

Percent Composition Notes

Answer Key

Percent composition is the percent of each element that makes up a compound based on the mass.

$$\% \text{element} = \frac{\text{mass of element}}{\text{mass of compound}} \times 100$$

Example 1. Determine the percent composition of carbon dioxide.

Using the periodic table, find the mass of each element then multiply by the number of atoms of each element in the compound.

Find the mass of carbon: 1 carbon x 12.01g = 12.01 g C

Find the mass of oxygen: 2 oxygen x 16.00g = 32.00g O

Find the mass of carbon dioxide: 32.00g + 12.01g = 44.01g

%C = mass C / mass CO₂ x 100 = 12.01g / 44.01g x 100 = 27.29% C

%O = mass O / mass CO₂ x 100 = ^{32g} 32.00 / 44.01 x 100 = 72.71% O

Example 2. Determine the percent of nitrogen in dinitrogen pentoxide.

Find the mass of nitrogen: 2 nitrogen x 14.01g = 28.02g N

Find the mass of oxygen: 5 oxygen x 16.00g = 80.00g O

Find the mass of N₂O₅: 28.02g + 80.00g = 108.02 g

%N = mass of nitrogen / mass of N₂O₅ x 100 = 28.02g / 108.02g x 100 = 25.94% N

Practice Problems:

1. Determine the percent of phosphorus if a compound is made up of 10.0g of phosphorus and 25.0g of oxygen.

$$\frac{10.0g \text{ P}}{35.0g \text{ P+O}} \times 100 = 28.6\% \text{ P}$$

2. Determine the percent composition of nitrogen in aluminum nitrate. Al(NO₃)₃

$$\text{N} = 42.03 \quad \frac{42.03g}{213.01} \times 100 = 19.73\% \text{ N}$$

3. Determine the percent of potassium in potassium phosphate. K₃PO₄

$$\text{K} = 117.03 \quad \frac{117.03}{212.27} \times 100 = 55.20\% \text{ K}$$

4. Determine the percent of iron in iron (III) sulfate. Fe₂(SO₄)₃

$$\text{Fe} = 55.85 \times 2 = 111.7g \quad \frac{111.7}{399.91} \times 100 = 27.93\%$$

5. What percent of tetraphosphorus decoxide is oxygen? P₄O₁₀

$$\text{O} = 16 \times 10 = 160g \quad \frac{160}{283.88} \times 100 = 56.36\% \text{ O}$$

1. 28.6% P 2. 19.73% N 3. 55.20% K 4. 27.93% Fe 5. 56.36% O

Honors Chemistry: Moles Classwork

CW: Percent Composition

Calculate the percentage compositions for each of the following compounds.

1. potassium chlorate $KClO_3 = 122.55 \text{ g}$

$$\begin{array}{ccc}
 \text{K} & \text{Cl} & \text{O} \\
 \frac{39.10}{122.55} \times 100 = 31.91\% & \frac{35.45}{122.55} \times 100 = 28.93\% & \frac{48}{122.55} \times 100 = 39.17\%
 \end{array}$$

2. $CoSO_4 = 155 \text{ g}$

$$\begin{array}{ccc}
 \text{Co} & \text{S} & \text{O} \\
 \frac{58.93}{155} \times 100 = 38.02\% & \frac{32.07}{155} \times 100 = 20.69\% & \frac{64}{155} \times 100 = 41.29\%
 \end{array}$$

3. A compound that contains 2.16g Al, 3.85g S, and 7.68g O.

$$\begin{array}{ccc}
 \text{Al} & \text{S} & \text{O} \\
 \frac{2.16}{13.69} \times 100 = 15.78\% & \frac{3.85}{13.69} \times 100 = 28.12\% & \frac{7.68}{13.69} \times 100 = 56.10\%
 \end{array}$$

$\rightarrow 13.69 \text{ g}$

Calculate the percentage compositions for the bolded element in each of the following compounds.

1. potassium chlorate

$$\begin{array}{l}
 KClO_3 \\
 = 122.55 \text{ g} \\
 \frac{39.10}{122.55} \times 100 = 31.91\%
 \end{array}$$

5. $CoSO_4$

$$\frac{64}{155} \times 100 = 41.29\%$$

2. $C_2H_5OH = 46.068 \text{ g}$

$$\frac{24.02}{46.068} \times 100 = 52.14\%$$

6. lithium carbide.

$$\begin{array}{l}
 Li_2C \\
 = 39.774 \\
 \frac{27.764}{39.774} \times 100 = 69.80\%
 \end{array}$$

