Nakshalbari College
Department of Bio-Science

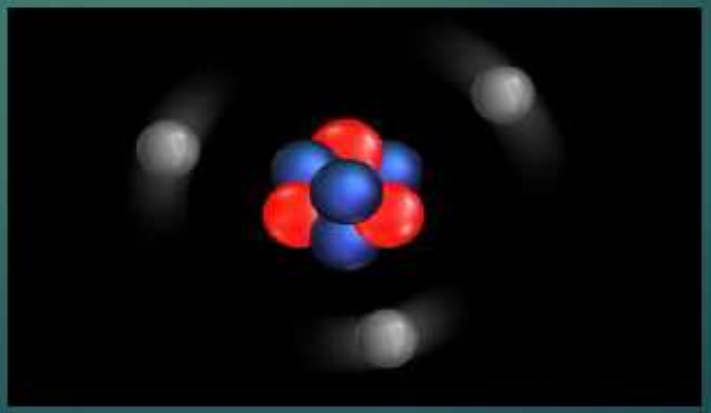
Topic- Atomic Structure
Semester- II (Minor)
Subject- Chemistry
Presented by- Dr. Bijeta Mitra

ELEMENTS and COMPOUNDS

- Pure substances which cannot be split into simple components through chemical process are called as elements.
- Substances formed by the combination of two or more elements through chemical reactions are called as compounds.

