ELECTROMAGNETIC RADIATION AND ATOMIC SPECTRA

1. What is the frequency and energy per quantum of

   a) red light with a wavelength of 700 nm and

   b) blue light with a wavelength of 400 nm?

2. What is the wavelength of the spectral line that corresponds to an electron transition from n = 5 level to n = 2 level in the hydrogen atom.

3. The spectral lines of hydrogen in the visible region represent transition to the n = 2 level from higher levels. What is the electron transition that corresponds to the 486.1 nm spectral line?

4. The Lyman series of lines in the hydrogen spectrum result from electron transitions to the n = 1 level from higher levels.

   a) What wavelength corresponds to transition from n = 5 level to n = 1 level?

   b) In what region of the electromagnetic spectrum do the Lyman lines occur?

5. The work function of an element is the energy required to remove an electron from the surface of the solid. The work function for lithium is 279.7 kJ/mol. What is the maximum wavelength of light that can remove an electron from an atom in lithium? What is the region of the electromagnetic spectrum in which this radiation is found?

6, Ozone, O_3, absorbs ultraviolet radiation and dissociates.

$$O_3(g) \rightarrow O_2(g) + O(g)$$

A 1.00 L sample of air at 22^{o}C and 748 mmHg contains 0.25 ppm of O_3. How much energy, in joules, must be absorbed if all the O_3 in the sample of air are to dissociate? Assume one photon dissociates one O_3 molecule and wavelength is 254 nm.

7. How many photons of microwave radiation having a wavelength of 3.00 mm would have to be absorbed by 1 kg of water to heat it by $10^{o}C$?

8. Below is a partial energy diagram for a hypothetical atom:

E_4: _____ -1.0×10^{-19} J
E_3: _____ -5.0×10^{-19} J
E_2: _____ -10×10^{-19} J
E_1 : _____ -15×10^{-19} J

a) What is the value, in joules, of energy and wavelength, in nm, needed to excite an electron from E_1 to E_4?

b) If the atom is originally in state E_4, what must it do to reach state E_2? What is the frequency of this radiation?

9. Calculate the ionization energy for

a) H atom in its n = 5 state. b) Li^{2+} in its ground state.

10. Consider only the following principal quantum levels for the hydrogen atom.

_____ n = 4
_____ n = 3

_____ n = 2

_____ n = 1

a) How many emission lines are possible?

b) Photons of the highest energy will be involved in a transition from n = _____ to n = _____.

c) The emission line having the longest wavelength in the visible region corresponds to transition from n = _____ to n = _____.

11. The ionization energy of the H-like species $\mathbf{X^{n+}}$ in its ground state is 12.25 times larger than for the ground state of the He^{+} ion. Determine **X** and **n** for the species $\mathbf{X^{n+}}$.