Chapter 11: Modern Atomic Theory

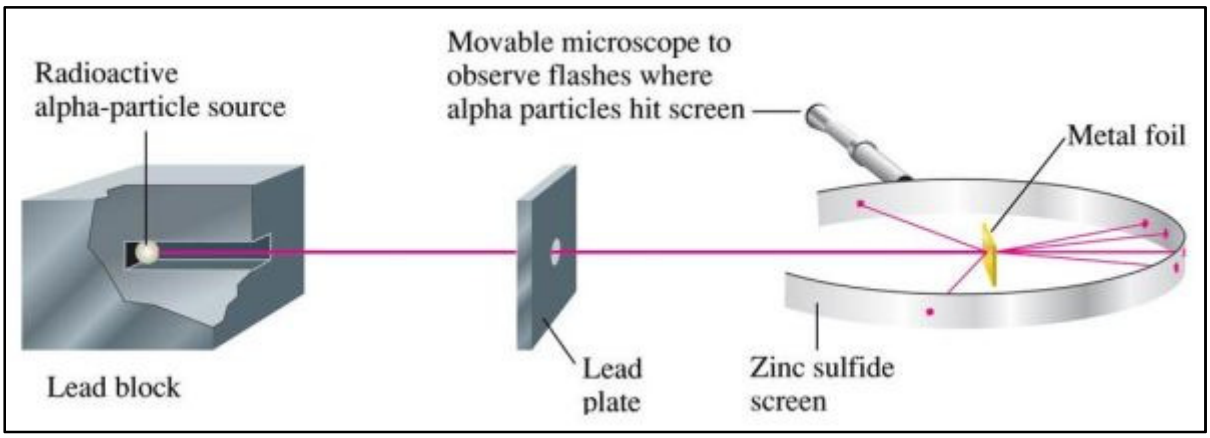
These Notes are to SUPPLIMENT the Text, They do NOT Replace reading the Text Material. Additional material that is in the Text will be on your tests!

To get the most information, READ THE CHAPTER prior to the Lecture, bring in these lecture notes and make comments on these notes. These notes alone are NOT enough to pass any test!

Certain elements can be grouped together because they behave similarly

Rutherford atom Atom has a small positive core called the nucleus with a negative charged electrons moving around the nucleus

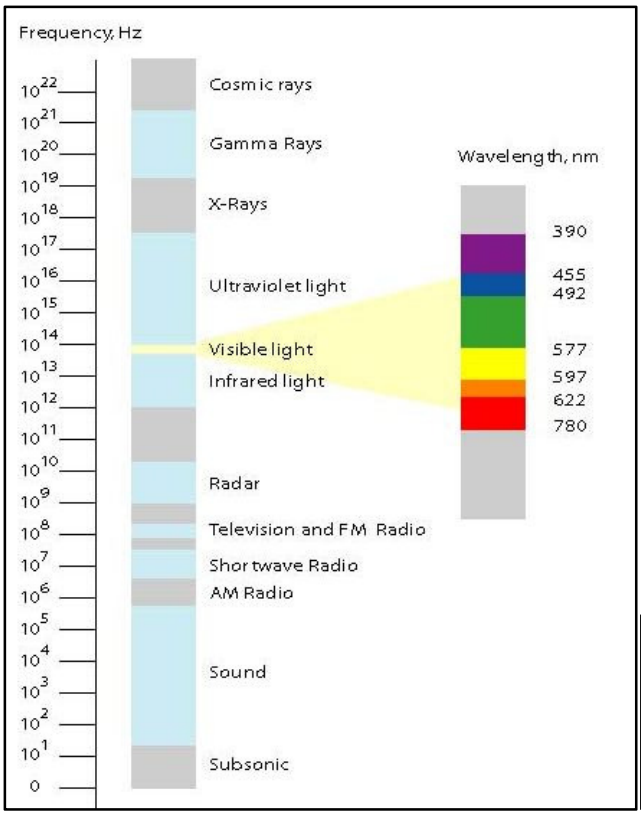
Rutherford bombard metal foil with particles [Alpha Particles, they have a Positive Charge]. This shows the nucleus of the atom is positive charged particles. The nucleus particles are called Protons and Neutrons

