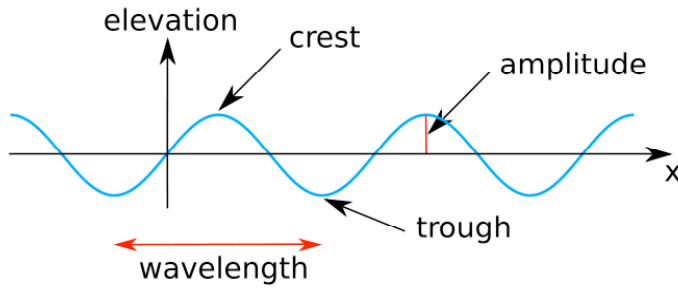


Chapter 7, part 1 – Electromagnetic Radiation and Electronic Structure of Atoms

Electromagnetic Radiation:

How we describe a wave:

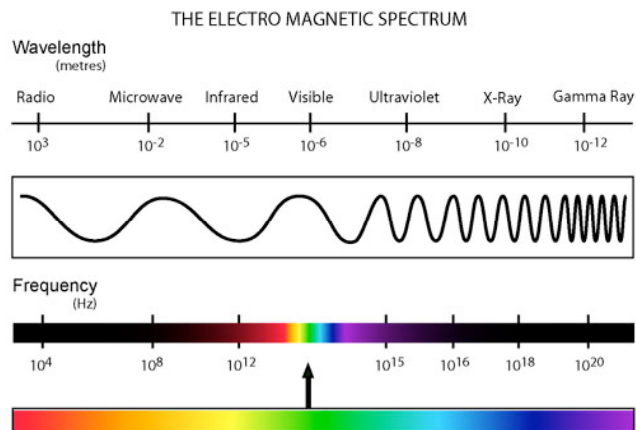


Wavelength:

Frequency:

Amplitude:

The Electromagnetic Spectrum



The speed of light:

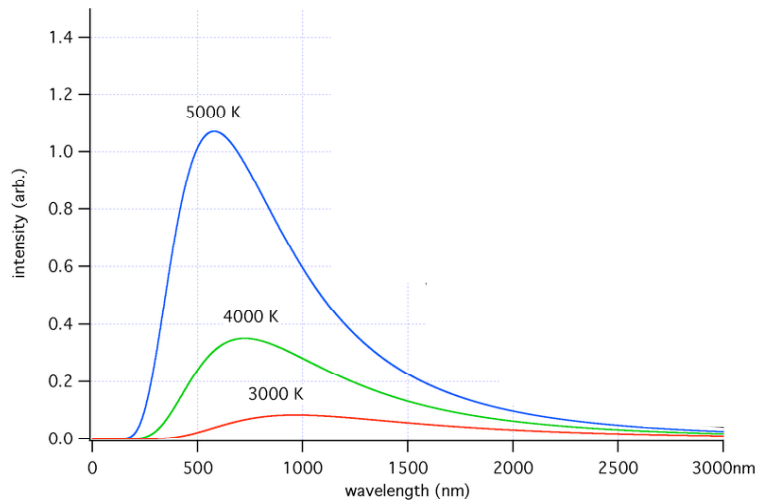
Green light has a wavelength of 522 nm. What is the frequency of this radiation?

What is the wavelength of radiation that has a frequency of 3.64×10^7 Hz?

Quantum Theory

Maxwell Planck, the year 1900

Blackbody Radiation:



The amount of radiation emitted by a _____ depends on its _____ . But also, the _____ (_____) of the light depends on temperature. Why?

Planck's theory:

Quantum:

The energy of a single quantum of energy:

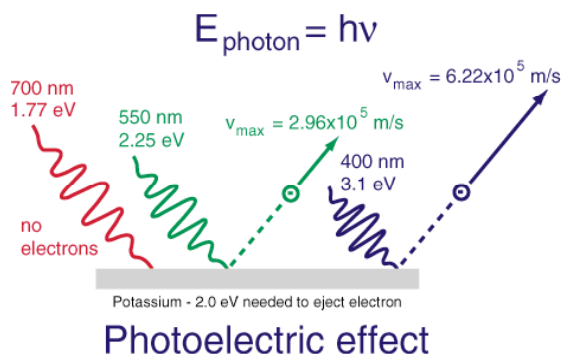
$h =$

photon:

What is the energy of a photon with a wavelength of 5.00×10^4 nm (infrared region)?

At the time of Planck's discovery, a lot of scientists did not agree with his theory. In 1905, the theory was proven experimentally by _____.

Photoelectric Effect:



Is light a wave or a particle?

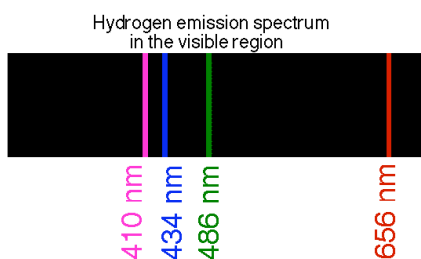
Can that be true? It is difficult to understand, but more scientists came up with experimental evidence that agreed with this theory.

Bohr's Theory of the Hydrogen Atom

Unlike heated objects, if an electric current is applied to a sample of an element in the gas phase,

Example: Hydrogen tube:

We call this the light emission of Hydrogen. When we consider all the wavelengths that hydrogen emits, we come up with the _____
_____:



The color we see with our eyes is a mixture of these colors.

Why does hydrogen gas only emit certain wavelengths when heated?

1913, Niels Bohr: The energy is _____.

