

METALS AND NON-METALS

PHYSICAL PROPERTIES :-

METALS

- (1) Lustrous : have shining surface (in pure state).
Metallic lustre
- (2) Generally Hard
- (3) Malleability : property of substance that it can be beaten into thin sheets.
(Gold and silver most malleable)
- (4) Ductility : Ability of metals to be drawn into thin wires. Eg of Gold metal \rightarrow 2km length of wire.

Trick

- ★ MALL SHEET - Ek mall ke andar bahut sari paper ki sheet padi hue hai.
- ★ DUCK WIRE - Ek duck ko wire se bandh diye hai.

- (5) Good conductor of Heat. Best are silver, copper.
- (6) Good conductor of electricity. Best are silver, copper, Gold.
- (7) Have High Melting point.
- (8) sonorous : Metals produce a sound on striking a hard surface.
- (9) Physical state : All metals except mercury exist as solids at room temperature.

NON-METALS

- (1) Non-Lustrous.
- (2) Generally soft.
- (3) Non-malleable.
- (4) Non-ductile

(5) poor conductor of Heat.

(6) poor conductor of electricity.

(7) Low melting point.

(8) Non-sonorous.

(9) solid \rightarrow Carbon, sulphur
liquid \rightarrow Bromine
Gases \rightarrow Nitrogen, Cl_2 , oxygen, F_2

EXCEPTIONS

METALS

- (i) Alkali metals :- Li, Na, K are so soft that they can be cut with a knife.
(also Ga and Cs)

Trick

Na K Ce Ga Li me chaku chalaya.

- (2) Gallium (Ga) and Cesium (Cs) very soft and have very low melting point. They melt if you keep them on your palm.

Trick

Chess khelti Ga ko hath me Rakha, Pighal gayi.

- (3) Mercury is poor conductor of Heat (exists as liquid)

Trick

Mercury planet pe doop nahi aati.

- (4) Lead (Pb) is a poor conductor of electricity.

Trick

Pb me light chali gayi.

NON-METALS

- (1) Iodine and Graphite are lustrous.

Trick Pencil me Iodex lagaya chamakne lagi.

- (2) Diamond (form of carbon) is Hardest Natural substance. It has high melting and Boiling point.

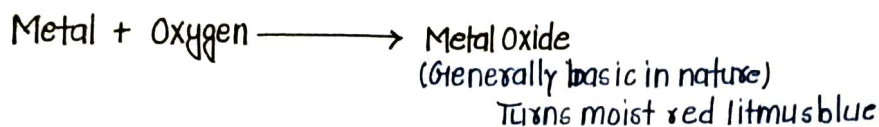
Trick

Matboot Heere ko hathode se toda tave pe garam kiya, beasar rha.

- (3) Graphite (form of carbon) is Hardest lustrous, conducts electricity.

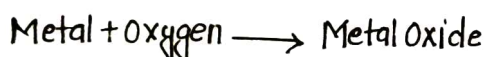
- (1) Copper and Aluminium are used for making cooking vessels. They are good conductors of heat and they do not melt (have high melting point).
- (2) Carbon is a non-metal that can exist in different forms. Each form is called an Allotrope. Example - Graphite, Diamond, Coal.

CHEMICAL PROPERTIES :-

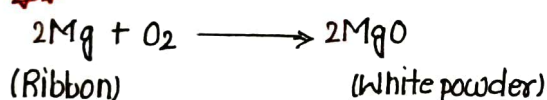


K and Na react so vigorously with oxygen that they catch fire. (Burns in air) even if kept in the open.

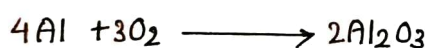
They are kept inside kerosene oil to
(i) protect them from burning in air.
(ii) Prevents accidental fires.



☆☆

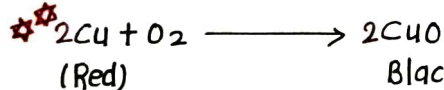


✓ Mg ribbon burns with dazzling white light.



✓ Aluminium burns with a brilliant white flame.

☆☆



✓ Cu does not burn (takes long time)

☆ Gold and silver do not react with oxygen even at high temperature.

FLAME TEST :-

Element	Ion	Flame test colour
Lithium	Li^+	Crimson
Sodium	Na^+	Yellow
Potassium	K^+	Lilac
Calcium	Ca^{+2}	Orange red
Copper	Cu^{+2}	Green

Yellow sun \longrightarrow yellow sodium

Green cop \longrightarrow copper

Liquor \longrightarrow Lithium crimson

Black bike \longrightarrow $KaLi$

Car orange \longrightarrow calcium orange.



Trick

Bhari dhup mein. Ek admi car chalte huye Arha hai. car ke upar orange rakhe huye hai. Ek police wala kaale rang ke bike se aya. Aur ushe liquor offer kiya.

Amphoteric oxide :-

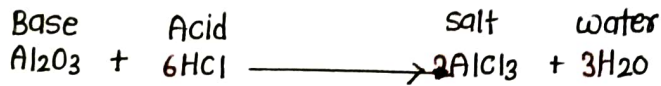
Metal Oxides are generally basic in nature. Turns moist red litmus blue.

Example - MgO , CuO , Na_2O , K_2O , Fe_2O_3

★ But some metal oxides show both acidic and basic nature called **Amphoteric oxide**.

Example - Oxides of Al and Zn

Trick $\frac{\text{Zanebey Ali}}{(Zn)} \frac{(Al)}{(Al)}$



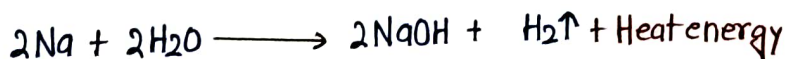
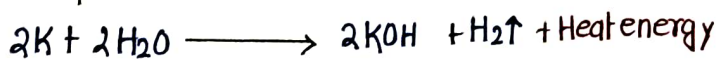
Reaction with water :-



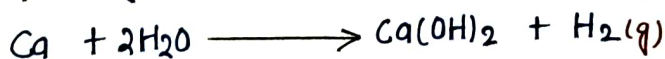
Trick

Potassium	Kudi	K	coldwater	Hydrides
Sodium	Naal	Na		
Calcium	car	Ca		
Magnesium	Mango	Mg	Hotwater	oxides
Aluminium	Alto	Al	steam	
Zinc	Zisko	Zn		
Iron	fir	Fe		
Lead	Iekar	Pb	Donot react with water	★ Ca and Mg floats in water
Hydrogen	Hum	H		
Copper	chale	Cu		
Mercury	Mathura	Hg		
Silver	sath	Ag		
Gold	Ghumne	Au		

★ Na reacts violently with coldwater. Reaction is highly exothermic. $H_2(g)$ evolved catches fire.



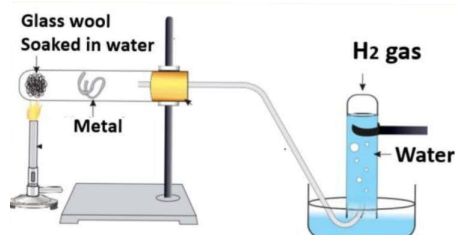
★ Ca reacts less violently with cold water. $H_2(g)$ does not catches fire. Ca starts floating in water as bubbles of $H_2(g)$ sticks to surface of Ca.



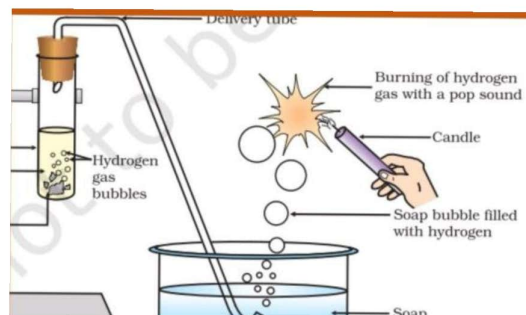
- ★ **Mg** reacts with hot water. it also floats due to the $H_2(g)$ bubble sticking to its surface.



- ★ **Al, Zn, Fe** reacts with steam to form oxides.

