# Notes for Ch. 7 Atomic Structure and Periodicity        Honors PreAP Chemistry

*(There will be 5 sections to this chapter. So, there will be 5 sections of notes, 5 sections of short homework assignments due on different days, and 4 videos to watch. I will post notes, videos, and hw problems and due dates as we move through the chapter. Please pace yourself and work on the section of notes and hw for each set as we progress through the lecture.)*

**Section 1 Light and Matter (p. 296-304)** For the first 3 sections of this chapter, it would be a good idea to read the pages that cover the section. It will help you understand the notes.

**Light (Electromagnetic Radiation)**
Light is electromagnetic radiation and travels in waves.
When we think of "light", we usually think of energy which it is.
Light energy travels in **waves** at "the speed of light".
What we don't always think of about light is that it also has **particle** (matter) properties. The particle properties of light are **photons**.

The "wave" properties of light are very similar to the "wave" properties of **electrons** ($e^-$). Electrons are **particles** of matter and have particle properties but they also have "**wave**" properties like light.

**Electromagnetic Radiation and its Waves.**
Since light is a wave and travels as i a wave, it has all the properties of waves.
Those properties are **wavelength λ (lambda)**, the distance from one point on a wave to the same point on the next wave, and **frequency ν (nu),** how many waves pass a certain point over a unit time.

All light travels at the **speed of light (c).**

$$c = \lambda \nu$$

The speed of light is a constant also known as the universal constant **$3.0 \times 10^8$ m/s.**

Wavelength and Frequency are **inversely proportional** to each other. The longer the wavelength the smaller the frequency. The shorter the wavelength the larger the frequency.

**Note:** Wavelength needs to be in **meters (m)** for all calculations involving wavelength.
Frequency needs to be in **$s^{-1}$ or (Hz) hertz** for all calculations involving frequency.

**Light or Electromagnetic Radiation** is not limited to visible light, the light we see. Visible light is ROYGBIV (red, orange, yellow, green, blue, indigo, and violet).
The **light spectrum** (see spectrum p.297) ranges from gamma, x-rays, uv rays, visible light, infrared rays, microwaves, and radio waves.

Max Planck discovered that electromagnetic radiation could only be absorbed or emitted in distinct amounts of energy (**photons**). He said that these packets of light energy were **quantized** which means having an exact amount of energy. He found that he could determine the amount of energy**, E,** by multiplying the frequency of the wave by a constant (**Planck's Constant), h.**

$$\mathbf{E = h\,\nu}$$

Since ν also = c/λ , this could be substituted for ν. Or $\mathbf{E = \dfrac{h\,c}{\lambda}}$

The E or energy of a photon is expressed in J/photon
or $E_{photon}$ = J/photon

## Photoelectric Effect

When photons of electromagnetic radiation of a high enough energy hit the surface of some metals, they transfer enough energy to the electrons of the metal to allow the electrons to be emitted from the metal. (See p.302) also (refer to Interactive Example 7.3)
Albert Einstein received the Nobel Prize in Physics for demonstrating this phenomenon known as the photoelectric effect.

From Einstein's Theory of Relativity, $E = m\,c^2$, Einstein concluded that the mass of a photon (remember a photon is a packet of light which is now having mass) could be calculated.

$$\mathbf{m} = E/c^2 = \frac{hc/\lambda}{c^2} = \frac{\mathbf{h}}{\boldsymbol{\lambda}\mathbf{c}} \qquad \mathbf{m} = \frac{\mathbf{h}}{\boldsymbol{\lambda}\mathbf{c}}$$

**de Broglie's Equation**

A young French scientist Louis de Broglie rearranged Einstein's equation to show that all matter also has wave properties and all waves have properties of matter.
De Broglie's equation for mass of a wave or the wavelength of any object with mass

$$\mathbf{m = h/\lambda\,v}$$

Where v is the **velocity** of the particle. (For a photon it would be c or the speed of light.

Mass and wavelength are inversely proportional so the bigger the mass of a particle the smaller the wavelength. **Large masses have almost negligible wavelengths.**

**These notes correspond to hw problems: 42,44,46,50,54,and 56 at the end of the chapter.**