HOMEWORK PROBLEMS 11/9/07

#13 0,175 mol $CaCl_2$ to g

- use formula weight!

Ca : 1 x 40.08

Cl : 2 x 35.45

110.98

=

$$0{,}175 \text{ mol } CaCl_2 \times \frac{110{,}98 \text{ g } CaCl_2}{1 \text{ mol } CaCl_2} = \boxed{19.4 \text{ g } CaCl_2}$$

#4 175 g $AgNO_3$ to mol

- use the formula weight

Ag: 1 x 107.9
N: 1 x 14.01
O: 3 x 16.00
169.91

=

$$175\ g\ AgNO_3 \times \frac{1\ mol\ AgNO_3}{169.91\ g\ AgNO_3} = 1.03\ mol\ AgNO_3$$

#6 25.0 mL of 6.00 M NaCl How many moles NaCl?

$$25.0\ \text{mL solution} \times \frac{6.00\ \text{mol NaCl}}{1000\ \text{mL solution}} = \boxed{0.150\ \text{mol NaCl}}$$

$$25.0\ \text{mL solution} \times \frac{10^{-3}\ \text{L}}{\text{mL}} \times \frac{6.00\ \text{mol NaCl}}{1\ \text{L solution}} = 0.150\ \text{mol NaCl}$$

#8 %F (by mass) in NaF

- Calculate formula weight

NaF:

Na: $1 \times 22.99 = 22.99$

F: $1 \times 19.00 = 19.00$

41.99

$$\frac{19.00\ g\ F}{41.99\ g\ total} \times 100\% = 45.25\%$$

#10 175 g H_2SO_4. How many g $NaOH$ is needed to react?

$$2NaOH + H_2SO_4 \longrightarrow 2H_2O + Na_2SO_4$$

$NaOH$: 40.00 g $NaOH$ = 1 mol $NaOH$

H_2SO_4: =

- Convert mass sulfuric acid to moles using formula weight

$$175\ g\ H_2SO_4 \times \frac{1\ mol\ H_2SO_4}{98.09\ g\ H_2SO_4} = 1.78408\ mol\ H_2SO_4$$

- Convert mol sulfuric acid to mol sodium hydroxide

=

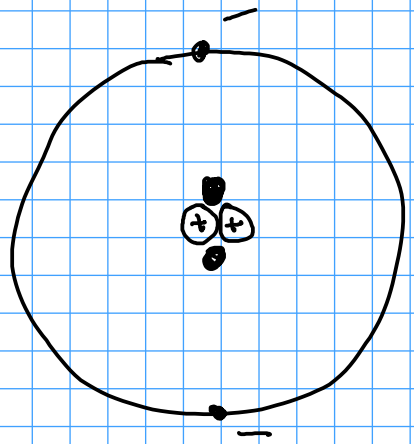
$$1.78408\ mol\ H_2SO_4 \times \frac{2\ mol\ NaOH}{1\ mol\ H_2SO_4} = 3.56815\ mol\ NaOH$$

- Convert moles sodium hydroxide to mass

$NaOH$:

$$3.56815 \text{ mol } NaOH \times \frac{40.00 \text{ g } NaOH}{1 \text{ mol } NaOH} = 143 \text{ g } NaOH$$

STRUCTURE OF THE ELECTRON CLOUD



The nuclear model describes atoms as consisting of a NUCLEUS containing protons and neutrons and an EL:ECTRON CLOUD containing electrons.

The ELECTRON CLOUD is described as being a diffuse (lots of empty space) region of the atom. Nothing else about it is part of the buclear model.