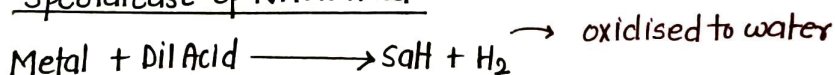


Reaction with Acids :-

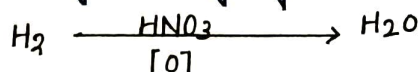


- Bubbles of $H_2(g)$ are formed. $H_2(g)$ Burns with a pop sound and Extinguishes a burning candle.
- Rate of formation of bubble.
 - $Mg > Al > Zn > Fe$
- Heat is evolved (exothermic Reaction order is same).

Specialcase of Nitric Acid



- ✓ $H_2(g)$ not evolved when a metal reacts with dil HNO_3 (nitric acid). HNO_3 is strong oxidising agent. it oxidises the $H_2(g)$ produced to



and itself gets reduced to (NO, NO_2, N_2O)

only Magnesium (Mg) and Manganese (Mn) reacts with very dil. HNO_3 to give $H_2(g)$.

Displacement Reaction :-



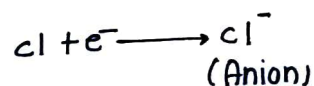
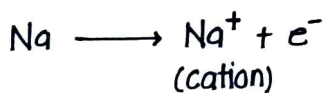
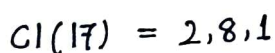
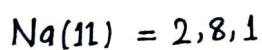
- $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$
(Blue) (aq) (Red)
- $Fe + CuSO_4 \longrightarrow FeSO_4(aq) + Cu$
(Green) (Red)
- $Cu + ZnSO_4 \longrightarrow CuSO_4 + Zn$

Metal and Non-Metal React \rightarrow ionic compound Electrovalent compound

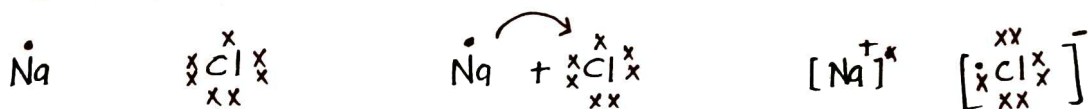
<u>Element</u>	<u>Atomic No.</u>	<u>Electronic configuration</u>	
Sodium (Na)	11	2, 8, 1	} Metal (lose e^-)
Magnesium (Mg)	12	2, 8, 2	
Calcium (Ca)	20	2, 8, 8, 2	
Chlorine (Cl)	17	2, 8, 7	} Non-met (gains e^-)
Oxygen (O)	8	2, 6	

Complete octet last shell = $8e^-$

Formation of sodium chloride ($NaCl$)

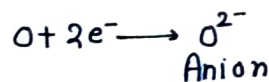
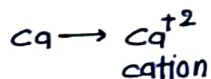
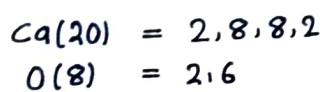


e^- dot structure

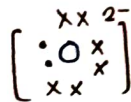


- Na^+ and Cl^- ions (oppositely charged) attract each other.
- Na^+ and Cl^- are held together by strong electrostatic forces of attraction.
- Sodium chloride ($NaCl$) do not exist as molecule but as combination of oppositely charged ions \rightarrow ionic compound Electrovalent compound.

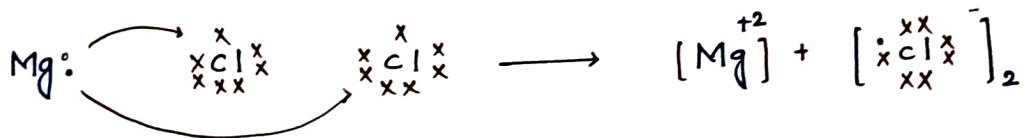
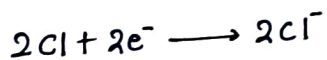
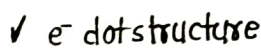
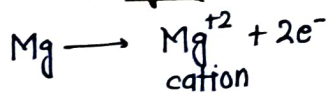
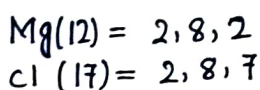
formation of calcium oxide