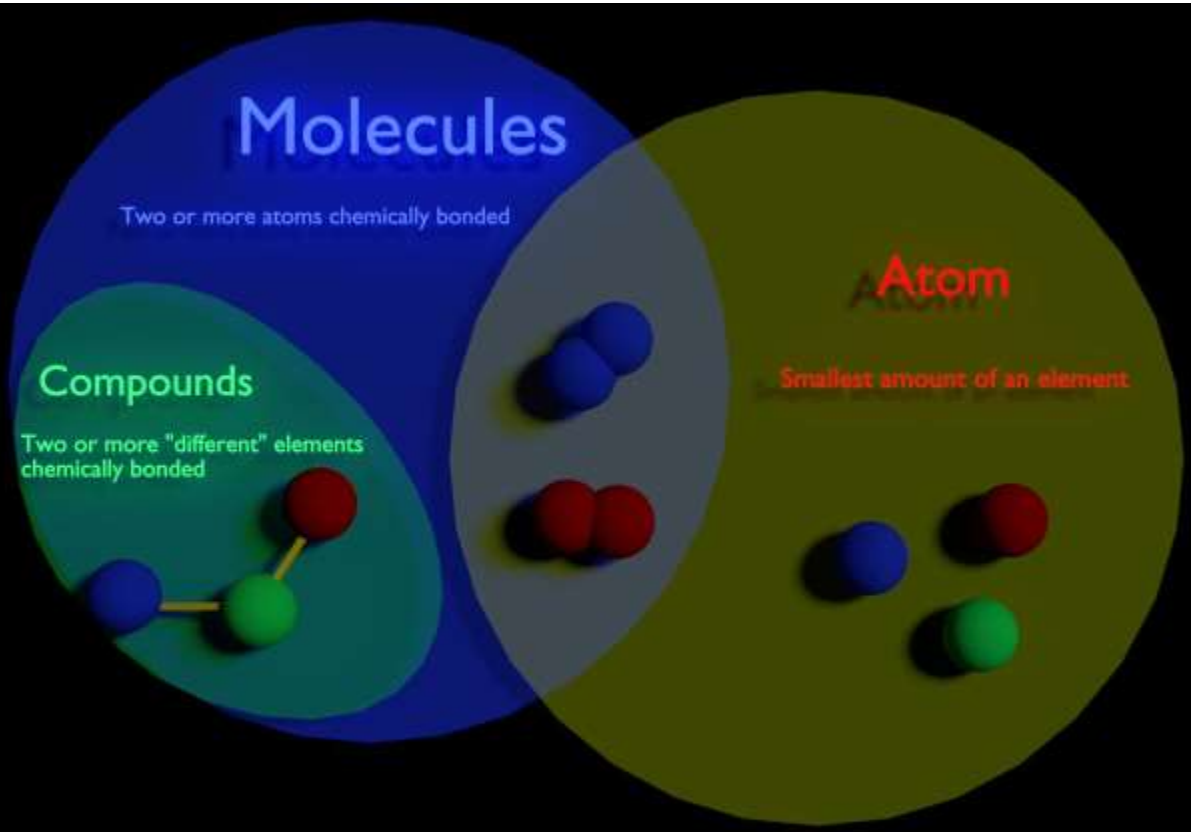
Atoms and molecules

- Atoms are the smallest particle which shows all the characteristic properties of an element.
- Molecules are the smallest particles which can exist independently.



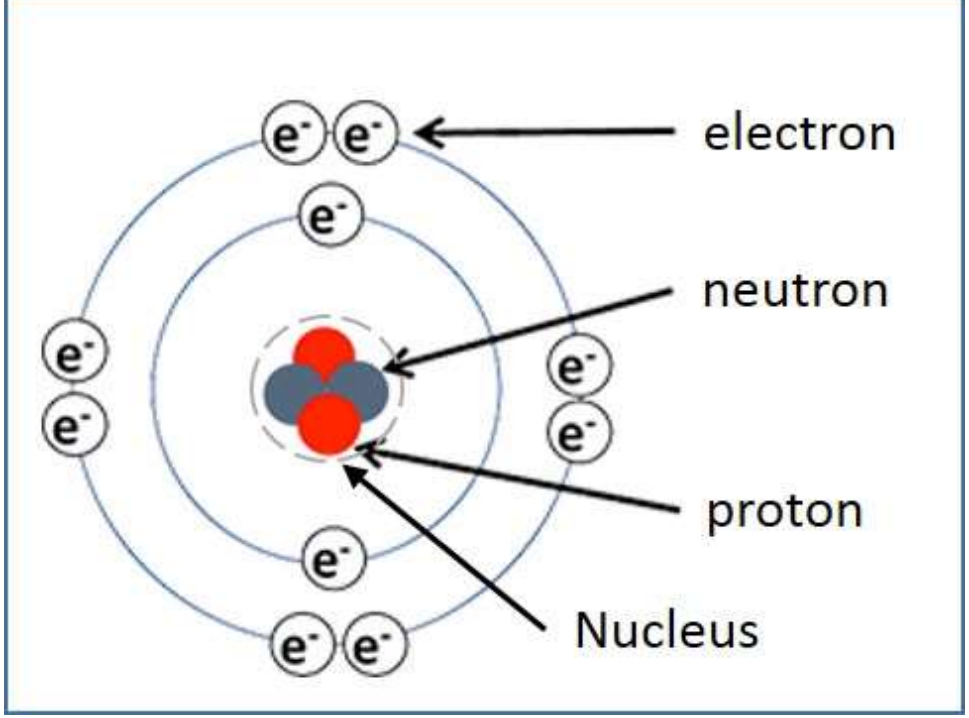
Types of molecules

Monoatomic	Diatomic	Polyatomic
Molecules with only one atom. e.g. He , Ne	Molecules with two atoms. e.g. H_2, Cl_2, O_2	Molecules with more than two atoms. e.g. S_8, P_4



Elements : a substance consisting of atoms which all have the same number of protons.

Substance : is matter which has a specific composition and specific properties.



Particle	Relative Mass	Relative Charge	Charge / C	Mass / kg
Protons	1	+ 1	$+ 1.6 \times 10^{-19}$	1.67×10^{-27}
Neutrons	1	neutral	0	1.67×10^{-27}
Electrons	0.0005	- 1	$- 1.6 \times 10^{-19}$	9.11×10^{-31}

