Heisenberg uncertainty principle:

When applied to e^- states: it is impossible to know the exact momentum of electron and its exact location in space at the same time.

Schrödinger equation:

Incorporates both wavelike and particle-like behavior of the electron

from his work came the study of quantum mechanics or wave mechanics

It's involved with the probability that an electron will be in a certain region of space at a given instant.

Solution to Schrödinger equation is a set of wave functions and corresponding energies

The wave functions are called ***orbitals***. Each orbital describes specific distribution of electron density in space.

Each orbital has characteristic energy and shape.

Quantum numbers:

Set of 4 numbers

describe the orbital and how the electron is moving.

1) principal quantum number (n)
has integral value: 1, 2, 3, 4….

As n increases:

a) the orbital gets larger
b) the farther away from the nucleus the e^- is
c) e^- has higher energy
d) e^- not tightly bound to nucleus

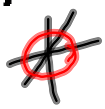
2) angular momentum quantum number (l)
has integral value from 0 to n-1 for each value of n

describes the shape of the orbital

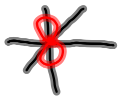
s 0
p 1
d 2
f 3

orbitals:

s 1 orbital lowest energy is 1s—has spherical shape



p 3 orbitals dumb-bell shape with 2 regions on either side of the nucleus with a node in the middle (at the nucleus)



d 5 orbitals 4 leaf clover shape first appear in the 3rd energy level

f 7 orbitals first appear in the 4th energy level

3) magnetic quantum number (m_l)

Have integral values between l and –l including 0

orbital	l	m_l
s	0	0
p	1	-1, 0, 1
d	2	-2, -1, 0,1, 2
f	3	-3,-2,-1,0,1,2,3

Orbitals with the same n value are in the same electron shell or energy level

ex. All orbitals where n=3 are in the 3rd shell or energy level.

Subshell—set of orbitals having same n and l values

ex. n = 3 l =2 are called 3d orbitals and are in the 3d subshell

4) spin quantum number (m_s)

Only 2 possible values: + ½ or – ½

+ ½ means e^- spins clockwise

-½ means e^- spins counterclockwise

Pauli Exclusion Principle says that no 2 electrons can have the same 4 quantum numbers. This is because there are only 2 values for the spin. This also means that only 2 electrons can be in the same space orbital.

lectron configuration:

Way in which electrons are distributed among the various orbitals in the electron cloud

Aufbau principle:

Orbitals are filled in order of increasing energy with no more than 2 electrons per orbital.

Hund's Rule:

For degenerate orbitals, lowest energy is attained when the number of electrons with same spin is maximized

This means electrons occupy orbitals singly before pairing. This gives electrons in the same orbitals parallel spins and helps to reduce electron repulsion.

Determine the quantum numbers for the last electron in each of the following atoms:

Li, C, Ne, Al, Na

Because e^- repel each other, different subshells have different amounts of energy

total number of orbitals in a shell is n^2.
(n = number of the shell)

1st shell	$1^2 = 1$
2nd	$2^2 = 4$
3rd	$3^2 = 9$

Remember: e^- in lowest orbital is in its ground state (at ordinary temp.)

Excited state— electron in any other orbital than ground state
e^- in excited state by the absorption of a photon of appropriate energy