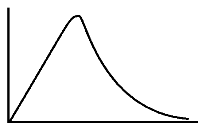
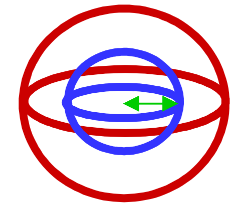


Solutions (Ψ) to Schrodinger's Equation



- **Many solutions are possible (Ψ_a, Ψ_b, Ψ_c...)**
- **Each produces a different electron probability distribution around the atom.**
- **Each distribution or orbital contains the electrons 90% of the time and *has a unique shape.***
- **Each orbital is identified by sets of numbers called quantum numbers.**

(much like addresses are used to identify buildings)

The Principle Quantum Number:

n

- Always a positive integer 1

  n=1, 2, 3, etc

- Electrons in orbitals with ***large n values*** have ***higher P.E***. than electrons with low n values.

- Electrons in orbitals with ***large n values*** are more likely to be ***farther from the nucleus***

The Angular Momentum Quantum Number:

ℓ *(script "L")*

- ℓ = 0, 1, 2, 3.....(n-1)
- Values of l are associated with the following letters:
  - ℓ = 0 "*s*" orbital
  - ℓ = 1 "*p*" orbital
  - ℓ = 2 "*d*" orbital
  - ℓ = 3 "*f*" orbital
- Values of l are identified with the various shapes of orbitals.

The Magnetic Quantum Number: m_ℓ

- $-\ell \quad \ldots \quad m_\ell \quad \ldots \quad +\ell$
- **Describes the direction an orbital points around the nucleus.**

Quantum numbers: n, ℓ, m_ℓ

Combinations of quantum numbers are like addresses for orbitals.

The Rules:

n = 1, 2, 3, ...

ℓ = 0, 1, 2, 3...(n-1)

$-\ell$ ... m_ℓ ... $+\ell$

List all of the quantum number combinations associated with n = 2.

n = 2
- ℓ = 0
  - m_ℓ = 0
- ℓ = 1
  - m_ℓ = -1
  - m_ℓ = 0
  - m_ℓ = +1

Ψ_{200} Ψ_{21-} Ψ_{210} Ψ_{211}

Quantum numbers: n, ℓ, m_ℓ

List all of the quantum number combinations associated with $n = 4$.

- **$n = 4$**
  - **$\ell = 0$**
    - $m_\ell = 0$
  - **$\ell = 1$**
    - $m_\ell = -1$
    - $m_\ell = 0$
    - $m_\ell = +1$
  - **$\ell = 2$**
    - $m_\ell = -2$
    - $m_\ell = -1$
    - $m_\ell = 0$
    - $m_\ell = +1$
    - $m_\ell = +2$
  - **$\ell = 3$**
    - $m_\ell = -3$
    - $m_\ell = -2$
    - $m_\ell = -1$
    - $m_\ell = 0$
    - $m_\ell = +1$
    - $m_\ell = +2$
    - $m_\ell = +3$

Question: Is $n=4$, $\ell=3$ and $m_\ell = -1$ a reasonable set of quantum numbers?

Yes! Ψ_{43-1} is reasonable! ***(at least it follows the rules!)***