Atomic number and Mass number

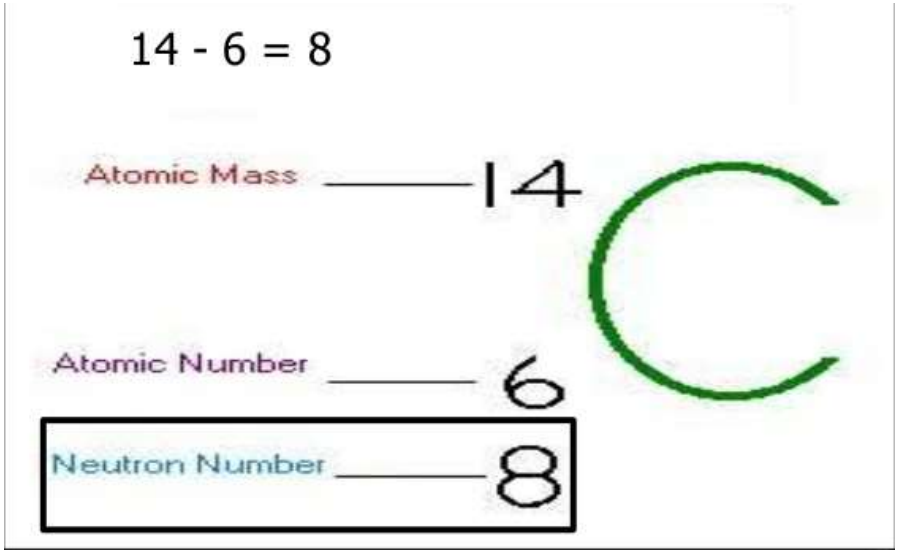
ATOMIC NUMBER VS MASS NUMBER

Mass number is the number of protons plus neutrons

$^{4}_{2}\mathrm{He}$

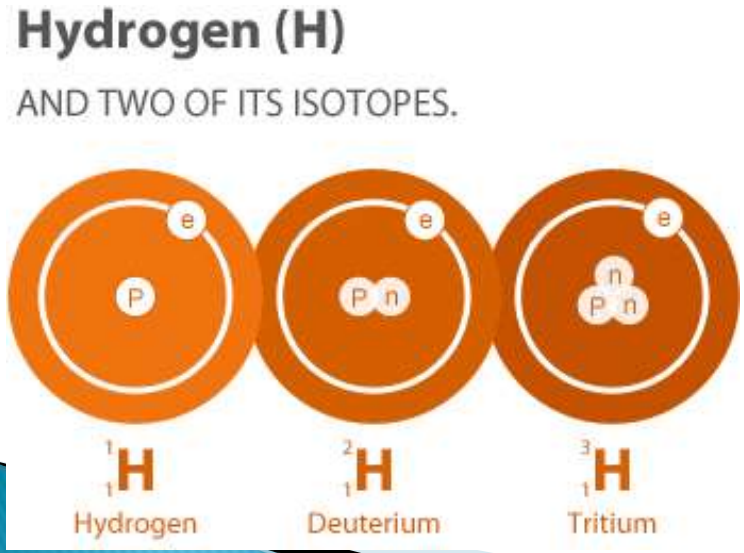
Helium

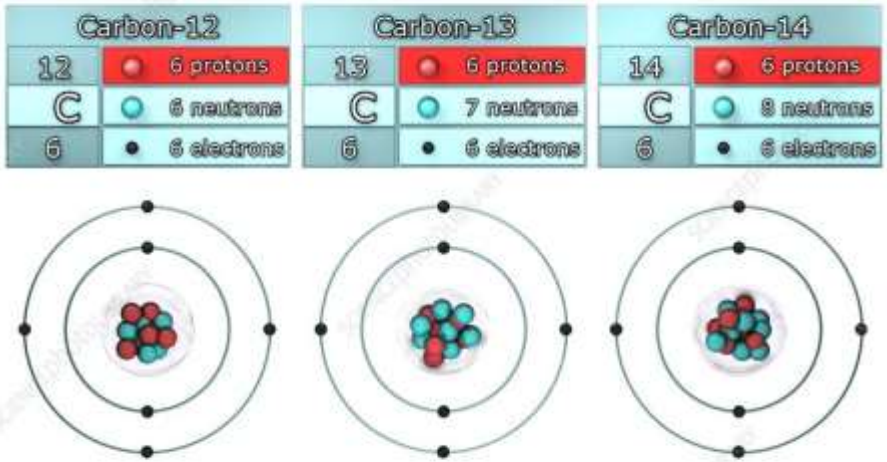
Atomic number is the number of protons



Isotopes

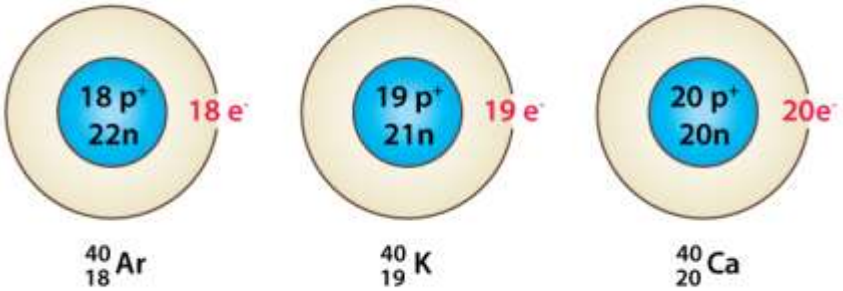
