$$\overset{42.081\ g/mol}{4\,C_3H_6} + 6\,NO \longrightarrow \overset{53.064\ g/mol}{4\,C_3H_3N} + 6\,H_2O + N_2$$

propylene acrylonitrile

Calculate how many grams of acrylonitrile could be obtained from 651000 g of propylene, assuming there is excess NO present.

---

1 - Convert 651000 g propylene to moles. Use FORMULA WEIGHT.
2 - Convert moles propylene to moles acrylonitrile. Use CHEMICAL EQUATION
3 - Convert moles acrylonitrile to mass acrylonitrile. Use FORMULA WEIGHT.

---

① $42.081\ g\ C_3H_6 = mol\ C_3H_6$

② $4\ mol\ C_3H_6 = 4\ mol\ C_3H_3N$

③ $53.064\ g\ C_3H_3N = mol\ C_3H_3N$

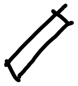
$$651000\ \cancel{g\ C_3H_6} \times \underset{①}{\frac{\cancel{mol\ C_3H_6}}{42.081\ \cancel{g\ C_3H_6}}} \times \underset{②}{\frac{4\ \cancel{mol\ C_3H_3N}}{4\ \cancel{mol\ C_3H_6}}} \times \underset{③}{\frac{53.064\ g\ C_3H_3N}{\cancel{mol\ C_3H_3N}}} =$$

$$= \boxed{821000\ g\ C_3H_3N}$$

CONCEPT OF LIMITING REACTANT

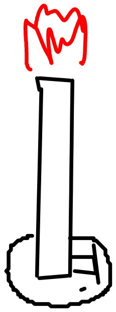
- When does a chemical reaction STOP?

$$2Mg(s) + O_2(g) \xrightarrow{\Delta} 2MgO(s)$$



Magnesium strip

+



Flame, oxygen from air

Magnesium oxide powder

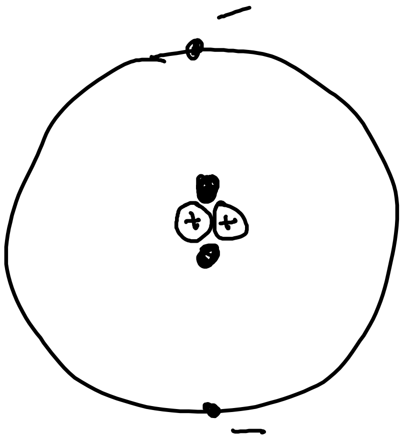
- When does this reaction stop? When burned in open air, this reaction stops when all the MAGNESIUM STRIP is gone. We say that the magnesium is LIMITING.

- This reaction is controlled by the amount of available magnesium

- At the end of a chemical reaction, the LIMITING REACTANT will be completely consumed, but there may be some amount of OTHER reactants remaining. We do chemical calculations in part to minimize these "leftovers".

- Reactants that are left at the end of a chemical reaction (in other words, they are NOT the limiting reactant) are often called "excess". So reacting magnesium with "excess oxygen" means that magnesium is limiting.

STRUCTURE OF THE ELECTRON CLOUD



The nuclear model describes atoms as consisting of a NUCLEUS containing protons and neutrons and an ELECTRON 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 nuclear model.

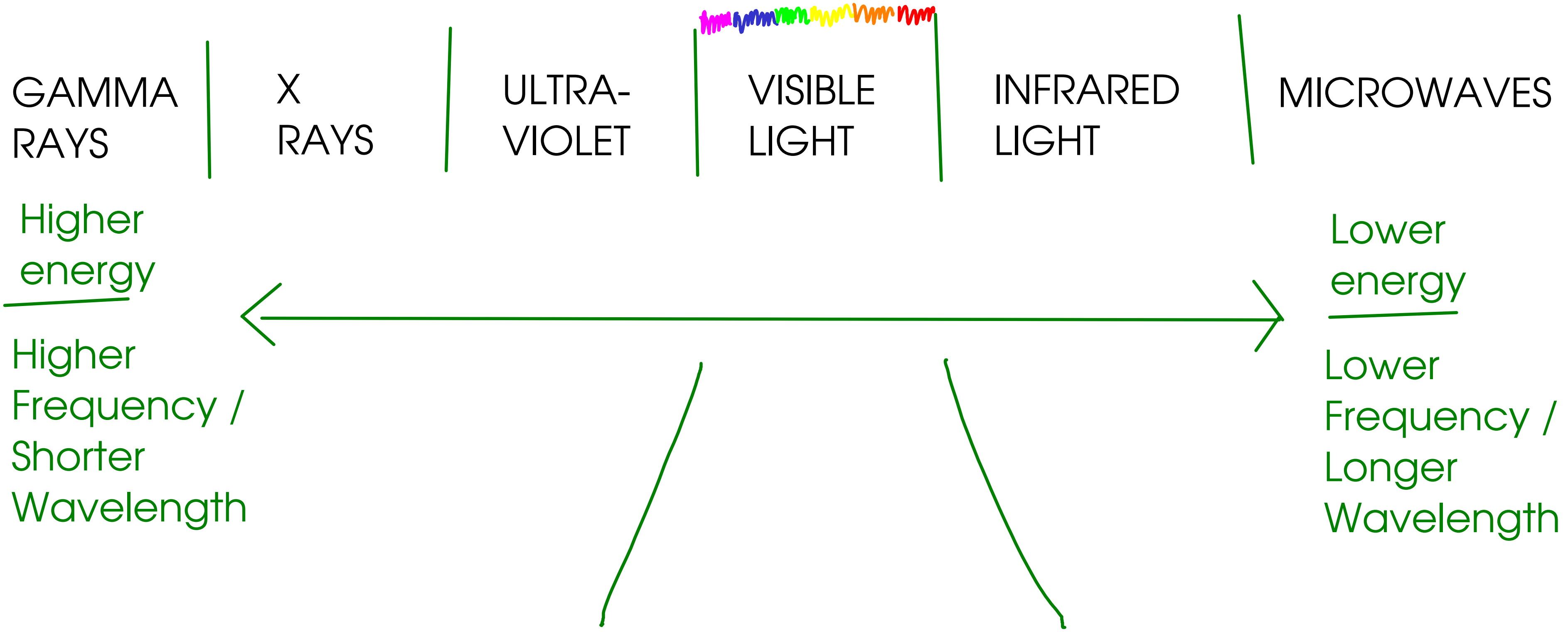
... but the nuclear model is not useful to explain several things:

- 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 p324-326)

- Different kinds of "light" have different energy contents



GAMMA RAYS | X RAYS | ULTRA-VIOLET | VISIBLE LIGHT | INFRARED LIGHT | MICROWAVES

Higher energy

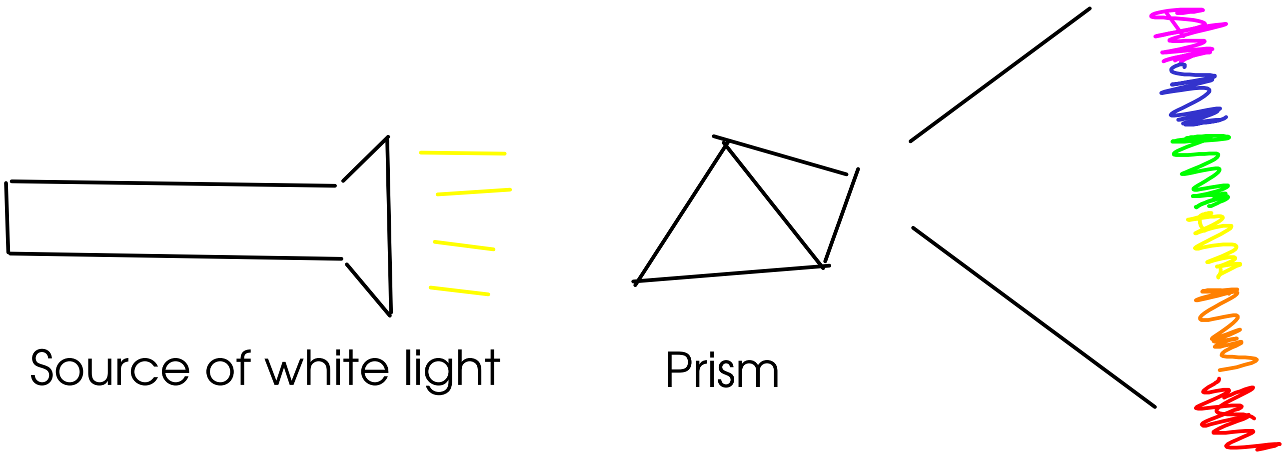
Higher Frequency / Shorter Wavelength

Lower energy

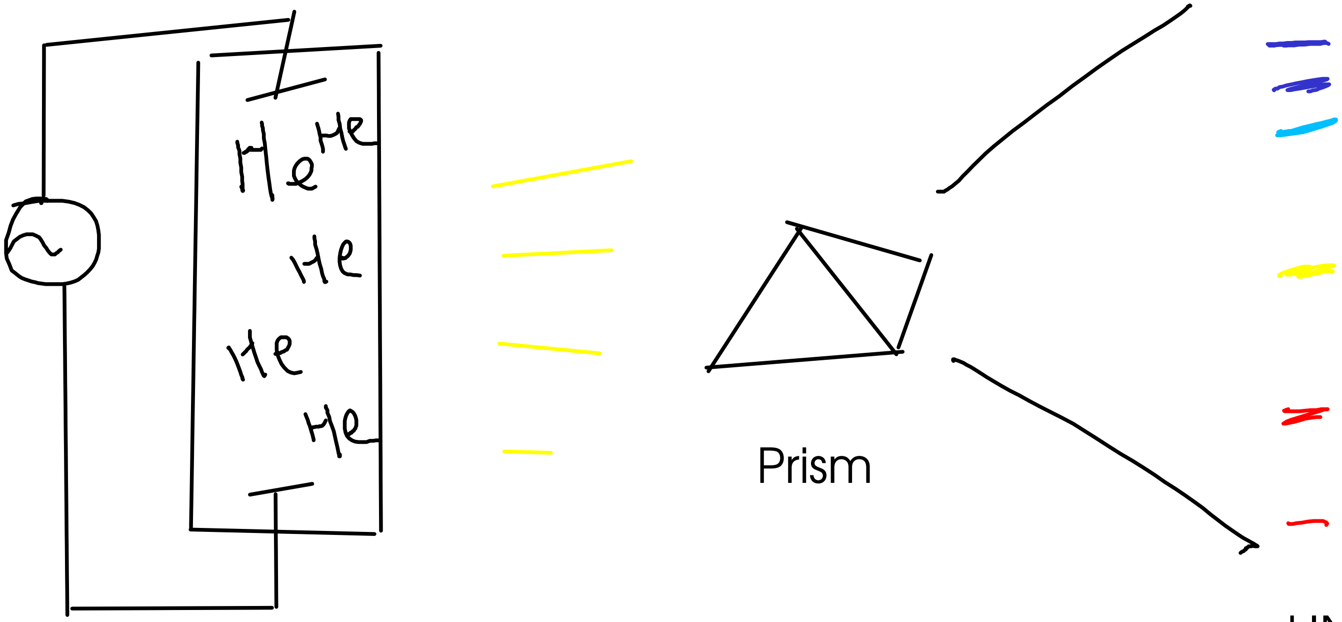
Lower Frequency / Longer Wavelength

VIOLET INDIGO BLUE GREEN YELLOW ORANGE RED

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



