Name: ____________________.
Date: ______________________.
Period: ____________.

CHEMISTRY

CHAPTER 11 PRACTICE PROBLEMS

Problem 1. Study the emission spectrum of sodium vapor in Figure 12.6, and provide a rough estimate of the seven wavelengths (in nm) emitted in the spaces provided below. Each line in Figure 12.6 represents a different wavelength of light being emitted.

a. __________ b. ___________ c. __________ d. __________ e. __________ f. ___________
g. __________

If you were to actually observe the emission spectrum of sodium vapor through a spectroscope, you would probably see only one or two bright lines instead of seven. The reason for this is that the yellow lines located near 570 nm are so bright, that they "wash out" the other lines. They are so bright, in fact, that sodium vapor lamps are commonly used as street lights in areas where strong illumination is needed such as high-crime neighborhoods.

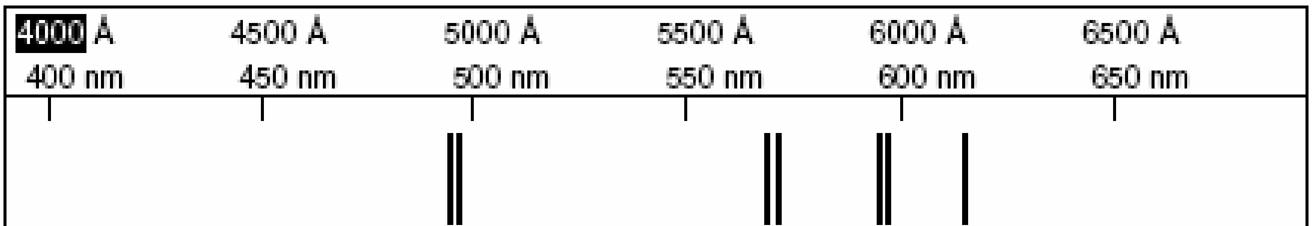

Figure 12.6 Emission Spectrum of Sodium

Each energy level can hold a maximum number of electrons. The number of electrons in any given energy level is limited to $2n^2$. This expression means $2(n^2)$, not $(2n)^2$! For example, the energy level 3 can be occupied by $2(3)^2$, or 18, electrons at the most.

Problem 2. Calculate the maximum number of electrons that could occupy the first four energy levels in Energy Level Maximum No. Electrons ($2n^2$)

1 __________
2 __________
3 __________
4 __________

Energy levels are sometimes called "shells" in which case each one is designated by a letter, K through Q (see Figure 12.13). You may see this notation in your future studies in chemistry, so it is important that you know something about it.

Each main energy level consists of one or more sublevels. The number of sublevels is equal to the number of the energy level. Therefore, the third energy level has three sublevels, and the fifth energy level has five sublevels. Which energy level has four sublevels? {32}_________. Which energy level has two sublevels? {33}__________. The energy level diagram can now be redrawn. The main energy levels and the sublevels within each energy level are labeled in Figure 12.11. Each sublevel is designated by a small letter (s,p,d,f).

By overlapping we mean that a higher energy level begins before a lower one ends. Notice on figure 12.11 how the 4th energy level begins before the third is full. Notice the overlapping of the main energy levels that occurs as you go beyond the third energy level. This means that a higher energy level begins before a lower one ends. Clearly, atoms are more complicated than a staircase. Certainly, the third step on a staircase cannot begin before the second step ends! However, you must keep in mind that energy levels are not "physical things," whereas staircases are real physical things. Energy levels are conceptual things – regions of space. The complexity of overlapping energy levels becomes more noticeable as you progress from the third energy level to the seventh.