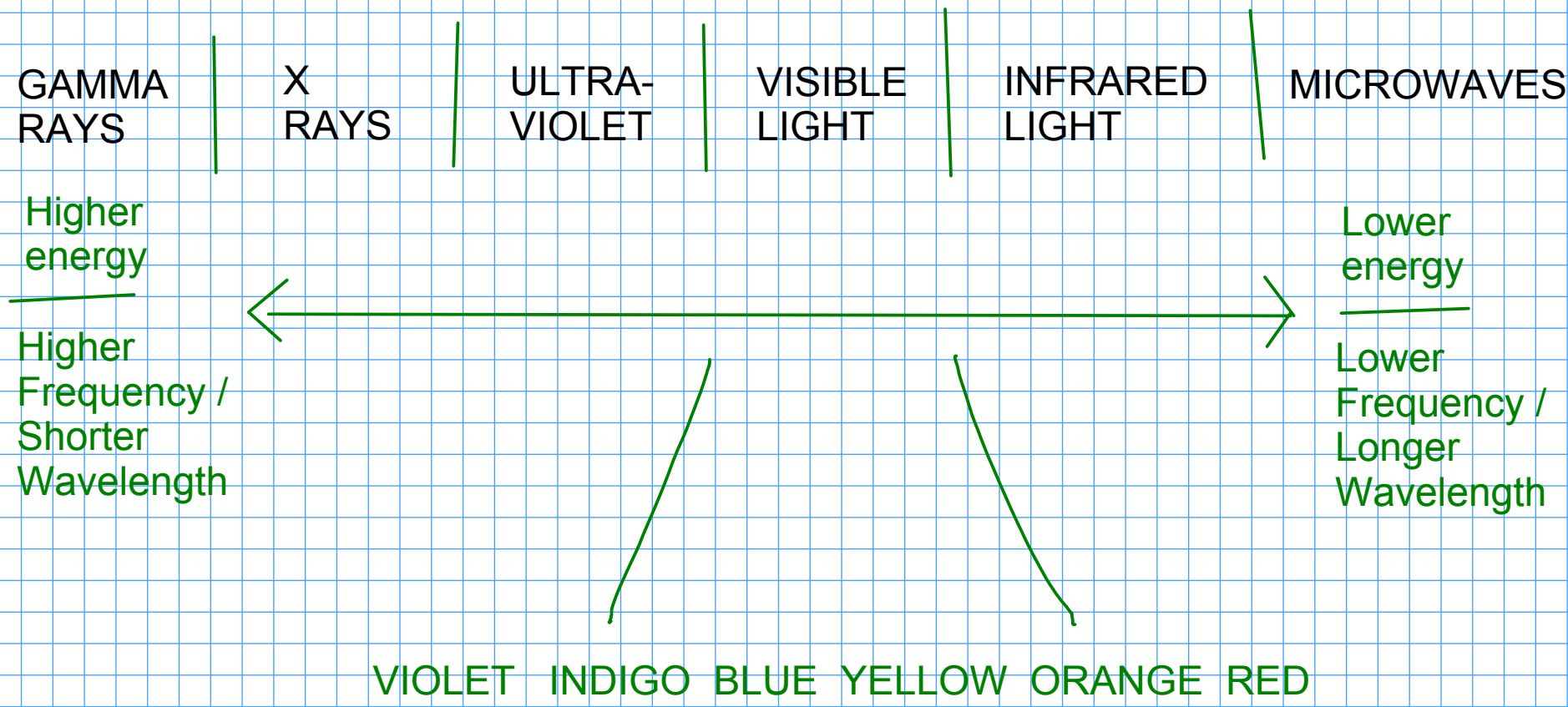
... but the nuclear model is not useful to explain several things:

- Does not explain why atoms react differently from one another
- Does not explain how atoms emit and absorb light (atomic line spectra)

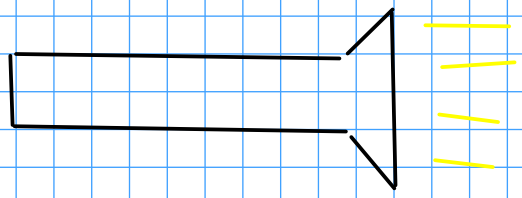
ELECTROMAGNETIC SPECTRUM

(see p256)

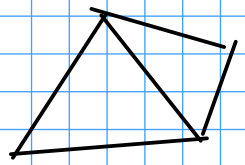
- Different kinds of "light" have different energy contents



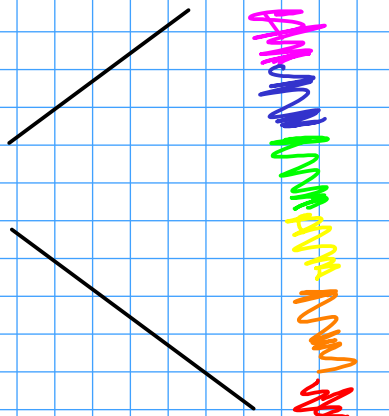
- Different colors of visible light correspond to different amounts of energy



