CLASS 10- SCIENCE

CHAPTER 3- METALS AND NON-METALS

PART 5- HOW DO METALS AND NON-METALS REACT?

INTRODUCTION

★ The atoms combine with one another to attain the inert gas configuration and become more stable.

★ The atoms can achieve this noble gas electron configuration by three ways:-

i) By losing one or more electrons to another atom

ii) By gaining one or more electrons from another atom

iii) By sharing one or more electrons with another atom

★ In the chemical reactions between metals and non-metals, the inert gas electron arrangement is attained by the loss and gain of electrons (or complete transference of electrons) between the atoms.

INTRODUCTION(cont)

★ Ions-

An ion is an electrically charged atom (or group of atoms) which is formed by the loss or gain of electrons by an atom and therefore contains unequal number of electrons and protons.

★ Types of ions-

a) Cations

b) Anions

★ Cation-

➢ A positively charged ion formed by the loss of one or more electrons by an atom is known as cation.

➢ As metals lose one or more valence electrons to attain the nearest noble gas electron configuration, they become cations and are called electropositive elements.

➢ Examples-

Element	Atomic No.	Electronic Configuration	Formation of ion	Cation Formed
Sodium	11	2,8,1	$Na - e^- \longrightarrow Na^+$	Na^+
Magnesium	12	2,8,2	$Mg - 2e^- \longrightarrow Mg^{2+}$	Mg^{2+}
Aluminium	13	2,8,3	$Al - 3e^- \longrightarrow Al^{3+}$	Al^{3+}

★ Anion-

➢ A negatively charged ion formed by the gain of one or more electrons by an atom is known as anion.

➢ As non-metals gain one or more electrons to attain the nearest noble gas electron configuration, they become anions and are called electronegative elements.

➢ Examples-

Element	Atomic No.	Electronic Configuration	Formation of ion	Anion Formed
Chlorine	17	2,8,7	$Cl + e^- \longrightarrow Cl^-$	Cl^-
Oxygen	8	2,6	$O + 2e^- \longrightarrow O^{2-}$	O^{2-}
Nitrogen	7	2,5	$N + 3e^- \longrightarrow N^{3-}$	N^{3-}

Electron Dot Representation-

➢ The outermost electrons of an atom known as the valence electrons take part in chemical bonding.

➢ In electron dot representation, the valence electrons of an atom are represented by showing dots (•) on the symbol of the element.

➢ One dot represents one valence electron.

➢ The electronic configuration of an element should be written to know the number of valence electrons, so as to write the electron dot structure.

➢ Examples-

a) Sodium- Its symbol is Na, atomic number is 11 and electronic configuration is 2,8,1. This means that it has only one valence electron and its electron dot representation is Na·

b) Magnesium- In the same way, Mg: represents magnesium atom with two valence electrons.

c) Chlorine- Similarly, ·$\dot{\underset{\cdot\cdot}{\text{Cl}}}$: represents chlorine atom, as it has seven valence electrons.

d) Oxygen- Likewise, :$\underset{\cdot\cdot}{\text{O}}$: represents oxygen atom with six valence electrons.

Ionic Bond(or Electrovalent Bond)-

➢ The chemical bond formed by the complete transference of electrons from one atom to another atom is known as an ionic bond(or electrovalent bond).

➢ Such bonds are formed only when one atom can donate electrons and the other atom can accept electrons to achieve the nearest inert gas electron configuration.

➢ As metals usually have 1, 2 or 3 valence electrons, they can easily donate them to become stable positive ions (or cations).

Ionic Bond (cont)-

➢ Similarly, as non-metals usually have 5, 6 or 7 valence electrons, they are ready to accept electrons to become stable negative ions (or anions).

➢ Thus, ionic bond is formed between a metal and non-metal by transferring the valence electrons from the metal atom to the non-metal atom.

➢ The compounds containing ionic bonds are called ionic compounds.

Examples-

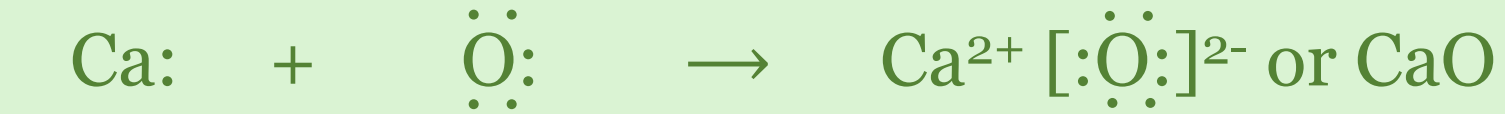
i) Formation of Sodium Chloride-

Element	Sodium	Chlorine
Symbol	Na	Cl
Atomic No.	11	17
Electronic configuration	2,8,1	2,8,7
Valence Electrons	1	7
Ion formed	Sodium (Na^+)	Chloride (Cl^-)
Electronic configuration	2,8	2,8,8
How the ion is formed?	By losing 1 valence electron	By gaining 1 electron

