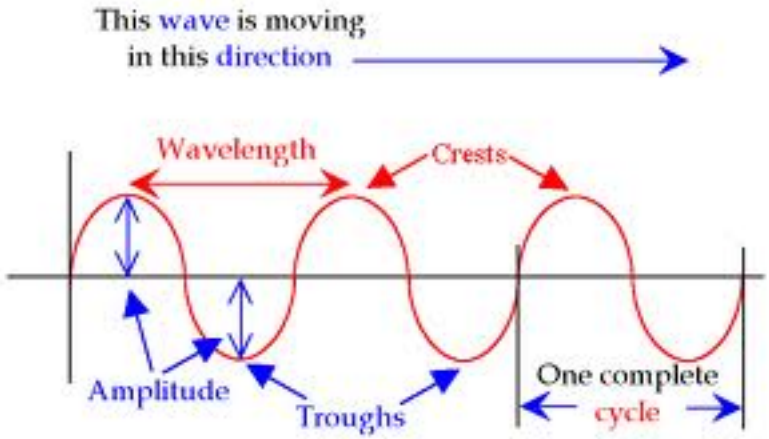
Waves

Longitudinal

Transverse



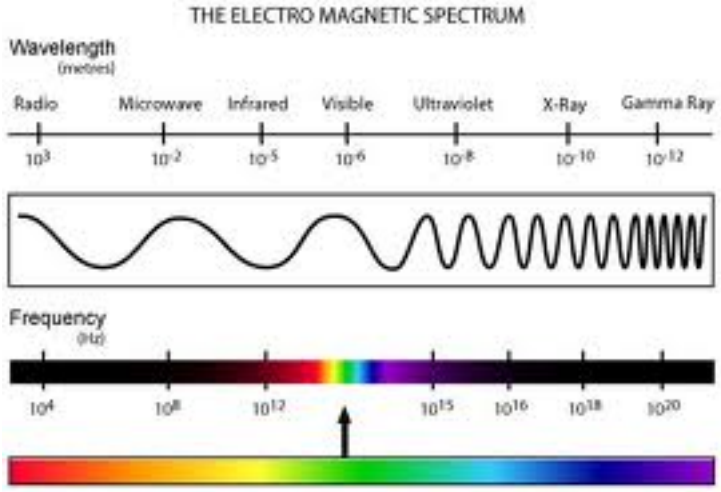
Wave Properties

Name	Symbol	Unit	Definition
Wavelength			
Frequency			
Period			
Amplitude			
Wave Number			

Now on to Light

The Speed of Light is given the symbol c.

C =3.00 x 10^8 m/sec =3.00 x 10^{10} cm/sec =186,282 miles/sec = 299,792.458 km/sec



How do we solve the mathematical problems involving light?

$$c = \lambda x \nu$$

Velocity(m/s)	Wavelength(m)	Frequency(Hz)
		$5.80x10^{14}$
	5.00×10^{-7}	
		$5.20x10^{14}$
	3.14	

What is the frequency of some red light that has a wavelength of 650 nm's?

What is the wavelength of tunes broadcast by the great 1970's station KMET-FM 94.7MHz?

Max Planck

The fist quantum hypothesis

h = 6.626×10^{-34} Joule x seconds (not joules per second)

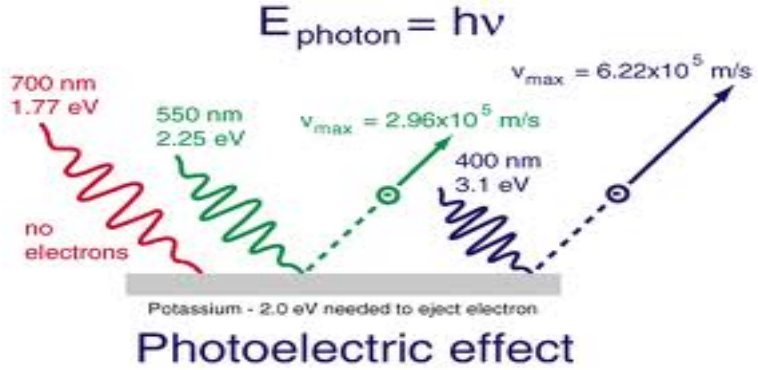
Velocity(m/s)	Wavelength(m)	Frequency(Hz)	Energy(J)
		5.80×10^{14}	
	5.00×10^{-7}		
			4.75×10^{-19}

What is the energy of a photon of light whose frequency is 5.50×10^{14} Hz?

