

Structure of Atom

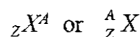
- The word atom is a Greek word meaning indivisible. According to Dalton's atomic theory, atom is the smallest indivisible part of matter which takes part in chemical reactions. In 1833, Michael Faraday showed that there is a relationship between matter and electricity. The discovery of electrons, protons and neutrons discarded the indivisible nature of atom proposed by John Dalton.

Atomic Number (Z)

- Atomic number of an element is the number of positive charges (or the number of protons, p) present in the nucleus of the atom.
- Since the atom as a whole is electrically neutral, therefore the number of positively charged particles *i.e.* protons present in the atom must be equal to the number of negatively charged particles *i.e.* electrons present in it.
- Atomic number of an element
= total number of protons present in the nucleus
= total number of electrons present in the atom.

Mass Number (A)

- The total mass of an atom is mainly due to protons and neutrons, and the sum of the number of protons and neutrons (nucleons) in the nucleus of the atom is known as mass number.
- $A = Z + N$, where N is the number of neutrons. An element X having a mass number A and atomic number Z is represented as:



Isotopes

- Isotopes are the atoms of the same element having different atomic masses. *e.g.* ${}_1^1\text{H}$, ${}_1^2\text{H}$ and ${}_1^3\text{H}$.
- Isotopes of an element possess identical chemical properties but differ slightly in physical properties.
- Number of neutrons present in the nuclei of various isotopes of an element is always different.
- All the isotopes of an element occupy the same position in the periodic table.

Isobars

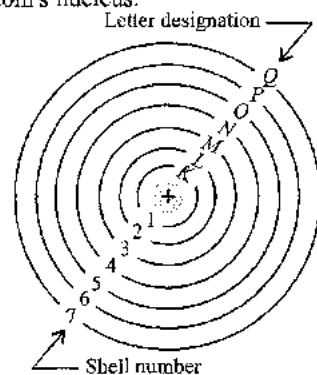
- These are the atoms of different elements having same mass number but different atomic numbers.
e.g. ${}_{19}^{40}\text{K}$ and ${}_{20}^{40}\text{Ca}$, ${}_{6}^{14}\text{C}$ and ${}_{7}^{14}\text{N}$, etc.
- Number of electrons or protons (atomic number) is

different but the sum of number of neutrons and protons (mass number) is same.

- Isobars occupy different positions in periodic table.
- Because these are atoms of different elements so their chemical properties are different but as their atomic masses are same so they possess almost identical physical properties.

CONCEPTS OF SHELLS AND SUBSHELLS

- An electron shell may be thought of as an orbit followed by electrons around an atom's nucleus.
- The electron shells are labelled as K, L, M, N, O, P and Q ; or 1, 2, 3, 4, 5, 6 and 7; going from innermost shell to outwards.
- Each shell can contain only a fixed number of electrons, the n shell can hold up to $2n^2$ electrons.
- The electrons in outer shell have higher average energy and travel farther from nucleus than those in inner shells. Thus electrons of outer shells are more important for reactivity.



Shell designation in an atom from nucleus than those in inner shells. Thus electrons of outer shells are more important for reactivity.

Subshell

- Each shell consists of one or more subshells and each subshell consists of one or more atomic orbitals.
- There are four different types of subshells. These various subshells are denoted by letters s, p, d and f .

Shell name	Subshell name	Max. electrons in subshell	Max. electrons in shell
K	1s	2	2
L	2s	2	2 + 6 = 8
	2p	6	
M	3s	2	2 + 6 + 10 = 18
	3p	6	
	3d	10	
N	4s	2	2 + 6 + 10 + 14 = 32
	4p	6	
	4d	10	
	4f	14	