# Rank Enhancer

QUANTUM NUMBERS

- Set of four numbers that are used to locate an electron out of many are called quantum numbers. For purpose of locating an electron, atom is divided into different parts and each part assigned with one quantum number.
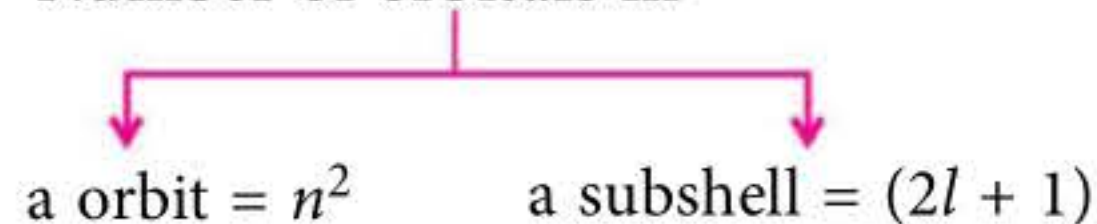
Atom	Quantum Numbers	Values	Signifies
Shells/ Energy level/ Orbits (K, L, M, N)	Principle quantum number(n)	1, 2, 3, 4, ..., K, L, M, N, ...	Orbit size, Radius Energy
Sub-shells (s, p, d, f)	Azimuthal quantum number (l)	0, 1, 2, 3, 4 (s) (p) (d) (f) (g)	Angular momentum electron repulsion, finding probability, area (shape)
Sub-subshell (or) orbital (s, p_x, d_{xy})	Magnetic quantum number (m)	$-l$ ....0....$+l$ -4....0.....$+4$	Orientation
2 electrons with opposite spin	Spin quantum number (s)	$+\dfrac{1}{2}$ (clockwise spin) / $-\dfrac{1}{2}$ (anti-clockwise spin)	Spin

Numerical concept

- **Maximum number of electrons in**

Orbit	Subshell	Sub-subshell
$= 2n^2$	$= 2(2l + 1)$	(Orbital) $= 2$
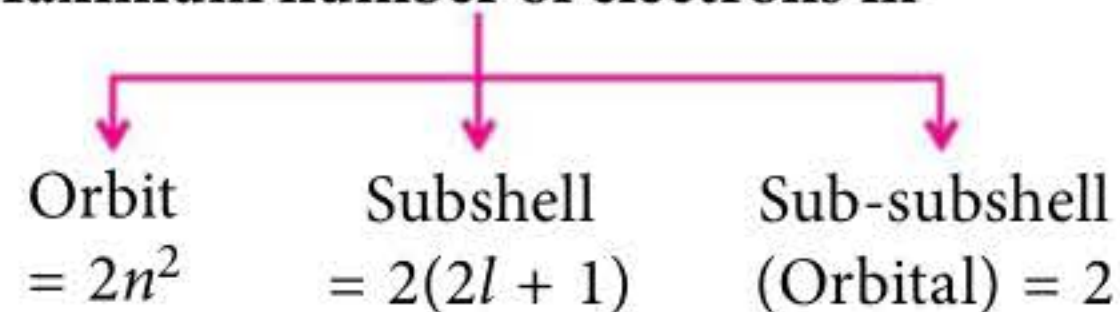
- **Number of orbitals in**

a orbit $= n^2$ a subshell $= (2l + 1)$

- **Number of subshell in**

a orbit $= n$

- Angular momentum
  - orbital $\dfrac{h}{2\pi}\sqrt{l(l + 1)}$
  - spin $\rightarrow \dfrac{h}{2\pi}\sqrt{s(s + 1)}$

