South Pasadena • AP Chemistry

Name _____
Period ___ Date ___/___/___

7 • Atomic Structure

STUDY QUESTIONS

"Natural science does not simply describe and explain nature, it is a part of the interplay between nature and ourselves." Werner Heisenberg (1901 – 1976)

1. a. Calculate the wavelength of electromagnetic radiation that has a frequency of 5.56 MHz.
   b. Calculate the frequency of electromagnetic radiation that has a wavelength equal to 667 nm.

3. Electromagnetic radiation at the blue end of the visible spectrum has a wavelength of 400 nm.
   a. Calculate the frequency of the radiation.
   b. Calculate the energy of one photon of this radiation.
   c. Calculate the energy of one mole of photons of this radiation.

4. Examine the emission spectrum for hydrogen (Figure 7.9 page 304, Figure 710 page 305, or Figure 7.12 page 309).
   a. How many lines appear in the visible region (Balmer series)?
   b. Why so few?

   The Lyman series occurs in the UV region.
   c. How many lines would you expect in the Lyman series?
   d. How many other series would you expect beyond the blue end of the visible spectrum?
   e. How many different series would you expect beyond the red end of the visible spectrum?

5. Calculate the frequency of the line in the hydrogen spectrum corresponding to the electron transition from n=9 to n=8. Whereabouts in the electromagnetic spectrum does this line occur?

6. The ionization energy of an element is the energy required to remove the most loosely held electron from atoms of the element in the gaseous state (*cf.* page 357). It is usually expressed in units of kJ/mol. Given that
   R, the Rydberg constant, is $1.097 \times 10^{7}\ m^{-1}$
   h, Planck's constant, is $6.626 \times 10^{-34}\ J\ s$
   c, the speed of light, is $2.998 \times 10^{8}\ m\ s^{-1}$
   calculate from these data the ionization energy of hydrogen in kJ/mol. Compare the results of your calculation with the value in your text (Appendix F).

7. Describe the electron density pattern for a
   a. 2s orbital
   b. $3p_x$ orbital
   c. $3d_{xy}$ orbital

8. Which statements are incorrect? Explain why.
   a. If $\mathbf{m_l} = 1$, the orbital must be a p orbital.
   b. If $\mathbf{n} = 2$, only two orbitals are allowed, one s and one p.
   c. If $\mathbf{l} = 3$, there are 3 possible values for the quantum number $\mathbf{m_l}$.
   d. If $\mathbf{m_l} = 0$, the value of $\mathbf{l}$ must equal 0.