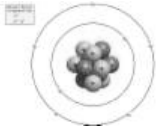
Quantum Mechanical Theory

Bohr

- Bohr proposed that the hydrogen atom has only certain _____.
- Bohr suggested that the single electron in a hydrogen atom moves around the nucleus in only certain allowed circular orbits.



De Broglie

- Applied wave-particle theory to e^-
- _____exhibit wave properties
- Came up with the equation:

$$\lambda = \frac{h}{mv}$$

The Heisenberg Uncertainty Principle

- The **Heisenberg uncertainty principle** states that it is fundamentally impossible to know precisely both the _____ and _____ of a particle at the same time.

The Schrödinger wave equation

- The atomic model in which electrons are treated as waves is called the wave mechanical model of the atom or, more commonly, the **_____ of the atom**.

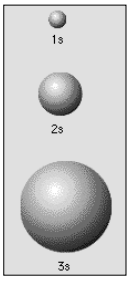
The Schrödinger wave equation

- A three-dimensional region around the nucleus called an _____ describes the electron's probable location.
- You can picture an atomic orbital as a fuzzy cloud in which the density of the cloud at a given point is proportional to the probability of finding the electron at that point.

Quantum Numbers (n, l, m)

- n = _____ Quantum Number
- It has whole number values (1, 2, 3, …)
- An n increases, the orbital becomes larger
- n tells you what _____ you are in
- n designates the _____

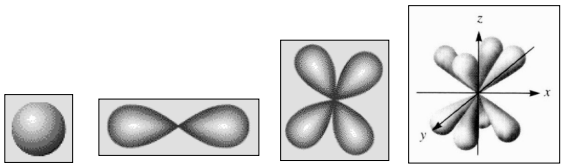
Size



Quantum Numbers (n, l, m)

- L = _____ Quantum Number or _____Quantum Number
- Can have values from 0 to (n-1) for each value of n
- Defines the _____ of the orbital
- L = 0 → s
- L = 1 → p
- L = 2 → d
- L = 3 → f
- Tells you what _____ you are in

Shapes

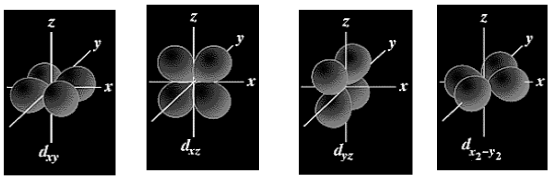


s p d f

Quantum Numbers (n, l, m)

- m_L = _____ Quantum Number
- Can have whole number values from – L to + L (including zero)
- This describes the orbital's _____ in space (which axis it is on)
- Tells you what _____ you are in

Orientation



Possible Values for n, l, m

- n (shell) = 1, 2, 3, 4, … (whole numbers)
- L (sub shell) values from 0 → (n -1)
- m_L (orbital) values from – L to + L (including zero)

Examples

- What are the possible values for L if n =2?

Examples

- What are the possible values of n, L, and m in the 2s sub shell?

Examples

- What are the possible values for n, L, & m in the 3d sub shell?

Example

- What is the designation for the sub shell where n = 2 and L = 1?

Example

- What is the designation for the sub shell where n = 4 and L = 3?

Possible Number of Values (how many answers are there?)

- A shell with Principal Quantum Number (n) has exactly n number of sub shells
- Therefore
- # L's = n

Example

- If n = 2 how many possible number of values are there for L?

Possible Number of Values (how many answers are there?)

- For a given value of L there are 2L + 1 possible values for m
- Those values as stated before range from –L to +L

Example

- How many values of m are there if L = 0?

Example

- How many possible values are there for m if L = 2?

Example

- What are the values for m if L = 2?

Possible Number of Values (how many answers are there?)

- The number of possible values of m = n^2
- Example:
- If n = 2, how many values are there for m?

Possible Number of Values (how many answers are there?)

- Since each orbital can hold at most 2 electrons, the number of electrons in a shell is $2n^2$
- How many electrons are in the n = 3 shell?

Summary

Possible Values

- L (0 → n-1)
- m (-L → +L)

# of Possible Values

- Orbitals (m)
  - #m = 2L +1
  - #m = n^2
- Sub shells (L)
  - # L = n
- Electrons
  - # electrons = $2n^2$

More examples

- How many sub shells are in n = 4?

More examples

- What designation would n = 5 and L = 1 have?

More examples

- In the 4d sub shell, what are the possible values for n, l, & m?

More examples

- In the 3p sub shell, what are the possible values for n, l, & m?