✓ e⁻ dot structure



formation of Magnesium chloride ($MgCl_2$)



ionic/ Electrovalent Compounds properties :-

- (1) Hard, solid Compounds because of strong force of attraction between +ve and -ve ions.
- (2) Brittle in nature, Breaks into pieces if pressure is applied.
- (3) Have High Melting and Boiling points because large amount of energy is required to break strong inter-ionic attraction.
- (4) Generally soluble in water but insoluble in organic solvents like kerosene, petrol, alcohol etc.
- (5) In solid state do not conduct electricity as ions cannot move because of strong electrostatic force of attraction.
- (6) In molten state, Heat Energy weakens the strong electrostatic forces of attraction and ions can move freely, hence in molten state conducts electricity.
- (7) In aqueous solution, conducts electricity as solution of ionic compound in water contains ions. Ions move to opposite electrodes. (water weakens the strong electrostatic forces of attraction between ions)

Extraction of Metals :-

Minerals :- Elements or compound which occur naturally in earth's crust.

Ores :- Those minerals which contain a very high % of a particular metal and metal can be profitably extracted from it, are called ores.

Gangue :- impurities like soil, sand, etc present in metal ore.

⑤ $\left. \begin{array}{l} K \\ Na \\ Ca \\ Mg \\ Al \end{array} \right\}$ Top in Activity Series
Very Reactive, so never found in free state as free metal.



③ $\left. \begin{array}{l} Zn \\ Fe \\ Pb \end{array} \right\}$ Middle of Activity series
moderately reactive. found in Earth's crust in form of oxides, sulphides and carbonates.

Trick
C O S \rightarrow sulphides
oxide
carbonates

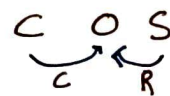
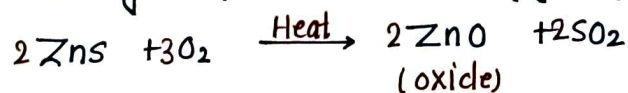
Free Comb ko silver Cup me Mercury liquid me dubaya.

⑤ $\left. \begin{array}{l} Cu \\ Hg \\ Ag \\ Au \\ Pt \end{array} \right\}$ least reactive, hence found in free state as free metals
low in Activity series

Extracting Metal \rightarrow Middle of Activity series

- 1) Present as oxide, sulphides or carbonate in nature.
- 2) sulphides / carbonates converted to oxide as it's easy to attract metal from oxide.

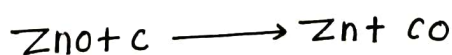
• Roasting :- Heating sulphides ores strongly in presence of excess air.



• Calcination :- Heating carbonate ores strongly in limited air.



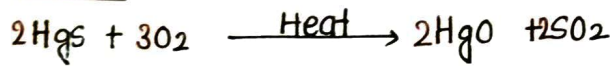
Now, metal oxide is reduced (removal of oxygen) with help of Reducing agent Carbon (coke).



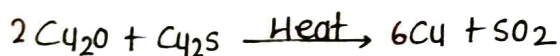
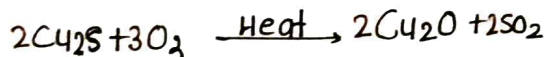
Extracting Metals low in Activity series

- Their sulphides are converted to oxides.
- The oxides on heating convert to metal, no reducing agent used.

★ Cinnabar (HgS) $\xrightarrow{\text{oxide Roasting}}$



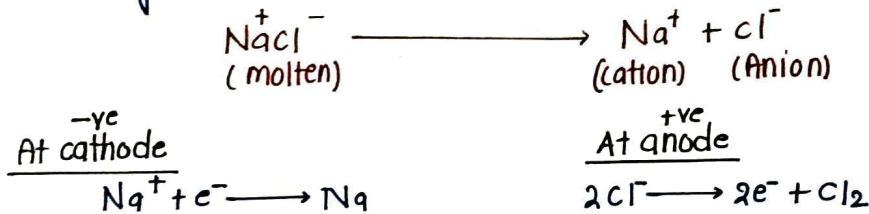
★ Cu₂S



K	
Na	
Ca	Electrolysis
Mg	
Al	
Zn	
Fe	Reduction using carbon
Pb	
Cu	
Ag	Found in native state
Au	

