Quantum Theory

What is light

- We found Electro-magnetic radiation was represented as a wave

Characteristics: Freq, Wavelength, amplitude, velocity

★ Can emit any level of Energy

Problem ① ↑ Temperature → Shorter Wavelengths

Ex. Metal Glows red → orange → white when hot

Ultra Violet Catastrophe - For small wavelengths, emitted energy will become infinitely large

Solution: ~~Energy does not exist at any level you want, but is quantized (only discre~~

Energy is not continuous, but is quantized, exists in a series of discrete bundles. (certain energy)

Photon - A quantum (packet) of light

★★ Quantum Theory - Light travels as a discrete "quata" or "particle" of energy, rather than a wave.

- A particle of light will have momentum and K.E.

Photoelectric Effect - When light strikes the surface of a material, electrons are emitted. The energy from the photons supplies the work necessary to free the electrons from the material surface to create a current.

$E_{photon} = hf$ h = Plancks Constant 6.6×10^{-34} J·S

Green light f = frequency

The ~~threshold~~ freq. of Sodium is 5.6×10^{14} Hz. What is the energy of the Photon in J and EV

$E_p = hf$ $(3.7 \times 10^{-19}$ J$)$ 3.7×10^{-19} J $\times \frac{1 \text{ eV}}{1.6 \times 10^{-19} \text{ J}} = 2.3$ EV

$E_p = (6.6 \times 10^{-34}$ J/Hz$)(5.6 \times 10^{14}$ Hz$)$

The energy of a photon is 2.11 eV

a) What is the energy of the photon in Joules

$$2.11 \text{ eV} \times \frac{1.6\times10^{-19}\text{ J}}{1 \text{ eV}} = 3.38\times10^{-19}\text{ J}$$

b) Find the frequency (Use Joules since h is in Joules)

$$E_{photon} = hf \qquad f = \frac{E}{h} = \frac{3.38\times10^{-19}\text{ J}}{6.63\times10^{-34}\text{ J}\cdot\text{s}} = 5.10\times10^{14}\text{ Hz}$$

c) What is the color of the light of the Photon

Using the Reference Table 5.10×10^{14} Hz $\Rightarrow$ Yellow Light

If you change the energy of an object, you will also change its mass.

When you form a nucleus, energy will be released and matter will be lost

$E = mc^2$

To break up a nucleus, energy is needed to separate the nucleons, mass must increase

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