polymer chain

Type 1: Addition Polymerisation

n(CH2=CH2)-[CH2-CH2]-

Type 2: Condensation Polymerisation

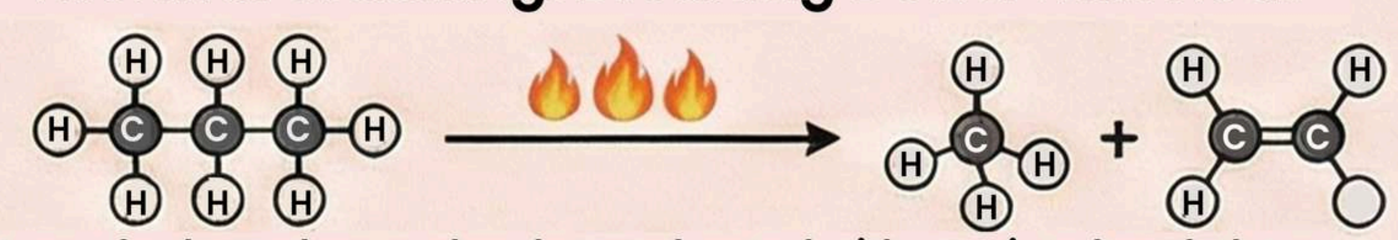
Monomers join, but a small molecule like water (H_2O) is lost. Example: Nylon 66.

Common Polymers & Uses

Polymer	Monomer	Common Use
Polythme	Ethene	Carry bags, sheets
PVC	Vinyl chloride	Pipes, furniture
Tefion	Tetrafluoroethene	Non-stick coobware coating
Nylon 66	Adipic acid + Hesamethylenediamine	Fabrics, bristles for brushes

OTHER IMPORTANT REACTIONS

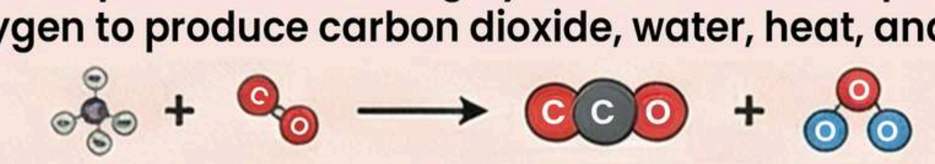
Thermal Cracking: Breaking Down with Heat



Large hydrocarbon molecules are heated without air to break them down into smaller, more useful hydrocarbons.

Combustion: Burning Hydrocarbons

This is the process of burning hydrocarbons in the presence of oxygen to produce carbon dioxide, water, heat, and light



$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_20 + \text{Heat}$$

KEY ORGANIC COMPOUNDS & MEDICINES

Key Organic Compounds

Ethanol
An important industrial alcohol made by fermenting molasses. It is used as a solvent, in paints, and as a fuel.

Ethanoic Acid
A 5-8% solution is known as vinegar. It is used to make synthetic fibres and disinfectants.

Esters
Formed when a carboxylic acid reacts with an alcohol. Esters have pleasant, fruity smells and are used for riches perfumes and food flavourings.

Chemistry in Medicines

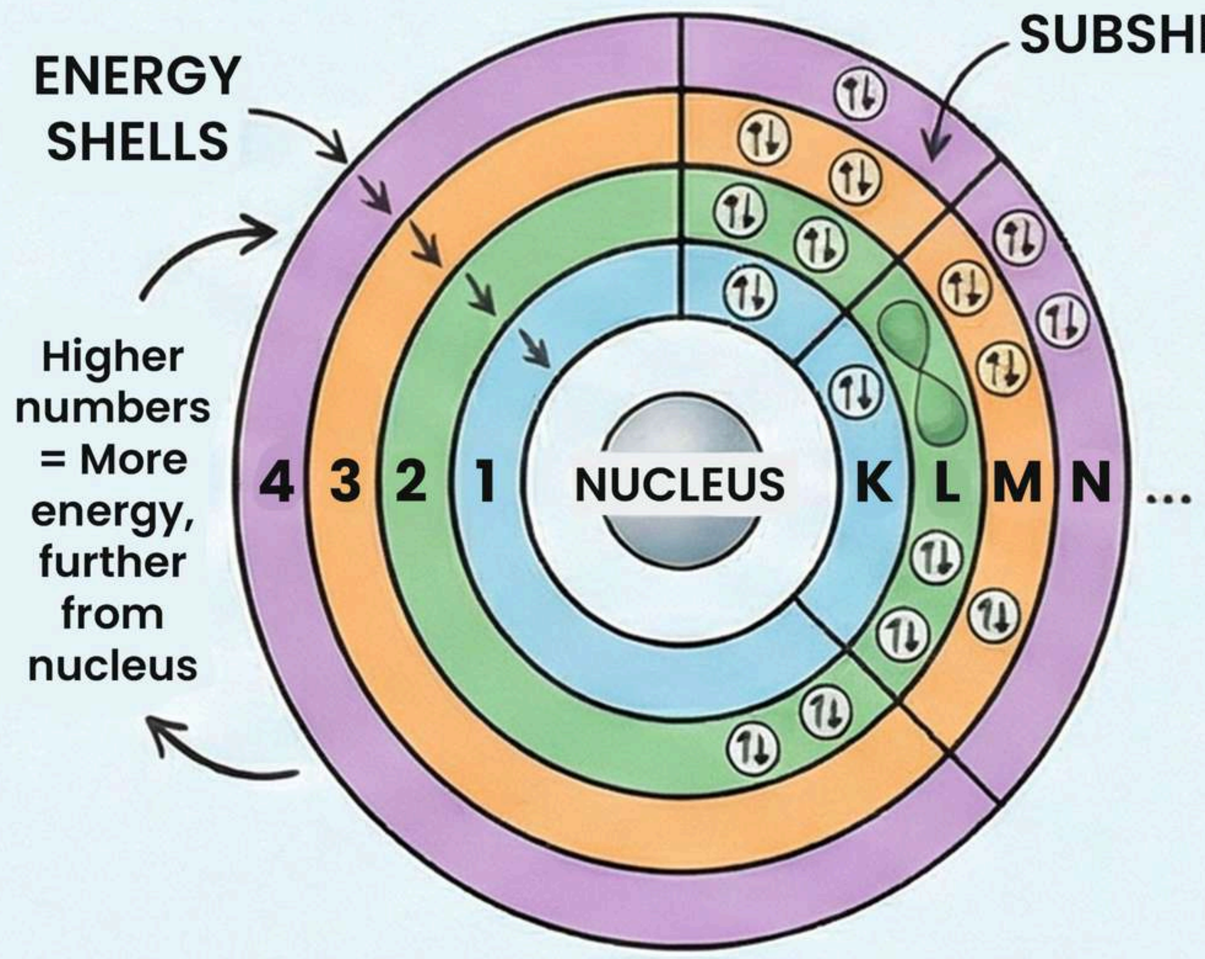
Analgesics
Pain Rellevers
Example: Aspirin.