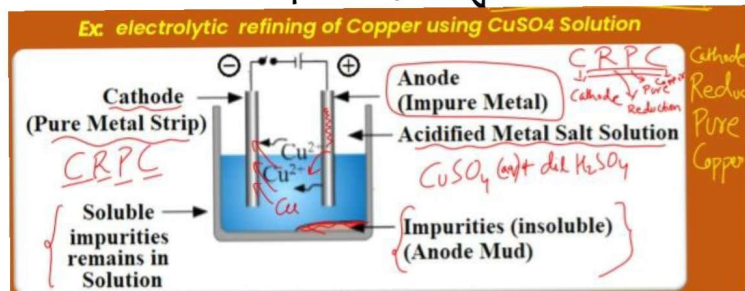
Extracting Metals - Top of Activity series

- Carbon cannot reduce their oxides, these metals are very reactive and have more affinity (likeness) for oxygen than carbon.
- Such metals are obtained by electrolytic reduction (Reduction with help of electric current).
- Na, Ca, Mg \rightarrow electrolysis of molten chlorides: Al form oxides



Refining of Metals

- Metals obtained after carbon reduction or electrolyte reduction is not very pure.
- The most common method for refining metal is Electrolytic refining.



At Anode :- Pure copper enters solution.

At cathode :- Equivalent amount of pure copper from solution deposits at cathode.

Galvanisation :-

- steel and iron are coated with thin layer of zinc.
- it is done through electrolysis.
- it does not change property of metal.

Anodising
 Al_2O_3 • process of forming a thick oxide layer of Al.
• This layer prevents corrosion of metal.
• The oxide layer also give articles attractive finish.

Alloy :- A homogenous mixture of two or more metals or a metal and non-metal.

step-1: Melting primary metal.

step-2: Dissolving other elements in fixed proportions.

step-3: cooling to room temperature.

★ The properties of An alloy is different from the metals from which it is obtained.

(1) Pure iron is very soft and stretches easily when hot

Pure iron + carbon (0.05%) → Hard and strong iron carbon Alloy

(2) stainless steel - iron + Nickel + chromium
Hard and do not rust.

(3) Amalgam - Alloy in which one metal is mercury.

(4) Brass (BcoZ) - Alloy of Zn + Cu.

(5) Bronze (CoaT) - Alloy of copper and Tin (Cu + Sn)

(6) Solder (SoTeLa) - Alloy of Lead and Tin (Pb + Sn)

Trick

steal ke rod par
crow ne nicker
Pehan kar baitha hai



Trick

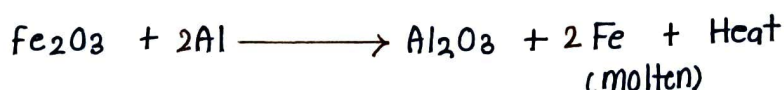
★ Brass (BcoZ) ⇒ Poor conductor of electricity
 Cu Zn

★ Solder
 ↓
has low
melting point.

iron crow Nicker
 ↓ ↓ ↓
iron chromium Nick

★ Bronze (CoaT) ⇒ poor conductor of electricity
 Cu Tin

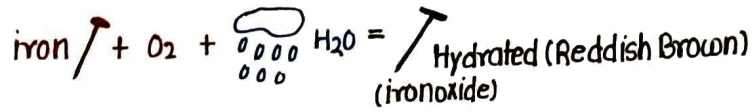
Thermit Reaction / Welding :-



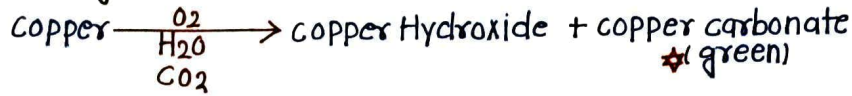
The above reaction is so highly exothermic, that heat given out produces metal in molten state. This molten metal is used to join railway tracks or cracked machine parts. This reaction is known as thermit reaction.

Corrosion :- When a metal is attacked by substances around it such as moisture (water vapour + oxygen), acid etc it is said to be corrode and this process is called corrosion.

(i) Rusting of iron.



(ii) Tarnishing of copper.



(iii) Tarnishing of silver.



Note :- Corrosion is an example of oxidation.



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