

Unit 2. Chemistry Basics – Atoms, Molecules, Elements, Compounds, and Mixtures



Chemistry is the study of the composition, structure, properties and change of matter [matter is defined as anything that has rest mass and volume (it takes up space) and is made up of particles]. Chemistry is chiefly concerned with atoms (a basic unit in chemistry) and their interactions with other atoms.

Atoms

An atom is a basic unit of matter that consists of a central nucleus surrounded by negatively charged electrons. The nucleus contains protons and neutrons. Electrons revolve around the nucleus in different orbits.

Subatomic particles

The constituent particles of an atom are called subatomic particles. They mainly include protons, electrons and neutrons. The electron is the least massive of these particles at 9.11×10^{-31} kg with a negative charge. Protons have a positive charge and Neutrons have no electrical charge.

Discoveries:

- Proton by Ernest Rutherford in 1918.
- Electron by J.J. Thomson in 1897.
- Neutron by James Chadwick in 1932.

Nucleus

The central part of an atom is called nucleus. Particles present inside the nucleus are called nucleons and they include mainly protons and neutrons. Due to the presence of protons nucleus has a positive charge.

Molecules

Molecules are made of atoms of one or more elements. Some molecules are made only by one type of atoms (two oxygen atoms bond together to form O₂ molecule) while molecules like protein are made up of atoms from different elements.

Elements

A chemical element is a pure chemical substance consisting of one type of atom distinguished by its atomic number. Carbon, Oxygen, Silicon, Arsenic, Aluminum, Iron, Copper, Gold, Mercury etc. are all examples of elements.

Note :

- Hydrogen and Helium are the most abundant elements in the universe.
- Iron is the most abundant element (by mass) in the earth.
- Oxygen is the most common element in the earth's crust.
- The 8 most abundant elements in Earth's crust (by mass) are the following :
 1. 46.6% Oxygen (O)
 2. 27.7% Silicon (Si)
 3. 8.1% Aluminum (Al)
 4. 5.0% Iron (Fe)
 5. 3.6% Calcium (Ca)
 6. 2.8% Sodium (Na)
 7. 2.6% Potassium (K)
 8. 2.1% Magnesium (Mg)

Periodic Table

Dmitri Ivanovich Mendeleev is the father of periodic table. The first detailed form of the periodic table was developed by Mendeleev (based on mass number) but later **Henry Gwyn Jeffrey's Moseley** made a new periodic table based on atomic number. Mosley is called the father of modern periodic table.

Periodic Table of Elements

1	2																	10
H	He																	Ne
3	4																	10
Li	Be																	Ne
11	12																	18
Na	Mg																	Ar
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	
Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
87	88	89	104	105	106	107	108	109	110									
Fr	Ra	+Ac	Rf	Ha	106	107	108	109	110									

* Lanthanide Series	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
+ Actinide Series	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Mn	Uu	Uu

Legend - click to find out more...

H - gas	Li - solid	Br - liquid	Tc - synthetic
Non-Metals	Transition Metals	Rare Earth Metals	Halogens
Alkali Metals	Alkali Earth Metals	Other Metals	Inert Elements

Natural elements

The elements which occur in naturally on earth are called natural elements.

Eg: Oxygen, Nitrogen, Carbon etc.

Synthetic or man-made elements

A synthetic element is a chemical element that does not occur naturally on the earth. These are prepared by artificially and are unstable. The first synthetic element made was Technetium.

Compounds

Compounds contain more than one kind of atoms (more on atoms, later). It cannot be separated into constituent atoms by simple methods.

Eg: common salt (NaCl), Sodium carbonate (Na₂CO₃).

Mixtures

Mixtures are a combination of two or more substances, which when combined, each substance retains its own chemical identity. Examples of Mixtures include :

- sand and water.
- salt and water.
- sugar and salt.