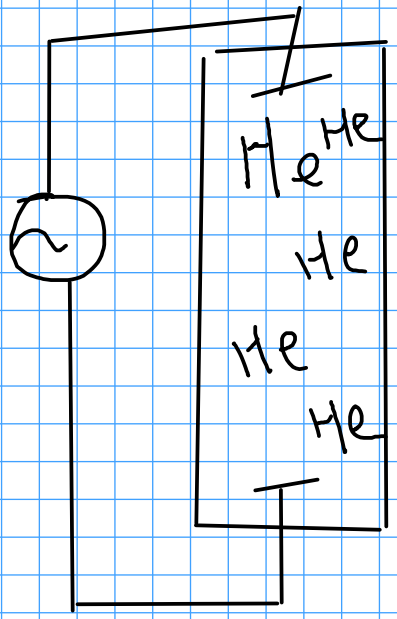
Source of white light



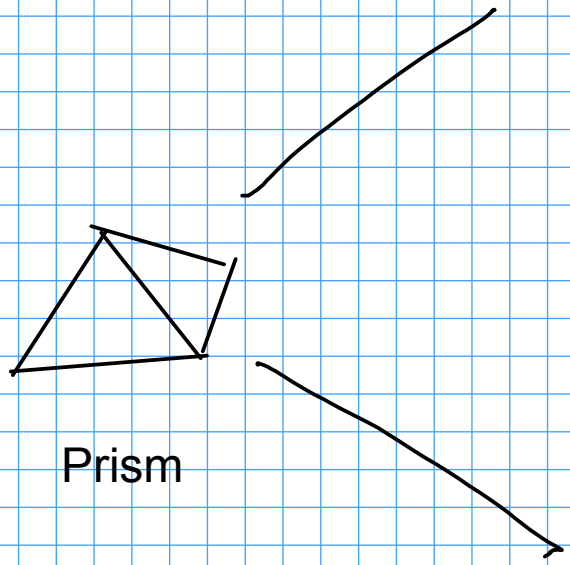
Prism



Rainbow (all colors represented)



Gaseous Helium excited
by electricity

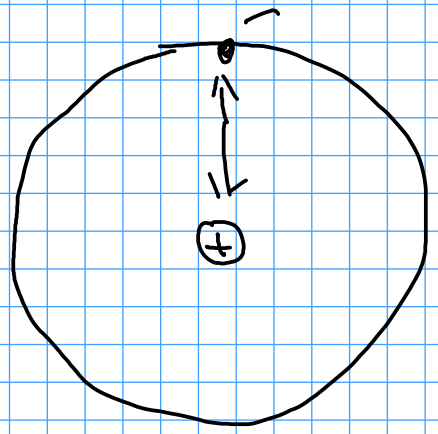


Prism

LINE SPECTRUM - only
a few specific colors appear!

- Atomic line spectra are UNIQUE to each element. They're like atomic "fingerprints".

- Problem was that the current model of the atom completely failed to explain why atoms emitted these lines.



An orbit that is FARTHER from the nucleus means that the electron has MORE energy

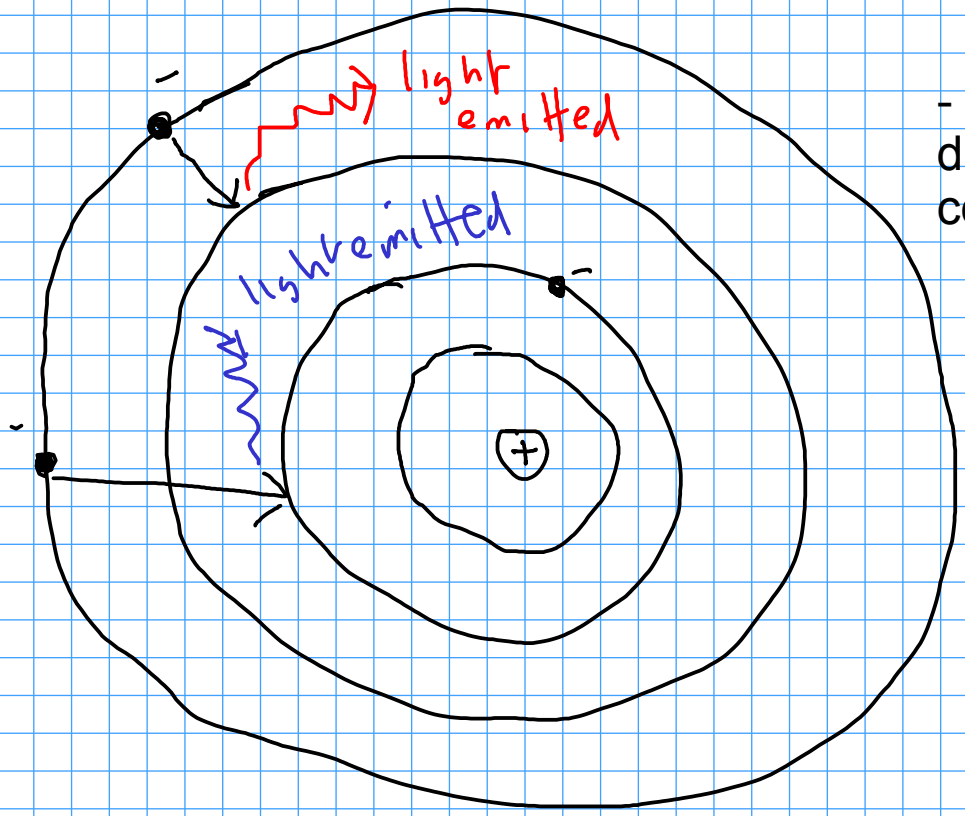
An orbit that is CLOSER to the nucleus means that the electron has LESS energy