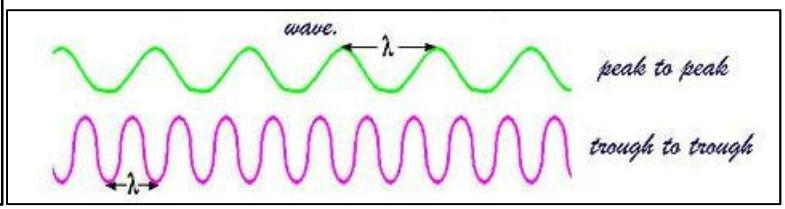


Nucleus is very small compared to the size of the atom. If the nucleus was the size of a grape, the electron cloud would be 2 miles away!

Electromagnetic Radiation:
Light from a bulb transmits energy to your hand as Electromagnetic Radiation. Energy is transmitted from one place to another as Electromagnetic Radiation.
This includes X-Rays, White light, Microwaves, Radio waves - these differ only in their wavelengths

Color	Wavelength (nm)
Red	780 → 622
Orange	622 → 597
Yellow	597 → 577
Green	577 → 492
Blue	492 → 455
Violet	455 → 390





Wave properties

Wavelength	λ	Distance between 2 consecutive wave peaks
Frequency	ν	Number of wave peaks per unit of time
Speed	c	How fast the peaks move. The speed of light is @ 300,000,000 meters / sec or 3. x 10^8 m/s

$c = \nu * \lambda$ But c is the speed of light and is a constant. So as the wavelength decreases, the frequency must increase!

Light travels as **waves** [see pictures above]

Radiation is a means of energy transfer. Feel the radiation from a light bulb – as heat!
Sun energy, Fireplace heat, Microwave ovens

A beam of light travels through space a a stream of packets of energy called **Photons**. Photonss differ in wavelengths and have different energy

Red is less energy than blue

Earth is protected by the **atmosphere ozone** - it absorbs high energy radiation.
Greenhouse Effect:

Sun Transmits in the Visible [Visible Light].
|
At Planet Earth, in the atmosphere, Carbon Dioxide CO_2, Water H_2O and Methane CH_4 **let the visible light** through until it hits the planet surface.
|
At the surface, the **Visible Light is absorbed** by roads, beach sand, etc and converted to heat.
|
This **heat is reflected back** into the atmosphere as heat [Infrared Radiation]. The IR as it heads to outer space is absorbed by the CO_2, H_2O and CH_4 in the atmosphere.
|
If the CO_2, H_2O and CH_4 gases were not present, energy would go out and earth would be COLD
But, these gases absorb the IR radiation and the retransmit it out in all directions.
Thus about ½ of the radiation is now reflected back to the earth.
The more CO_2 in the atmosphere, the more heat is reflected back and the warmer the earth gets!
|
As a result, the Arctic sea, Greenland Ice is melting much faster in recent years

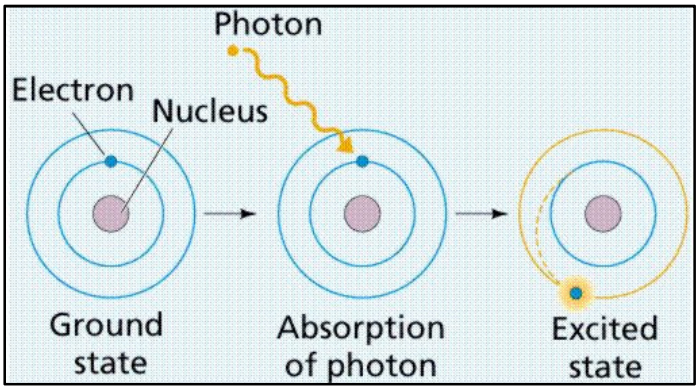
CO_2 comes from burning coal and oil to generate electricity
CO_2 comes from automobiles
CO_2 comes from all of the small cooking fires in China and other 3rd world countries

Emission of Energy by an atom
Li -> deep red Cu+2 -> yellow-orange Na+ -> Yellow-Orange

High energy photon correspond to short wavelengths of light **Low-energy** to long wavelengths

Red has less energy than blue

An excited Li Atom emits photon of red light



And atom in the **"Ground State"** absorbs Energy.
It now has excess energy is said to be in an **Excited State**
The Excited State atom emits energy and moves to a lower energy state. This emitted energy can be seen as colors [as will be seen in this weeks lab experiment].