When energy is put into the hydrogen atom,

This form of the atom is unstable, so

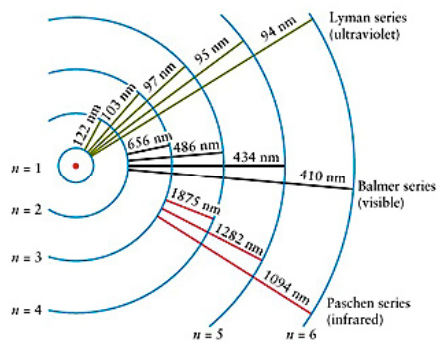
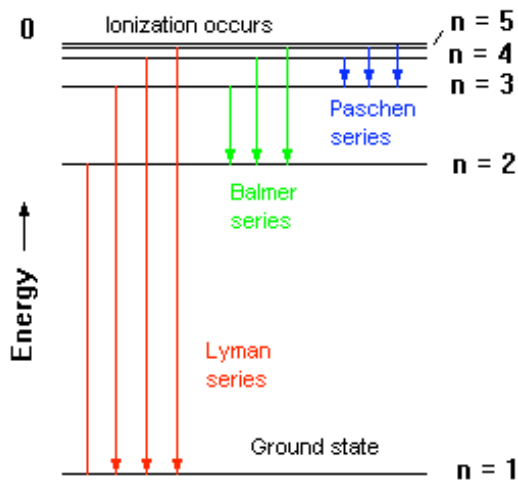
This is how we describe it:

And the energy associated with the difference between the two levels is given by this equation:

$R =$

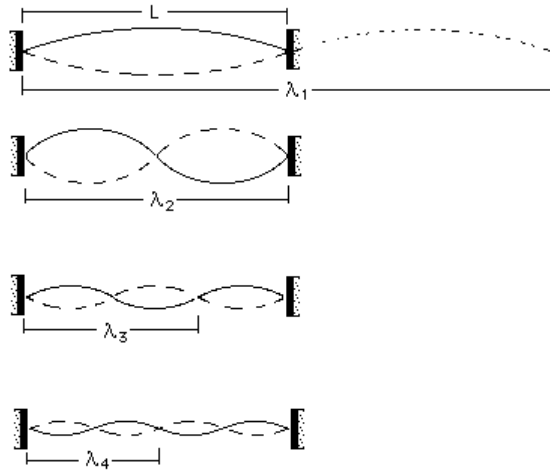
We can calculate the difference between any two levels with this equation:

We can imagine all the levels of a Hydrogen atom like this:



Why do electrons in an atom behave this way? Not until 1924 did someone come up with any more experimental evidence.

de Broglie:



So, an electron has a dual nature:

The wavelength of an electron can be calculated:

A Joule of energy is equal to

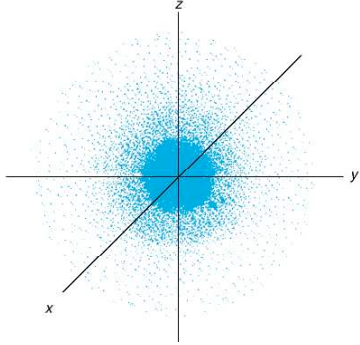
What is the wavelength of an electron (9.1094×10^{-31} kg) moving at 68 m/s?

Quantum Mechanics and Electron Configuration

The dual nature of electrons leads to a behavior of electrons described by

_____:

So our view of the atom now looks like this:



We describe each electron in a multi-electron atom using 4 quantum numbers.

1. “shell”

n =

2. “subshell”

___ =

3. “orbital”

m =

4.

$m_s =$ (there can only be ___ electrons in an orbital.)

Quantum number ___ is going to help us describe exactly what atomic orbitals look like.

___ value	kind of orbital

s orbitals:

p orbitals:

d orbitals:

f-orbitals: we won't worry about these for now. Atoms that have f orbitals are the _____ and _____ at the bottom of the periodic table.

Examples.

H atom: $n =$ ____ $l =$ ____ $m =$ ____

If $n=2$, ____ = ____ What subshells are possible?

What orbitals are possible?

If $n=3$, ____ = ____ What subshells are possible?

What orbitals are possible?

1. When $n = 2$, the values of ____ can be
2. When ____ = 1, the values of m can be _____ and the subshell has the letter _____
3. When ____ = 2, the subshell is called a ____ subshell.
4. When a subshell is labeled s, the value of ____ is _____ and m has a value of _____
5. When a subshell is labeled p, _____ orbitals occur within the subshell.

Electron Configurations

This tells us how the _____ are _____ in the various atomic orbitals.

We fill the _____ orbital first (____) and build from there. We use the **Pauli exclusion principle** to do this, which tells us that _____ can have the same _____.

We'll draw each orbital like this:

So the electron configuration for H is:

And for He it is:

What comes next? We can use this to help us:

The slight difference in E between subshells of the same n value is due to

Here is a diagram to help us correctly assign electrons: the basic rule is

So Li looks like this:

Be:

And then B:

Now we need to know Hund's rule to do Carbon correctly. Hund's rule says that the most _____ arrangement of electrons in subshells is the one with the _____ number of parallel spins (that is, _____ electrons).

So C looks like this:

Then N:

O:

F:

Ne:

All the boxes are filled for our noble gases:

Substances that have _____ spins are called _____.

Example, O.

Substances that have _____ spins are called _____.

Example, Ne.

Homework: Ch 7 # 8, 12, 16, 18, 20, 30, 32, 34, 40, 42, 56, 60, 68, 82, 84, 86