Problem Set #5

1. What does it mean when we say energy is quantized? Why don't we notice the quantization of energy in everyday life?

2. An AM radio station broadcasts at 1440 kHz, and its FM partner at 94.5 MHz. Calculate and compare the energy of photons emitted by these radio stations. Which would reach by the largest audience?

3. For each of the following electronic transitions in the hydrogen atom, calculate the energy, frequency, and wavelength of the associated radiation, and determine whether the radiation is emitted or absorbed during the transition: (a) from n=5 to n=1; (b) from n=6 to n=2; (c) from n=4 to n=5. Do any of these transitions emit or absorb visible light?

4. Give the values for n, l and m_l for (a) each orbital in the 2p subshell (b) each orbital in the 5d subshell.

5. Write the complete electron configuration for the following elements (a) C; (b) N; (c) P and (d) Ne

6. Write the abbreviated electron configuration for the following elements (a) Gd; (b) W (c) Cu and (d) Ru

7. Images of Ganymede, Jupiter's largest moon, were transmitted from Galileao, the unmanned spacecraft, when its distance from Earth was 522 million miles. How long did it take for the transmitted signals to travel from the spacecraft to Earth?

8. The rays of the Sun that cause tanning and burning are in the ultraviolet (UV) portion of the electromagnetic spectrum. These rays are categorized by wavelength: So-called UV-A radiation has wavelengths in the range of 320-380 nm, whereas UV-B radiation has wavelengths in the range of 290-320 nm. (a) Calculate the frequency of light that has a wavelength of 320 nm. (b) Calculate the energy of a mole of 320-nm photons. (c) Which are more energetic, photons of UV-A radiation or photons of UV-B radiation? (d) The UV-B radiation from the Sun is considered a greater cause of sunburn in humans than is UV-A radiation. Is this observation consistent with your answer to part (c)?

9. Microwave ovens emit microwave radiation that is absorbed by water. The absorbed radiation is converted to heat that is transferred to other components of the food. Suppose that the microwave radiation has a wavelength of 11.2 cm. How many photons are required to heat 200 mL of coffee from 23°C to 60°C?

10. Carotenoids, present in all organisms capable of photosynthesis, extend the range of light absorbed by the organism. They exhibit maximal capacity for absorption of light in the range of 440-470nm. Calculate the energy represented by absorption of an Avogadro's number of photons of wavelength 455 nm. If the electron responsible for the light starts out in the n=2 energy level where does it end up?