CHM 4, PAL – Compounds Student name:

This worksheet focuses on compounds (textbook sections 5.1-5.5 and 4.7). It will be useful to have a periodic table and a copy of the "*Important elements/ions to know for CHM 4, 1A, and 1B*" handout available when completing this worksheet.

PART A: Compounds and constant composition

1. Copper(I) chloride is a compound that contains just copper and chlorine. One sample of the compound produces 35.31 g of copper and 19.69 g of chlorine. A second sample weighs 145 g. How many grams of copper are in this second sample?

2. Methane is a compound that contains just hydrogen and carbon. A sample of methane gas is found to be 74.9% carbon by mass. If a second sample of methane contains 34.0 g of carbon, how many grams of hydrogen must it contain?

3. Glucose is a compound that contains only carbon, hydrogen and oxygen. A 14.5 g sample of glucose is found to contain 5.80 g of carbon and 0.972 g of hydrogen. How many grams of oxygen must there be in a second sample of glucose that weighs 21.7 g?

The remainder of this worksheet focuses on various aspects of ionic compounds. Feel free to refer to our "*Important elements/ions to know for CHM 4, 1A, and 1B*" handout.

PART B: The nature of ionic compounds

4. Ionic compounds are made out of charged ion. Many elements form predictable ion charges based on their position on the periodic table. Use a periodic table to complete the Table 1 below.

Table 1

Element symbol	Commonly formed ion	Number of protons in ion	Number of electrons in ion
Na			
O			
Mg			
Cl			
Al			

5. Even though ionic compounds are made out of charged ions (i.e. cations and anions), the ions are combined in a ratio that results in compounds that have no net charge and are neutral overall. Fill in the missing blanks in Table 2 below (the first line has been done for you with Li_2CO_3).

Table 2

Cation	Anion	Ratio	Formula
Li^+	CO_3^{2-}	2:1	Li_2CO_3
Fe^{3+}	Cl^-		
Sn^{2+}	AsO_4^{3-}		
		1:2	$Pb(SO_3)_2$
		3:2	$Cu_3(PO_4)_2$

6. Once we have the correct formula for an ionic compound, we can determine how many of each type of atom is in a single unit of that compound. For example, one unit of Li_2CO_3 contains 2 lithium atoms, 1 carbon atom, and 3 oxygen atoms for a total of 6 atoms. How many of each atom and how many total atoms are there in a single unit of $Cu_3(PO_4)_2$?

Table 3 at the bottom of this page contains a list of some common household products that contain ionic compounds. Use Table 3 to answer questions 7-9.

7. Ionic compounds typically contain at least one metal and at least one non-metal.
   a. What compound from Table 3 does not fit this pattern?

   b. What ion seems to be able to take the place of a metal ion in this case?

8. Some ionic compounds contain a polyatomic ion. A polyatomic ion is composed of two or more different elements that are thought of as a single unit having an overall charge. For example, looking back at Table 2 on the previous page we see that CO_3^{2-} and AsO_4^{3-} are polyatomic ions while Li^+ and Cl^- are examples of monatomic ions. For all the compounds in Table 3 that contain a polyatomic ion, write the formula for the polyatomic ion in the empty third column of the table.

9. Hopefully you have started learning the names and formulas for all of the ions on our "*Important elements/ions to know for CHM 4, 1A, and 1B*" handout. For all the polyatomic ions you identified in question 8, provide the corresponding ion name in the empty fourth column of Table 3. Only use your "*Important elements/ions to know for CHM 4, 1A, and 1B*" handout if no one on your PAL team can name the ion.

Table 3

Product	**Formula of ingredient**	**Formulas of any polyatomic ions**	**Names of any polyatomic ions**
shampoo	$MgSO_4$		
hair coloring	Li_2CO_3		
body wash	NH_4Cl		
sunscreen	ZnO		
baking soda	$NaHCO_3$		
hand soap	FeO		
toothpaste	$SnCl_2$		
conditioner	$Pb(C_2H_3O_2)_2$		

We'll see next week that we use different rules for naming ionic and molecular compounds. To make sure we use the right set of rules, it is crucial that we can quickly identify whether or not a compound is ionic.

10. Circle all of the ionic compounds in the following table:

$Sn(CO_3)_2$	CH_3NH_2	$Mg(NO_3)_2$
NH_4OH	P_4O_6	$CuC_2H_3O_2$
CH_3OH	$HClO_3$	NH_3
CCl_4	$(NH_4)_2SO_4$	NaBr

When an ionic compound containing a polyatomic ion dissolves in water, the polyatomic ion typically stays together as a charged unit. For example, Figure 1 below, shows that when $Ba(NO_3)_2$ dissolves in water, each unit breaks up into a Ba^{2+} ion and two NO_3^- ions (a polyatomic ion). By generating ions when dissolved in water, the resulting solution conducts electricity.

11. Following the example from Figure 1, complete Figure 2 to show what happens when Li_2CO_3 dissolves in water. Compare your drawing with the others in your PAL group.
    a. What aspects of your drawings must all be the same from person to person?

    b. What aspects of your drawings can differ from person to person?

Figure 1: $Ba(NO_3)_2$ separates into ions when dissolved in water.

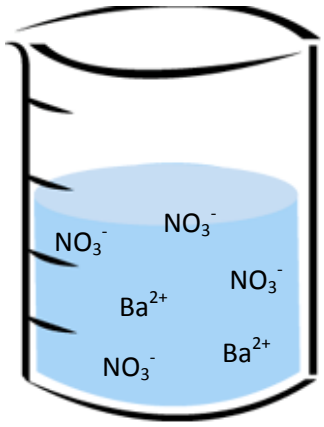

Figure 2: Draw what happens when Li_2CO_3 dissolves in water