Homework KEY
Chapter 3 Radiation (+ some Ch. 4)

Review and Discussion

1. A wave is some sort of fluctuation or disturbance that is moving (propagating) through space. Waves carry energy because (e.g., energy is required to move the water back and forth as a water wave passes). However, waves do not carry material along with them.

2. Wave period is the time needed for a wave to repeat itself at some point in space.
Wavelength is the distance between any two consecutive parts of the wave, such as two wavecrests.
The amplitude is the maximum height (or depth) of the wave above (or below) the undisturbed state.
The wave frequency is the number of waves that pass a point per unit of time, usually waves per second.

3. The longer the wavelength the lower the frequency and the shorter the wavelength the higher the frequency. Wavelength a frequency are inversely related such that their product is a constant, the speed of the wave.

4. Diffraction is the tendancy of waves to bend around corners or to spread out when passing through openings. Diffraction would not occur with light if light were made up of a stream of particles.

5. The speed of light, c, is special because it is the same for all types of electromagnetic radiation. Also, the speed of a given light wave appears to be the same, c, to two different observers moving at constant velocities with respect to each other.

6. White light is usually a combination of all colors of a continuous spectrum: red, orange, yellow, green, blue, and violet. However, it is possible to combine just 3 or 4 colors (e.g., Red, Green, and Blue) and make light that appears white to the eye.
The colors are E-M waves of different wavelengths.

10. Light is called an electromagnetic wave because the quantity that varies as the wave passes is electric and magnetic fields.

11. Radio waves through gamma rays are all types of electromagnetic radiation. They differ in wavelength and frequency. They also can different greatly in how they interact with matter: some can harm living tissues, others do not; some can pass into Earth’s atmosphere, others cannot.

12. The atmosphere allows visible, radio (wavelengths between 1 cm and 10 m), and some infrared and UV radiation all the way down to the Earth. Most IR, UV, X-rays, and Gamma rays are blocked.

Ch. 4 Spectroscopy

3. What is a continuous spectrum? An absorption spectrum?
A continuous spectrum shows a smooth, gradual change of intensity with wavelength. An example is a blackbody spectrum.
An absorption spectrum is like a continuous spectrum but with occasional sharp dips in intensity corresponding to absorption by atoms at particular frequencies. (Most stars have absorption spectra.)

4. Why are gamma rays generally harmful to life-forms, but radio waves generally harmless?
   The energy per photon (E=hf) is dependent on frequency such that radio waves have a much lower E than gamma rays. The energy of the photon, in turn, determines whether it can ionize atoms or disassociate molecules in a way that can be harmful to organisms. Radio waves can’t break molecules!

6. In the particle description of light, what is color?
   Color corresponds to the energy of the photon. Blue light is made up of higher energy photons than red.