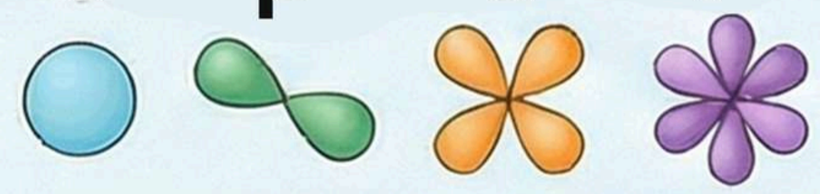
Antipyretics
Fever Reducers.
Example: Paracetamol.

Multi-purpose Medicines:
Peracetemol is both antipyretic and analgesic. Aspirin is an analgesic and helps prevent blood clots.

Periodic Table and Electron Configuration

SECTION 1: THE MODERN ATOM: SHELLS, SUBSHELLS & ORBITALS



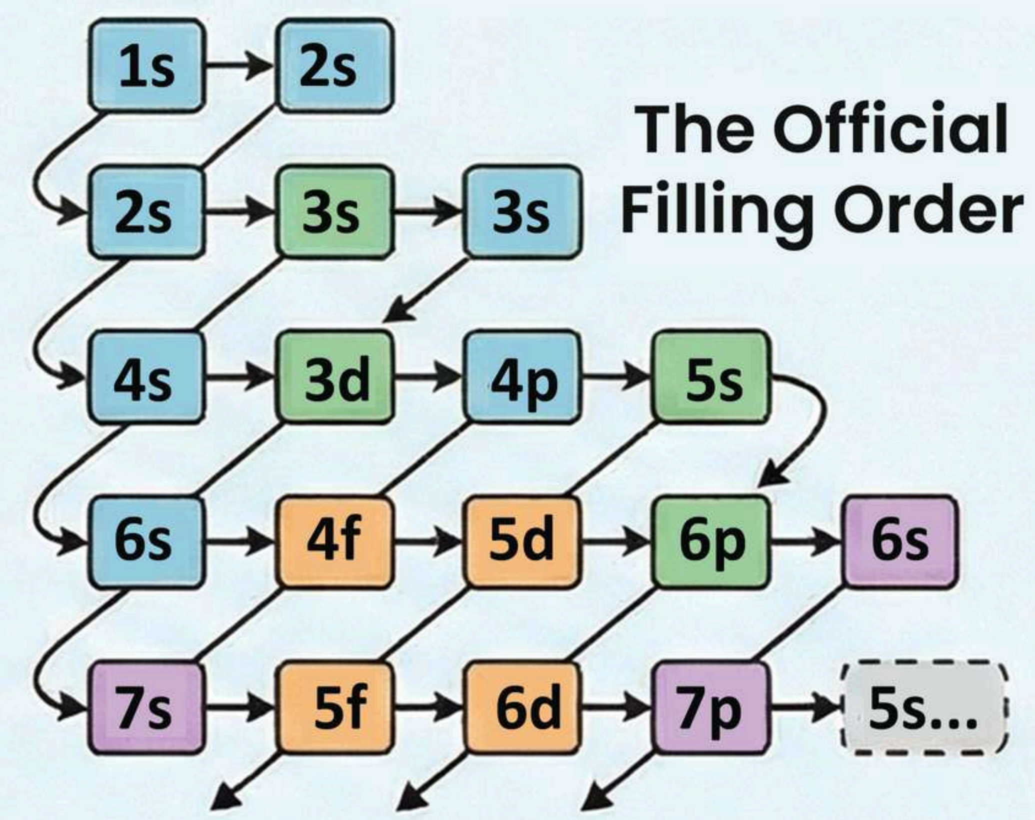


Each type of subshell has a unique shape

SUBSHELL CAPACITY		
Subshell Type	Number of Orbitals	Maximum Electrons
s	1	2
p	3	6
d	5	10
f	7	14

