CLASS IX
CHEMISTRY
CHAPTER 4
SYMBOLS, FORMULAE AND EQUATIONS

NOTES

INTRODUCTION

- Scientists use a unique symbol for each elements to save both time and space when describing atoms and molecules
- Dalton was the first scientist to use the symbols for elements in a very specific sense.

MODERN SYMBOLS OF ELEMENTS:

- Symbol of an element is the short method of representation of chemical elements using one or two letters. For example, the symbol of iron is Fe, Hydrogen is represented by H, Oxygen by O and Carbon by C etc.
- Berzelius suggested the use of first letter of the name of the element in Capital Letter.
  e.g. "H" for Hydrogen, "O" for Oxygen, "P" for Phosphorus etc.
- But as there are various numbers of elements whose names begin with same letter. So, two-letter combinations were started using. The first letter of the Symbol is capital and the 2nd letter is small.
  e.g. "Al" for Aluminium, "Ba" for Barium, "Zn" for Zinc, "Ne" for Neon etc.
- Symbols of some elements are derived from their Latin or German names.

e.g.

Name of the element	Latin Name	Symbol
Antimony	Stibium	Sb
Gold	Aurium	Au
Mercury	Hydrargyrum	Hg
Silver	Argentum	Ag

SIGNIFICANCE OF THE SYMBOL OF AN ELEMENT:

- The symbol of an element represents
  (a) The name of the element
  (b) An atom of the element
  (c) The mass of an atom of the element
- For e.g. The symbol "Na" represents
  (d) The element Sodium
  (e) An atom of sodium
  (f) The mass of an atom of sodium

CHEMICAL FORMULA

- The expression obtained by writing the symbols of constituent elements side by side and indicating the number of each kind by a subscript figure (placed at the right hand bottom of each symbol) is called a formula. **E.g.** H_2O, NaCl, CH_4, CO_2 etc.
- A chemical formula is a symbolic representation of the composition of the molecule of a substance
- Carbon (C), Sodium (Na), Copper (Cu), Aluminium (Al), Iron (Fe) and all other metals exist as collection of atoms. Such elements are represented by the symbol of their atoms.

VALENCY

- The combining capacity of an atom of an element to form a molecule is termed as Valency is equal to the number of valence electrons.
  - **(i)** If an atom consists of 1, 2 or 3 electrons in its shell then its valency is 1, 2 or 3 respectively,
  - **(ii)** If an atom consists of 5, 6 or 7 electrons in the outermost shell, then it will gain 3, 2 or 1 electron respectively and its valency will be 3, 2 or 1 respectively.
  - **(iii)** If an atom has 4 electrons in the outermost shell than it will share this electron and hence its valency will be 4.
  - **(iv)** If an atom has 8 electrons in the outermost shell then its valency is 0.

IONS

- The charged particles (atoms) are called ions.
- Negatively charged ions are called anions ($C1^-$).
- Positively charge ions are called cations (Na^+).

Name of the Element	Symbol	Valency	Ion.
Hydrogen	H	1	H^+
Helium	He	0	–
Lithium	Li	1	Li^+
Beryllium	Be	2	Be^{2+}
Boron	B	3	B^{3+}
Carbon	C	4(Shares electrons)	–
Nitrogen	N	3	N^{3-}
Oxygen	O	2	O^{2-}
Fluorine	F	1	F^-
Neon	Ne	0	–
Sodium	Na	1	Na^+
Magnesium	Mg	2	Mg^{2+}
Aluminium	Al	3	Al^{3+}

WRITING CHEMICAL FORMULA:

Rules:

(i) The valencies or charges on the ion must be balanced.

