Announcements

Wednesday, October 29, 2008

Chapter 8 WebAssign due next Monday, Nov 3
Chapter 9 WebAssign due next **Tuesday**, Nov 4

Exam 2 Wednesday, Nov 5 (ch 5-9)

- Study guide will be on webpage today

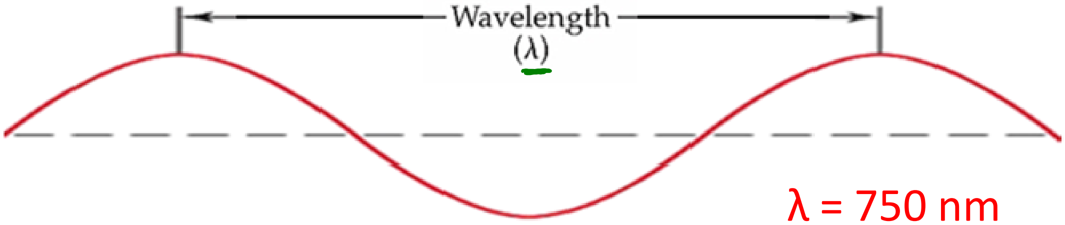
Question sessions in lab next week

- Mon **1:00 pm** (note the changed time)
- Wed 8:00 am

Wavelength and color

λ : greek lowercase lambda

Red light:



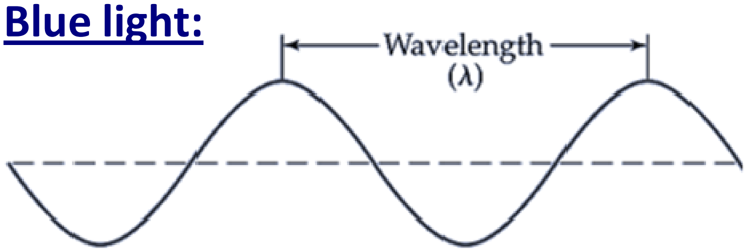
$\lambda = 750$ nm

$n = 10^{-9}$

750×10^{-9} m

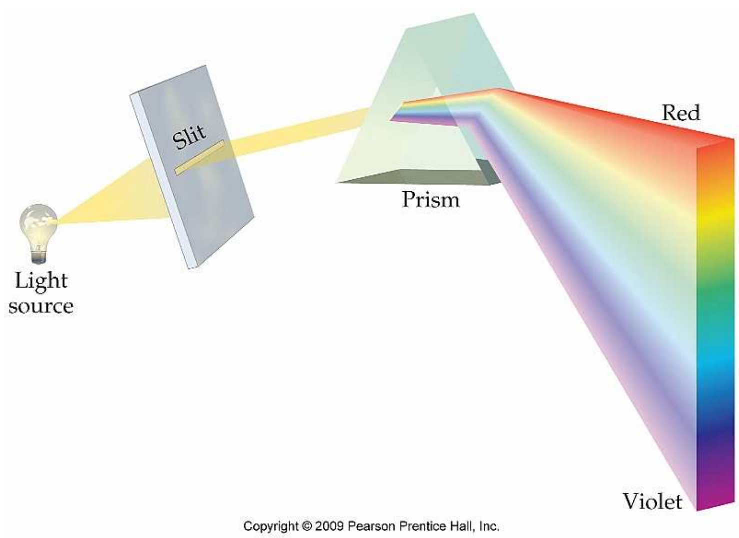
7.50×10^{-7} m

Blue light:



$\lambda = 450$ nm

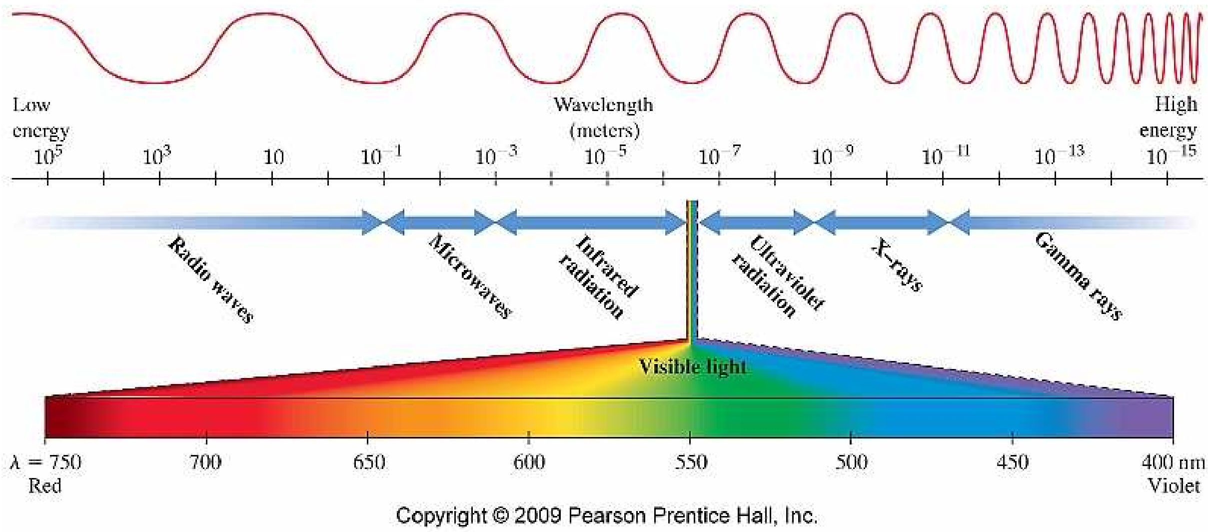
The visible spectrum



R $\cong$ 750 nm
O
Y
G
B
I
V $\cong$ 380 nm

The electromagnetic spectrum

(all wavelengths)



Energy and wavelength (λ) have what relationship?

inverse relationship: energy ↑, λ ↓

Radio: long λ, low energy

Microwaves:

Infrared: remote controls, night vision

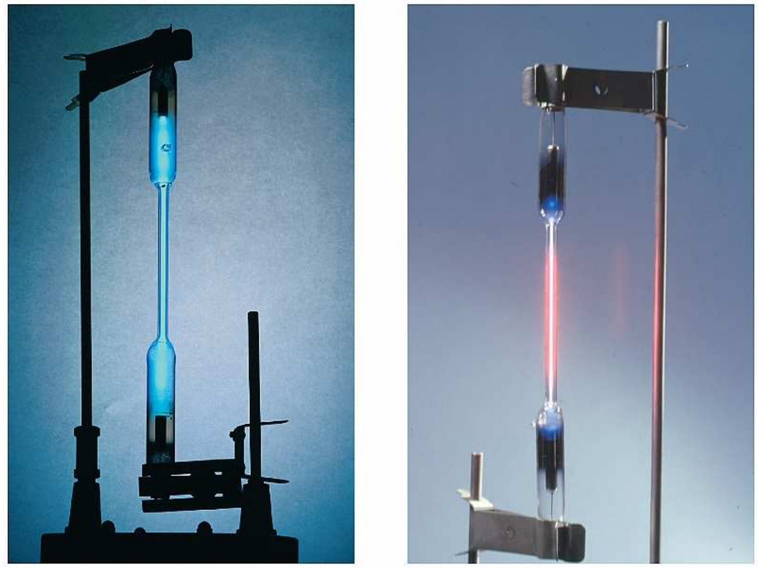
Visible:

UV: longwave less energy: blacklight
shortwave more energy: sanitizing lamps, sunburn

X-ray:

Gamma: highest energy electromagnetic radiation
(shortest λ) radioactivity

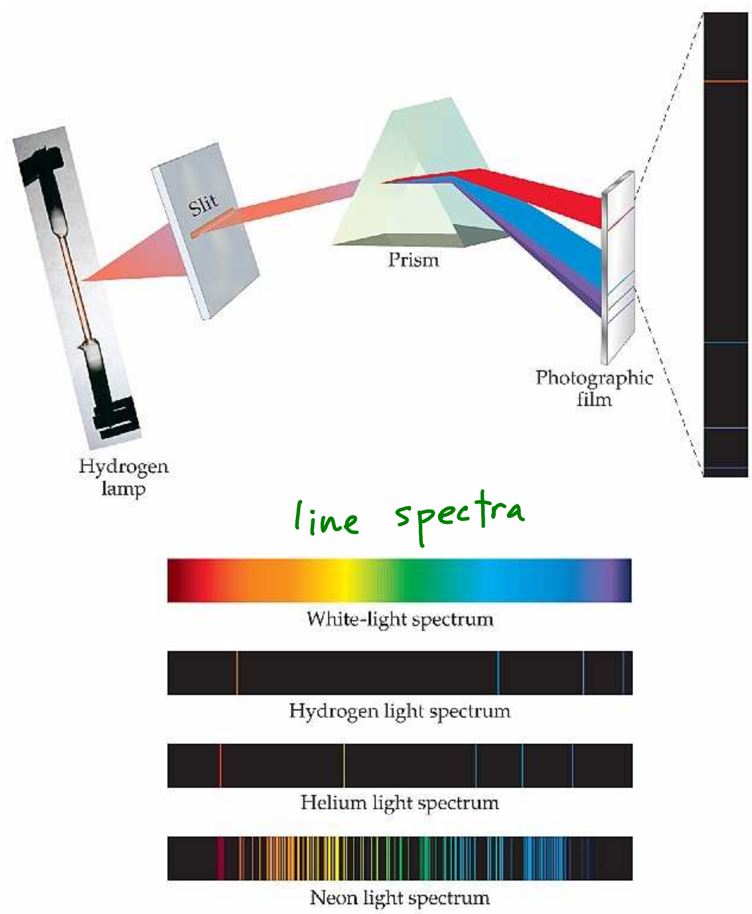
A **gas lamp** is a sealed glass tube that contains a gas sample, and **glows** when a high voltage is applied to it.



Hg(g) H_2(g)

But **only certain wavelengths** of light are given off by a gas lamp.

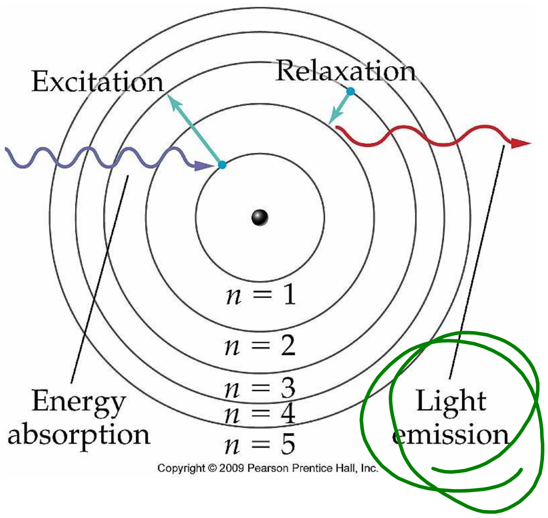
Compare with the continuous spectrum given off by a white light source like a light bulb.



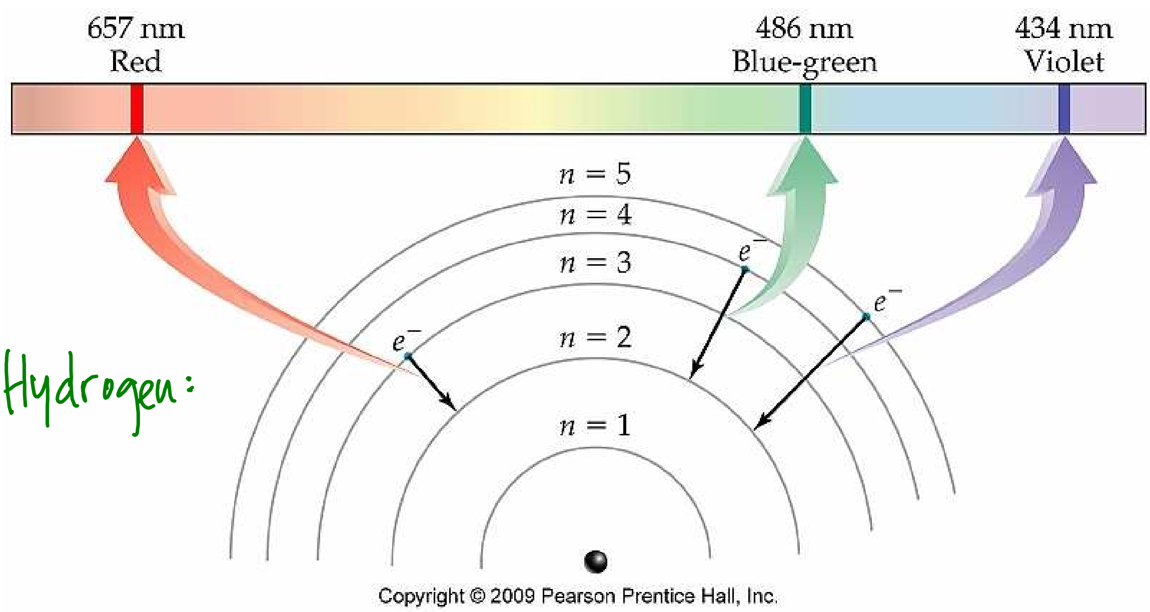
<u>Why</u> are only **<u>certain</u>** colors of light given off by a pure gas sample?

