WORKSHEET #1

CHAPTER 6: 6.1-6.3 Name:_____ Per:_____ Date:_____

6.1 The Wave Nature of Light

Electromagnetic radiation travels as waves through space. In a vacuum it travels at a constant speed (*c*) equal to 3.00 x 10^8 m/s. It can be represented as wavelength times frequency equals the speed of light: $\lambda\nu = c$
The SI unit of frequency is hertz: 1 Hz 1/s or $1s^{-1}$

1. A typical radar transmitter emits microwaves with a frequency of 9300 MHz. What is the wavelength of these waves expressed in meters?

2. Sodium emits yellow light at a wavelength of 589 nm. What is its frequency?

3. The frequency of a photon of green light is 5.49 x 10^{14} Hz. What is its wavelength in nanometers?

4. Using the visible spectrum on page 219
   a. Determine the color of visible light with a frequency of 4.62 x 10^{14} Hz.

   b. Determine the frequency of a photon of yellow light (use an average value from the Figure).

   c. Describe the relationship between the frequency of the above two problems, the color they emit and the wavelength.

6.2 Quantized Energy and Photons

According to Planck's theory light can exists as a wave or as a tiny particle called a photon. He determined that the energy of a photon is directly proportional to the frequency of the light: $E_{photon} = h\nu$ (Planck's constant H = 6.626 x 10^{-34} Js)

5. What is the energy, in joules, of a photon having:
   a) the frequency of 4.50 x 10^{15} Hz?

   b) a wavelength of 589 nm? (*hint: use both* $c=\lambda\nu$ *and* $E_{photon} = h\nu$ *to solve)*

6.3 Line Spectra and the Bohr Model

It was discovered that the Rydberg equation could be used to calculate the wavelengths of the spectral lines of the simplest element, hydrogen: $1/\lambda = 1.096776 \times 10^7 m^{-1} (1/n_1^2 - 1/n_2^2)$ Substituting n for whole numbers, one can calculate the wavelengths of hydrogen which can be verified by use of a spectrometer. The use of whole numbers in the equation supports the beginning of the development of quantum theory; electrons are restricted to certain energy levels.

6. Calculate the wavelength, in nanometers, of the line in the spectrum of hydrogen corresponding to $n_1 = 2$ and $n_2 = 3$ in the Rydberg equation. Use Figure 6.4 on page 219 to determine what color this is in the visible spectrum of hydrogen.