Some common terms in Chemistry

1. Atomic number (Z) = no. of protons in an atom = no. of electrons in a neutral atom
2. Mass number (A) = no. of protons (Z) + no. of neutrons (n)
3. Isotopes : Atoms with same atomic number but different mass number. Eg.- Protium(^1_1H); Deuterium(^2_1D); Tritium(^3_1T).
4. Isobars : Atoms of different elements having same mass number. Eg.- $^{14}_{6}C$ and $^{14}_{7}N$.
5. Isotones : Atoms of different elements having same number of neutrons. Eg.- $^{32}_{16}S$ and $^{31}_{15}P$.

Drawbacks of Rutherford's Model of an Atom

Rutherford nuclear model of an atom is like a small scale solar system with the nucleus playing the role of the massive sun and the electrons being similar to the lighter planets. Further, the Coulomb force $\frac{k.q_1.q_2}{r^2}$ is mathematically similar to gravitational force $G\frac{m_1m_2}{r^2}$. When classical mechanics is applied to the solar system, it shows that the planets describe well-defined orbits around the sun. The similarity between the solar system and nuclear model suggests that electrons should move around the nucleus in well-defined orbits. However, when a body is moving in an orbit, it undergoes acceleration. . So an electron in the nuclear model describing planet like orbits is under acceleration. According to the electromagnetic theory of Maxwell, charged particles when accelerated should emit electromagnetic radiation. Therefore, an electron in an orbit will emit radiation the energy carried by radiation comes from electronic motion. The orbit will thus continue to shrink. Calculations show that it should take an electron only 10^{-8}s to spiral into the nucleus. But this does not happen. Thus, the Rutherford model cannot explain the stability of an atom. If the electrons were stationary, electrostatic attraction between the dense nucleus and the electrons would pull the electrons toward the nucleus to form a miniature version of Thomson's model of atom. Another serious drawback of the Rutherford model is that it says nothing about the electronic structure of atoms i.e., how the electrons are distributed around the nucleus and what are the energies of these electrons.

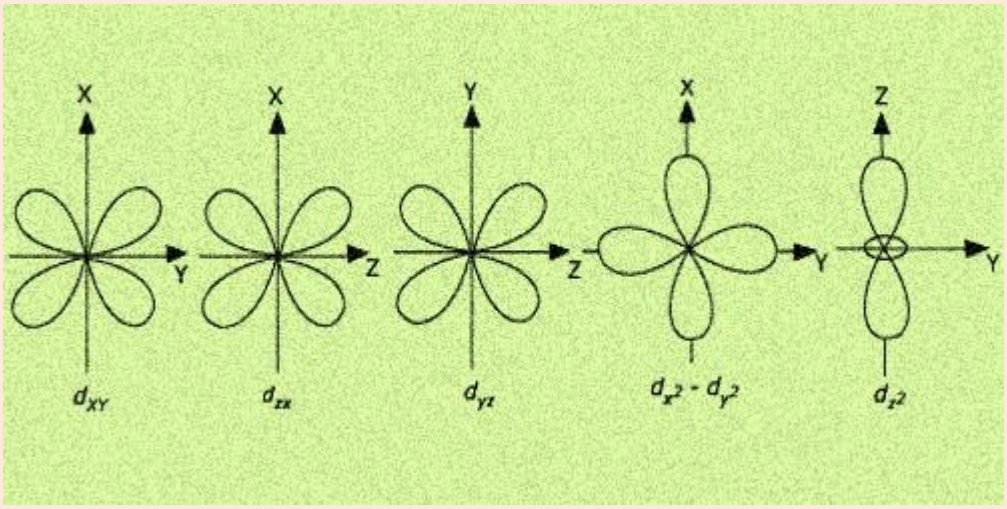
Wave nature of Electromagnetic Radiation

Energy from any source is emitted continuously in the form of radiation or waves. Maxwell suggested that when charged particles undergo acceleration, they create alternating electric and magnetic fields. These radiations are called Electromagnetic Radiation. They do not require any material medium for propagation. It is established that there are many types of Electromagnetic Radiation. In vacuum, they travel at a speed of $3 \times 10^8 m/s$ regardless of their wavelength. This is known as speed of light and is represented as 'c'. Wavelength is represented as 'λ' and Frequency is represented as 'ν'. Another commonly used quantity in spectroscopy is wavenumber ($\bar{\nu}$). It is defined as the number of wavelengths per unit length. $\bar{\nu} = \frac{1}{\lambda}$ and $\lambda = \frac{c}{\nu}$.

Electromagnetic Spectrum

Different Electromagnetic Radiations differ in their wavelength and frequency. Arrangement of all electromagnetic radiation in increasing order of their wavelength is given below.

3. **d-orbitals**



Afbau Principle

In the ground state of an atom, the orbitals are filled in the order of their increasing energy. The energy of subshells of Hydrogen atom depend only on the Principal Quantum Number.

1s<2s=2p<3s=3p=3d<4s=4p=4d=4f

Orbitals having same enery are called Degenerate Orbitals. The value of energy of orbitals of other atoms depend on the value of 'n' and 'l' which is given by the 'n+l' rule. Electrons come first in orbitals with less 'n+l' vlaue. If value of 'n+l' is same then electron goes to orbit having less value of 'n'. The order of energy is as follows:-

1s<2s<2p<3s<3p<4s<3d<4p<5s<4d<5p<6s<4f<5d<6p<7s<6p<5d

Hund's Rule of Maximum multiplicity

Pairing of electrons in an orbital does not take place until each orbital belonging to that particular subshell carries atleast one electron. Pairing will always start with 4th electron in p-orbital, 6th electron in d-orbital and so on.

Pauli's Exclusion Principle

No two electrons in an atom can have the same set of all three quantum numbers. If two electrons have same value of 'n', 'l' and 'm' the they will have opposite spin. Thus it is possible to calculate that the maximum number of electrons in an orbital is 2 since third electron must have same spin as first which is not possible.

Magnetic Property

If all the electron in an atom are paired, it is called **diamagnetic.** It even one electron is unpaired, it is called **paramagnetic.**

Reasons for stability of Half-filled and Fully-filled orbitals

1. **Symmetrical Distribution of electrons :** Half and fully filled orbitals have symmetricsl distribution of electrons. Hence they are more stable.