- Electrons may gain or lose energy by either ABSORBING (to gain) or EMITTING (to lose) a PHOTON of light. (Photon = particle or "packet" of energy.)

- If the electrons can gain or lose ANY amount of energy, then each atom would emit a RAINBOW rather than an LINE SPECTRUM.

BOHR MODEL

- Theorized that electrons couldn't be just ANYWHERE around the nucleus. There must be restrictions on the motion of electrons that traditional physics did not explain.



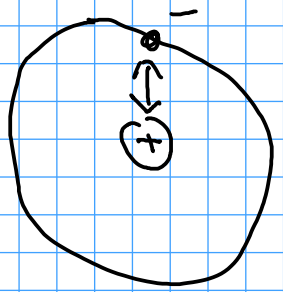
- theorized that electrons could only be certain distances from the nucleus. In other words, they could only have certain values for ENERGY.

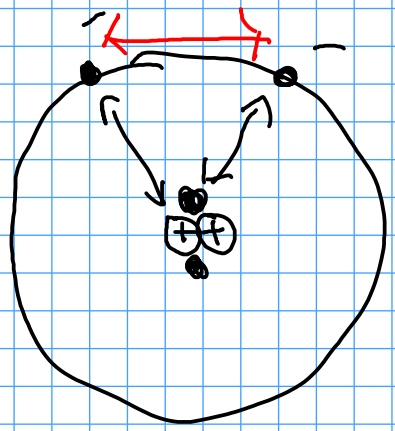
- Electrons could move only from one "energy level" to another DIRECTLY by giving up or abosrbing a photon (light) that was equal in energy to the distance between the energy levels.

- The restrictions on where electrons could be in Bohr's model predicted that atoms would give LINE SPECTRA.

- Bohr's model accurately described the line spectrum of hydrogen (first time this had been done!)

- For other atoms, Bohr's model predicted a line spectrum, but the lines weren't the right colors!





Bohr's model didn't account for electron-electron interactions (which didn't exist in HYDROGEN)

- To account for this added complexity, a more sophisticated model had to be devised: QUANTUM THEORY. Quantum theory is the modern picture of the atom and its electron cloud.

SHELLS, SUBSHELLS, AND ORBITALS

- Bohr's model predicted that energy levels (called SHELLS) were enough to describe completely how electrons were arranged around an atom. But there's more to it!

SHELL: Equivalent to Bohr's energy levels. Electrons in the same SHELL are all the same distance from the nucleus. They all have SIMILAR (but not necessarily the SAME) energy.

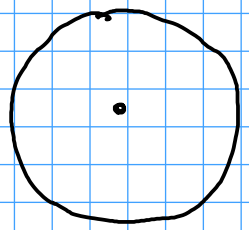
- Shells are numbered (1-... - Elements on the periodic table have shells numbered from 1 to 7)

- Higher numbers correspond to greater distance from the nucleus and greater energy, and larger size!

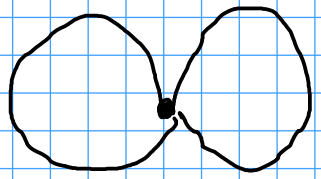
- Higher shells can hold more electrons than lower shells!

SUBSHELLS: Within a SHELL, electrons may move in different ways around the nucleus! These different "paths" are called SUBSHELLS

- SHAPES of regions of space that electrons are able to exist in.



"s" subshell
(a spherical region)



"p" subshell
(a dumbbell shaped region)