(ii) A metal and non-metal compound should show the name or symbols of the metal first.

e.g., Na^{+} Cl^{-} → NaCl

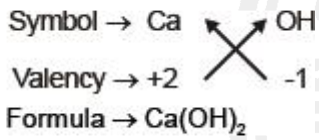
(iii) If a compound consist of polyatomic ions. The ion before writing the number to indicate the ratio.

e.g., $[SO_4]^{2-}$ → polyatomic radical

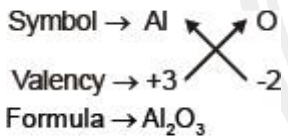
$H^{1+} + SO_4^{2-} \rightarrow H_2SO_4$

Chemical formula of some simple compounds

(a) Calcium hydroxide



(b) Aluminium oxide



MOLECULAR MASS

- It is the sum of the atomic masses of all the atoms in a molecule of the substance. It is expressed in atomic mass unit (u).

  e.g., For H_2O [H = 1, 0 = 16]

  $1 \times 2 + 16 = 18$ u

FORMULA Unit MASS

- It is the sum of the atomic masses of all atoms in a formula unit of a compound. The word formula unit mass is used for those substances whose constituent particles are ions.

  e.g., $Na^{+} + Cl^{-} \rightarrow NaCl$

  $1 \times 23 + 1 \times 35.5 = 58.5$ u

MOLE CONCEPT:

- **Definition of mole:** The mole is the unit of measurement for amount of substance in the International System of Units (SI). A mole of a substance or a mole of particles is defined as exactly $6.02214076 \times 10^{23}$ particles, which may be atoms, molecules, ions, or electrons. In short, for particles 1 mole = $6.02214076 \times 10^{23}$
- **One mole** of any substance is that quantity in number having a mass equal to its atomic or molecular mass in grams.

  This number 6.022×10^{23} is called the Avogadro number or Avogadro constant.
- **Molar mass** is defined as the mass of 1 mole of a substance. It is always expressed in gram, and is also known as gram atomic mass or gram molecular mass.

  1u of hydrogen has → 1 atom of hydrogen

  1 g of hydrogen has → 1 mole of hydrogen

  = 6.022×10^{23} atoms of hydrogen.

WHY IS MOLE SO SIGNIFICANT

- Besides being related to a number, a mole has one more advantages over other number like dozen or gross. The advantage is that mass of 1 mole of a particular substance is also fixed.

SIGNIFICANCE OF A FORMULA

- A formula of a substance has both qualitative as well as quantitative meaning.

  (a) Qualitatively, it represents

  (i) The name of the compound

  (ii) The elements present in the compound

  (b) Quantitatively, it represents

  (i) One molecule of the substance

  (ii) The number of atoms of various elements which constitute one molecule.

  (iii) The molecular mass of the substance.

  (iv) The number of parts by mass of the elements present in the molecule.

  (v) One mole of the substance.

CHEMICAL EQUATION

- A chemical equation is the symbolic representation of an actual chemical reaction with the help of symbols and formulas of respective reactants and products.
- While writing chemical equations, the following points must be kept in mind:

(i) The reactants are placed on the left hand side separated by plus(+) sign which means "reacts with".

(ii) The products are placed on the right hand side separated by (+) sign which means "along with"

(iii) The reactants and products are separated by an arrow pointing towards the product ($\rightarrow$) or the sign of equality (=) which means 'to produce'

(iv) Above the arrow, the reaction conditions such as catalyst, temperature, pressure etc may be indicated.

(v) If the product is a gas, it indicated by an upward arrow ($\uparrow$) and if the product is a precipitate, it is indicated by a downward arrow ($\downarrow$).

(vi) Sometimes the physical state of reactants and products are also indicated in a chemical reaction.

Eg: $Zn + 2HCl \qquad ZnCl_2 + H_2$

INFORMATION CONVEYED BY A CHEMICAL EQUATION

Qualitatively, it represents

(i) What are the reactants and what are the products,

(ii) The composition of reactants and products

Quantitatively, it represents

(i) The relative of each kind of the molecules and atoms

(ii) The relative masses of the reactants and products

(iii) The number of moles of the reactants and products

(iv) The volumes of gaseous substance involved.

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