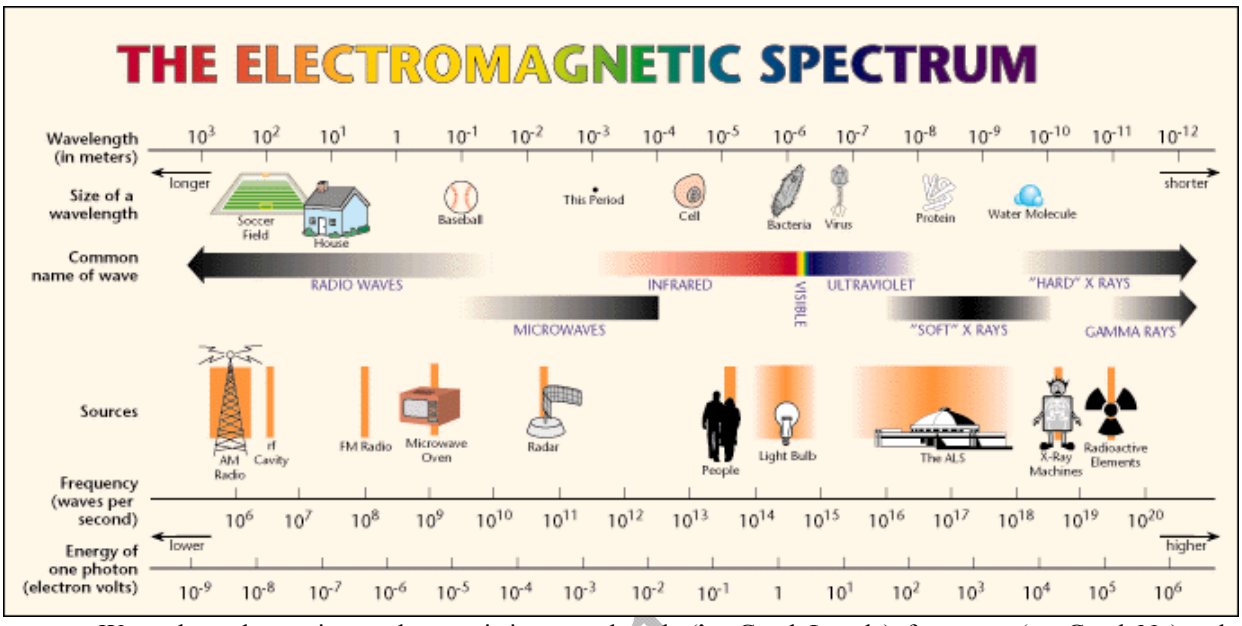
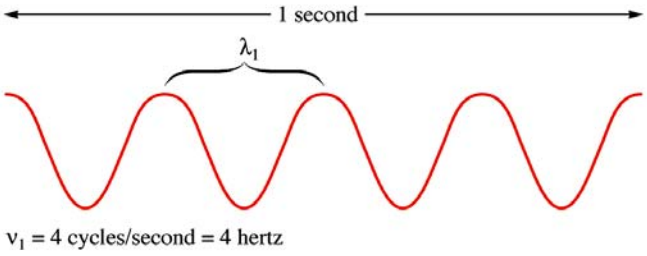
Name _____ **Honors Chemistry** ___/___/___

Electromagnetic Radiation

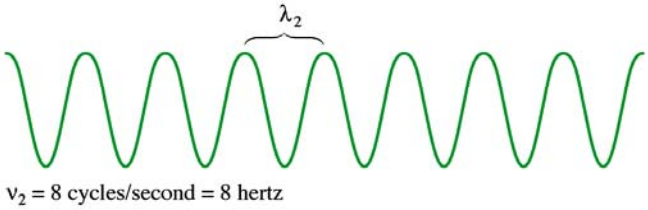
- One way energy travels through space is by electromagnetic radiation.
- The electromagnetic spectrum represents the total range of electromagnetic radiation ranging from the longest radio waves to the shortest gamma waves.