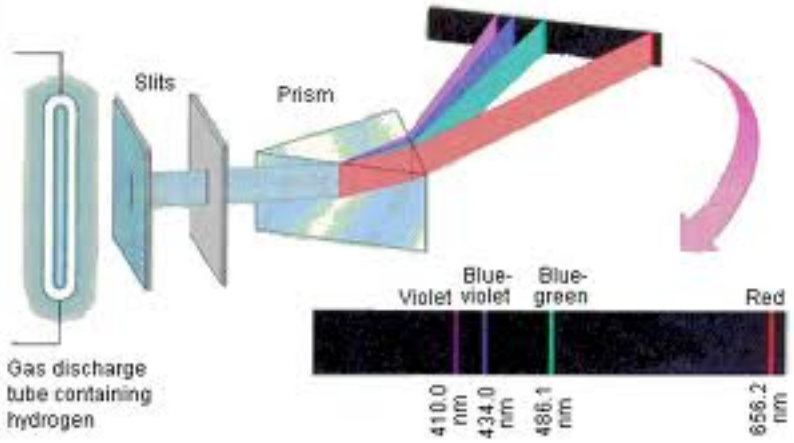
What is the energy of a mole of photons of red light whose wavelength is 700 nm's?

<u>Photoelectric Effect</u>

Noun: Ejection of electrons from a substance by incident electromagnetic radiation, especially by visible light.



In 1885 a Swiss School Teacher named Johann Balmer showed us the spectrum of Hydrogen:



This could be explained by a formula involving integer numbers.

Another Swiss named Johannes Rydberg moved the formula forward to give us our current form:

The constant equal to 109,680 $cm^{-1,}$ has many values in different units.

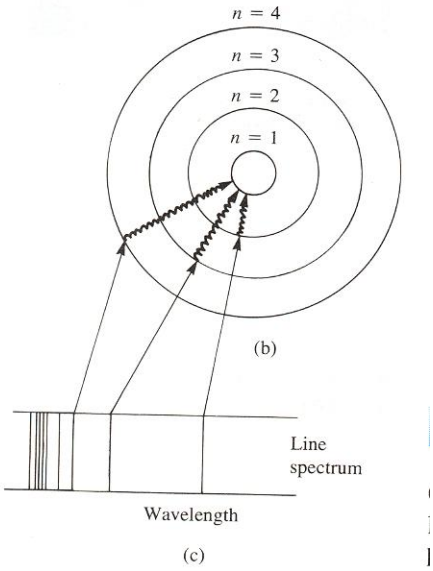
The number n_f can tell us how much energy is going to be associated with he light and where we are going to see the lines grouped together.

Name	**N_f**	**N_i**	**Region of Electromagnetic Spectrum**

Niels Bohr

1911 and the gospel of the planetary atom.

1913- Chance and the prepared mind. Serendipity



What are the circles?

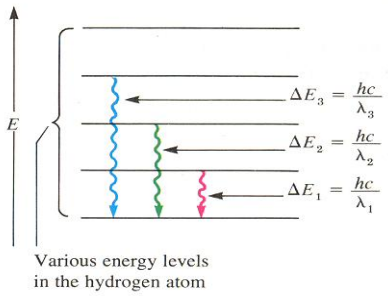


Figure 7.7

A change between two discrete energy levels emits a photon of light.

What were the magic four words?

An electron jumps from the n=4 to the n=2 state what is the wavelength of the light emitted?

Quantum Mechanics becomes a teenager.
A bullet in Sarajevo changes everything.

The Nature of Matter

A Prince has a crazy idea!

Louis de Broglie

How do you get out of fighting a war?

1924, a doctoral dissertation, and a Nobel Prize

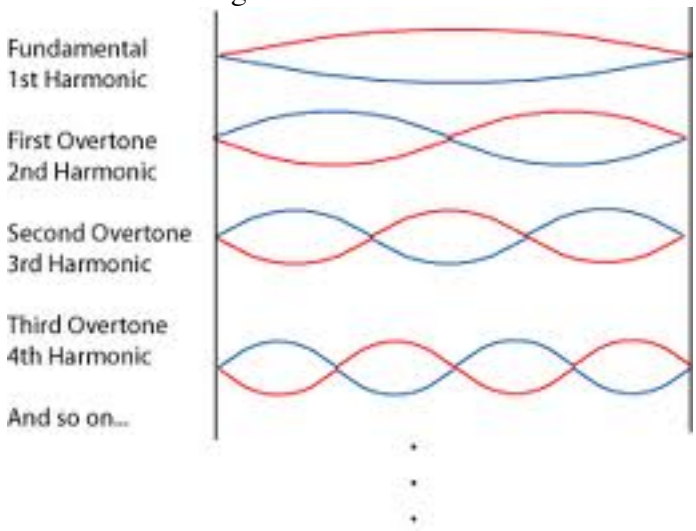
All matter is wavelike?

The de Broglie Wavelength

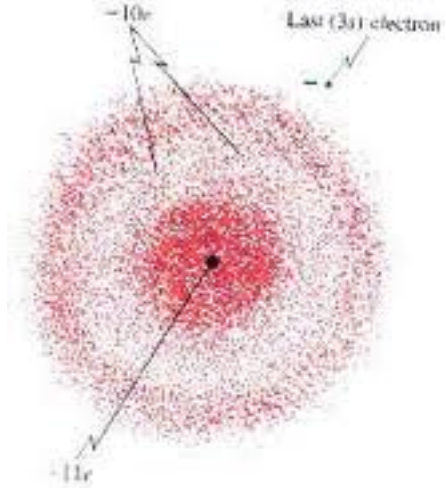
What is the de Broglie wavelength of an electron traveling at 90% of the speed of light? The mass of an electron is 9.11×10^{-31}kg.

What is the de Broglie wavelength of a baseball whose mass is 5 oz (0.14 kg) traveling at 90 mph (40 m/s)?

What is a standing wave?



Where is the electron likely to be found?



The Schrodinger Wave Equation

Werner Heisenberg and The Uncertainty Principle

Quantum Mechanics

The Quantum Numbers

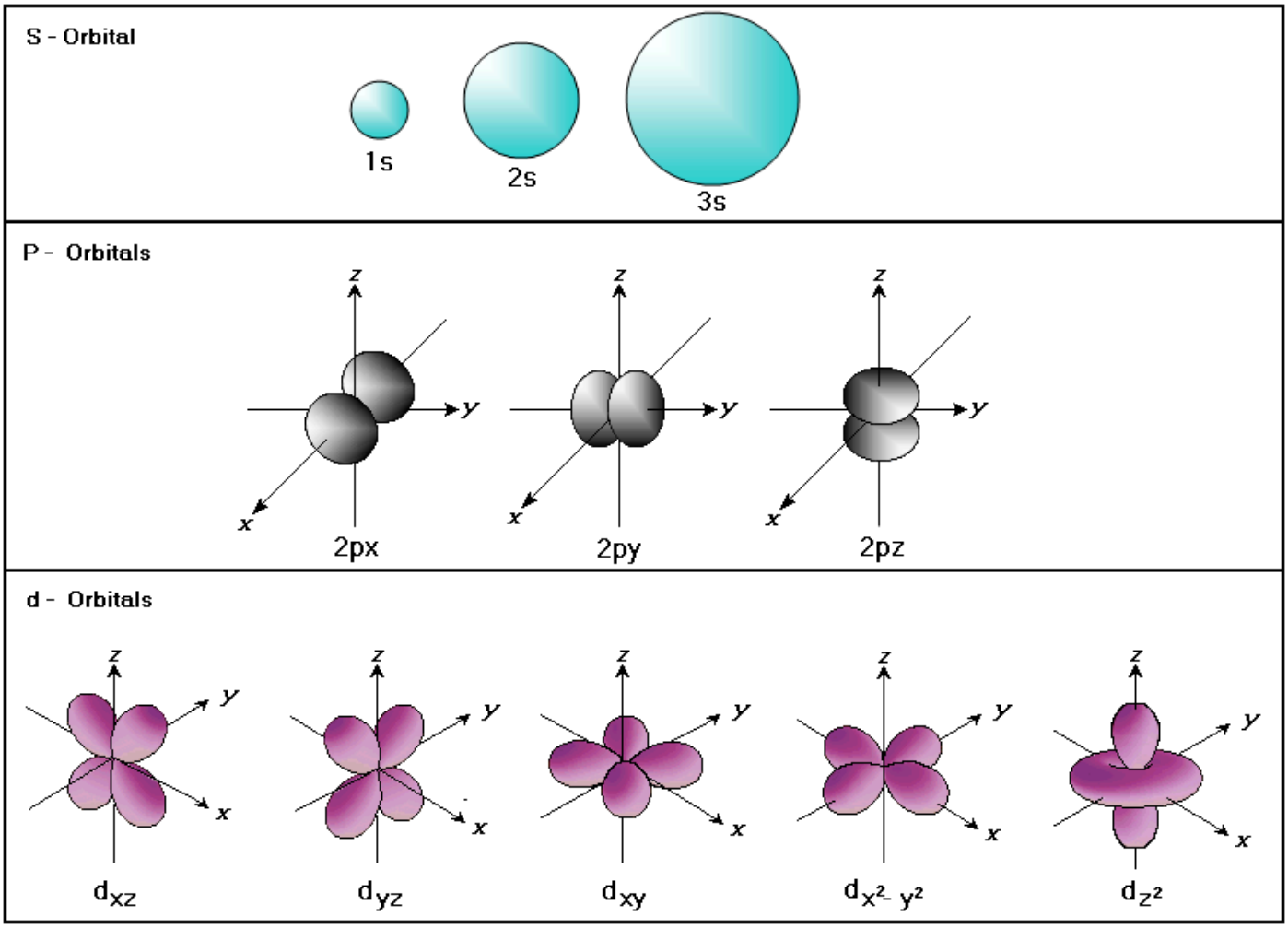
When we solve the Schrodinger Equation we get lots of correct answers. What do they mean? They are descriptions of the orbitals.

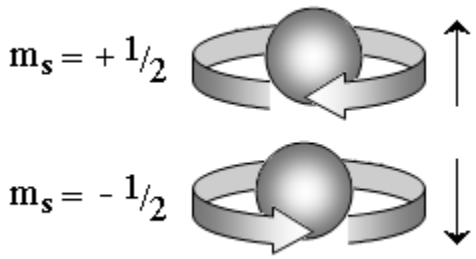
Quantum Number	Symbol	Values	Physical Meaning

What does a 1S orbital look like? What about a 2S orbital?

What does a 2P Orbital look like? How is a 3P orbital different?

What does a 3d Orbital look like? How is a 4d orbital different?





How do you work with Quantum Numbers?

L=	0	1	2	3
Orbital				

How many orbitals are in the n=3 shell? What about n=2?

How many orbitals are in the n=3 and l=2 subshell?

How many orbitals can have the designation n= 2, l=1, and ml = 1?

How many electrons can have the following designations:

a. n = 2 L = 1 $m_L = +1$

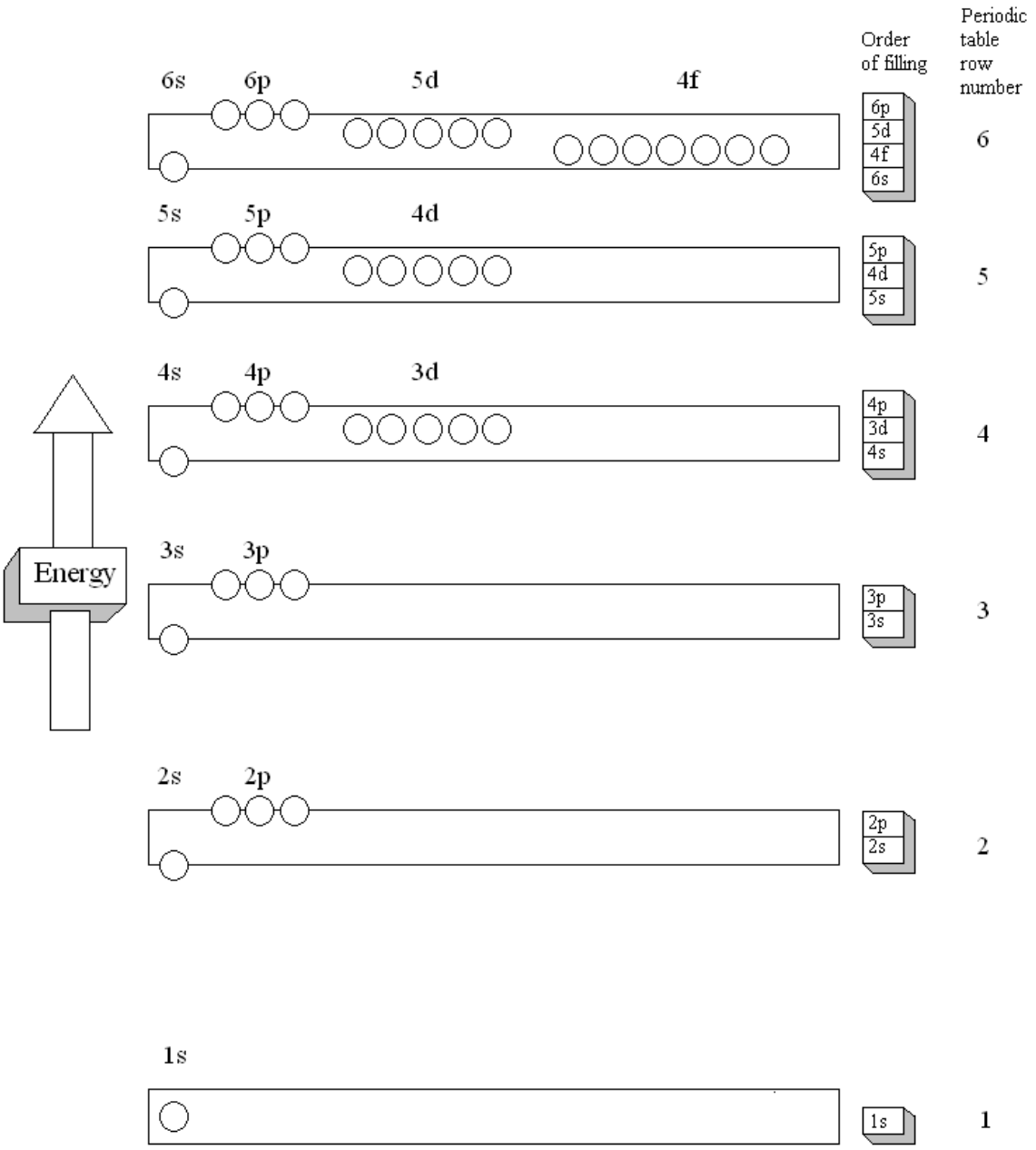
b. n = 4 L = 3 $m_L = +3$ $m_s = 1/2$

c. n = 5 L = 3 $m_L = +1$ $m_s = -1/2$

d. n = 4 L = 2 $m_L = +2$ $m_s = 1/2$

e. n = 5

Aufbau Principle



Frederick Hund

$_{1}$H 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{2}$He 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{3}$Li 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{4}$Be 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{5}$B 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{6}$C 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{7}$N 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{8}$O 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{9}$F 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{10}$Ne1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{11}$Na1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{12}$Mg1S___2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{13}$Al 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{14}$Si 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{15}$P 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{16}$S 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{17}$Cl 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{18}$Ar 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{19}$K 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{20}$Ca1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{21}$Sc 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{22}$Ti 1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{23}$ V1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{24}$ Cr1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

$_{25}$ Mn1S___ 2S___ 2P ___ ___ ___ 3S ___ 3P___ ___ ___4S ___ 3d ___ ___ ___ ___ ___

