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e content preparation
CLASS X -SCIENCE
CHAPTER NO:3

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Properties of Metals

Properties	Exceptions
1. Generally solids	• Mercury is a liquid • Lithium , Sodium are soft
2. Hard	
3. Malleable and ductile(gold is the most ductile metal)	
4. Good conductors of heat and electricity (Silver & copper is the best conductor)	
5. Metallic Lusture	
6. Sonorous	
7. High m.p and b.p	• Gallium and cesium have very low m.p –melts in the palm

Properties of Non-metals

Properties

1. Generally solids or gases
2. Soft
3. Brittle
4. Bad conductor of heat and Electricity
5. No Lusture

Exceptions

- Bromine is a liquid
- Diamond- an allotrope of carbon is the hardest substance
- Graphite is a good conductor
- Iodine shows lusture

Chemical Properties of Metals

Reaction with Air/Oxygen

- Almost all metals combine with oxygen to form metal oxides.
  - Metal + Oxygen → Metal oxide
- metal oxides are basic in nature.
- But some metal oxides show both acidic as well as basic behaviour-Amphoteric oxides.
  - Such metal oxides react with both acids as well as bases to produce salts and water.
    - ✔ Eg-Al_2O_3, ZnO

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

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

- Most metal oxides are insoluble in water
- But some of the metal oxides dissolve in water to form alkalis
  - Eg-Sodium oxide , Potassium oxide

$$Na_2O(s) + H_2O(l) \rightarrow 2NaOH(aq)$$

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

Relative reactivity of Metals towards Oxygen

- All metals do not react with oxygen at the same rate.
  - potassium and sodium react so vigorously that they catch fire if kept in the open.
    - ✔ Hence, to protect them and to prevent accidental fires, they are kept immersed in kerosene oil.
  - At ordinary temperature, the surfaces magnesium , aluminium, zinc, lead, etc., are covered with a thin layer of oxide.
    - ✔ The protective oxide layer prevents the metal from further oxidation.
  - Iron does not burn on heating but iron filings burn vigorously when sprinkled in the flame of the burner.
  - Copper does not burn, but the hot metal is coated with a black coloured layer of copper oxide.
  - Silver and gold do not react with oxygen even at high temperatures

Reaction with Water

- Metals react with water to produce a metal oxide and hydrogen
- Metal oxides that are soluble in water dissolve to form metal hydroxide.
  - Metal + Water → Metal oxide + Hydrogen
  - Metal oxide + Water → Metal hydroxide

Relative reactivity of Metals towards water

- Potassium and Sodium react violently with cold water.
  - the reaction is so violent and exothermic that the evolved hydrogen immediately catches fire.
- The reaction of calcium with water is less violent.
  - The heat evolved is not sufficient for the hydrogen to catch fire.
  - Calcium starts floating
    - ✔ the bubbles of hydrogen gas formed stick to the surface of the metal.
- Magnesium does not react with cold water. It reacts with hot water
  - form magnesium hydroxide and hydrogen.
  - It also starts floating
- Aluminium, iron and zinc do not react either with cold or hot water.
  - they react with steam to form the metal oxide and hydrogen.
- lead, copper, silver and gold do not react with water

Reaction with Acids

- Metal + Acid → Salt + Hydrogen
- Hydrogen gas is not evolved when a metal reacts with nitric acid.
  - It is because HNO_3 is a strong oxidising agent.
  - It oxidises the H_2 produced to water and itself gets reduced to any of the nitrogen oxides (N_2O, NO,NO_2).
  - But magnesium (Mg) and manganese (Mn) react with very dilute HNO_3 to evolve H_2 gas.

Reaction with Other Metal salt solution

- A more reactive metal displaces less reactive metal from its solution
  - Metal A + Salt solution of B → Salt solution of A + Metal B
- Displacement reaction can be used to determine the relative reactivity of Metals

Reactivity Series

- Metals arranged in the decreasing order of their reactivities

K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	Reactivity decreases
Fe	Iron	
Pb	Lead	
H	Hydrogen	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

Why Inert Gases are Inert?