- Atoms of a chemical element with the same atomic number and position in the periodic table and nearly identical chemical behavior but with different atomic masses and physical properties.





Isobars and Isotones

- Isobars- Atoms having same mass number but different atomic numbers.



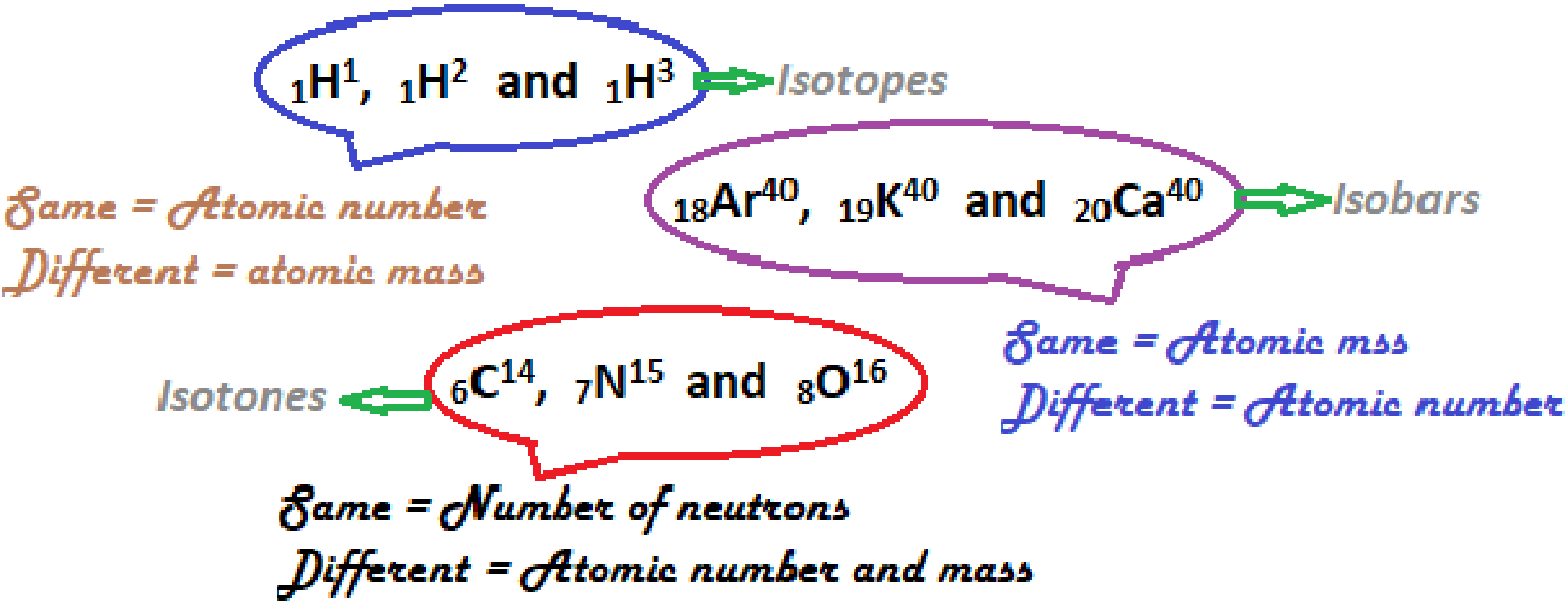
- Isotones- Atoms having same numbers of neutrons.