Some Notable Exceptions

Cr

Cu/Cu^{2+}

Mo

Ag/Ag^{+}

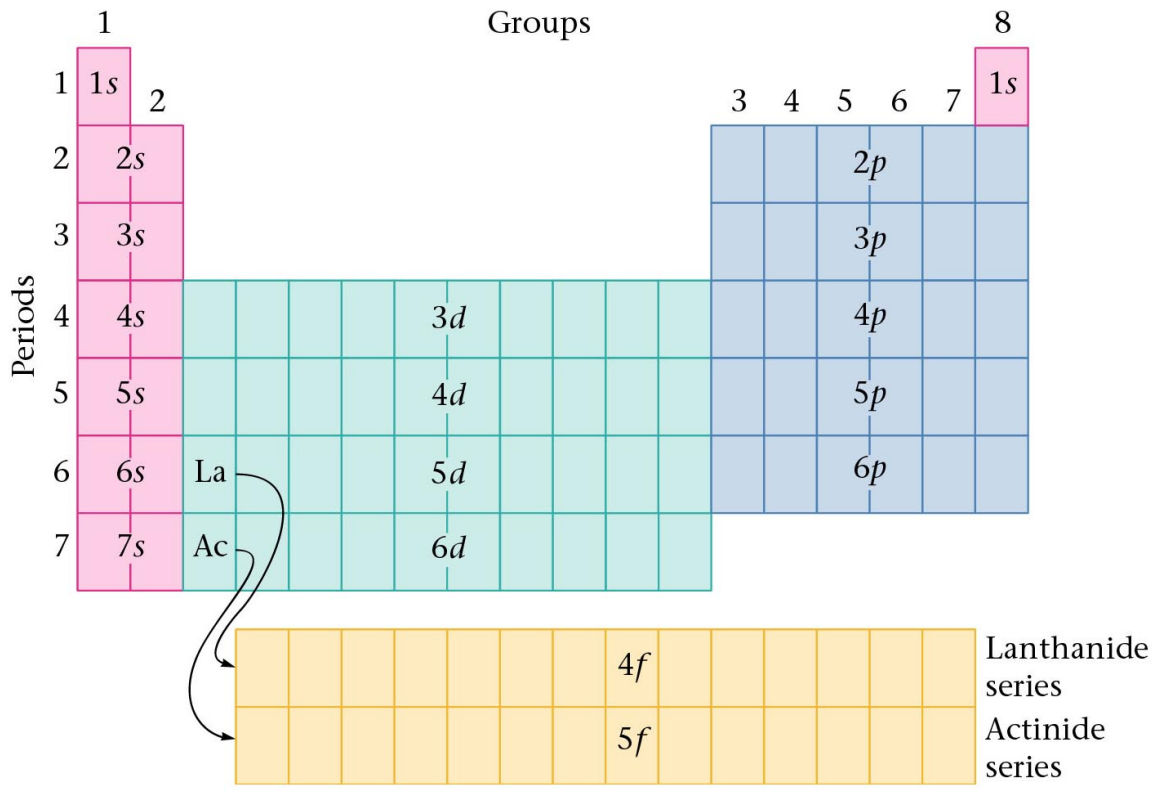
Au

Polyelectronic Models

Hydrogen versus Helium