Rainbow (all colors represented)



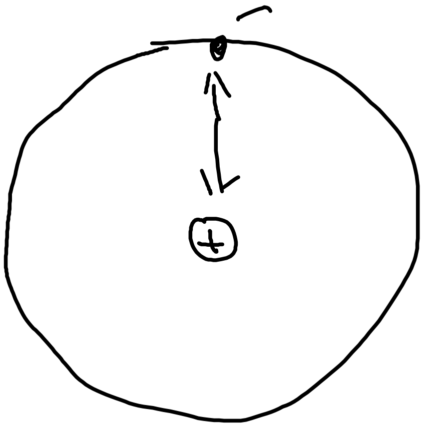
Gaseous Helium excited by electricity

LINE SPECTRUM - only a few specific colors appear!
(see p329 for example)

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

p329:

- 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

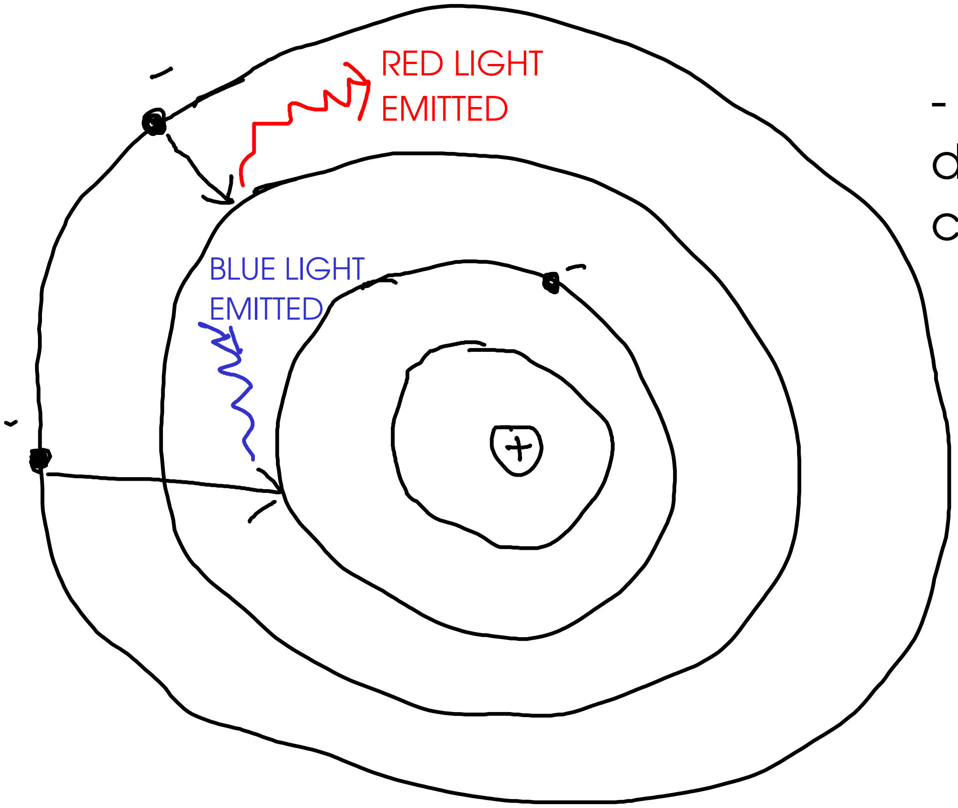
An orbit that is CLOSER to the nucleus means that the electron has LESS energy

- 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!