Oxygen $^{16}_{8}O$ (p=8; n=8)

Nitrogen $^{15}_{7}N$ (p=7; n=8)

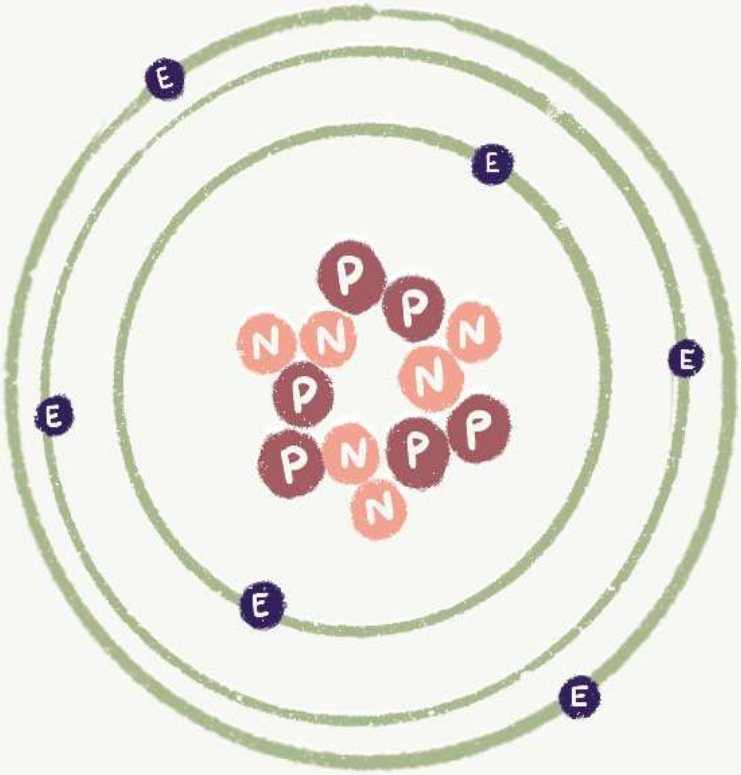
Carbon $^{14}_{6}C$ (p=6; n=8)

Isotopes, Isobars and Isotones :



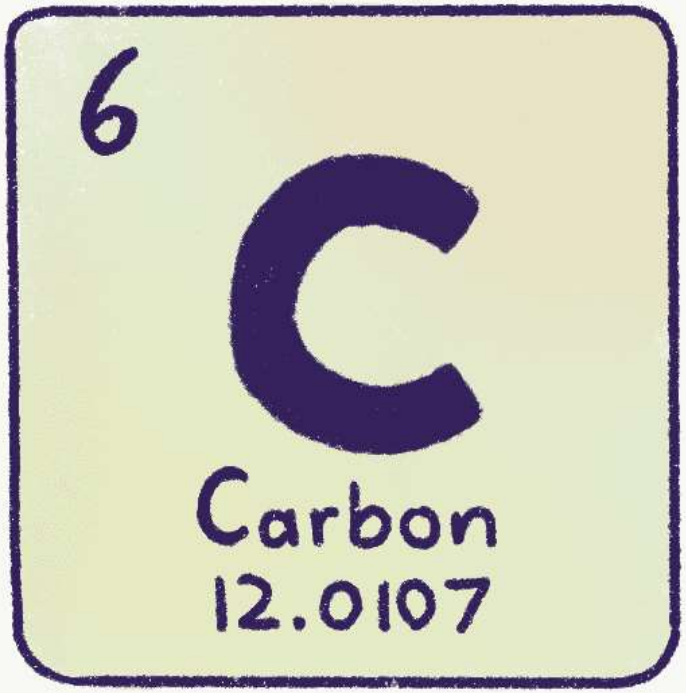
Atomic Weight vs. Atomic Mass

Atomic mass is the sum of protons and neutrons of a single atom.