SECTION 2: HOW TO FILL SUBSHELLS WITH ELECTRONS

Step 1: Follow the Energy Order



The Official Filling Order

Writing an Electron Configuration For Sodium (11 electrons):

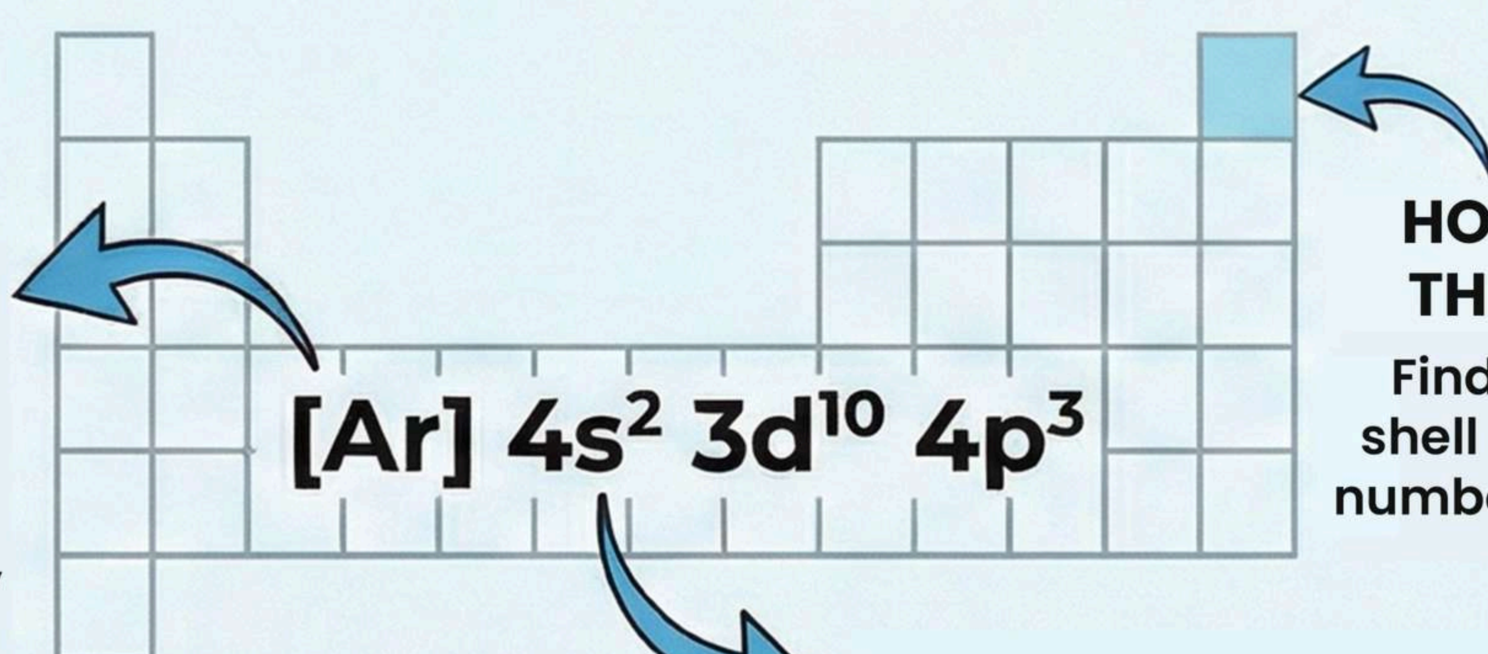
$1s^2\,2s^2\,2p^6\,3s^1$

Superscripts Number of electrons

Special Case: The Stability Rule
Half-filled (d^5) and completely-filled (d^{10}) subshells are extra stable, causing exceptions (e.g., Cr, Cu)

SECTION 3: USING CONFIGURATION TO FIND AN ELEMENT'S ADDRESS

HOW TO FIND THE BLOCK
Look at the last subshell filled. The letter (s, p, d, or f) is the block.



HOW TO FIND THE PERICOD
Find the highestt shell number. That number is the period.

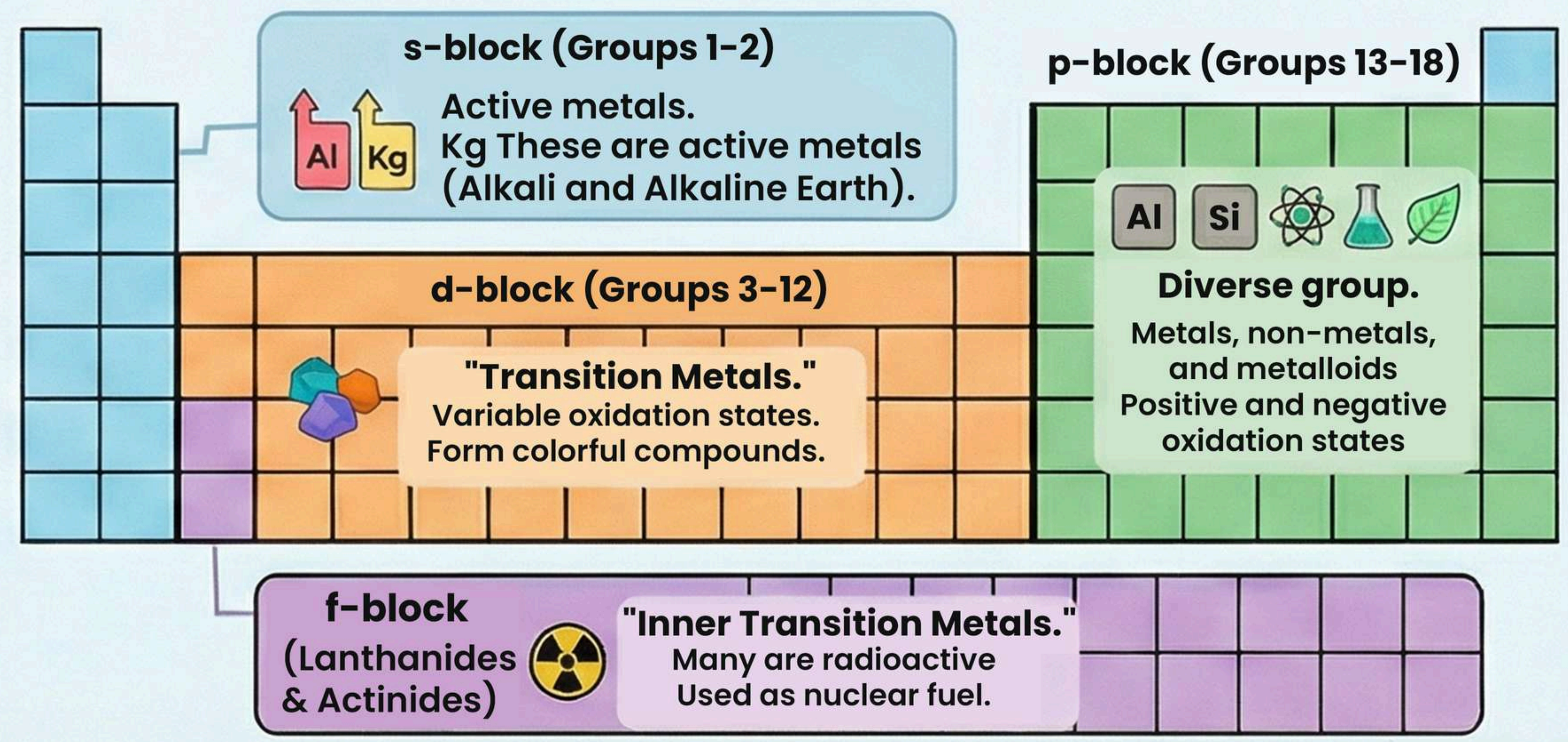
HOW TO FIND THE GROUP

s-block:
Group electrons ain outermost 's'.

p-block:
Group=10+ (total electrons in outermost 's' and 'p').

d-block:
Group (electrons in outermost 's') + (electrons in inner 'd').