The first sublevel of each energy is designated as an "s" sublevel. This is followed by a "p" sublevel, the a "d", then an "f", depending upon how many electrons there are

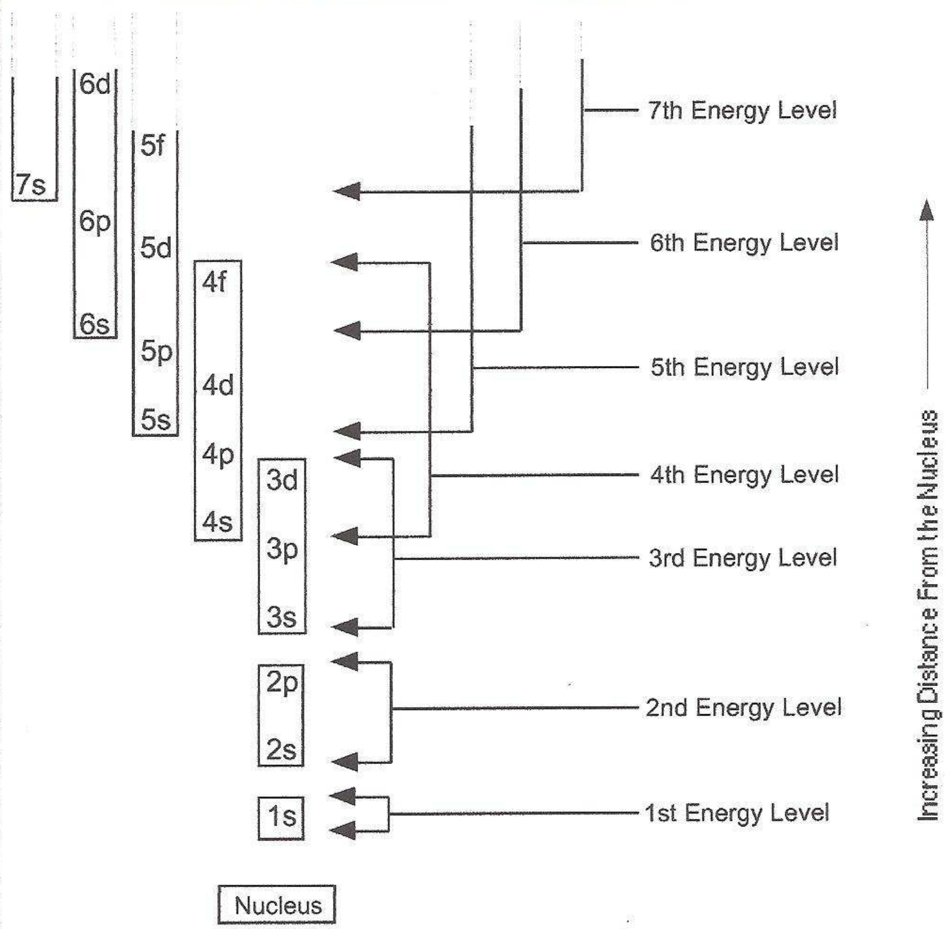

Figure 12.11 Overlapping of Energy Levels

We will learn more about orbitals later in this chapter, and we will change the definition somewhat at that time. Looking at Figure 12.13, notice that every s sublevel has only one orbital. Look at the p sublevels in figure 12.13. How many orbitals does the p sublevel have?{34}__________. How many orbitals does the d sublevel have?{35}__________. How many orbitals does the f sublevel have?{36}__________ Since each orbital can hold a maximum of two electrons, what is the capacity of an "s" sublevel?{37}__________ Of a "p" sublevel?{38}__________ Of a "d" sublevel?{39}__________ Of an "f" sublevel?{40}__________. To help you remember the order in which the energy levels and sublevels fill, you should become familiar with the diagonal rule. It is shown in Figure 12.12. By simply following the arrows along the diagonals, you have the correct order of filling. Use this diagonal rule to see if the levels and sublevels are properly arranged in Figure 12.13. The order of filling is:

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d

In theory there are other orbitals such as 5g, 6f, etc., but they are never used since there are no atoms that have enough electrons to fill them.

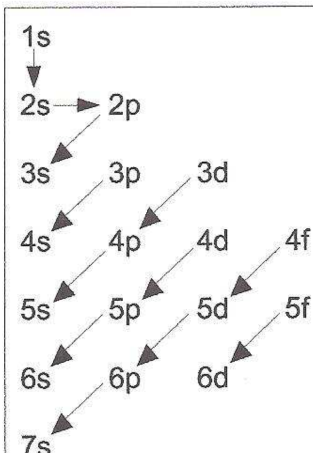

Figure 12.12
The Diagonal Rule