Carbon-6 Atom
Atomic Mass = 12

Atomic weight is the weighted average of the atomic mass of all natural isotopes of an element.



Carbon
Atomic Weight = 12.0107

$$\text{Atomic Weight} = \frac{\text{Weight of one atom of an element}}{\text{Weight of one atom of hydrogen}}$$

$$= \frac{\text{Weight of one atom of an element}}{\frac{1}{12}\text{ weight of one atom of carbon}}$$

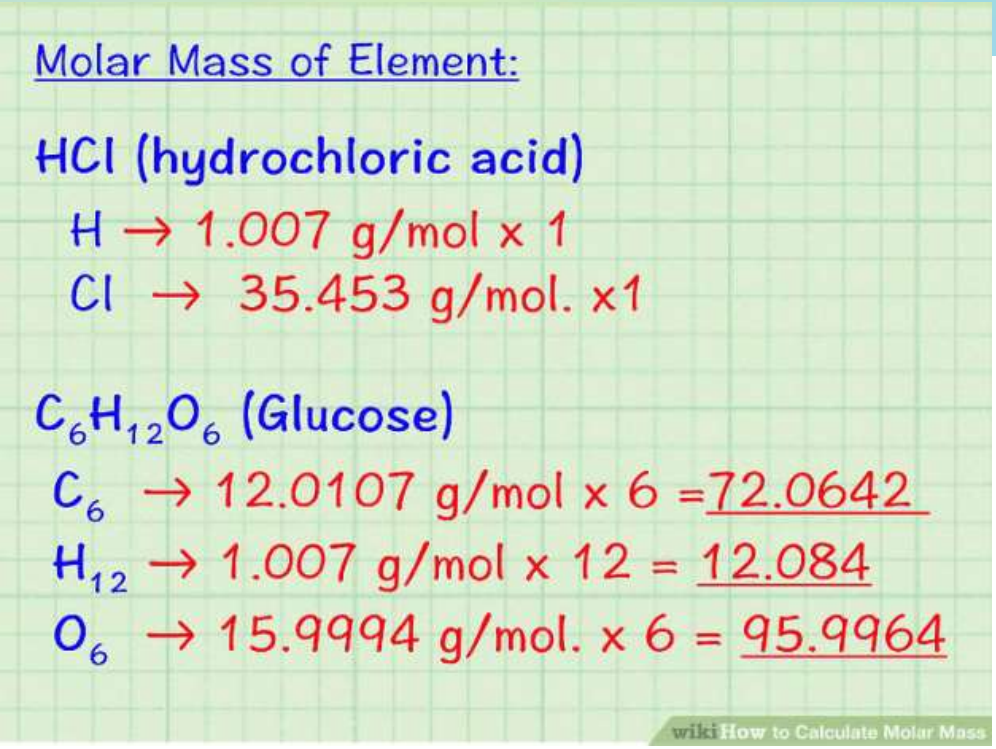
Atomic Mass & Gram-Atomic Mass

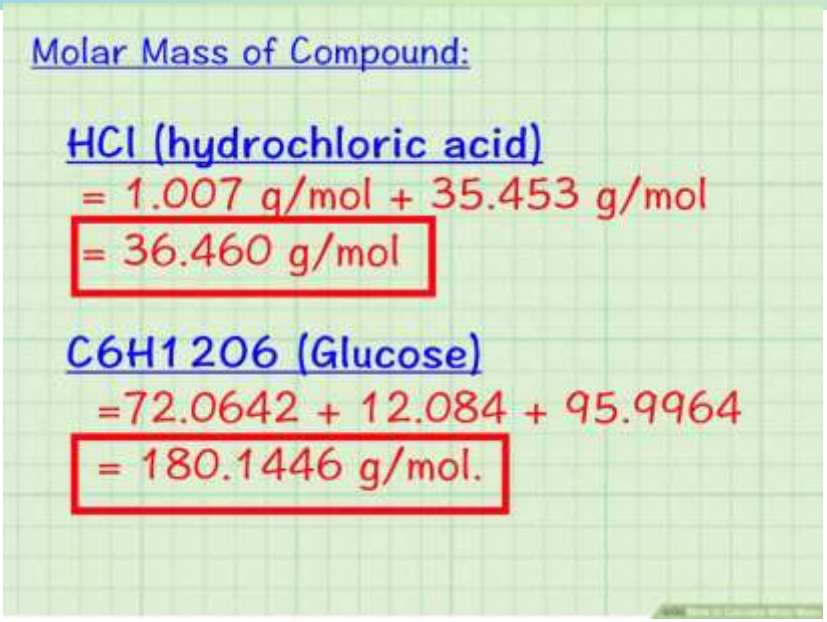
- Examples:

