C/W

Chapter - 1
Foundation and fundamentals

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Chemistry is the science of molecules and their transformation which deals with the study of matters, its composition, the change that matter undergoes and the relation between changes in composition and changes in energy. Chemistry plays an important role in meeting human needs for food, health care products.

Importance of Chemistry

Chemistry plays a central role in science and is often intertwined with other branches of science.

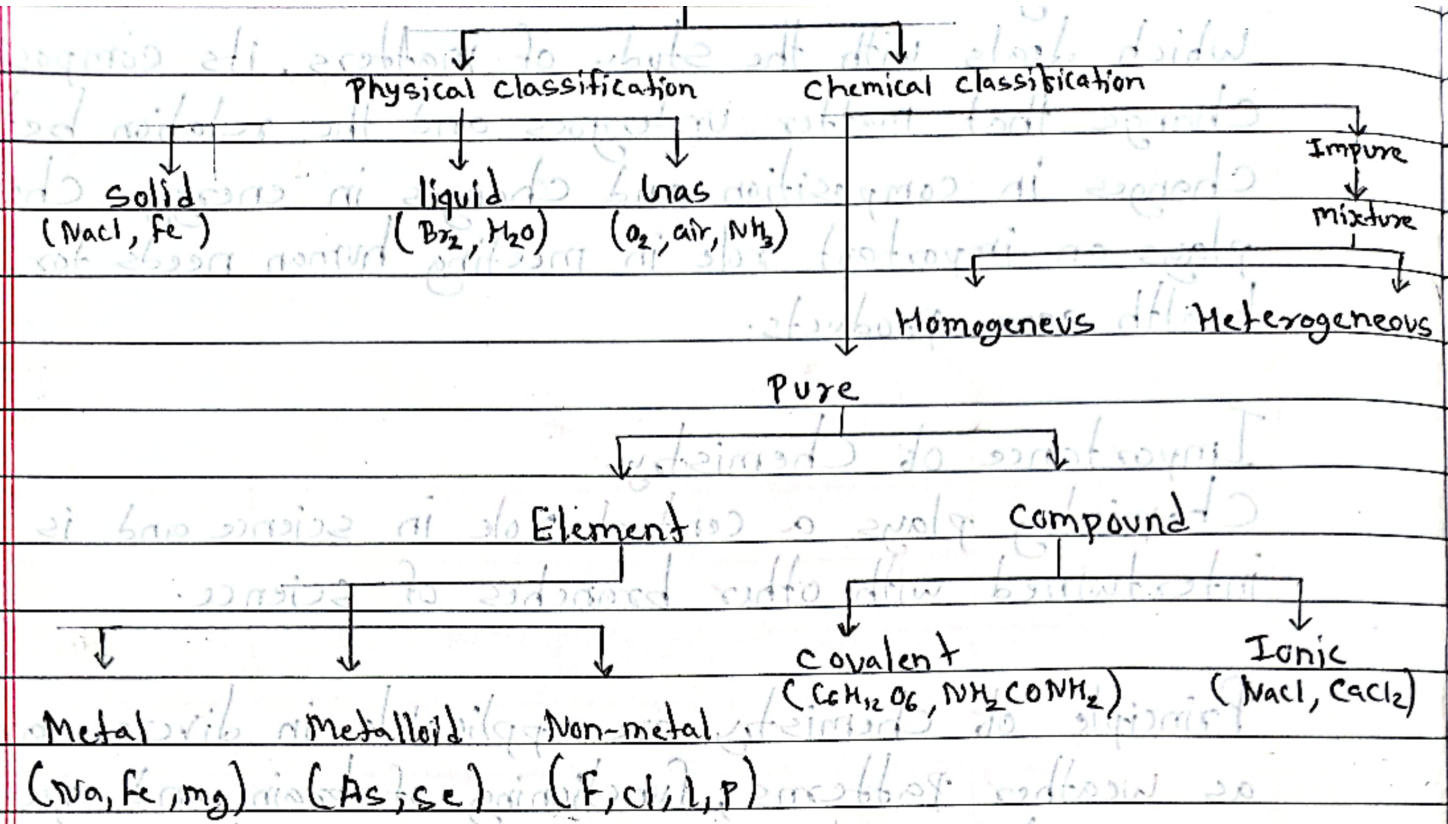
Principle of chemistry are applicable in diverse areas such as weather patterns; functioning of brain and operation of a computer, production in chemical industries, manufacturing fertilisers, alkalis, acids, salts, dyes, polymers, drugs, soaps detergents, metals, alloys etc. including new materials.