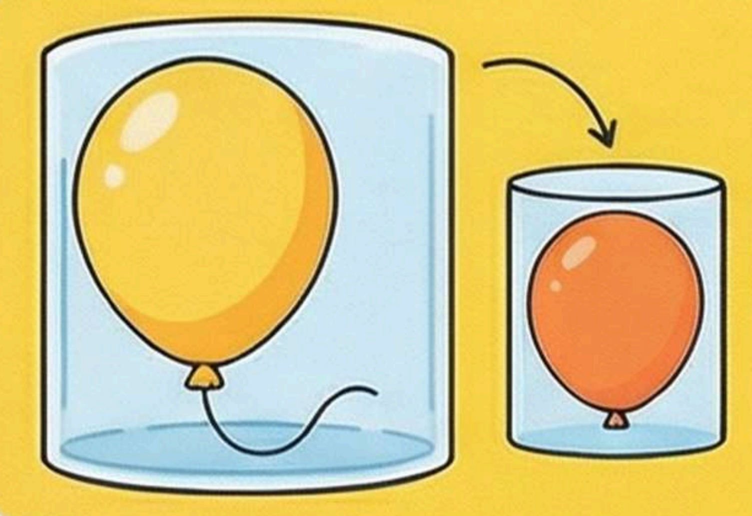
SECTION 4: QUICK FACTS ABOUT THE BLOCKS




Electrochemistry
It Happens in Electrochemical Celle
Powering Our Daily Lives
GALVANIC CELLS
(Makes Electricity)
Energy Conversion:
Chemical Energy → Electrical Energy
(Spontaneous)
Salt bridge
Anode (-)
Oxidation
Cathode (+)
Reduction
Zn
Cu
$Zn \rightarrow Zn^{2+} + 2e^-$
$Cu^{2+} + 2e^- \rightarrow Cu$
Zine Sulphate
Daniel Cell
Copper Sulphate
Chemical Reaction
Electricity
What is Electrochemistry?
The study of reactions that produce electricity and reactions caused by electricity.
Energy Conversion:
Electrical Energy → Chemical Energy
(Non-spontaneous)
Anode (+)
Oxidation
Electrolysis
Setup
Cathode (-)
Reduction
Al
Electroplating
Production of
Metals & Non-Metals
Purification
of Metals
THE REACTIVITY
SERIES OF METALS
Potassium (K)
Sodium (Na)
Calcium (Ca
Magnesium (Mg)
Aluminium (Al)
Zino (Zn)
Lead (Pb)
Hydrogen (H)
Copper (Cu)
Silver (Ag)
Gold (Au)
Everyday Batteries
Primary Cells
(Use and Throw)
eg., Dry cells, Button cells
Cannot be recharged
Secondary Cells
(Rechargeable
e.g., Lead-acid, Nickel-cadmium
-Recharged by electric current
Lithium-ion Batteries
(Modern & Powerful)
e.g, Smartphones, EVs
High energy density, long life
Use 1: Predicting Displacement Reactions
Zn
$CuSO_4$
Cu
A more reactive metal displaces a less reactive one from its salt solution
Use 2: Reacting with Acids
H_2
H_2
H^+
H^+
H^+
Mg
Cu
Metals *above* Hydrogen displace hydrogen gas from dilute acids

Gas Laws and Mole Concept

The World of Gases: Properties & Measurements



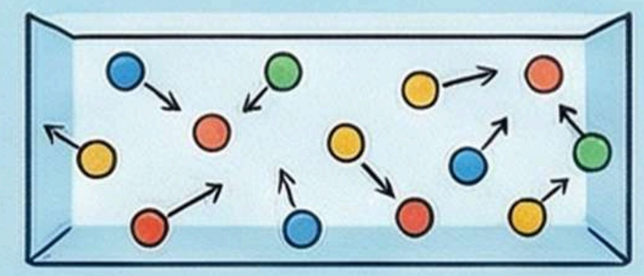
Volume (V)

Volume of a gas = Volume of its container.

Expands to fill any space.

Common unit: Litre (L)

What Makes a Gas a Gas?



According to the Kinetic Molecular Theory, gas molecules are far apart, move constantly and randomly, and have very weak attraction to each other.

Pressure (P)

Force created by gas molecules colliding with container walls.

Measured in atmospheres (atm).

Temperature (T

Measures average kinetic energy of gas molecules.

ALWAYS use Kelvin (K) scale for gas laws.

Celsius to Kelvin Conversion
K=°C + 273

The Rules Gases Follow: Key Laws

Boyle's Law: Pressure & Volume

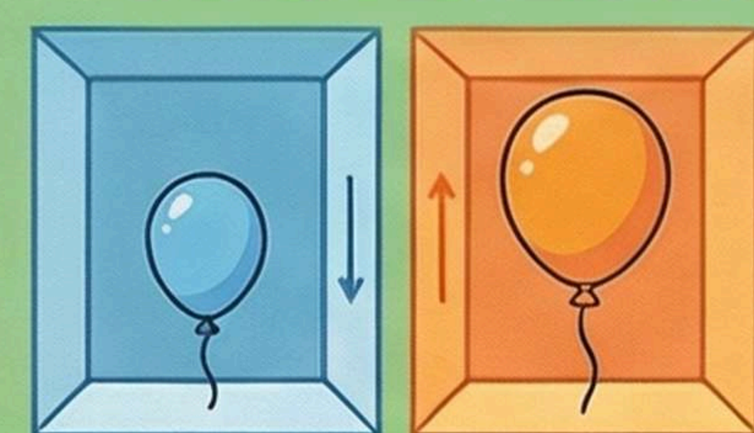
Constant T

When pressure increases, volume decreases.

$P_1V_1 = P_2V_2$

Air bubbles in an aquarium enlarge as they rise (pressure decreases).

Charles's Law: Volume & Temperature



Constant P

When temperature increases, volume increases.

$\frac{V_1}{T_1} \quad \frac{V_2}{T_2}$

A balloon infletes slightly when moved from a cold room To a warm room

Avogadro's Law: Volume & Molecules

Constant T & P

Equal volumes = Equal number of molecules.

More molecules = More volume

Vαn (n = moles)

How to Count Particles: The Mole Concept

Avogadro's Number (N_A)

6.022×10^{23} particles

The "magic number: 1 mole of ANY substance contains this many particles.

What is a Mole?

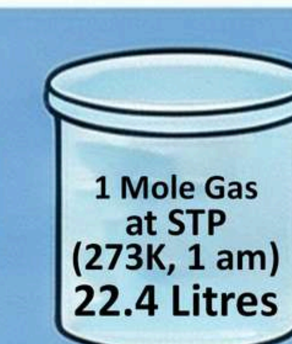
A unit to count huge numbers of particles (atoms, molecules) Think of it like a "chemist's dozen"

Molar Mass

Mass of 1 mole in grams.

Equals molecular mass (e.g., Molar Mass of H_2O is 18 g).

Molar Volume at STP

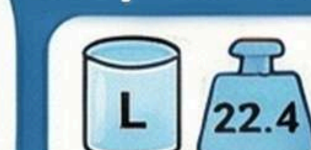


At STP, 1 mole of ANY gas occupies 22.4 Litres

Key Calculation: Moles from Mass

$$\text{Number of moles} = \frac{\text{Given volume (g)}}{\text{Molar mass (g/mol)}}$$

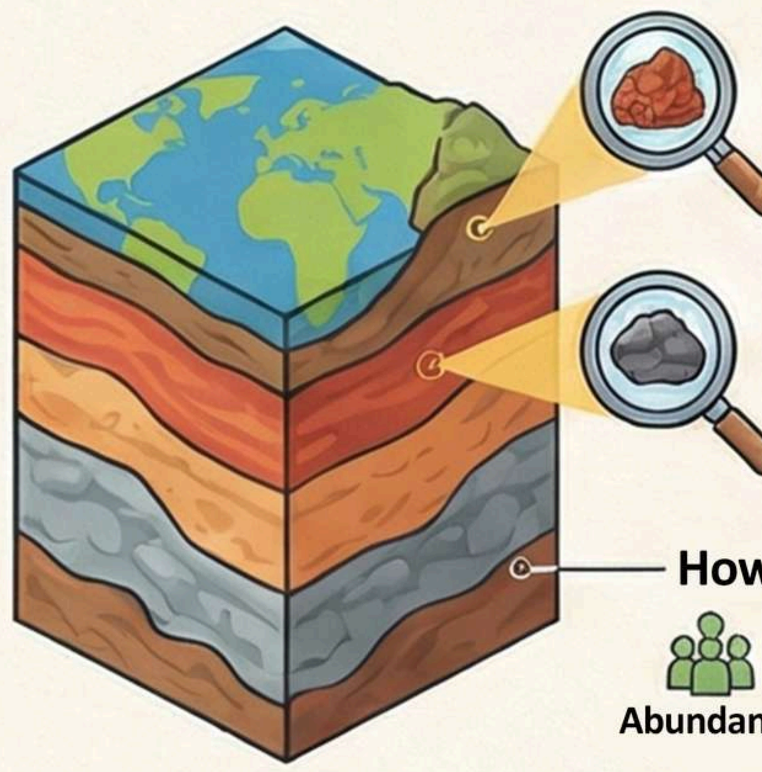
Key Calculation: Moles from Volume (at STP)



$$\text{Number of moles} = \frac{\text{Given volume (L)}}{\text{22.4 (L/mol)}}$$

Metals

1. Finding Our Metals: Minerals and Ores



What is a Mineral?
Minerals are naturally occurring substances in the earth's crust that contain metals or their compounds.

What is an Ore?
An ore is a mineral from which a metal can be extracted easily, conveniently, and at a low cost. All ores are minerals, but not all minerals are ores.

How to Choose a Good Ore

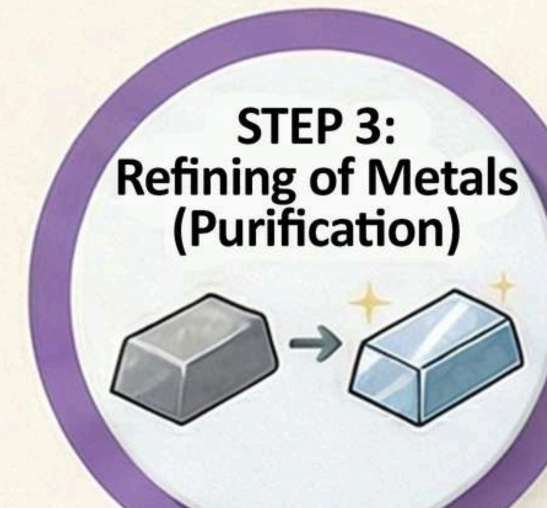
Abundance · High Metal Content · Easy Extraction · Low Cost

Example: Bauxite is the chosen ore for aluminium.

Common Ores

Metal	Ore Name	Chemical Formula	
Aluminium (Al)	Bauxite	$Al_2O_3.2H_2O$	
Iron (Fe)	Haematite	Fe_2O_3	
Copper (Cu)	Copper Pyrites	$CuFeS_2$	
Zinc (Zn)	Zinc Blende	ZnS	
Zinc (Zn)	Calamine	$ZnCO_3$	

2. The Journey of Metallurgy: A 3-Step Process



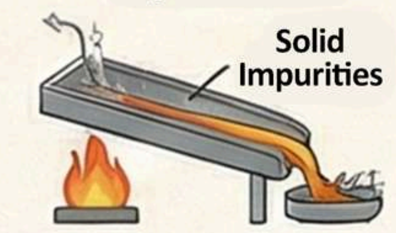
STEP 1: Concentration of the Ore (Cleaning)
This is the first step, where we remove earthly impurities like soil and sand (called 'gangue') from the ore. The method used depends on the properties of the ore and the gangue.

STEP 2: Extraction of Metal from Concentrated Ore
This step Involves converting the concentrated ore into crude metal. The method depends on the metal's position in the reactivity series.

STEP 3: Refining of Metals (Purification)
The crude metal obtained after extraction still has impurities. Refining is the final process to get a pure metal.

Common Refining Methods

Liquation

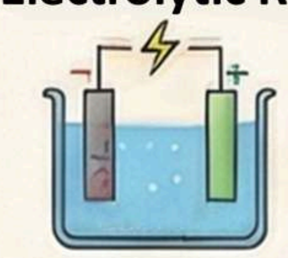


Used for metals with low melting points (like Tin). The impure metal is heated and the pure metal melts and flows away, leaving impurities behind.

