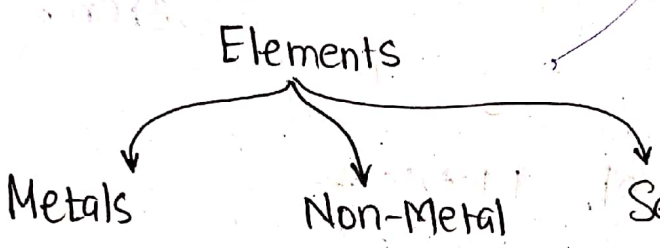
The easiest way to start grouping metals and non-metals is just by comparing some physical and chemical properties.

These are elements



Physical Properties:-

→ Shiny (lustrous)
→ Good conductor of heat & electricity.
→ Density & MP are high
→ Opaque
→ Ductile
→ Malleable (Mouldable)

Chemical Properties

→ No of electron are 1, 2, 3 in outermost shell.
→ Can lose electrons
→ Easily form oxides
→ Oxides are of basic nature
→ Low electronegativities
→ Get rust if exposed to moisture.

Non Metal

- Poor conductor of heat & electricity
- Non-ductile
- Brittle in Nature
- Not sonorous
- Generally transparent,

★ No of electrons is generally 4-8.
★ Easily gain valence electrons
★ Oxidising agents.
★ High electronegative elements
★ Forms acidic oxides.

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→ Exist generally in Solid State. (excep → Hg)

→ Are hard. (excep → Na)

→ Generally grey in color.

→ Metal forms an alloy, with other Non-Metals.

→ There exist in all three states.

→ Non metals take different forms (Allotropes)
ex- Carbon
Hydrogen

→ Iron — Austenite
ferrite.

Physical Properties of Metals :-

- Metals are Malleable – All the metals can be beaten into thin sheets, with a hammer.
  ex- gold, AL, Silver.

→ Metals are strong - but they can be easily bent or shaped – they can be deformed.

- Ductility – It is the ability of material to be drawn or plastically deformed without fracture.
  - It is the property that describes the ability of material to stretch thin when tensile stress are applied

→ here CSA is reduced but vol is constant.
ex- Cu, Al, steel.

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malleability or hardness can be explained – Metallic bonds tend to have weak intermolecular force.

Compact & Rigid structure — Most metals – have high inter molecular force of interaction & thus really little molecular spaces – resulting in compact & rigid structures –

Lustre → It is the physical property which occurs due to reflections of photons – by mobile electrons on the metal surface or inside the surface.

★ Metals are good conductors of Heat & electricity

Metals are good conductors of heat

⇒ Their particles are closely packed so the vibrations are passed on very quickly. They contains large nm of free electrons, these drift / swift slowly in the structure.

As metal is heated, the atoms closest to the HAZ are excited & transfer their energy to neighbouring atoms and ~~are~~ this process continues till thermal equilibrium is achieved.

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Hardness ⟶ It is ability of material to resist abrasion or penetration on its surface

→ Resistance to scratch.

→ As hardness increases – brittleness increases – i.e there will be higher risk of cracking as hardness increases.

Toughness ⟶ It is the ability of material to resist impact (absorb the energy)

→ higher toughness lesser is risk of cracking.

Sonorous ⟶ It is the physical properties of metal by which sound is produced when metal is struck.

exception → lead.

– Molecules of solid substance on coming contact with molecules of another solid substance causes formation of sound.

– In metals atoms – has a tendency to vibrate to & fro motion, in its own position, this tendency of metals to oscillates in its own position causes disturbances & this disturbances produces sound.

→ ★ Metals form dislocations & point defects which can absorb large energies – thats why metals are tough.

★ Many other metallic properties such as electrical conductivity

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Chemical Properties of Metal & Non-Metals

a) Reaction of Metal with Oxygen

- Metals react with oxygen to form oxides.

$$\text{Metal} + \text{Oxygen} \longrightarrow \text{Metal Oxide}$$

$$4Na + O_2 \longrightarrow 2Na_2O$$

$$2Mg + O_2 \longrightarrow 2MgO$$

Metallic oxides are generally basic in Nature.

$$2Cu + O_2 \longrightarrow 2CuO$$

- Some metals oxides - shows both acidic & basic behaviours to produce salt & water - amphoteric oxides.

$$Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$$

$$Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$$

- Metallic oxides are insoluble in water - but some of them dissolve in water to form alkalis.

ex - $Na_2O(s) + H_2O(l) \longrightarrow 2NaOH(aq)$

$K_2O(s) + H_2O(l) \longrightarrow 2KOH(aq)$

- Metals such as K, Na - react vigorously with air - and they catch fire - so they are kept in Kerosene oil.

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Reaction with Water:-

Metal + Water ⟶ Metal hydroxide + H_2 gas

Metal + Water ⟶ Metal oxide + Hyd gas

- Metals react with water - & produces a metal oxide and hydrogen gas.

Metal oxides that are soluble in water dissolve in it to further form metal hydroxide.

$$2K(s) + 2H_2O(l) \longrightarrow 2KOH(aq) + H_2(g) + \Delta H$$

$$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g) + \Delta H.$$

$$Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$$

Non-Metals do not react with water.

Reaction of Non-Metals with Air

Non-Metal + Oxygen ⟶ Non-Metallic Oxide

$$C + O_2 \longrightarrow CO_2 \text{ (carbon dioxide)}$$

$$S + O_2 \longrightarrow SO_2 \text{ (Sulpher dioxides)}$$

These oxides dissolve in water to form Acids.

$$CO_2 + H_2O \longrightarrow H_2CO_3 \text{ (Carbonic Acid)}$$

$$SO_2 + H_2O \longrightarrow H_2SO_3 \text{ (Sulphurous Acid)}$$

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★ Reaction With Acids:-

Metal + Dilute Acid ⟶ Salt + Hydrogen gas

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

Zinc — Sulphuric Acid — Zinc Sulphate — Hydrogen gas

$Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$

→ Non-metals donot react with Acids.

★ Reaction with Base

Metals → Most metals do not react with bases.
Only a few like AL, Zn, Pb, react with strong solution of bases to produce a compound of metal and hydrogen gas.

Non Metals → Reaction of Non-Metals with base are quiet complex.

Displacement Reaction

K (Potassium) – Na (Sodium) – Ca (Calcium) – Mg (Magnetium) – Al (Aluminium) – Zn (Zinc) – Fe (Iron) – Sn (Tin) – Pb (lead) – H

Cu (Copper) – Hg (Mercury) – Ag (Silver) – Au (Gold) – Pt (Platinum)

In displacement reaction, a metal react with a salt sol^m and displaces the metal present in it.

→ Displacement reaction are explained on basis of activity series.

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A metal will only react with a salt soln if it is placed higher in activity series than metal in the salt.

ex → (A) $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

$Ag + CuSO_4 \longrightarrow$ No reckn

Metal A + Salt soln of B → Salt soln of A + Metal B.

Uses of Metal & Non Metal

Metal

→ Al metal in form of Alloys is used to make aeroplane

→ Silver & gold → in jewellery.

→ Zinc Metal is used in galvanizing iron so as to prevent it from rusting.

→ Copper Metals - is used to make electric wires, motors, utensils.

Non-Metals :-

→ Oxygen is used by Plants & animals for breathing.

→ Chlorine is used in purification of water.

→ Nitrogen is used in fertilisers.

→ Sulpher is used in Vulcanisation of rubber.

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