s = Total spin

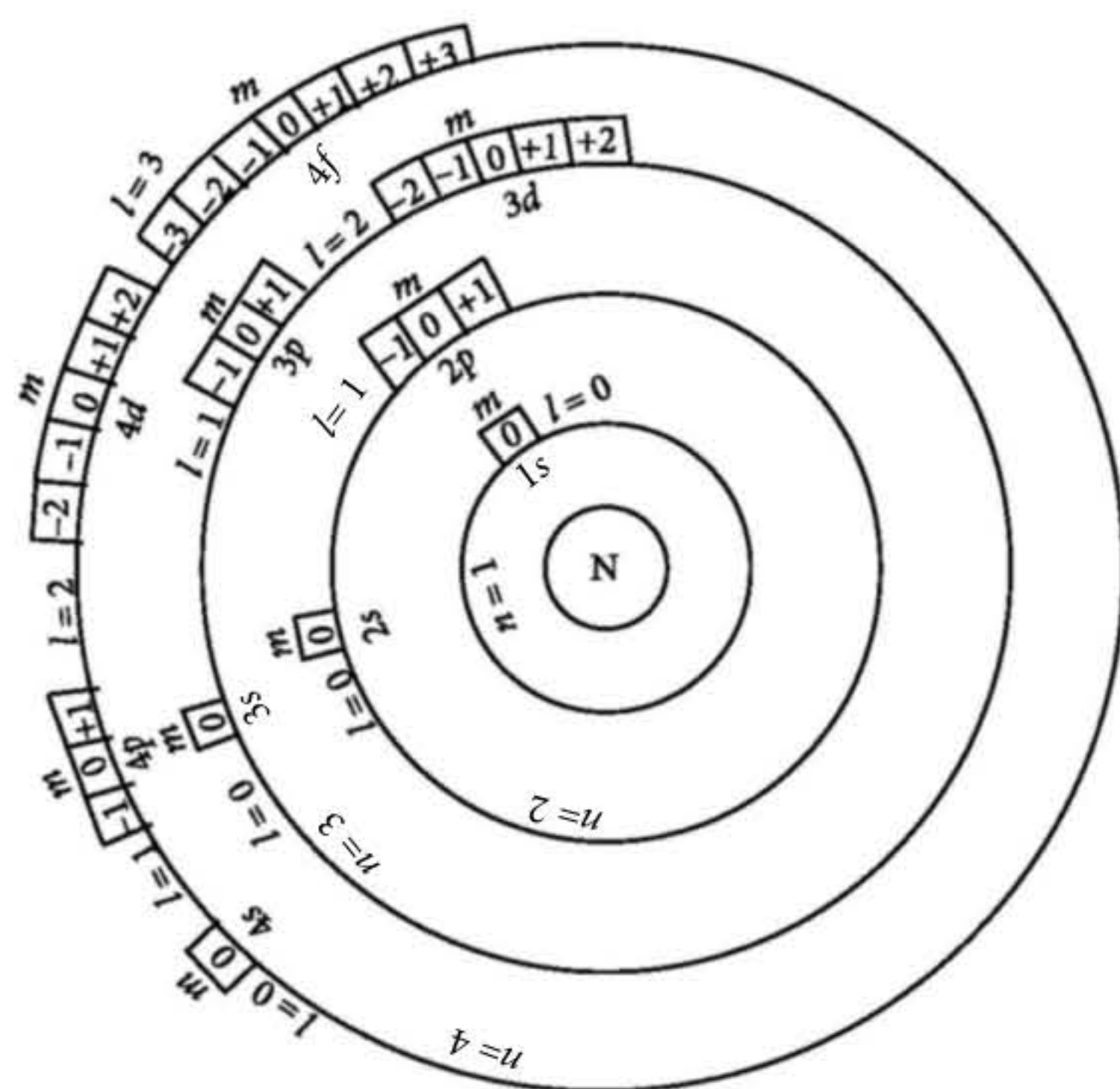- Spin multiplication = $2s + 1$

	Subshell	l	Orbitals	Electrons
(1)	s	0	1	2
(2)	p	1	3	6
(3)	d	2	5	10
(4)	f	3	7	14
(5)	g	4	9	18

- Permitted values :

n	1 ......n
l	0 .....$(n - 1)$
m	$-l$....0......$+l$
s	$+\dfrac{1}{2}$ and $-\dfrac{1}{2}$

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Rules for writing configuration

- **Aufbau's principle :** Subshells are filled with electrons in increasing order of energy.

  $1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < \ldots$

- **Bohr's-Bury rule or $(n + l)$ rule**

  Energy of subshell directly proportional to $(n + l)$ value and if $(n + l)$ is same, then directly proportional to n.

Example :

	6s	5d
$n+l$	$6+0=6$	$5+2=7$

$\therefore 6s < 5d$

	5d	6p
$n+l$	$5+2=7$	$6+1=7$

but n of $5d$ is less $\therefore 5d < 6p$

- **Pauli's exclusion principle :** No. two electrons can have all same set of quantum numbers (or) any orbital can accommodate 2 electrons with anti-parallel spin.

- **Hund's rule of maximum multiplicity :** In degenerate orbitals, all orbitals are singly occupied with electrons before pairing up.

QUESTIONS FOR PRACTICE

Single Option Correct Type

1. Maximum number of electrons that can be accommodated in a d-orbital is
(a) 10   (b) 6   (c) 2   (d) 14

2. Maximum number of possible electrons in $_{24}\mathrm{Cr}$ with $s = +1/2$, is
(a) 24   (b) 12   (c) 15   (d) 18