The lowest energy state is the **ground state**
Energy contained in the photon corresponds to the change in energy that the atom experiences.
Energy Levels are like a staircase: person can move from one step to another or 2 or 3 steps but must move in whole steps only. Energy levels are **QUANTIZED**

Because certain photons are emitted, only certain energy changes can occur.

Bohr Model of the Atom – electrons are in certain circular orbital's

Electrons DO NOT move around the nucleus in circular orbits like planets orbiting the sun

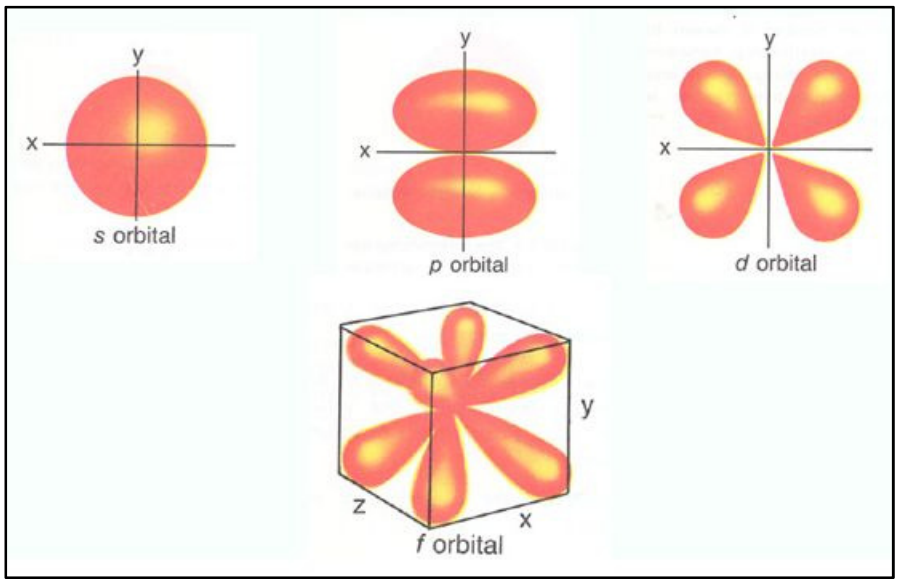
Schrodinger: Wave Mechanical Model of the Atom

Light has wave and particle characteristics. It behaves as a wave and a particle
Wave Mechanical Model of the atom - electron states are orbital's
Firefly flying about in a room. You cannot describe precisely the electron [or firefly's] path, but can predict the probabilities of finding the electron [firefly] in space around the nucleus.

This probability map is called an Orbital. The Orbital is the size of the sphere [or other shape] that contains 90% probability. There is a 90% probability of finding the electron in this area.

NUMBER IS ENERGY LEVEL, **LETTER** IS SHAPE

Principal energy level	**1, 2, 3, 4**
Sublevel	s sublevel or orbital. There are 2 e^- in the s sublevel
	p sublevel or orbital. There are 6 e^- in the p sublevels.
	The p orbital has 3 different lobes, each with 2 e^- in them
	d sublevel or orbital. There are 10 e^- in the d sublevels.
	The p orbital has 5 different lobes, each with 2 e^- in them
	f sublevel or orbital. There are 14 e^- in the f sublevels.
	The f orbital has 3 different lobes, each with 2 e^- in them



Pauli exclusion principal - an atomic orbital can hold a maximum of 2 electrons, they must have opposite spin