Sodium Chlorine Sodium Chloride

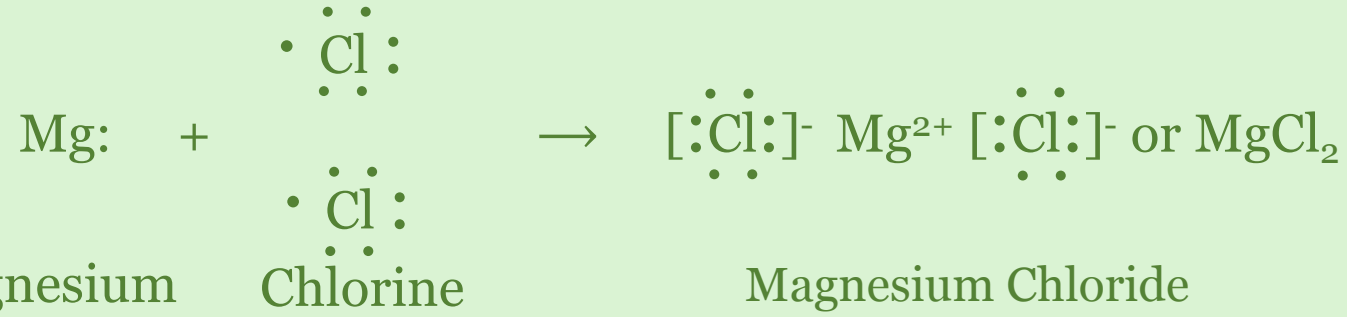
ii) Formation of Calcium Oxide-

Element	Calcium	Oxygen
Symbol	Ca	O
Atomic No.	20	8
Electronic configuration	2,8,8,2	2,6
Valence Electrons	2	6
Ion formed	Calcium (Ca^{2+})	Oxide (O^{2-})
Electronic configuration	2,8,8	2,8
How the ion is formed?	By losing 2 valence electrons	By gaining 2 electrons



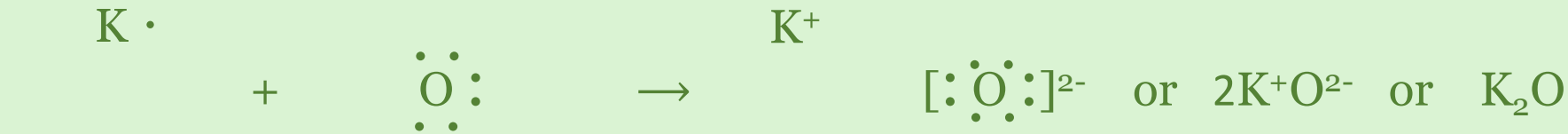
iii) Formation of Magnesium Chloride-

Element	Magnesium	Chlorine
Symbol	Mg	Cl
Atomic No.	12	17
Electronic configuration	2,8,2	2,8,7
Valence Electrons	2	7
Ion formed	Magnesium (Mg^{2+})	Chloride (Cl^-)
Electronic configuration	2,8	2,8,8
How the ion is formed?	By losing 2 valence electrons	By gaining 1 electron



iv) Formation of Potassium Oxide-

Element	Potassium	Oxygen
Symbol	K	O
Atomic No.	19	8
Electronic configuration	2,8,8,1	2,6
Valence Electrons	1	6
Ion formed	Potassium (K^+)	Oxide (O^{2-})
Electronic configuration	2,8,8	2,8
How the ion is formed?	By losing 1 valence electron	By gaining 2 electrons



Potassium Oxygen Potassium Oxide

Properties of Ionic Compounds-

1) Ionic compounds are solids because their oppositely charged ions attract each other strongly and form a regular crystal structure, which makes them hard and brittle.
2) Ionic compounds have high melting points and high boiling points. This is because a large amount of heat energy is required to break these strong ionic bonds.
3) Ionic compounds are generally soluble in water and insoluble in solvents such as kerosene, petrol, ether, acetone, alcohol, etc.
4) Ionic compounds conduct electricity in molten and solution state. This happens when an ionic solid is dissolved in water or is melted, due to which their crystal structure breaks down and ions become free to move and conduct electricity. These compounds do not conduct electricity in solid state, as due to their rigid structure the movement of ions is not possible.

THANK YOU