

# Chapter 5: Electrons in Atoms

## Section One: Light and Quantized Energy

**Electromagnetic Radiation:** a form of energy that exhibits wavelike behavior as it travels through space.

- Ex. X-rays, ultraviolet and infrared light, microwaves, and radio waves

**Wavelength ( $\lambda$  – the Greek letter lambda):** the shortest distance between equivalent points on a continuous wave

- Unit for wavelength is either the meter, centimeter, or nanometer

**Frequency ( $\nu$  – the Greek letter nu):** the number of waves that pass a given point per second

- Expressed in wave/second but *waves* is understood
  - 1/s or  $s^{-1}$
- One wave/second is called a hertz (Hz) – the SI unit of frequency
- FM measures in MHz
- AM measures in kHz

**Amplitude:** the wave's height from the origin to a crest, or from the origin to a trough

- Wavelength and frequency do not affect the amplitude of a wave

Frequency and wavelength are mathematically related:

$$c = \lambda \nu$$

$$c = \text{speed of light } (3.0 \times 10^8 \text{ m/s})$$

$$\lambda = \text{wavelength and } \nu = \text{frequency}$$

**Electromagnetic spectrum:** all forms of electromagnetic radiation, with the only differences in the types of radiation being their frequencies and wavelengths

- Radio, Microwave, Infrared, Visible light, Ultraviolet, X-Ray, and Gamma Ray

**Quantum:** the minimum quantity of energy that can be lost or gained by an atom

$$E = h\nu$$

E = energy, in joules

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

$\nu$  = frequency

**Photoelectric effect:** the emission of electrons from a metal when light shines on the metal

- Ejects electrons from the metal and creating an electric current
- In 1905, Albert Einstein expanded on Planck's theory by introducing the idea that electromagnetic radiation has a dual wave-particle nature.
  - Called these photons

**Photon:** a massless that carries a quantum of energy

$$E_{\text{photon}} = h\nu$$

**Atomic emission spectrum:** a set of frequencies of the electromagnetic waves emitted by atoms of the element

- <http://chemistry.bd.psu.edu/jircitano/periodic4.html>

**Continuous spectrum:** the emission of a continuous range of frequencies of electromagnetic radiation