Balancing of Chemical Equation:

Observe the following two chemical equations :

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$ .....(i)

$Na + H_2O \longrightarrow NaOH + H_2$ .....(ii)

In equation (i), the number of atoms of Zn, H, S and O are equal on both sides, i.e., the equation is balanced

Balanced Equations : The equations in which atoms of various elements on the reactants' and the products side are equal.

Equation (ii) is not balanced because the number of hydrogen atoms in not equal on both sides. It is called a skeleton chemical equation.

Reason of Balancing Equations :

The number of atoms of elements on both sides of a chemical equation should be equal in accordance with the law of conservation of mass.

Balancing

The process of making atoms of various elements equal in an equation on either side is called balancing.

Steps in Balancing of Chemical Equations:

A number of steps are involved in balancing a chemical equation, e.g.,

$Na + H_2O \square NaOH + H_2$

Step-1 : Examine the number of atoms of different elements present in unbalanced equations.

	Number of atoms in reactants	Number of atoms in products
Na	1	1
H	2	3
O	1	1

Step-2 : Pick an element to balance the equation. In the above equation Na and O are balanced, Hydrogen is not.

Step : To balance Hydrogen on both sides we need to multiply H_2O by 2 which makes Hydrogen atoms equal to 4 on the reactants' side. To make Hydrogen 4 on the products' side, multiply NaOH by 2. Now oxygen has become 2 on both side. But Sodium atoms has become two on the products' side. Multiply Na by 2 on the reactants side so that they become equal on both side. The steps are as follows :

(i) $Na + 2\ H_2O \square NaOH + H_2$

(ii) $Na + 2\ H_2O \square 2NaOH + H_2$

(iii) $2\ Na + 2\ H_2O \square 2NaOH + H_2$

The equation is now balanced.

Example : $Fe + H_2O \longrightarrow Fe_3O_4 + H_2$

Step-1 :

Element	Number of atoms in reactants	Number of atoms in products
Fe	1	3
H	2	2
O	1	4

Step-2 :Pick up the compound which has the maximum number of atoms whether a reactant or a product, and in that compound select the elements which has the highest number of atoms, e.g., we select Fe_3O_4 in the above equation :

To balance oxygen atoms,

	In reactants	In products
Initial	1 (in H_2O)	4 (in Fe_3O_4)
To balance	1 × 4	4 × 1

To equalise the number of atoms, we put the coefficient on the left side of the formula.

A coefficient is a small whole number, like coefficients used in algebraic equations.

You must keep in mind that we can put coefficients but we cannot change the subscripts in the formula, i.e., to balance Oxygen atoms, we can put the coefficient 4 as 4 H_2O and not H_2O_4 or $(H_2O)_4$. Now the partly balanced equation becomes as follows :

$$Fe(s) + 4\ H_2O(g) \longrightarrow Fe_3O_4(s) + H_2(g)$$

(Partly balanced)

Step-3 : Pick up the second element to balance this partly balanced equation. Let us try to balance hydrogen atoms.

In partly balanced equation. Atoms of Hydrogen.

	In reactants	In products
Initial	8 (in 8 H_2O)	2 (in H_4)
To balance	8 × 1	2 × 4

To equalise the number of Hydrogen atoms, we use 4 as the coefficient of H_2 in the products.

$$Fe(s) + 4\ H_2O(g) \longrightarrow Fe_3O_4(s) + 4\ H_2$$

Step-4 : Pick up third element to be balanced. The element which is left to be balanced is Fe.

	In reactants	In products
Initial	1 (in Fe)	3 (in Fe_3O_4)
To balance	1 × 3	3 × 1

To equalise, we use 3 as coefficient of Fe in reactants.

$$3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$$

Atoms	In reactants	In products
Fe	3	3
H	8	8
O	4	4

The equation is balanced because atoms of all the elements are equal on both sides.

This method of balancing equation is known as hit and trial method.