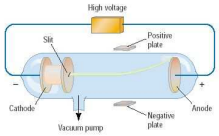
Chemistry "B" Name
Chapter 11 Notes: **"Modern Atomic Theory"** Per. #

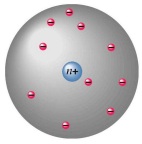
Sec. 11-1 Rutherford's Atom

Review & Remember

Dalton: Elements consists of atoms. compounds are

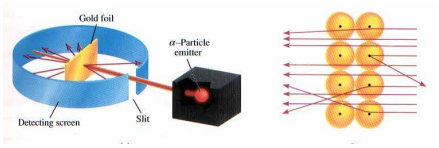
2. J. J. Thompson:
   Used the cathode ray.
3. William Thompson (aka Lord Kelvin):





   Robert Millikan: Electrons have

5. **Rutherford**: found that the atom had a nucleus with electrons on the outside revolving around. The nucleus was very small and was made of p. He and James Chadwick later discovered the neutron.



Problem:

Sec. 11-2 Energy & Light

In the early 20th century, a new model evolved as a result of investigations into the absorption and emission of light by matter.

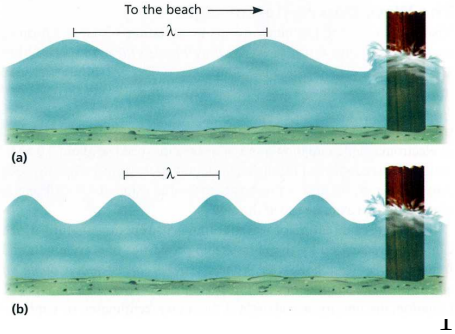
Let us look at the properties of waves and light
Energy can be transmitted from one place to another by

What factors define waves?

- Velocity **v or c**
  (Note: Speeds of waves are different through different media)
- Frequency **ν**

  Wavelength **λ**

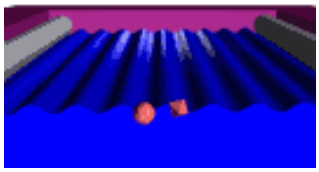
  (Note: color and pitch are related to frequency and wavelength)

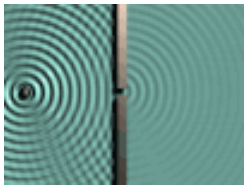


- Amplitude height of the wave from resting position to the crest
- Energy **E**
- **Big Idea!!!** Knowing

  $c = \lambda \nu$, $E = h \nu$, $E = hc/\lambda$
  (Note: h = Planck's constant; 6.626 x 10^{-34} J s)

What do waves do?





- form standing waves…. reflection and interference (like a vibrating string)
- refract …
- diffract …

For many years' scientists thought light behaved solely as a wave. This changed when they discovered "The Photoelectric Effect".

This simple observation would mean that light has particle-like properties.

- The light "particles" are called **photons**
- !!!
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Sec. 11-3 Emission of Energy by Atoms
When an atom receives energy from

An atom can then release this energy by

The energy they give off is the exact amount of Energy they received.

Sec. 11-4 The Energy Levels of Hydrogen
Remember: Different wavelengths carry different amounts of Energy per photon…

When hydrogen absorbs energy from an outside source it becomes excited and releases this energy. Interestingly, only certain colors of visible light are emitted, that is, only certain photons at specific wavelengths and frequencies.

This suggests that the electron of a hydrogen atom can exist only in very specific energy states.

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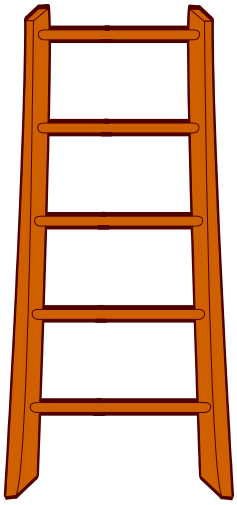
Problem:

Sec. 11-5 The Bohr Model of the Atom
Why don't the electrons fall into the nucleus?