3. tetraphosphorus decoxide

$$\begin{array}{l}
 P_4O_{10} = 283.88 \\
 \frac{123.88}{283.88} \times 100 = 43.64\%
 \end{array}$$

7. $H_2O_2 = 34.016$

$$\frac{32.00}{34.016} \times 100 = 94.07\%$$

4. $Fe_3O_4 = 231.55$

$$\frac{167.55}{231.55} \times 100 = 72.36\%$$

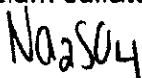
8. barium chloride $BaCl_2 = 208.28$

$$\frac{137.33}{208.28} \times 100 = 65.96\%$$

CW: One and Two Step Mole Problems
One Step Mole Problems

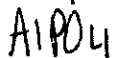
1. Calculate the molar mass for each of the following compounds.

a. sodium sulfate



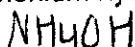
142.05 g/mol

b. aluminum phosphate



121.95 g/mol

c. ammonium hydroxide



35.05 g/mol

2. What is the mass of 1.75 moles of zinc atoms?

$\frac{1.75 \text{ mol Zn}}{1 \text{ mol Zn}} \times 65.39 \text{ g Zn} = 114 \text{ g Zn}$

3. How many moles are there in 42.0g of aluminum?

$\frac{42.0 \text{ g Al}}{26.98 \text{ g Al}} \times 1 \text{ mol Al} = 1.56 \text{ mol Al}$

4. How many atoms are there in 1.50 moles carbon?

$\frac{1.50 \text{ mol C}}{1 \text{ mol C}} \times 6.022 \times 10^{23} \text{ atoms C} = 9.03 \times 10^{23} \text{ atoms C}$

5. How many moles are there in 7.50×10^{23} atoms of iron?

$\frac{7.50 \times 10^{23} \text{ atoms Fe}}{6.022 \times 10^{23} \text{ atoms Fe}} \times 1 \text{ mol Fe} = 1.25 \text{ mol Fe}$

6. How many molecules are in 0.254 moles of carbon dioxide?

$\frac{0.254 \text{ mol CO}_2}{1 \text{ mol CO}_2} \times 6.022 \times 10^{23} \text{ molecules CO}_2 = 1.53 \times 10^{23} \text{ molecules CO}_2$

7. How many moles are in 42.24 g of nickel(II) sulfite? NiSO_3

$\frac{42.24 \text{ g NiSO}_3}{138.76 \text{ g NiSO}_3} \times 1 \text{ mol NiSO}_3 = 0.3044 \text{ mol NiSO}_3$

8. How many grams are in 0.049 moles of silver nitrate? AgNO_3

$$\frac{0.049 \text{ mol AgNO}_3}{1 \text{ mol AgNO}_3} \times 164.88 \text{ g AgNO}_3 = 8.3 \text{ g AgNO}_3$$

9. How many liters are in 12.42 moles of chlorine gas?

$$\frac{12.42 \text{ mol Cl}_2}{1 \text{ mol Cl}_2} \times 22.4 \text{ L Cl}_2 = 278.2 \text{ L Cl}_2$$

10. How many grams are in 0.0425 moles of potassium chloride? KCl

$$\frac{0.0425 \text{ mol KCl}}{1 \text{ mol KCl}} \times 74.55 \text{ g KCl} = 3.17 \text{ g KCl}$$

11. How many grams are in 6.21 mole of carbon tetrachloride? CCl_4

$$\frac{6.21 \text{ mol CCl}_4}{1 \text{ mol CCl}_4} \times 153.81 \text{ g CCl}_4 = 955 \text{ g CCl}_4$$

12. How many moles are in 4.16 L of dinitrogen pentoxide?

$$\frac{4.16 \text{ L N}_2\text{O}_5}{22.4 \text{ L N}_2\text{O}_5} \times 1 \text{ mol N}_2\text{O}_5 = 0.186 \text{ mol N}_2\text{O}_5$$

Moles 2 Step Problems Perform the following conversions.

13. 6g of S to atoms

$$\frac{6 \text{ g S}}{32.07 \text{ g S}} \times 1 \text{ mol S} \times 6.022 \times 10^{23} \text{ atoms S} = 1 \times 10^{23} \text{ atoms S}$$

14. 6.02×10^{14} atoms of Zn to grams

$$\frac{6.02 \times 10^{14} \text{ atoms Zn}}{6.022 \times 10^{23} \text{ atoms Zn}} \times 1 \text{ mol Zn} \times 65.39 \text{ g Zn} = 6.54 \times 10^{-8} \text{ g Zn}$$

