*Chapter 7: Quantum Theory of the Atom.

*7.5: Quantum numbers and atomic orbitals:

*Atomic Orbitals: A wave function for an electron in an atom.

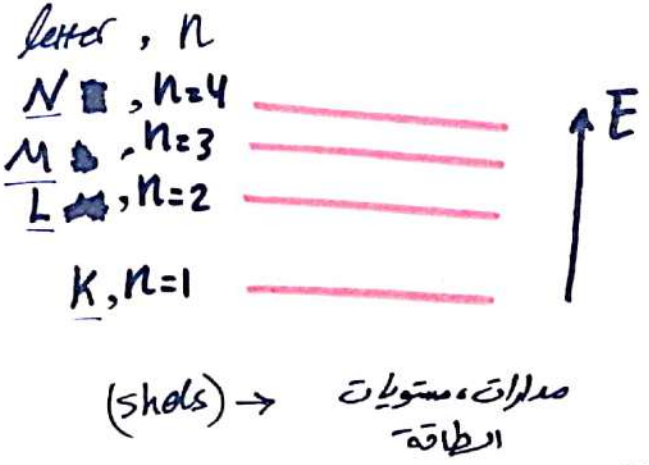
⟹ Quantum Numbers:

1] Principal Quantum Number: is the one on which the energy of an electron in an atom principally depends, it can have any positive value: 1, 2, 3, ..., ∞

→ a) Energy of the shell

b) Avarege distance between electrons an nucleus

c) Size of the orbital, larger n → larger orbital



(shells) → مدارات، مستويات الطاقة

2] Angular Momentum Quantum Number (l) - also called Azimuthal Quantum Number

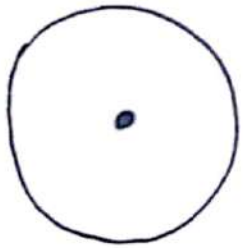
⇒ This quantum number distinguishes orbitals of given n having different shape; it can have any integer value from 0 to n-1.

*orbitals of the same n but different L are said to belong to different **subshells** of agiven shell

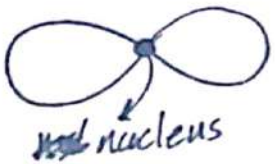
Letter →	s	p	d	f	g ...
L →	0	1	2	3	4 ...

Example:
n=1 , L=0
n=2 , L=0,1
n=3 , L=0,1,2

* 4P > 3P > 2P



S orbital



P orbital

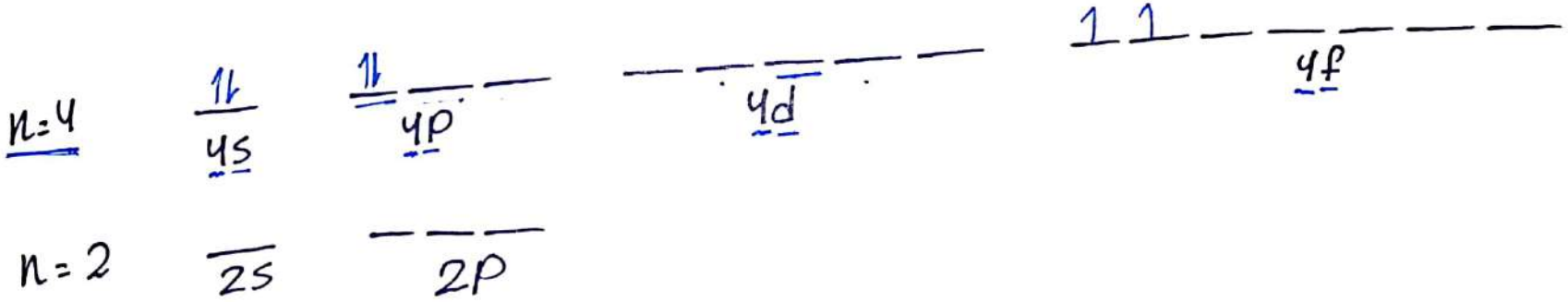
d orbital

3] Magnetic Quantum Number (m_L): This quantum number distinguishes orbitals of given n and L, of given energy and shape but having different orientation in space.

* The allowed values are the integers from $-L$ to $+L$.
* describe the orientation of the orbital
* number of m_L values $= 2L + 1$

4] Spin Quantum Number (m_s): it refers to the two possible orientations of the spin axis of an electron.

* possible values are $+1/2$ and $-1/2$ (↑↓)



* **Example:** state whether each of the following sets of quantum numbers is Permissible for an electron in an atom. If a set is not permissible, explain why:-

a] $n=1, L=1, m_L=0, m_s=+1/2$

not permissible → $l \neq 1$

B] $n=3, L=1, m_L=-2, ms=-1/2$

not permissible → $m_L \neq -2$

c] $n=2, L=1, m_L=0, m_s=+1/2$

Permissible

d] $n=2, L=0, m_L=0, m_s=1$

Not permissible → $ms=+1/2$ or $-1/2$ not 1