Increasing Energy



Fifth

Fourth

Third

Second

First

- Further away from the nucleus means more energy.
- There is no "in between" energy
- Energy Levels

Sec. 11-6 The Wave Mechanical Model of the Atom
Problems with Bohr's Model

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Schrödinger, Heisenberg and De Broglie devised some math equations to explain the "wavicle" properties of electrons. They explained it like this:

- .
- .

Sec. 11-7 & 11-8 The Wave Mechanical Model Further Developed

The cloud or probability map is called an **orbital**. The set of math equations that describes the electrons is called wave mechanics or quantum mechanics.
These equations contain variables we call quantum numbers: ***n***, ***l***, ***m***, and ***s***. Think of them as addresses for electrons.

Within the energy level the complex math of Schrödinger's equations describes several shapes.

The letter ***l***
The letter ***m***
The letter ***s***

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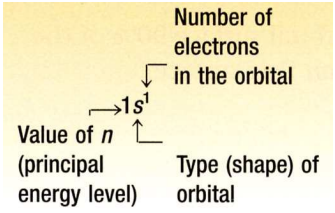
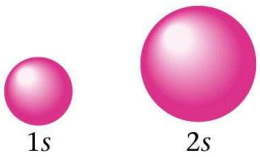
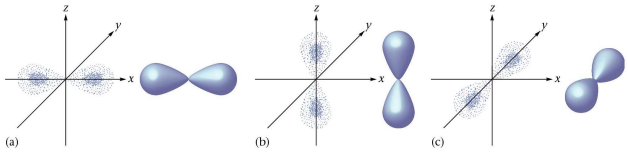
Sec. 11-9 & 11-10 The Electron Configurations

It is a list showing how many electrons are in each orbital or subshell in an atom or ion.
A subshell notation will list the subshells of increasing energy, with number of electrons in each subshell as a superscript.

Example: 

This atom has 10 electrons and represents the element Neon or some other ion with 9 electrons, like F^-.

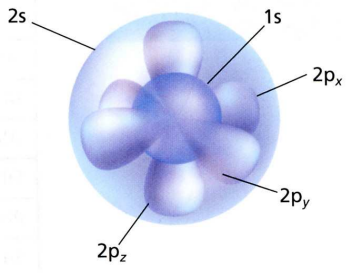




The S Orbital

The 2py orbital

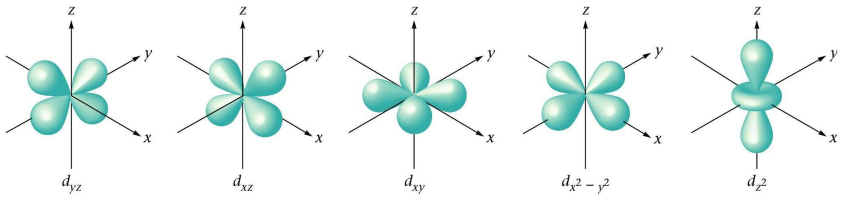
If the orbitals overlapped they would look like this →



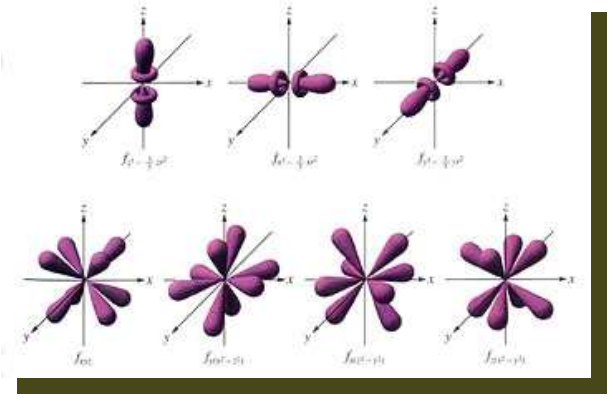
Orbital Labels

1. The number tells the principal energy level.
2. The letter tells the shape. The letter *s* means a spherical orbital; the letter *p* means a two-lobed orbital. The *x*, *y*, or *z* subscript on a *p* orbital label tells along which of the coordinate axes the two lobes lie.

The d subshells (The 3dxz orbital)



The f subshells



You can also represent configuration in an orbital diagram (box diagram) where an arrow represents the electron

Other points
Valence electrons
Core electrons