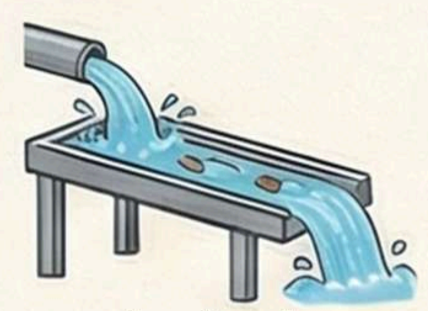
Distillation

Used for metals with low boiling points (like Zinc).

Electrolytic Refining

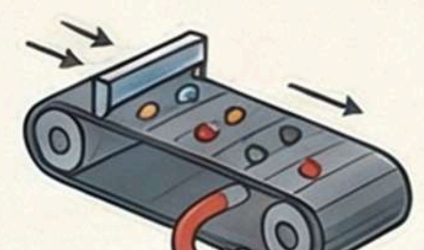


Common Concentration Methods



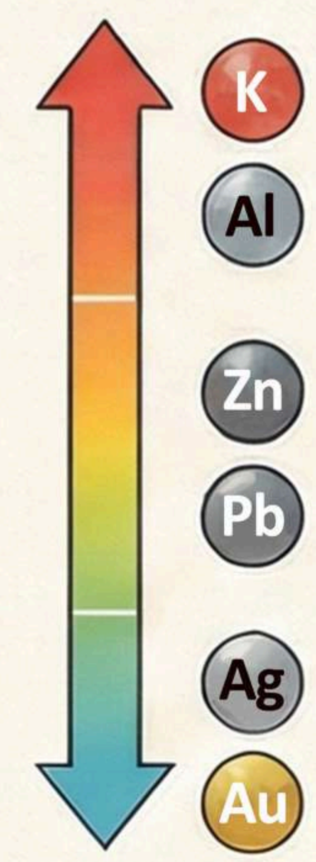
Levigation (Hydraulic Washing)

Froth Flotation



Magnetic Seperation

Leaching

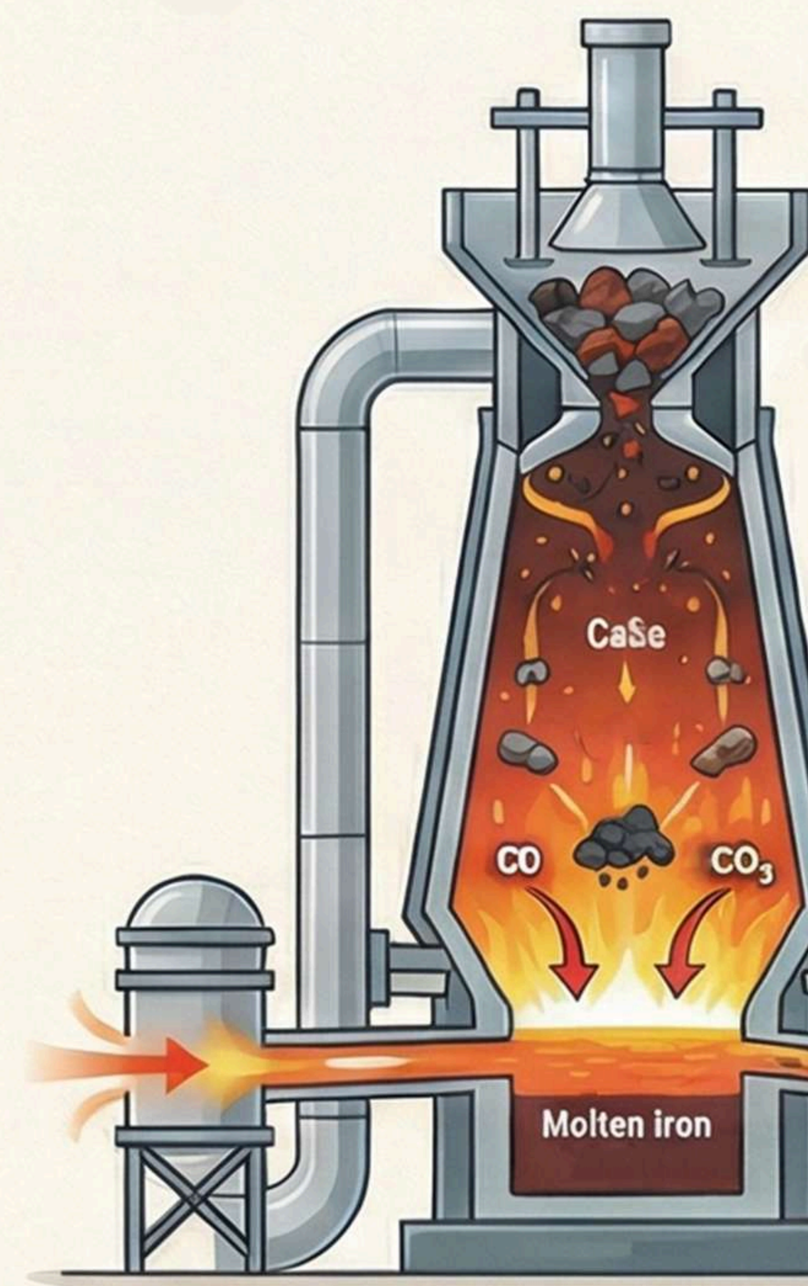


High Reactivity Metals (K, Na, Al)
Extracted using electrolysis, as they form very stable compounds.