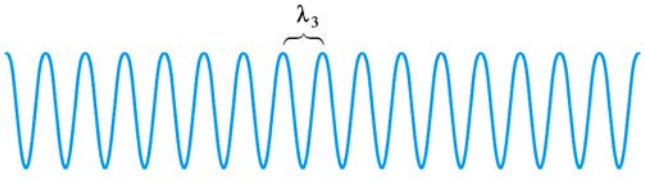
- Waves have three primary characteristics: wavelength, (λ – Greek Lamda), frequency (ν – Greek Nu),and speed of light (c).
- Wavelength, (λ), is the distance between consecutive peaks or troughs in a wave.
- Frequency, (ν), is the number of waves that pass a specific point in space per second.



ν_1 = 4 cycles/second = 4 hertz



ν_2 = 8 cycles/second = 8 hertz



ν_3 = 16 cycles/second = 16 hertz

- **$c = \lambda \nu$;** c = speed of light (3.00×10^8 m/s), λ = wavelength in meters, ν = frequency in cycles per second (Hz)
- Calculating Radiation: Example: The red colors in fireworks are due to the emission of light with wavelengths around 650 nm when strontium salts are heated. Calculate the frequency of red light with the wavelength of 6.50×10^2 nm.

  $c = \lambda \nu$
  6.50×10^2 nm $\div 10^9 = 6.50 \times 10^{-7}$
  $(6.50 \times 10^{-7}$ m) $\nu = 3.00 \times 10^8$ m/s
  $\nu = 4.61 \times 10^{14}$ s^{-1} = **4.61×10^{14} Hz**

Flame Tests

The normal electron configuration of atoms or ions of an element is known as the "ground state." In this most stable energy state, all electrons are in the lowest energy levels available. When atoms or ions in the ground state are heated to high temperatures, some electrons may absorb enough energy to allow them to "leap" to higher energy levels. The element is then said to be in the "excited state." This excited configuration is unstable, and the electrons "fall" back to their normal positions of lower energy. As the electrons return to their normal levels, the energy that was absorbed is emitted in the form of electromagnetic energy. Some of this energy may be in the form of visible light. The color of this light can be used as a means of identifying the elements involved. Such crude analyses are known as flame tests.

Only metals, with their loosely held electrons, are excited in the flame of a laboratory burner. Thus, flame tests are useful in the identification of metallic ions. Many metallic ions exhibit characteristic colors when vaporized in the burner flame. In this experiment, characteristic colors of several different metallic ions will be observed, and an unidentified ion will be identified by means of its flame test.

Objective:

- To observe the characteristic colors produced by certain metallic ions when vaporized in a flame.
- To identify an unknown metallic ion by means of its flame test.

Safety:

- We will be using gas and fire in this lab. You must wear your goggles and apron at all times during the lab.
- If you should accidentally burn your self during the lab, immediately rinse the burnt area with water and contact the teacher.

Materials (per group):

1 Bunsen burner 1 pack of matches Cotton Swab

Procedure:

1. Light your Bunsen burner making sure to get a perfect flame.
2. Dip the platinum wire in the chemical.
3. Hold the wire in the flame briefly to observe the color.
4. Record the color of the flame.
5. Continue with the next ion.

Data Table:

Metallic Ion	Color In Flame	Metallic Ion	Color In Flame
Na^+		Cu^{2+}	
K^+		Sr^{2+}	
Li^+		Ba^{2+}	
Control (no ions)		Unknown	

Questions:

1. Radio station WMZQ operates at frequency of 98.7 MHz (megahertz). Calculate the wavelength distance between waves.

2. What is the frequency in hertz of blue light having a wavelength of 425 nm?

3. A microwave over produces energy with a frequency of 2.45 GHz (gigahertz). Calculate the wavelength distance.

4. What is the frequency of radiation that has a wavelength of 77.0 inches? What type of radiation would this be?

5. Which of the ions was the unknown?

6. What inaccuracies may be involved in using flame tests for identification purposes?

7. Which pairs of known ions produce similar colors in the flame tests?

8. Explain how the colored light observed in the flame tests is produced.

9. Write the **short cut electron configuration** and **orbital diagram** for each of the following elements used in today's lab. Also, give **a possible set of four quantum numbers** for each element.

   a. Li

   b. Na

   c. K

d. Cu

e. Sr

f. Ba

g. S

h. Mg

i. Co

j. Cr