Element	Atomic mass	Gram-atomic mass
Carbon	12.01 *u*	12.01 g/mol
Oxygen	16.00 *u*	16.00 g/mol
Aluminum	26.98 *u*	26.98 g/mol
Silicon	28.09 *u*	28.09 g/mol
Gold	197.0 *u*	197.0 g/mol

Molecular Weight (MW)

The sum of the atomic weights of all the atoms in a molecule of the substance.





Gram Molecular Weight

Molecular Weight expressed in grams is called gram molecular Weight.

Eg. Molecular weight of Carbon Monoxide (CO) is 28 hence it's gram Molecular Weight is 28 g.

It is also called "one mole molecule" which refers to Avogadro's number of molecule.

Avogadro's law

Equal volumes of all gases under identical conditions of temperature and pressure contain equal number of molecules

Avogadro's Number

6.023×10^{23}

Empirical vs Molecular Formula

Empirical	Molecular
Simplest whole number ratio of elements	Actual whole number ratio Multiple of Empirical
CO_2	CO_2
H_2O	H_2O
NO_2	N_2O_4
P_2O_5	P_4O_{10}
C_5H_{11}	$C_{10}H_{22}$
C_2H_6O	$C_6H_{18}O_3$

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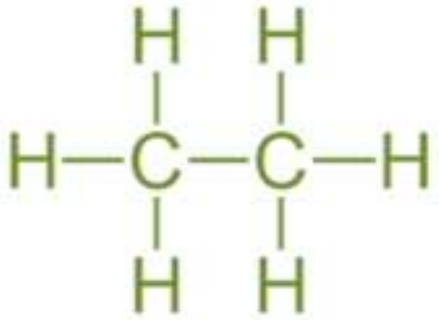
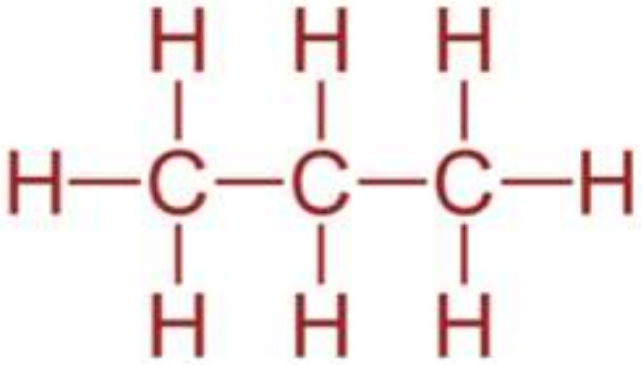
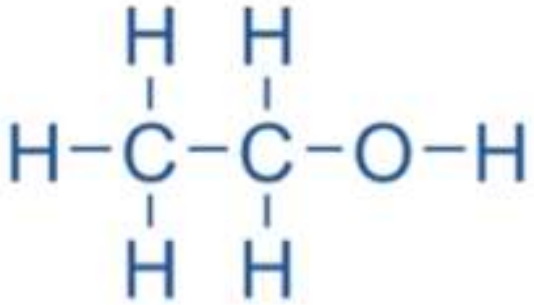
Structural formula



Ethane
C_2H_6



Propane
C_3H_8



Ethanol
C_2H_6O