Medium Reactivity Metals (Zn, Fe, Pb)
Extracted by chemical reduction, usually using carbon (coke), insolves two stages; converting to oxide (roasting/calcination) then reducing to get metal.

Low Reactivity Metals (Ag, Au)
Often found in their free slate and require minimal processing.

3. Spotlight on Iron: The Blast Furnace



1. The Charge

Iron ore (Heamatite) · Coke (Carbon) · Limestone

2. The Reactions

$$Fe_2O_3 + 3CO \rightarrow \underbrace{2Fe}_{\text{Molten iron}} + 3CO_2$$

3. Removing Impurities

Limestone + Sand (gangue) → Slag ($CaSiO_3$) (Molten Waste)

4. Collection

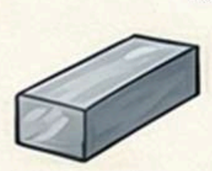
Molten Slag

4. More Important Concepts for Your Exam

What are Alloys?

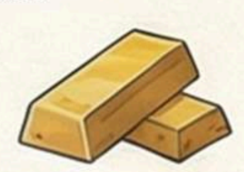
Alloys are homogeneous oristures of two or more metals, or a metal and a non-metal, created to improve properties like strength or resistance to rust.

Key Alloys to Remember



Steel: An alloy of Iron and Carbon.

Stainless Steel: An alloy of Iron, Chromium, and Nickel that resists corrosion.

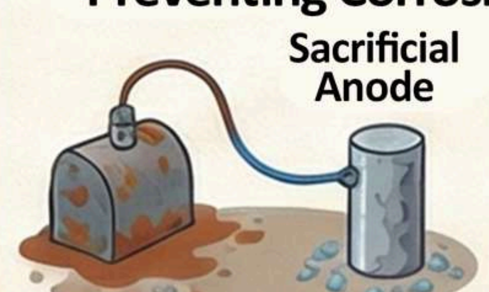


Brass: An alloy of Copper and Zinc.

What is Corrosion?

Corrosion is the gradual destruction of metals due to chemical reactions with their environment, such as air and water. The most caramon example is the rosting of iron.

Preventing Corrosion: Cathodic Protection



To protect a metal like iron, it can be connected to a more reactive metal (like zinc or magnesium). The more reactive metal will corrode first, sacrificing itself to protect the iron.

Industrial Chemicals & Reactions

AMMONIA (NH_3): The Fertilizer Foundation

What is Ammonia?
Colorless gas, pungent smell. Crucial for nitrogen-based fertilizers.

Ammonia is a Base
Basic nature. Turns moist red litmus paper bloe. Forms Ammonium hydroxide (NH_4OH) in water.

Industrial Production: The Haber Process

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + \text{heat}$$

Step 1: Reactants
- N_2 gas (1vol)
- H_2 gas (1vol)

Step 2: Optimal Conditions
- High Pressure
- 450°C Temp
- Sponge iron Catalyst

Everyday Uses of Ammonia
- Fertilisers (urea)
- Refrigerant
- Artificial fibers (nylon, rayon)

SULPHURIC ACID (H_2SO_4): The King of Chemicals

The King of Chemicals
Used in countless substances: fertilizers, paints, detergents, fibers.

Industrial Production: The Contact Process

Step 1: Make Sulphur Dioxide (SO_2)	Step 2: Make Sulphur Trioxide (SO_3)	Step 3: Create Oleum	Step 4: Dilute to H_2SO_4
$S(g) + O_2(g) \rightarrow SO_2(g)$	$2SO_2(g) + O_3(g) \rightleftharpoons 2SO_3(g)$ (V_2O_3 catalyst, ~450°C)	$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ (Oleum)	$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$ (Concentrated Acid)

Dehydrating Agent
Removes water elements. Example: Sugar ($C_{12}H_{22}O_{11}$) to black carbon.

Oxidizing Agent
Strong oxidizing agent, reacts with metals and non-metals.

CHEMICAL EQUILIBRIUM & REACTIONS

FERTILIZERS: Food for Plants

What are Fertilizers?
Natural/artificial substances for plant growth.

Primary Nutrients (NPK):
Nitrogen (N), Phosphorus (P), Potassium (K).

Nitrogenous Fertilizers
Accelerate growth. Examples: Urea, Ammonium sulphate.

Phosphate Fertilizers
Help growth, increase productivity. Example: Ammonium phosphate

Potash Fertilizers
Increase productivity, boost immunity. Example: Potassium chloride.

UNDERSTANDING CHEMICAL REACTIONS: EQUILIBRIUM

Reversible Reactions
Forward reaction: reactants become products.
Backward reaction: products become reactants.

$\rightleftharpoons$

Chemical Equilibrium
Forward reaction speed equals backward reaction speed.

Le Chatelier's Principle Explained
System adjusts to counteract changes in concentration, pressure, or temperature.

Effect of Concentration
Increasing reactant concentration speeds up the forward reaction. Removing the product also speeds up the forward reaction.

Effect of Pressure
Increase pressure favors direction producing fewer gas molecules (moles).

Effect of Temperature
Increase favors endothermic. Decrease favors exothermic.

Role of a Catalyst
Speeds up both forward and backward reactions equally, faster equilibrium.