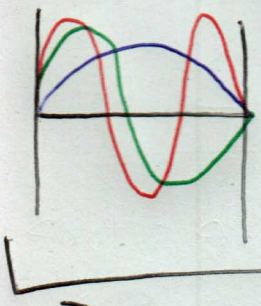
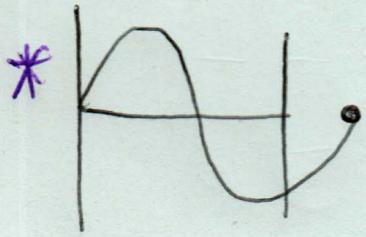
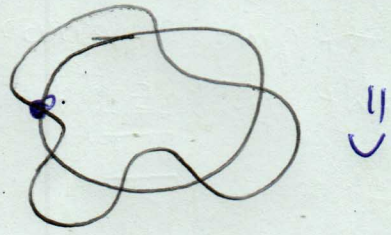


$y = a \sin n\theta$

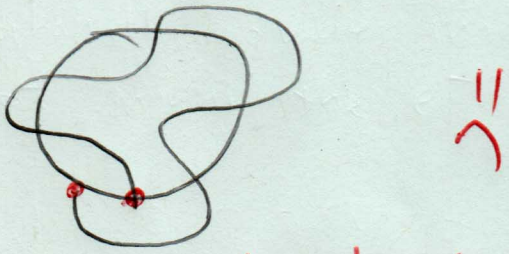


In a standing wave system, there are an indefinite # of waves that are able to exist, but only if they match the physical parameters of the system (endpoints match). This means there are only particular ~~that~~ energy levels that exist.

* Any wave that does not match the physical parameters of the system will not be able to exist.



endpoints match



endpoints do not match

In standing wave systems, energy comes in fixed packets (quanta). The shape of the wave in the system depends on the # of packets used.

$\psi(n, \ell, m_\ell, m_s) = \psi(r, \theta, \phi) = R(r)\,Y(\theta, \phi)$

psi — quantum #s — spherical coordinates — radial — Spherical

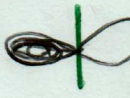
$\psi^2 \propto$ probability

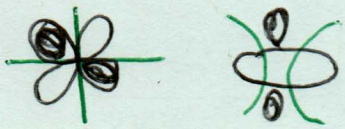
$n \rightarrow$ principal quantum # $\rightarrow$ total # of energy packets

$n-1$ # of packets that can be distributed radially or spherically

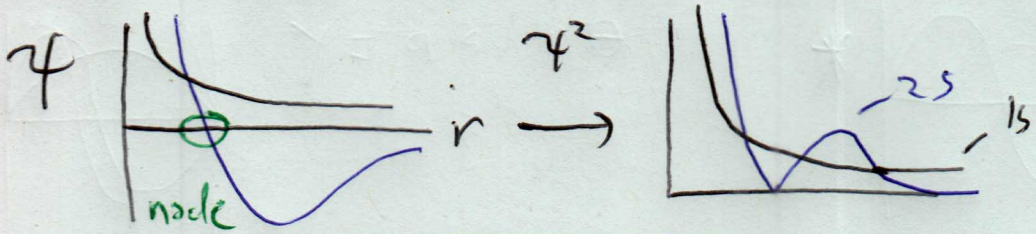
$\ell \rightarrow$ orbital angular momentum $\rightarrow$ spherical portion $\rightarrow$ # of spherical nodes

$\ell = 0$  s

$\ell = 1$  p

$\ell = 2$ 

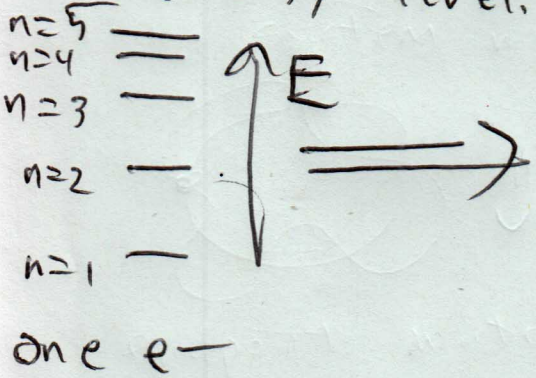
(n-1) - ℓ = # of radial nodes



1s 

2s 

In an atom with only one e⁻, all orbitals in the same level are the same energy. In atoms with multiple electrons, the inner electrons can shield the nucleus from interacting with electrons further away. This causes differences in energy for orbitals within the same energy level.



$\Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} \ldots$

Core configuration:

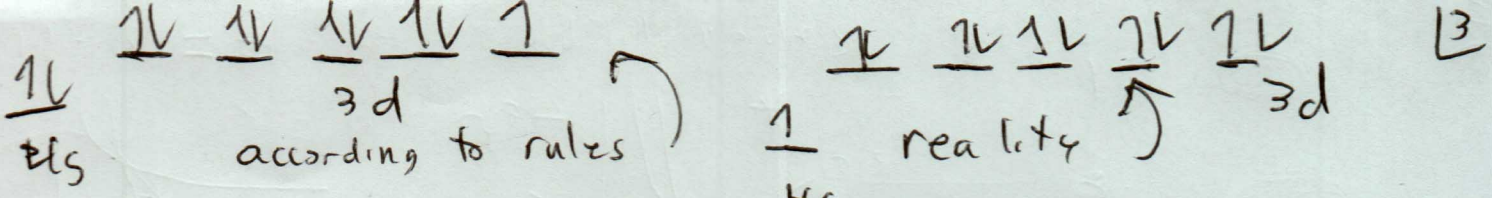
$Sc: 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$

$Sc: [Ar]\, 4s^2 3d^1$

$Sc^+: [Ar]\, 4s^1 3d^1$

Orbital filling rules:

- Aufbau (building up) — orbitals fill from lowest energy first
- Hund's rule — In equal-energy (degenerate) orbitals each orbital is filled with one electron first before pairing (due to pairing energy)
- Pauli exclusion principle — two electrons can occupy the same orbital as long as they have different spin



Cu: [Ar] $4s^2 3d^9$ Cu: [Ar] $4s^1 3d^{10}$

shell – a particular energy level

Subshell – all orbitals within an energy level with same l

Whenever a subshell is completed, the energy of the electrons is lowered slightly (very favorable),

The octet rule is the observation that exactly completing the s + p subshells of the valence shell produces an unusually unreactive atom.

In Cu, a 4s electron moves up to the 3d subshell because completing the 3d subshell provides more stabilization than the energy cost of moving the e^- up.