Chemistry

Electrons In Atoms

Name_____

Date_____

Worksheet *Atomic Spectra*

1. What type of electromagnetic radiation is involved in the Paschen series?

2. What type of electromagnetic radiation is involved in the Lyman series?

3. What electron energy level transitions are involved in the following?

   a. "b" line in the Lyman series

   b. "d" line in the Balmer series

   c. "a" line in the Paschen series

   d. the blue line in the atomic spectrum

   e. the line with a wavelength of 10,800 Angstroms

4. What are the approximate wavelengths of the following spectral lines?

   a. "c" line of the Lyman series

   b. "a" line of the Balmer series

   c. "b" line of the Paschen series

   d. the electron transition from the fourth to the third energy level

   e. the electron transition from the sixth to the second energy level

   f. the violet line in the atomic spectrum

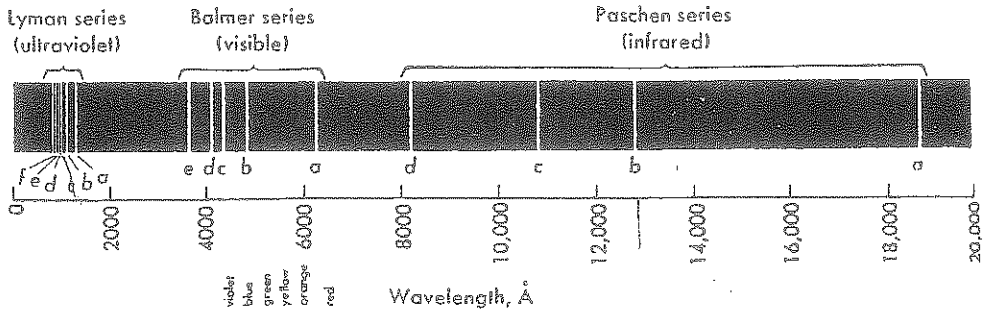

Figure 4-5. Representative lines in the hydrogen spectrum. The small letter below each line indicates which of the energy-level transitions in Figure 4-6 produces it.

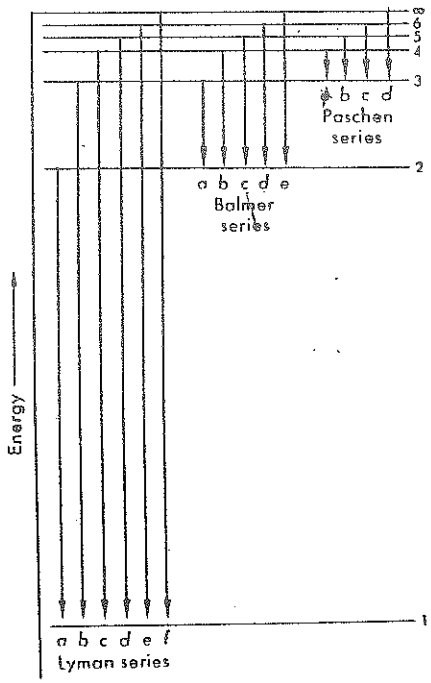

Figure 4-6. An electron energy-level diagram for hydrogen showing some of the transitions that are possible in this atom. Transitions that leave an electron in a particular final energy level belong to a particular spectral series. Some of these series are named for the people who discovered them.

speeds. Bohr's theory states that electrons do not give off energy when they remain in given energy levels. They only give off energy when they change to lower energy levels. This helps explain why electrons in atoms do not lose energy, fall into the nucleus, and cause the atom to collapse.

This model works well in explaining the spectra of the one-electron hydrogen atom. But it does not satisfactorily explain the spectra of more complex atoms.

4.4 Wave-mechanics concept of an atom

During the past half century, the work of theoretical physicists, including Heisenberg, de Broglie, and Schrödinger, helped develop a theory of atomic structure based on wave mechanics. The basic ideas of wave mechanics are beyond the scope of a high school chemistry course. It will be useful, however, to consider some of its conclusions.

The motion of an electron about an atom is not in a definite path like that of the earth about the sun. In fact, it is impossible to determine an electron's path without changing that path! So an electron's location can be given only in terms of probabilities. This location is described by a *space orbital*. A space orbital may be thought of as a highly probable location in which an electron may be found. The motion of the single hydrogen electron creates a spherical *electron cloud* surrounding the nucleus. The electron cloud gives size and shape to an atom. It also prevents two free atoms (or portions of free atoms) from occupying the same space.

4.5 Quantum numbers

The mathematics of wave mechanics shows that the energy state of an electron in an atom may be described by a set of four numbers. These are called *quantum numbers*. Quantum numbers describe the space orbital the electron occupies in terms of: (1) distance from the nucleus; (2) shape; (3) position with respect to the three axes in space; and (4) the direction of spin of the electron in the orbital. As you read on, refer to the corresponding columns in Table 4-1.