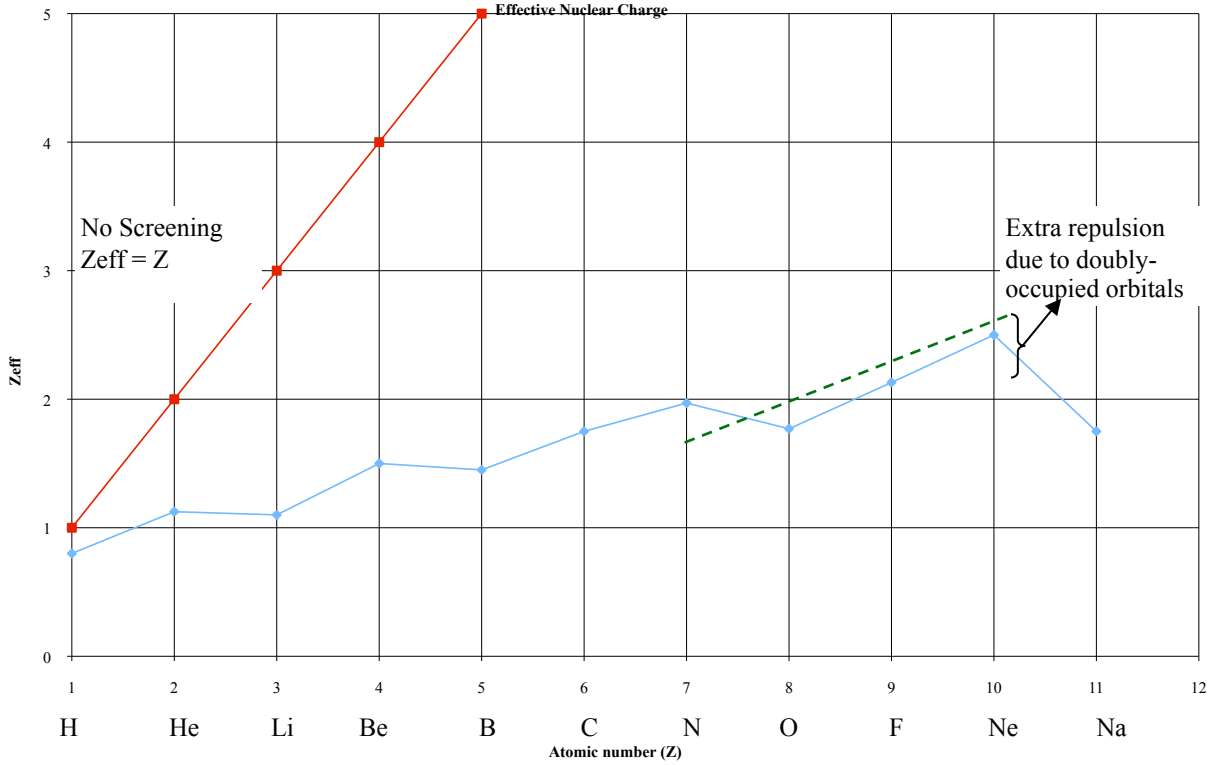
Effective Nuclear Charge and Shielding

The Modern Periodic Table (Glenn Seaborg 1947)

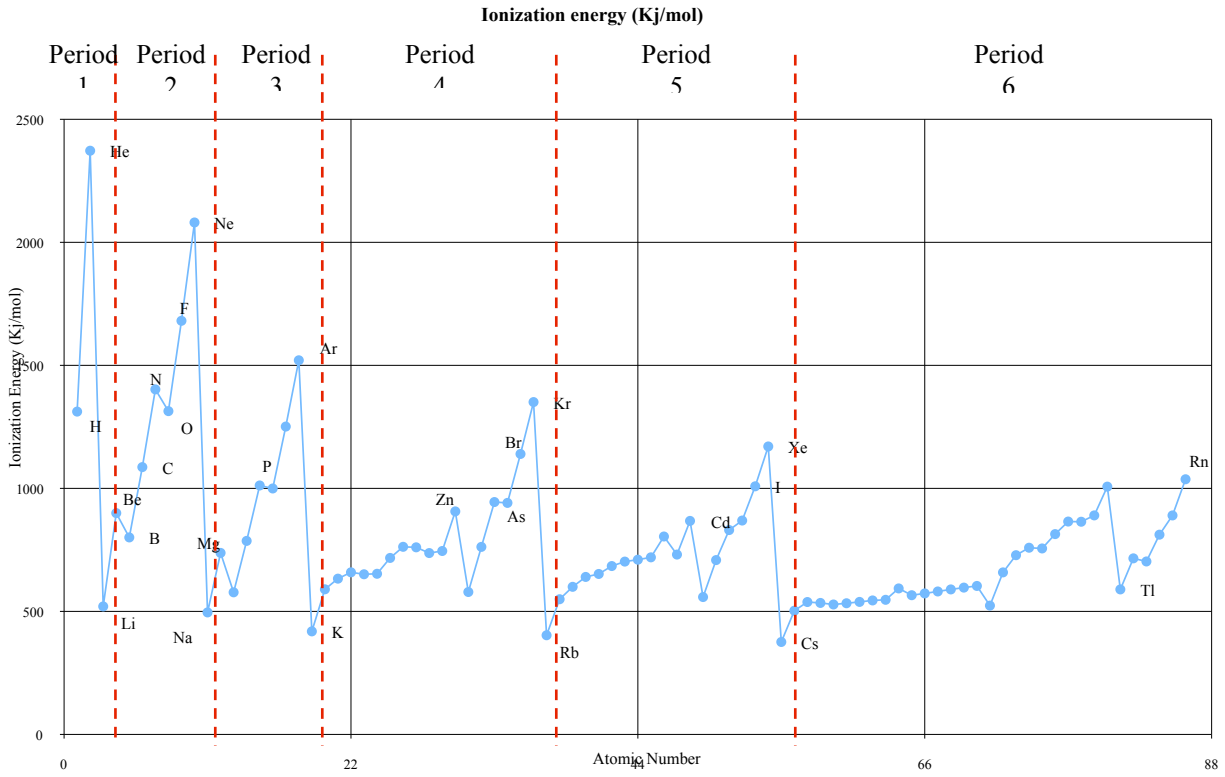


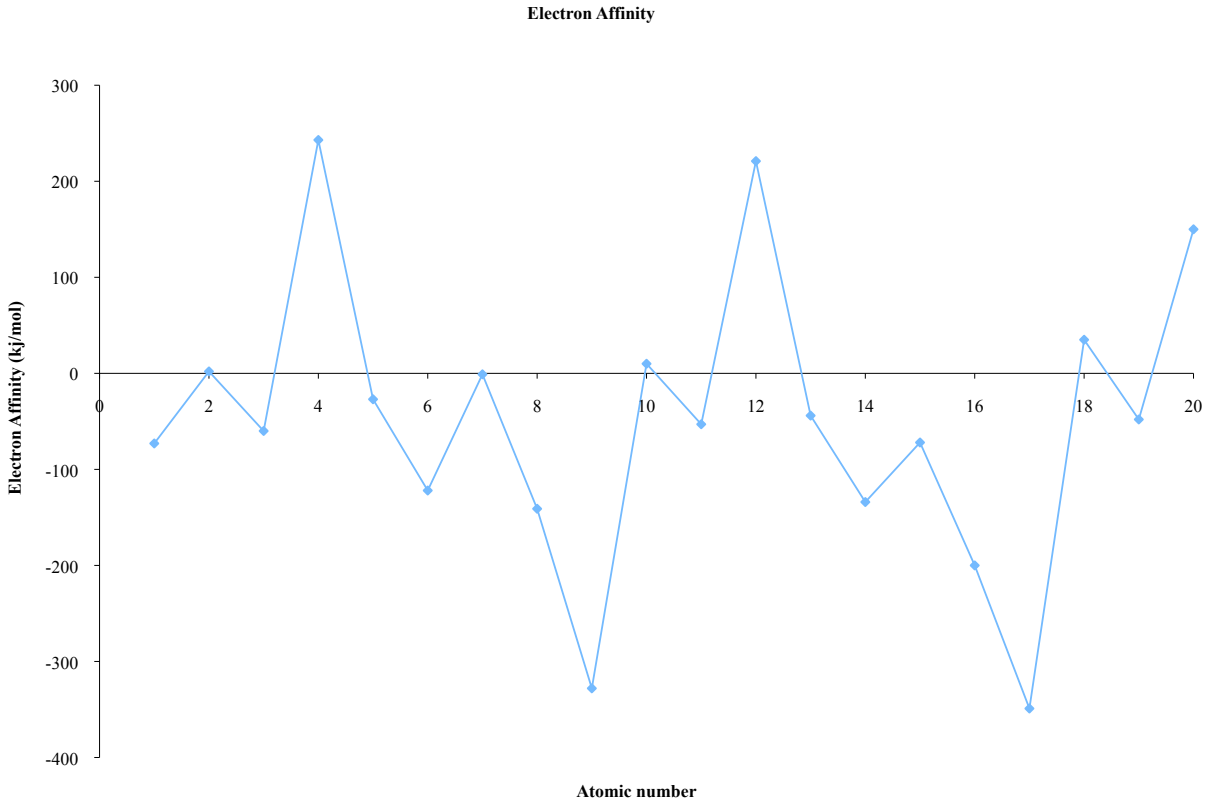
Periodic Properties

Effective Nuclear Charge

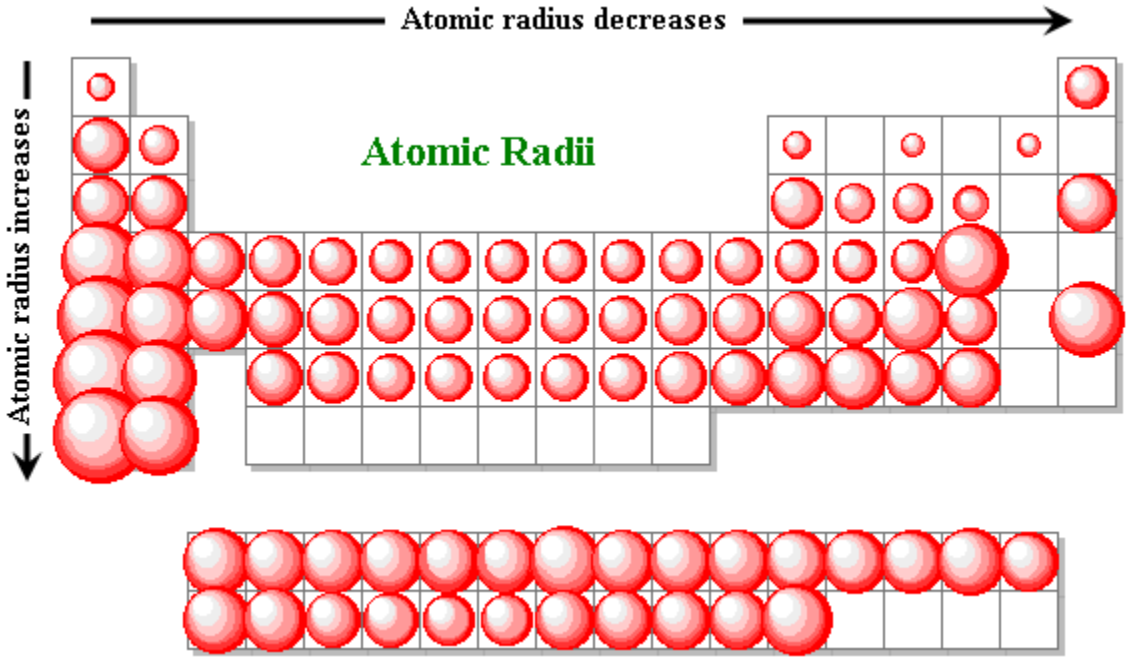


Ionization Energy





Atomic Radii

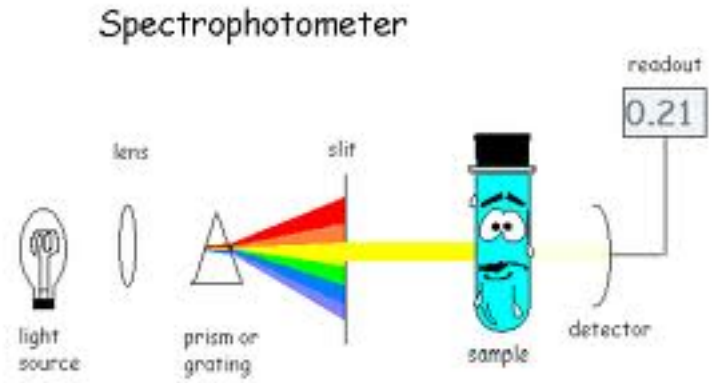


Spectroscopy Lab

Spectroscopy

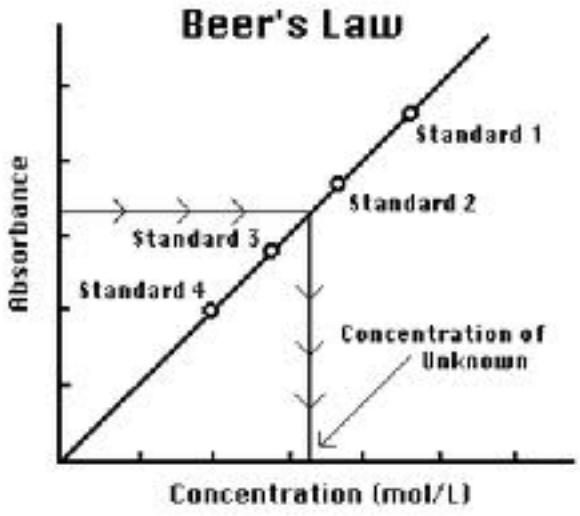
Why is a liquid colored?

Spectrophotometer



What happens when light travels through a medium?

Beer's Law



Calibration of the meter.

What colors absorb what other colors?

All measured in nanometers