Do Now

- Draw the Lewis dot structure for the element with the electron notation that ends with 4p5.

Today

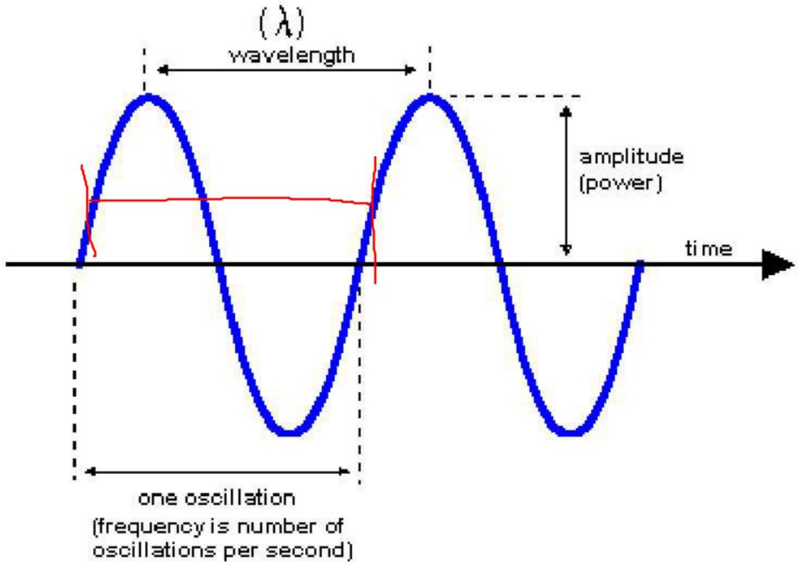
- Wavelength and Frequency of Light.
- Atomic Emission Spectra.
- Frequency of light and energy.
- Homework: Ch 5 problems 14-16, 21, 22, 30, 32, 35, 37, 41, 42, 54, 55, 56

Properties of Light

- Light travels in waves.
- Waves have an amplitude, wavelength, and a frequency.
- C-Speed of Light = 2.998x10^8m/s.

3.00m/s x10^8 m/s

Amplitude, Frequency & Wavelength



$$C = \lambda V$$

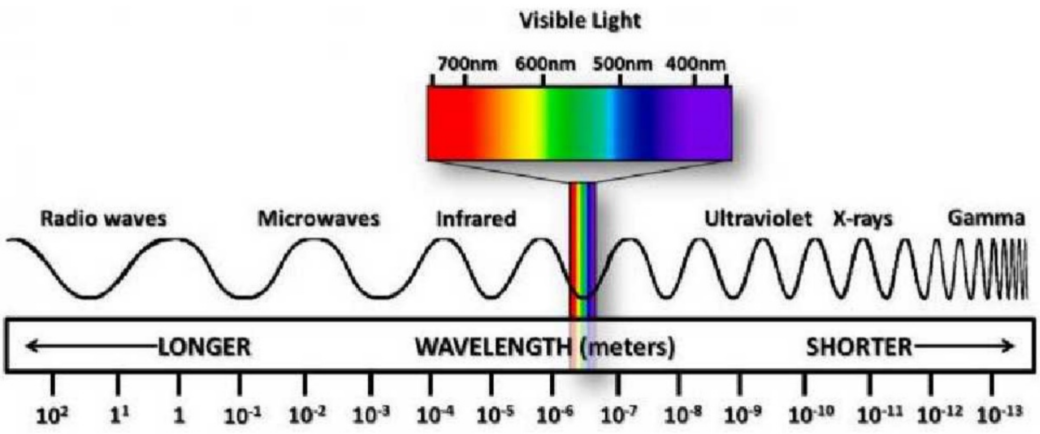
- C-Speed of light. 2.998x10^8 m/s. The speed of light is constant.
- λ-Wavelength. The distance in meters between the beginning and end of one full oscillation of a wave.
- V-Frequency [Hz]. How often (per second) a full wave passes a given point.

Inverse Proportion

- Speed of light is constant.
- The longer the wavelength, the less times that a full wave passes a stationary point.
- The shorter the wavelength, the more times that a full wave passes a stationary point.

Relate to frequency: wavelength=1/frequency

The Electromagnetic Spectrum



The Electromagnetic Spectrum

- Radio waves-λ=100m. Low energy.
- Light-λ=700 to 380 nm (10^(-9))m
- Gamma rays-λ=10^(-14)m.
- Light is the only portion of the electromagnetic spectrum that we can perceive. What % of the spectrum is that?

WHAT???!!!

- The human eye can only see 3.1x10^(-21) % of the electromagnetic spectrum.
- That's 0.0000000000000000000031%.
- With all those other waves flying around, it's no wonder I can never get a wifi signal.

Determining λ and V

- If I have λ I can find V.
- If I have V I can find λ.
- This is because C is the same for all waves of the electromagnetic spectrum.
- $C=\lambda V$.

The wavelength of the waves in my microwave is 12.2cm. What is the frequency of my microwave oven?

$$C = \lambda \nu$$

$$C = 3.00\times10^{8}\,\frac{m}{s}, \quad \lambda = \frac{12.2\,cm}{1} \times \frac{10^{-2}\,m}{1\,cm} = 0.122\,m$$

$$\frac{c}{\lambda} = \frac{\lambda \nu}{\lambda} \Rightarrow \nu = \frac{c}{\lambda} = 2.46\times10^{9}\,Hz$$

The frequency of x-rays is $3x10^{18}$ Hz. What is the wavelength λ of x-rays?

Do Now: Take out the homework, a calculator, a pencil and your notbook.

On the whiteboard, solve the following. The frequency of a beam of light is 7.42x10^4Hz. What is its wavelength? C=3.00x10^8m/s.

Green light has a wavelength of 550nm.
What is it's frequency? Hz=1/s.

$$V = \frac{550\,nm}{1} \times \frac{10^{-9}\,m}{1\,nm} = 5.5 \times 10^{-7}\,m$$

$$C = 3.00 \times 10^{8}\,\frac{m}{s}$$

$$\frac{C}{\lambda} = \frac{\lambda V}{\lambda}$$

$$V = \frac{C}{\lambda} = \frac{3 \times 10^{8}\,\frac{m}{s}}{5.5 \times 10^{-7}\,m} = 5.45 \times 10^{14}\,Hz$$

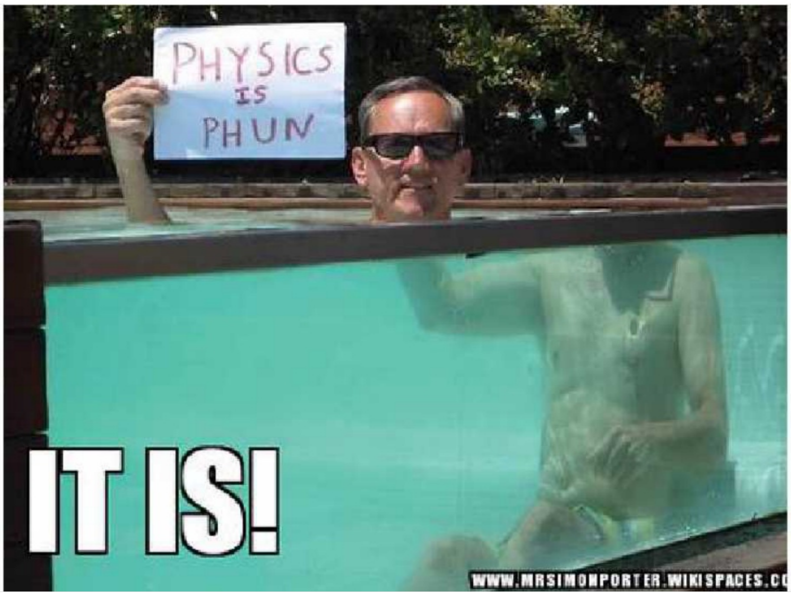
Atomic Spectra

- When atoms absorb energy, their e- move to higher energy levels.
- The e- loses that energy quickly and they release light as they return to their original energy level.

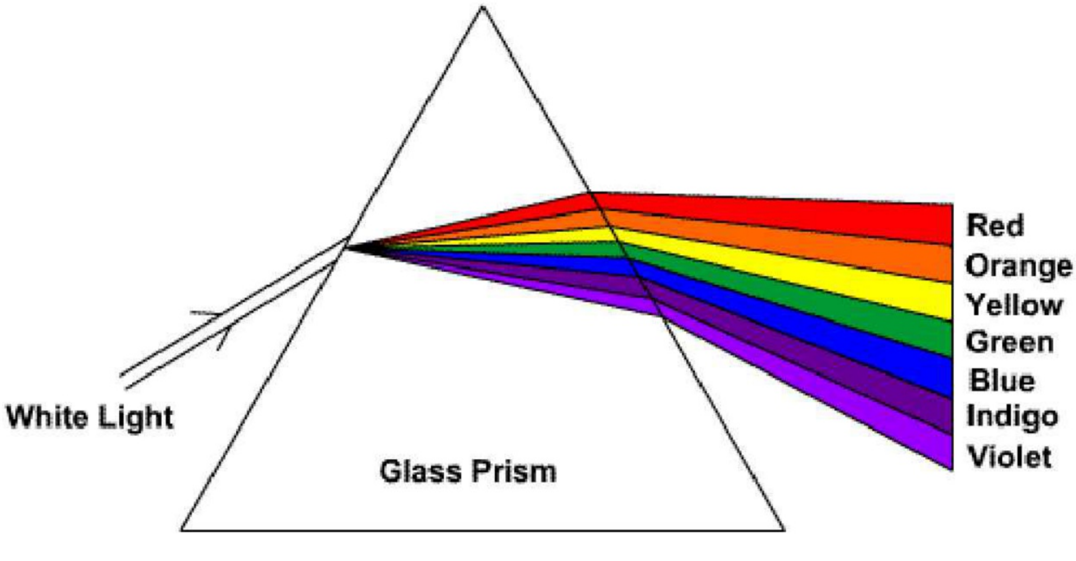
Emission Spectra

- Depending on the e- configuration, light is released in different frequencies.
- This is because they have e- changing on different energy levels.
- This makes different materials different colors.

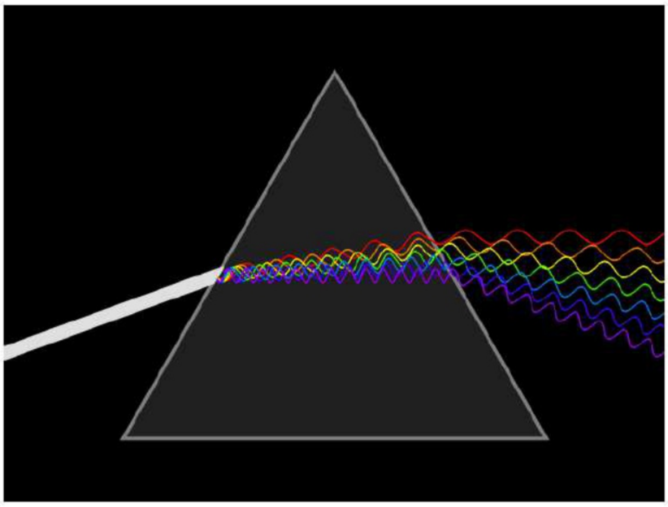
Prisms



Light “Bends” In a Prism



Light Dispersion



Do Now: Take out the homework, a calculator, a pencil and your notebook. CHeck the homework on the left side of the room. On the whiteboard, solve the following. The frequency of a beam of light is 7.42x10^4Hz. What is its wavelength? C=3.00x10^8m/s.

$C = 3.00 \times 10^8$ m/s

$\nu = 7.42 \times 10^4$ Hz

$\lambda = ?$

$$\frac{C}{\nu} = \frac{\lambda \nu}{\nu}$$

$$\lambda = \frac{3.00 \times 10^8 \text{ m/s}}{7.42 \times 10^4 \text{ Hz}} = 4.04 \times 10^3 \text{ m}$$

e- and Atomic Spectra

- Light given off by atoms is **directly proportional** to the energy change of the electron (quanta).
- E=hv
- E-Energy is measured in joules [j].
- V-still means frequency [1/s].

h-The Plank Constant

- A **constant** value that relates the frequency of light given off by an atom to the energy (quanta) released.
- H = 6.626 x 10^(-34) [j·s]

h

Light with a wavelength of 470nm is emitted by an atom. What is the energy given off by the atom? Answer in joules.

An atom absorbs 2.6x10^(-40)j. What is the frequency of light emitted by the atom?

$h = 6.626 \times 10^{-34}\ Js$

$E = 2.6 \times 10^{-40}\ J$

$$\frac{E}{h} = \frac{hv}{h}$$

$$v = ? = \frac{E}{h} = \frac{2.6 \times 10^{-40}\ J}{6.626 \times 10^{-34}\ Js} = 3.92 \times 10^{-7}\ Hz$$

Using Frequency (V) to connect λ to E

- The V in C= λV has the same value of V in the equation E=hv.
- If you can solve for V in one equation, you can find out a value in the other equation.
- We are mathemagicians!

The wavelength of AM radio waves is around 30m. What is the energy contained in an AM radio wave? Answer in joules.

An electron releases 3x10^-16 joules of energy. What is the ~~wavelength~~ of the wave emitted by the atom? frequency

$E = 3\times10^{-16}\,J$

$h = 6.626\times10^{-34}\,Js$

$$\frac{E}{h} = \frac{h\nu}{h}$$

$$\nu = ? = \frac{3\times10^{-16}\,J}{6.626\times10^{-34}\,Js} = 4.52\times10^{17}\,Hz$$