Unit 3 - Electrons and Energy

- Section 2 - Wave Calculations - **Radiant Energy**

How does light energy transfer through space?

- Light travels in packets of energy called **photons**
  - Photons have **no mass** and have electrical and magnetic properties.
- Energy of a photon can be calculated using **frequency** or **wavelength** of the wave emitted
- Both would require a value to be plugged in for h
  - h = Planck's constant =

    6.626×10^{-34} J · sec

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

E = Energy of a single photon

$h = 6.626 \times 10^{-34}\ \text{J} \cdot \text{s}$ (Planck's constant)

ν = frequency (Hz)

λ = wavelength (m)

$c = 2.998 \times 10^{8}\ {}^{m}/_{s}$ (speed of light)

Calculation of Energy of a Photon

- ***Calculate the energy of a photon (E) of blue light with a wavelength (λ) of 450 nm. (Convert to m)***

$E = hc / \lambda$

$E = (6.626 \times 10^{-34}\ J \cdot sec)(2.9979 \times 10^{8}\ m/sec) / 4.5 \times 10^{-7}\ m$

$E = 4.41424 \times 10^{-19} \rightarrow \underline{4.4 \times 10^{-19}\ J}$

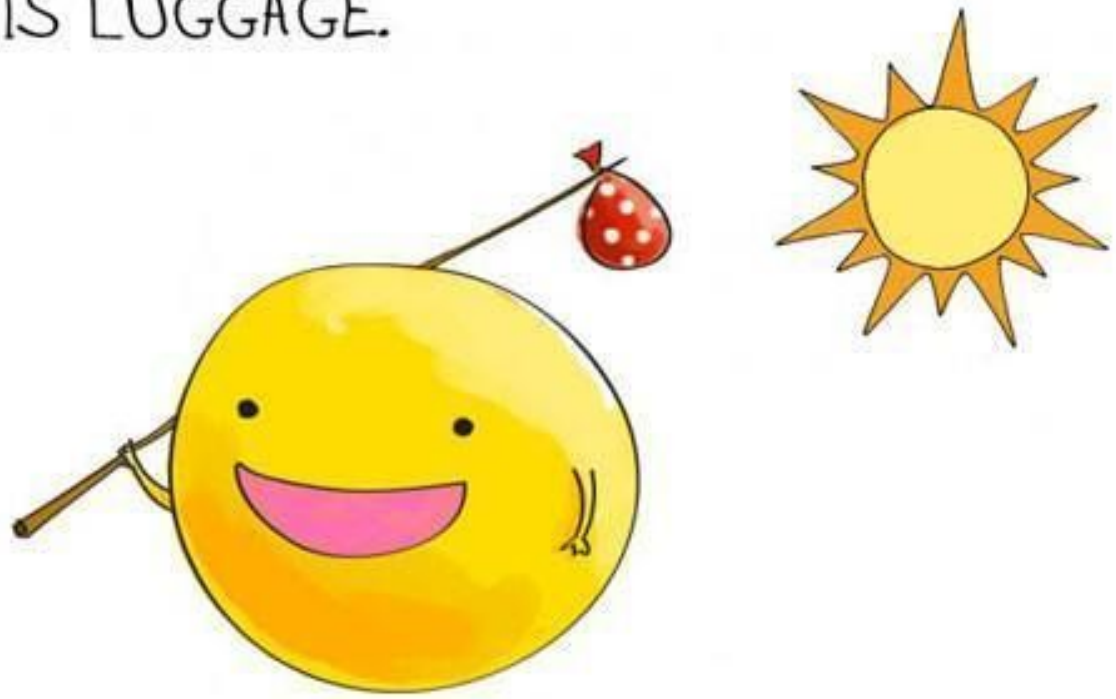
- ***What is the energy of a photon (E) corresponding to radio waves with a ν = 1.255 x 10^6 Hz?***

$E = h\nu$

$E = (6.626 \times 10^{-34}\ J \cdot sec)(1.255 \times 10^{6}\ Hz)$

$E = 8.31563 \times 10^{-28} \rightarrow \underline{8.316 \times 10^{-28}\ J}$

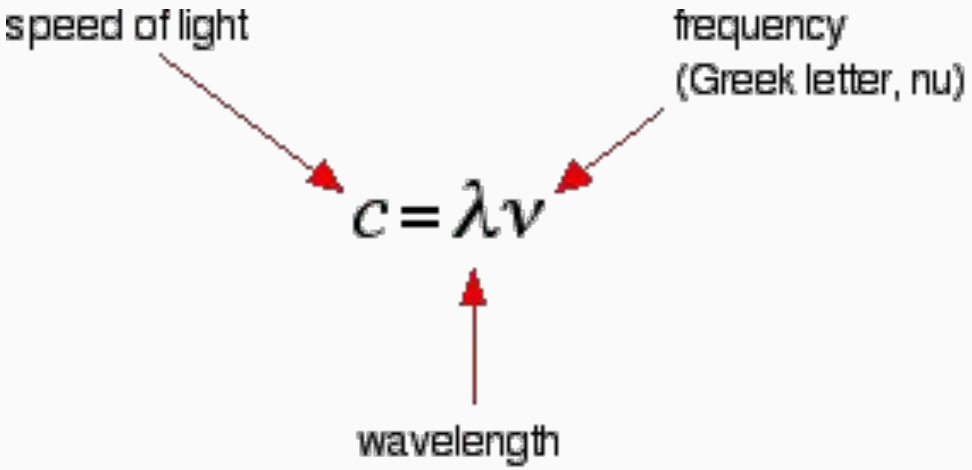
A PHOTON CHECKS INTO A HOTEL AND IS ASKED IF HE NEEDS ANY HELP WITH HIS LUGGAGE.

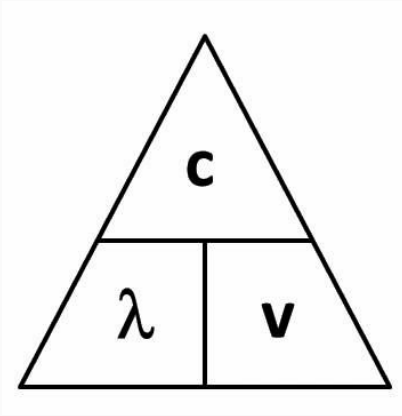


"NO, I'M TRAVELLING LIGHT."

Calculation of Wavelength and Frequency of Light

- Wavelength is calculated by using the speed the light is traveling and its frequency.
  - Speed of Light (c) - **2.998 x 10^8 m/sec**
  - Can redesign formula to solve for frequency **or** wavelength!





Calculation of Wavelength and Frequency of Light

- ***What is the wavelength of light emitted from an atom (in nm) if the frequency of the radiation is 5 x 10^{12} Hz (Hertz)?***

  $\lambda = 2.9979 \times 10^{8} m/s / 5 \times 10^{12} Hz$

  $\lambda = 0.000599$ m (x 1 x 10^{9}nm) = **60,000 nm**

- ***The wavelength of green light is 522 nm (convert to m). What is the frequency (in Hz) of this radiation?***

  5.22×10^{-7} m = 2.9979×10^{8} m/s / ν

  v = **5.74 x 10^{14} Hz**

At the bottom of your notes, write a reflection where you explain in WORDS why this section of notes relates to Chemistry and how the calculations work!