- The outer most shell of noble/inert gases contain 8 electrons (except He)
- No other elements have 8 electrons in their valence shell
- The configuration of 8 electrons is very stable which makes the noble gases inert
  - The configuration of 8 electron is known as octet
- Atoms of other elements attains stability if they get 8 electrons in their outermost shell

Type of element	Element	Atomic number	Number of electrons in shells			
			K	L	M	N
Noble gases	Helium (He)	2	2			
	Neon (Ne)	10	2	8		
	Argon (Ar)	18	2	8	8	
Metals	Sodium (Na)	11	2	8	1	
	Magnesium (Mg)	12	2	8	2	
	Aluminium (Al)	13	2	8	3	
	Potassium (K)	19	2	8	8	1
	Calcium (Ca)	20	2	8	8	2
Non-metals	Nitrogen (N)	7	2	5		
	Oxygen (O)	8	2	6		
	Fluorine (F)	9	2	7		
	Phosphorus (P)	15	2	8	5	
	Sulphur (S)	16	2	8	6	
	Chlorine (Cl)	17	2	8	7	

How ‘Na’ attains stability

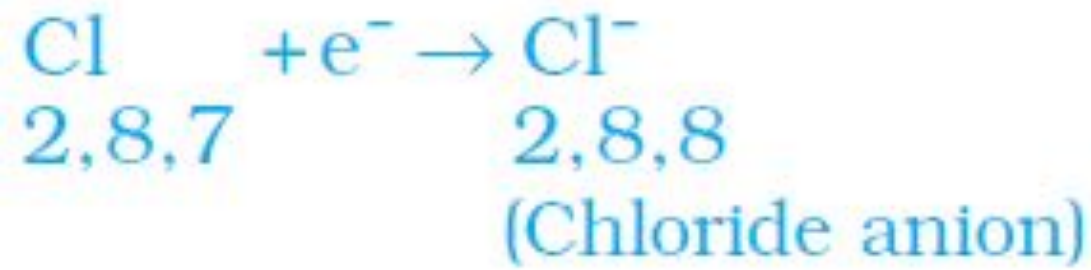
- ‘Na’ will loose one electron from its outer most shell

$$\underset{2,8,1}{Na} \rightarrow \underset{2,8}{Na^{+}} + e^{-}$$

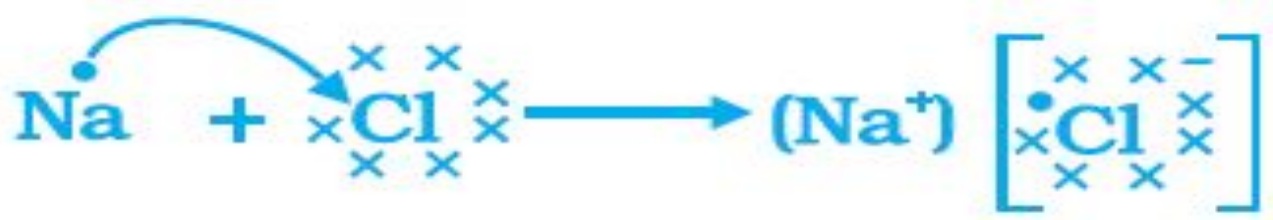
(Sodium cation)

How ‘Cl’ attains stability

- ‘Cl’ will gain one electron to its outermost shell



When ‘Na’ and ‘Cl’ react……



- Sodium and chloride ions, are oppositely charged,
  - They attract each other
  - They are held by strong electrostatic forces of attraction to exist as sodium chloride (NaCl).
- sodium chloride does not exist as molecules but aggregates of oppositely charged ions

Properties of ionic compounds

- Physical nature
  - Solids, Hard, Brittle in nature
- Melting and Boiling Point
  - High melting and Boiling point
- Solubility
  - Soluble in polar solvents and insoluble in nonpolar solvents
- Conduction of electricity
  - Conducts electricity through solution.Non conductor in solid state

LINKS:

https://youtu.be/RV7Z1HnJJ9A

https://youtu.be/wh_JyiS-6bE