The **<u>Bohr model</u>** can help explain why:

- Electrons orbit in specific fixed distances from nucleus, called **<u>shells</u>**
- Electrons **jump** to higher, more distant orbits when they **absorb** energy (excitation)
- They **drop** down to lower orbits when they **give off** energy, usually as <u>light</u> (relaxation)



Hydrogen:



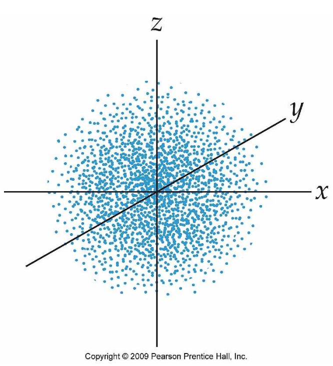
Shortcomings of the Bohr model:

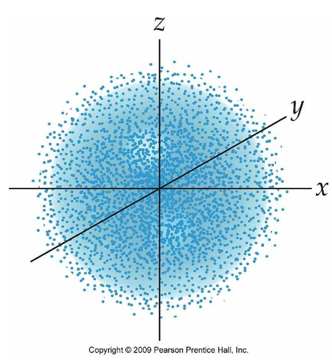
- Can predict the energies of electrons in a hydrogen atom, but not for any other element
- Assumes electrons travel in single circular paths, not likely
- Does not explain periodic table behavior

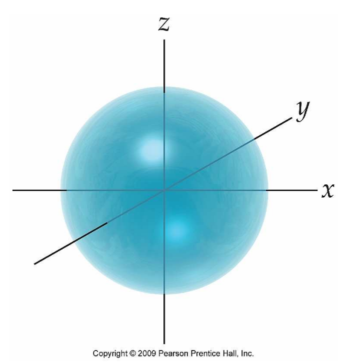
<u>Quantum mechanical model:</u>

- Assumes electrons can act like particles **<u>or</u>** waves (supported by experimental evidence)
- Exact position or path of a single electron are impossible to predict
- But, you can predict the probability of finding an electron within a certain space:

<u>Orbital</u>: 3-dimensional shape that defines the **probability** of finding an electron







The quantum mechanical model has **shells** like the Bohr model

closest to nuc

- n = 1, 2, 3, 4, … (principal quantum number)
- As n increases, energy of the electron increases, and **average** distance from the nucleus increases.

But shells alone cannot explain electron behavior. Each new row on the periodic table is a new shell, and the major sections (main group, transition, etc) each have their own **subshell**.

Each shell has n subshells:

Shell	# subshells	Subshell letters
n = 1	1	1s
n = 2	2	2s, 2p
n = 3	3	3s, 3p, 3d
n = 4	4	4s, 4p, 4d, 4f

Electron configurations

Period	H							He
1	($1e^-$)							($2e^-$)
Period	Li	Be	B	C	N	O	F	Ne
2	($3e^-$)	($4e^-$)	($5e^-$)	($6e^-$)	($7e^-$)	($8e^-$)	($9e^-$)	($10e^-$)

If the elements in period 1 have their electrons in the 1s subshell,
the s subshell can hold a maximum of 2 electrons.

Electron configuration: subshell$^{\#\ e-}$

H: $1s^1$ **He**: $1s^2$ (filled)

Actually, **every s subshell** can hold a max of 2 electrons (including 2s, 3s, 4s, 5s, etc)

In period 2, we fill the 2nd shell (2s and 2p subshells)

Li: $1s^2 2s^1$ **Be**: $1s^2 2s^2$ (filled)

When we cross to a new section on the periodic table, a new subshell is being filled. B-Ne fill into the 2p subshell

B: $1s^2 2s^2 2p^1$ **C**: $1s^2 2s^2 2p^2$ **N**: $1s^2 2s^2 2p^3$

O: $1s^2 2s^2 2p^4$ **F**: $1s^2 2s^2 2p^5$ **Ne**: $1s^2 2s^2 2p^6$ (filled)

Electron configurations and the rest of the periodic table

Available subshells to fill:

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d
7s 7p

Subshell	Max # e^-
s	2
p	6
d	
f	

Na: $1s^2 2s^2 2p^6 3s^1$

Ar:

Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

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

Ba: