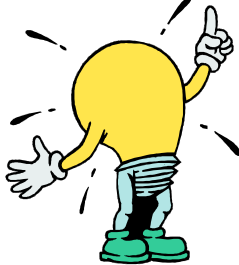


Light

What is it?

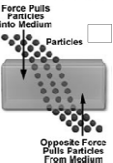


Theories – What must they explain?

- Propagation
- ➔ Reflection
- Refraction
- ➔ Interference
- Diffraction

Particle Theory

- Propagation - yes
- Reflection – yes
- Refraction – no
 - Newton theorized that as a light particle traveled through a uniform medium it traveled in a straight line.
 - As it approached a new, denser, medium it would be attracted to the larger amount of particles and would turn towards that medium. (ie. air/water)
 - Required light to move faster in water
 - Light moves slower in water than in air, but was not proven until after Newton died.



Wave Theory (mechanical)

- Interference - yes
- Diffraction - yes
- Reflection – yes
- Refraction – yes
- Propagation – no
 - Had trouble describing using this theory because waves require a medium.

Electromagnetic Wave Theory

- Heat, light, and electricity are transmitted through free space at the speed of light as electromagnetic disturbances (waves).
- Still does not explain all properties of light such as the photoelectric effect.

Photoelectric Effect (p.854)

- The emission of electrons (photoelectrons) by a substance when illuminated by electromagnetic radiation or light.

Ex: Photocell

1st Law of Photoelectric Emission

- The rate at which electrons are emitted is directly proportional to the intensity of the light.

2nd Law of Photoelectric Emission

- The kinetic energy of the electrons is independent of the intensity of light

3rd Law of Photoelectric Emission

- The maximum kinetic energy of photoelectrons is directly proportional to the difference between the frequency of the incident light and the cutoff frequency.
- The cutoff frequency is the frequency at which photoelectrons are not emitted off of a given material.

Quantum Theory (p854)

- The transfer of energy between light radiation and matter must occur in discrete packets called quanta or photons. (the link between the wave and particle theories)
- The amount of energy emitted depends on the frequency of the radiation.

$$E = hf \quad \text{or} \quad \lambda = h / mc$$

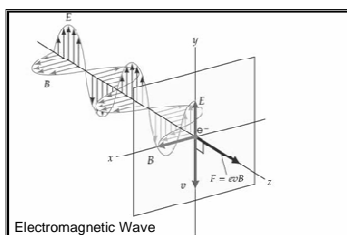
$h = \text{Planck's constant} = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$

What does it all mean? The Dual Nature of Light

- Light acting as a wave can explain many of the observable characteristics.
- Some characteristics could not be explained such as the photoelectric effect
- Light can be explained by describing it both as a particle and a wave.

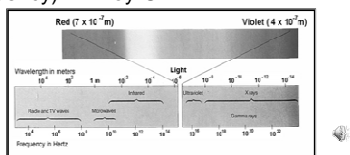
What is Light ?

- Range of electromagnetic waves that move in distinct quantities that stimulate the eye.



So...what is light ?

- The visible portion of the electromagnetic spectrum
- Wavelengths of 4×10^{-7} m to 7×10^{-7} m (400 nm to 700 nm)
- Different wavelengths produce different colors.
- In order of decreasing wavelength (or increasing frequency) => Roy G. Biv



Return to Honors Physics
Notes