Chemistry contributes in a big way to the national economy. It also plays an important role in meeting human needs for food, healthcare products and other material aimed at improving the quality of life.

Matter

Matter is any things that occupies space, has mass, offer resistance and can be felt / perceived of directly by our senses. For example;

i. Book
ii. Pen
iii. Water
iv. Air
v. All living beings



Classification of Matter

1. Physical Classification
   i. Solid
   ii. Liquid
   iii. Gas
2. Chemical Classification
   i. Pure substance
   ii. Impure substance

Elements : Element is the pure substance which can neither decompose nor form by ordinary physical or chemical methods. (Eg : C, Ag, N)

Compounds : Compound is a pure substance obtained by the union of two or more elements and can be decomposed in two or more simple substance. (Eg : CO_2, H_2SO_4, SO_4)

Types of Compounds

a. Organic Compounds : These are the compounds which contain carbon atom and are generally associated with living organism.
Eg: glucose, alcohols, proteins etc.

b. Inorganic Compounds : These are the compounds which does not contain carbon to hydrogen bond and generally contain a metal.
Eg: NaCl, H_2, O_2, CO_2 etc.

Atom

It is the smallest part of an element which can take part in chemical reaction.

Atomic Mass Unit : Atomic mass unit is the referance of measurement of mass of proton, neutron atom etc.

Atomic Mass : Atomic mass of an element is defined as average relative mass of its atom as compared to $\frac{1}{12}$th the mass of a carbon-12 atom

Relative atomic mass

The relative mass of an element is the average mass of the atoms compared to $\frac{1}{12}$ th the mass of a carbon-12 atom

Mathematically,

$$\text{Relative atomic mass} = \frac{\text{Mass of atom}}{\text{Mass of } \frac{1}{12}\text{th part of C-12 atom}}$$

Note : The $\frac{1}{12}$ th the mass of ~~C-12~~ an atom of C-12 isotopes is called atomic mass unit. (amu)

One atomic mass is the average mass of a proton and neutron which is nearly equal to 1.67×10^{-24} gram.

Gram Atomic Mass or Gram atom

Atomic mass of an element expressed in gram is called gram atomic mass or gram atom.

For example; we know Atomic mass of oxygen = 16

Gram atomic mass of oxygen = 16 gram

1 gram atom of oxygen = 16 gram

Molecular Mass or Molecular weight

It is the mass of a molecule of a substance with respect to the mass of $^1/_{12}$ th of an atom of C-12 isotope.

A molecular masses is calculated by the summation of atomic masses of all the atoms present in the given molecule.

Gram Molecular Mass (g mole)

The molecular mass is a relative term and it is a ~~unitless~~ unitless number e.g. molecular mass of H_2SO_4 = 98.

It means, the weight of 1 molecule of H_2SO_4 is 98 times heavier than the mass of $^1/_{12}$ th of an atom of C-12 isotope (i.e. 1 amu).

Mathematically,

$$\text{No. of g mole} = \frac{\text{Mass in gram}}{\text{Molecular mass in g}}$$

Percentage Composition

Percentage composition of each element present in a molecule is the number of parts of that element in 100 parts of a molecule. Mathematically,

$$\text{Percentage Composition} = \frac{\text{No. of parts of element in a compound}}{\text{No. of mass of compound}} \times 100$$

~~Example~~ : Molecul

Q. Calculate the percentage composition of blue vitrol crystal

Solution:

Here, Atomic weight of copper = 63.5

Atomic weight of Sulphur = 32

Atomic weight of oxygen = 16

Atomic weight of Hydrogen = 1

Now,

Molecular weight of $CuSO_4 \cdot 5H_2O$ = 63.5 + 32 + 9×16 + 10×1

= 249.5 amu

% of Cu = $\frac{63.5}{249.5} \times 100 = 25.45\%$

% of S = $\frac{32}{249.5} \times 100 = 12.82\%$

% of O = $\frac{144}{249.5} \times 100 = 57.71\%$

% of H = $\frac{10}{249.5} \times 100 = 4\%$

Q. Calculate the percentage of composition of hypo. ($Na_2S_2O_3 \cdot 5H_2O$)

Solution:

Here, Atomic weight of Sodium = 23

Atomic weight of Sulphur = 32

Atomic weight of oxygen = 16

Atomic weight of Hydrogen = 1

Now,

Molecular weight of $Na_2S_2O_3 \cdot 5H_2O$ = 2×23 + 2×32 + 8×16 + 10×1

= 248 amu

% of Na = $\frac{46}{248} \times 100 = 18.54\%$

% of S = $\frac{64}{248} \times 100 = 25.80\%$

% of O = $\frac{128}{248} \times 100 = 51.61\%$

% of H = $\frac{10}{248} \times 100 = 4.03\%$

Q. Calculate percentage ~~Compist~~ composition of ~~blue vitrol~~ bleaching powder. ~~($CaOCl_2$)~~ $Ca(OCl)_2$

Solution:

Here, Atomic weight of Calcium = 40

Atomic weight of Oxygen = 16

Atomic weight of Chlorine = 35.453

Now,

~~Molecular weight of $CaOCl_2$ = 40 + 16 + 2 × 35.453~~

Molecular weight of ~~$Ca(OCl)_2$~~ $Ca(OCl)_2$ = 40 + 2 × 16 + 2 × 35.453

= 142.906 amu

% of Ca = $\frac{40}{142.906} \times 100 = 27.99\%$

% of O = $\frac{32}{142.906} \times 100 = 22.39\%$

% of Cl = $\frac{70.906}{142.906} \times 100 = 49.61\%$

Q. Calculate percentage composition of Epsom salt. ($MgSO_4 \cdot 7H_2O$)

Solution:

Atomic weight of Magnesium = 24.3

Atomic weight of Sulphur = 32

Atomic weight of Hydrogen = 1

Atomic weight of Oxygen = 16

Molecular weight of $MgSO_4 \cdot 7H_2O$ = 24.3 + 32 + 11×16 + 14×1

= 246.3

% of Mg = $\frac{24.3}{246.3} \times 100$ = 9.86%.

% of S = $\frac{32}{246.3} \times 100$ = 12.99%.

% of H = $\frac{14}{246.3} \times 100$ = 5.68%.

% of O = $\frac{176}{246.3} \times 100$ = 71.45%.

Q. Calculate percentage composition of green vitriol. ($FeSO_4 \cdot 7H_2O$)

Solution:

Atomic weight of iron = 55.8

Atomic weight of Sulphur = 32

Atomic weight of Oxygen = 16

Atomic weight of Hydrogen = 1

Now,

Molecular weight of $FeSO_4 \cdot 7H_2O$ = 55.8 + 32 + 11×16 + 14×1

= 277.8 amu

% of Fe = $\frac{55.8}{277.8} \times 100$ = 20.08%.

% of S = $\frac{32}{277.8} \times 100$ = 11.51%.

% of O = $\frac{176}{277.8} \times 100$ = 63.35%.

% of H = $\frac{14}{277.8} \times 100$ = 5.039%.

Q. Calculate ~~Molecular Comp~~ percentage composition of plaster of paris. ($CaSO_4 \cdot \frac{1}{2} H_2O$)

Solution:

Atomic weight of Calcium = 40

Atomic weight of Sulphur = 32

Atomic weight of Hydrogen = 1

Atomic weight of oxygen = 16

Now,

Molecular weight of $CaSO_4 \cdot \frac{1}{2} H_2O$ = 40 + 32 + 4 × 16 + 1 × 1

= ~~153 amu~~ 145 amu

% of Calcium = $\frac{40}{153} \times 100 = 26.14\%$

% of Sulphur = $\frac{32}{153} \times 100 = 20.91\%$

% of Hydrogen = $\frac{1}{153} \times 100 = 0.65\%$

% of oxygen = $\frac{80}{153} \times 100 = 52.28\%$

Now,

% of Calcium = $\frac{40}{145} \times 100 = 27.58\%$

% of Sulphur = $\frac{32}{145} \times 100 = 22.06\%$

% of Hydrogen = $\frac{1}{145} \times 100 = 0.68\%$

% of oxygen = $\frac{72}{145} \times 100 = 49.65\%$