SOLUTIONS TO THE PRACTICE PROBLEMS FOR MODULE #9

1. Ionic compounds are named by simply listing the ions present. In order to get the formula, you must determine the charge of each ion and balance those charges. We learned how to do this in the last module, so the only new thing here is the fact that there are now polyatomic ions to consider.

a. The name indicates a potassium ion and a sulfate ion. Potassium is abbreviated with a K, and, since it is in group 1A, it has a charge of 1+. We are supposed to have memorized that the sulfate ion is SO_4 and has a charge of 2-. Ignoring the signs and switching the numbers gives us:

$$\underline{K_2SO_4}$$

We do not put parentheses around the polyatomic ion because there is only one sulfate ion in the molecule.

b. The name indicates a calcium ion and a nitrate ion. Calcium is abbreviated with a Ca, and, since it is in group 2A, it has a charge of 2+. We are supposed to have memorized that the nitrate ion is NO_3 and has a charge of 1-. Ignoring the signs and switching the numbers gives us:

$$\underline{Ca(NO_3)_2}$$

c. The name indicates a magnesium ion and a carbonate ion. Magnesium is abbreviated with a Mg, and, since it is in group 2A, it has a charge of 2+. We are supposed to have memorized that the carbonate ion is CO_3 and has a charge of 2-. Since the numerical values of the charges are the same, we ignore them. This gives us:

$$\underline{MgCO_3}$$

We do not put parentheses around the polyatomic ion because there is only one carbonate ion in the molecule.

d. The name indicates an aluminum ion and a chromate ion. Aluminum is abbreviated with an Al, and, since it is in group 3A, it has a charge of 3+. We are supposed to have memorized that the chromate ion is CrO_4 and has a charge of 2-. Ignoring the signs and switching the numbers gives us:

$$\underline{Al_2(CrO_4)_3}$$

2. In order to name ionic compounds, we only have to put the names of the ions together.

a. Since we see that NH_4 is in parentheses, that means it is a polyatomic ion. We are supposed to have memorized that NH_4^+ is the ammonium ion, and the only other ion is the single-atom oxide ion. Thus, the name is <u>ammonium oxide</u>.

b. In looking at this molecule, we should notice the NO_2. It tells us the nitrite polyatomic ion is present. The only thing left after that is the potassium ion. Thus, the name is <u>potassium nitrite</u>.

c. Since we see that PO_4 is in parentheses, that means it is a polyatomic ion. We are supposed to have memorized that PO_4^{3-} is the phosphate ion, and the only other ion is the single-atom calcium ion. Thus, the name is calcium phosphate.

d. In looking at this molecule, we should notice the PO_4. It tells us that the phosphate polyatomic ion is present. The only thing left after that is the aluminum ion. Thus, the name is aluminum phosphate.

3. First, we have to determine the formulas of the molecules involved:

Calcium nitrate includes Ca^{2+} and NO_3^-. Thus, its formula is $Ca(NO_3)_2$.
Sodium carbonate includes Na^+ and CO_3^{2-}. Thus, its formula is Na_2CO_3.
Calcium carbonate includes Ca^{2+} and CO_3^{2-}. Thus, it formula is $CaCO_3$.
Sodium nitrate includes $Na^+$and NO_3^-. Thus, its formula is $NaNO_3$.

The problem tells us the phases, so the unbalanced equation is:

$$Ca(NO_3)_2\,(aq) + Na_2CO_3\,(aq) \rightarrow CaCO_3\,(s) + NaNO_3\,(aq)$$

Remembering that you must distribute any superscripts after parentheses to all atoms in the parentheses, the atomic inventory is:

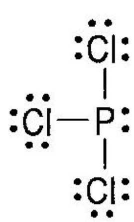
Reactants Side	Products Side
Ca: 1x1 = 1	Ca: 1x1 = 1
N: 1x1x2 = 2	N: 1x1 = 1
Na: 1x2 = 2	Na: 1x1 = 1
C: 1x1 = 1	C: 1x1 = 1
O: 1x3x2 + 1x3 = 9	O: 1x3 + 1x3 = 6

To balance, we need to multiply the $NaNO_3$ by two:

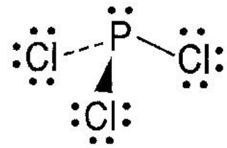
$$Ca(NO_3)_2\,(aq) + Na_2CO_3\,(aq) \rightarrow CaCO_3\,(s) + 2NaNO_3\,(aq)$$

If you count it all up now, the equation balances.

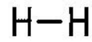
4. To determine shapes, we must first draw the Lewis structure:



We see that the central atom has four groups of electrons around it. Three of them are bonds, and one is a non-bonding pair. Since there are four groups, the basic shape is that of a tetrahedron. However, one of the legs is missing because it contains a non-bonding pair of electrons. As a result, the molecule's shape is pyramidal with a bond angle of 107°:

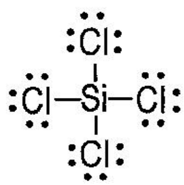


5. To determine shapes, we must first draw the Lewis structure:

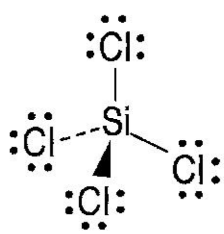


Since there are only two atoms here, the molecule is linear with a bond angle of 180°. The picture looks just like the Lewis structure.

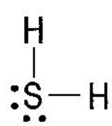
6. To determine shapes, we must first draw the Lewis structure:



We see that the central atom has four groups of electrons around it. Since there are four groups, the basic shape is that of a tetrahedron. None of the legs are missing because the molecule contains no non-bonding pairs of electrons. As a result, the molecule's shape is tetrahedral with a bond angle of 109°:



7. To determine shapes, we must first draw the Lewis structure:



We see that the central atom has four groups of electrons around it. Since there are four groups, the basic shape is that of a tetrahedron. Two of the legs are missing, however, because two of the groups are non-bonding pairs of electrons. As a result, the molecule's shape is bent with a bond angle of 105°: