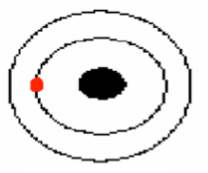
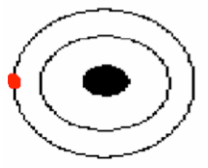
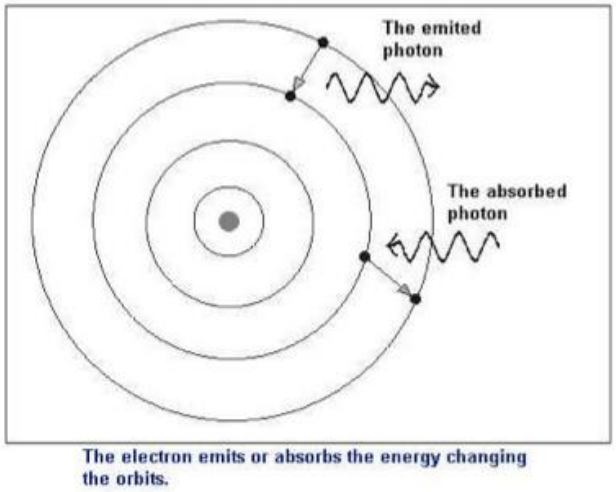
Wave Theory



Ground state:



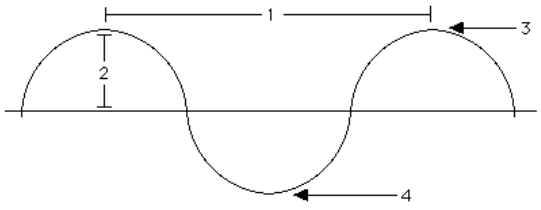
Excited state:



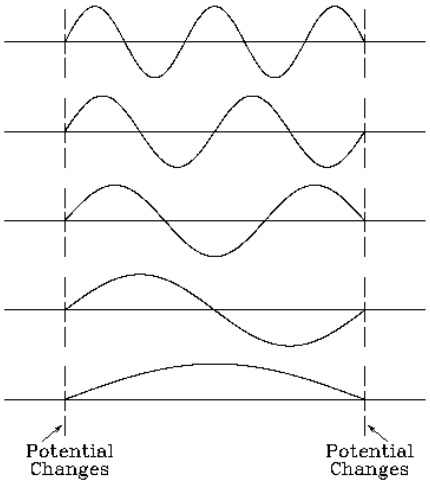
When an electron falls from a HIGH energy level to a LOW energy level, it releases energy in the form of _____.

Light can be thought of as **waves** moving through space. Since light is given off in the form of waves it is necessary to have knowledge about waves to understand light.

Label the parts of a wave:



Frequency = cycles/second



- From what we know, we can relate speed of light, frequency, and wavelength to one another.
- The _____ are INVERSELY related.
- ALL electromagnetic waves travel at the speed of light in a vacuum.
- Quantum theory states that energy of a photon is directly proportional to its frequency.

$c = \lambda v$

$c =$

$\lambda =$

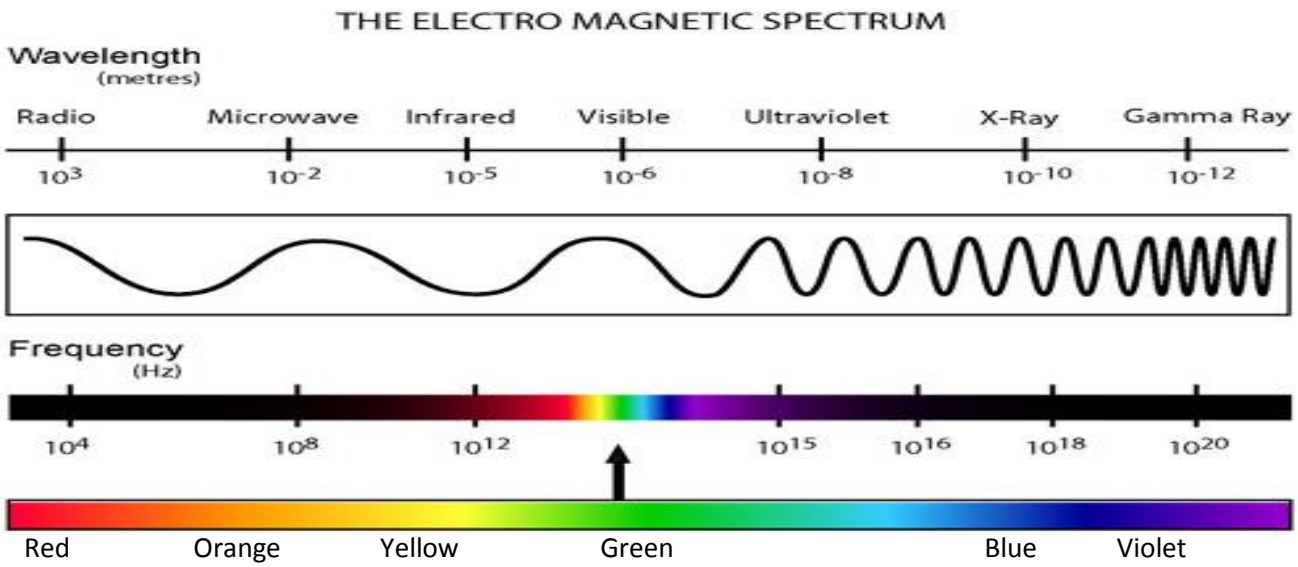
$v =$

$E = hv$

$E =$

$h =$

$v =$



λ = (Large Wavelengths)
v = (Low frequency)
E = (Low energy)

λ = (Small Wavelengths)
v = (High frequency)
E = (High energy)

$c = \lambda v$ **$E = hv$** ***$c = 3.00 \times 10^{8}\ m/s$*** ***$h = 6.63 \times 10^{-34}\ Js$***

Problem 1: Determine the frequency of light whose wavelength is 4.357×10^{-7} cm.

Problem 2: Determine the wavelength, in meters, of light whose frequency is 3.45×10^{14} Hz.

Problem 3: How much energy of a photon is produced if it has a frequency of 3.55×10^{17} 1/s ?

Dual Nature of Light: Light travels NOT ONLY in waves, but also act like particles!
Photon:

Quantum:

Atomic Emission Spectrum:
-Every element emits light when it is excited by the passage of an electric discharge through its gas (a fingerprint of sort!)
The Emission of light:
-As previously stated, in order for an electron to go from ground state to an excited state it takes a quantum of energy to raise it.
-The same amount of energy is emitted as a photon when the electron drops from excited state back to the ground state.
-Only electrons in transition form a higher to lower energy levels lose energy and emit light.

Wave Theory HOMEWORK

Solve the following problems. Show all work or no credit will be given.

$c = \lambda v$ **$E = hv$** ***$c = 3.00 \times 10^{8}$ m/s*** ***$h = 6.63 \times 10^{-34}$ Js***

1. An excited hydrogen atom emits light whose frequency is 1.14×10^{14} Hz. What is the wavelength in meters of this wave?

2. A certain violet light has a wavelength of 4.13×10^{-7} mm. What is the frequency, in hertz, of this light?

3. What is the frequency, in hertz, of light if it has energy of 6.85×10^{-6} kJ of energy?

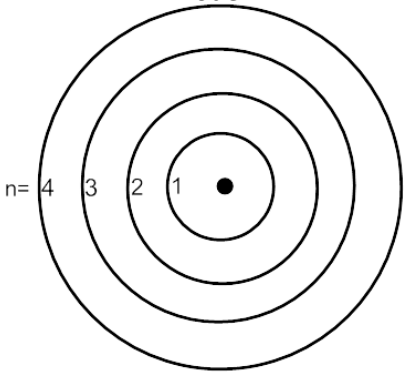
4. What is the energy, in joules, of a photon of light with frequency of 2.87×10^{15} Hz?

6. As frequency increases, wavelength _____ 7. As energy increases, wavelength _____

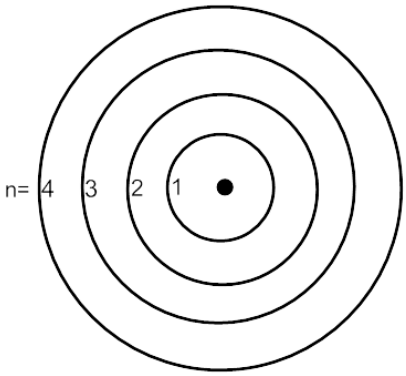
8. As energy increases, frequency _____

9. a. On model A below show an electron falling from energy level four to two.
   b. On model B below show an electron falling from energy level four to one.
   c. On model C below show an electron falling from energy level three to two.

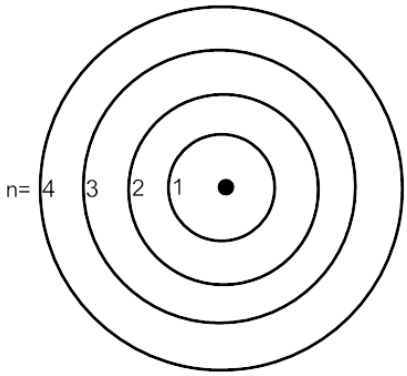
Model A



Model B



Model C



10. CHALLENGE QUESTION: Notice that the electrons in each model above fall at different lengths/ distances. How does the length of the electrons falling relate the energy that is releases?