

**CHEM 1**  
**Problem Set 7**

1. Give the equation for each of the following important mathematical relations in this chapter:
  - a) The relationship between wavelength, frequency, and speed of light.
  - b) The relation between energy and frequency of radiation.
  - c) The energy of an electron in a given energy state of the H atom.
  
2. The U.S. Navy has a system for communicating with submerged submarines. The system uses radio waves with a frequency of  $76 \text{ s}^{-1}$ . What is the wavelength of this radiation in meters? In miles?
  
  
  
  
  
  
  
  
  
  
3. The most prominent line in the line spectrum of aluminum is found at 396.15 nm.
  - a) What is the frequency of this line?
  - b) What is the energy of one photon with this wavelength?
  - c) Of 1 mole of these photons?
  
  
  
  
  
  
  
  
  
  
4. When copper is bombarded with high-energy electrons, X-rays are emitted. Calculate the energy (in joules) associated with the photons if the wavelength of the X rays is 0.154 nm.

5. Calculate the wavelength of a photon emitted by a hydrogen atom when its electron drops from the  $n = 5$  state to the  $n = 3$  state.
  
  
  
  
  
  
  
  
  
  
6. Does a baseball in flight possess wave properties? If so, why can we not determine its wave properties?
  
  
  
  
  
  
  
  
  
  
7. What is the de Broglie wavelength associated with a 2.5 g Ping-Pong ball traveling at 35 mph?
  
  
  
  
  
  
  
  
  
  
8. Exposure to high doses of microwaves can cause damage. Estimate how many photons, with  $\lambda = 12$  cm, must be absorbed to raise the temperature of your eye by  $3.0$  °C. Assume the mass of an eye is 10. g and its specific heat is  $4.0$  J/g-°C.
  
  
  
  
  
  
  
  
  
  
9. Explain the process of emission of light by an atom.
  
  
  
  
  
  
  
  
  
  
10. When a compound containing cesium ions is heated in a Bunsen burner flame, photons with an energy of  $4.30 \times 10^{-19}$  J are emitted. What color is the cesium flame?