Solutions to the Extra Problems for Chapter 4

1. The s orbitals are spherical, so only (a) and (c) are s orbitals. The others are p orbitals. The larger the energy level, the larger the orbital. This means (a) is a 1s orbital and (c) is the 2s orbital.

2. a. To get to beryllium, we have to walk through both elements in the 1s block and both elements in the 2s block, so the electron configuration is $1s^2 2s^2$.

b. To get to carbon, we have to walk through both elements in the 1s block, both elements in the 2s block, and two elements in the 2p block. Thus, it is $1s^2 2s^2 2p^2$.

c. To get to argon, we have to walk through both elements in the 1s block, both elements in the 2s block, all elements in the 2p block, both elements in the 3s block, and all elements in the 3p block. Thus, it is $1s^2 2s^2 2p^6 3s^2 3p^6$.

d. To get to selenium, we have to walk through both elements in the 1s block, both elements in the 2s block, all elements in the 2p block, both elements in the 3s block, all elements in the 3p block, both elements in the 4s block, all elements in the 3d block (remember, subtract one from the row number when doing the d orbitals), and four boxes in the 4p block. Thus, it is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$.

3. To do the abbreviated version, we look for the noble gas (Group 8A) element right before it. For In, that would be Kr. After Kr, we have to go through both 5s elements, all 4d elements (remember, subtract one from the row number when doing the d orbitals), and one 5p element. That means the abbreviated configuration is $[Kr]5s^2 4d^{10} 5p^1$.

4. a. An s orbital can hold two electrons, and it must be full before you go on to fill other types of orbitals. Thus, the $3s^1$ is not correct.

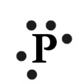
b. The $4d^{10}$ is wrong. When you hit the d orbital block, you subtract 1 from the row number. Thus, 3d comes after 4s.

c. The configuration is missing the 4d orbitals. They come after 5s.

5. If you look at the end of the configuration, it is $3d^4$, so this element is in the 3d group, and it is the fourth box in that group. That makes it Cr. You can check this by adding up the total electrons. There are 2 + 2 + 6 + 2 + 6 + 2 + 4 = 24 electrons, and since atoms have the same number of electrons and protons, that means it's element 24, which is Cr.

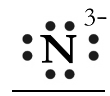
6. Elements are grouped in the Periodic Table so that the ones with similar electron configurations (and therefore similar chemistry) fall in the same column. The only two elements in this list that fall in the same column are S and Se.

7. Phosphorus is in Group 5A, so it has five dots in its Lewis structure. There needs to be one pair, since there are five total. Thus, it is:



The pair doesn't have to be exactly where it is drawn here. The key is that you have one pair and three single electrons.

8. Since it needs three electrons to get the ideal electron configuration (8 dots in its Lewis structure), it will gain three electrons. That makes it have a charge of 3-. Its name is the nitride ion, and its Lewis structure is:



9. Calcium is in Group 2A, so it has two dots in its Lewis structure. It is a metal, so it loses electrons. Thus, to get the ideal electron configuration, it should have no dots in its Lewis structure. That means it must lose two electrons, so it will become 2+. The name is the calcium ion, and the Lewis structure is:

$$\mathbf{Ca}^{2+}$$

10. a. Ca is in Group 2A, which means it needs to lose its two electrons to get the ideal configuration. That makes it 2+ in ionic compounds. Chlorine is in Group 7A, so it needs one more electron to get the ideal electron configuration (eight valence electrons). That means it is 1-. Switching the numbers and making them subscripts gives us $CaCl_2$.

b. Li is in Group 1A, which means it becomes 1+ in ionic compounds. Sulfur is in Group 6A, which makes it 2- in ionic compounds. Switching the numbers and making them subscripts gives us Li_2S.

c. Al is in Group 3A, which means it is 3+ in ionic compounds. Se is in Group 6A, which means it is 2-. Switching the numbers and making them subscripts gives us Al_2Se_3.

d. Sr is in Group 2A, which means it is 2+ in ionic compounds. Se is in Group 6A, which means it is 2-. The charges are the same, so we ignore them: SrSe.

11. Lithium is in Group 1A, which means it is 1+ in ionic compounds. Phosphorus is in Group 5A, which means it is 3-. Switching the numbers and making them subscripts gives us Li_3P.

12. It is an ionic compound. Ionic compounds need to have a metal and a nonmetal. Potassium is a metal, and nitrogen is a nonmetal.

13. The Roman numeral tells you that Cr has a 3+ charge in this compound. Oxygen is in Group 6A, which makes it 2- in ionic compounds. Switching the numbers and making them subscripts gives us Cr_2O_3.

14. We are told that Fe can take on different charges, so we need to use the Roman numeral notation. The other element is Cl, and it has a "4" subscript. Remember, to get the formula, we switch the numbers on the charges, so that "4" tells us Fe's charge is 4+. That makes it iron (IV) chloride.

15. Ionic compounds tend to conduct electricity when dissolved in water. Only compound (b) is ionic, because it is the only one that contains at least one metal and one nonmetal.