Cu_2SO_4 15. 5.5×10^{25} molecules copper (I) sulfate to grams

$$\frac{5.5 \times 10^{25} \text{ molecules Cu}_2\text{SO}_4}{6.022 \times 10^{23} \text{ molecules Cu}_2\text{SO}_4} \times 1 \text{ mol Cu}_2\text{SO}_4 \times 223.17 \text{ g Cu}_2\text{SO}_4 = 2.1 \times 10^4 \text{ g Cu}_2\text{SO}_4$$

CaCO_3 16. 5.5×10^4 grams calcium carbonate to molecules

$$\frac{5.5 \times 10^4 \text{ g CaCO}_3}{100.9 \text{ g CaCO}_3} \times 1 \text{ mol CaCO}_3 \times 6.022 \times 10^{23} \text{ molecules CaCO}_3 = 3.3 \times 10^{26} \text{ molecules CaCO}_3$$

Ca(OH)_2 17. 244.2 g calcium hydroxide to liters

$$\frac{244.2 \text{ g Ca(OH)}_2}{74.096 \text{ g Ca(OH)}_2} \times 1 \text{ mol Ca(OH)}_2 \times 22.4 \text{ L Ca(OH)}_2 = 73.82 \text{ L Ca(OH)}_2$$

18. 6.89 liters of bromine gas to grams

$$\frac{6.89 \text{ L Br}_2}{22.4 \text{ L Br}_2} \times 1 \text{ mol Br}_2 \times 159.8 \text{ g Br}_2 = 49.2 \text{ g Br}_2$$

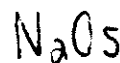
CW: Empirical & Molecular Formulas

Empirical formulas

1. If 4.02g of N reacts with 11.48g of O, what is the empirical formula of this compound?

$$\frac{4.02 \text{ g N}}{14.01 \text{ g N}} \times \frac{1 \text{ mol N}}{1} = 0.2869 / 0.2869 = 1 \times 2 = 2$$

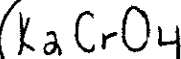
$$\frac{11.48 \text{ g O}}{16.00 \text{ g O}} \times \frac{1 \text{ mol O}}{1} = 0.7175 / 0.2869 = 2.5 \times 2 = 5$$



2. Calculate the empirical formulas of the compounds with the following percentage compositions:

a) 40.2% K, 26.9% Cr, 32.9% O

$$\frac{40.2 \text{ g K}}{39.10 \text{ g K}} \times \frac{1 \text{ mol}}{1} = 1.028 / 0.5174 = 2$$

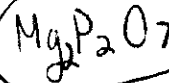


$$\frac{26.4 \text{ g Cr}}{51.99 \text{ g Cr}} \times \frac{1 \text{ mol}}{1} = 0.5174 / 0.5174 = 1$$

$$\frac{32.9 \text{ g O}}{16 \text{ g O}} \times \frac{1 \text{ mol}}{1} = 2.056 / 0.5174 = 4$$

b) 21.8% Mg, 27.9% P, 50.3% O

$$\frac{21.8 \text{ g Mg}}{24.31 \text{ g Mg}} \times \frac{1 \text{ mol}}{1} = 0.8968 / 0.8968 = 1 \times 2 = 2$$



$$\frac{27.9 \text{ g P}}{30.97 \text{ g P}} \times \frac{1 \text{ mol}}{1} = 0.9009 / 0.8968 = 1 \times 2 = 2$$

$$\frac{50.3 \text{ g O}}{16 \text{ g O}} \times \frac{1 \text{ mol}}{1} = 3.144 / 0.8968 = 3.5 \times 2 = 7$$

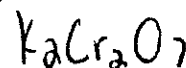
3. Determine the empirical formula for the following two compounds.

a) 0.89g K, 1.18g Cr, 1.27g O

$$\frac{0.89 \text{ g K}}{39.10 \text{ g K}} \times \frac{1 \text{ mol K}}{1} = 0.02276 / 0.02276 = 1 \times 2$$

$$\frac{1.18 \text{ g Cr}}{51.99 \text{ g Cr}} \times \frac{1 \text{ mol Cr}}{1} = 0.0227 / 0.02276 = 1 \times 2$$

$$\frac{1.27 \text{ g O}}{16.00 \text{ g O}} \times \frac{1 \text{ mol O}}{1} = 0.07938 / 0.02276 = 3.5 \times 2$$

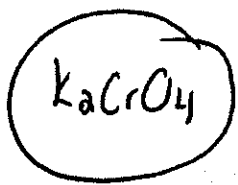


b) 1.03g K, 0.69g Cr, 0.84g O

$$\frac{1.03 \text{g K}}{39.10 \text{g}} \cdot \frac{1 \text{ mol}}{1} = 0.02634 / 0.01327 = 2$$

$$\frac{0.69 \text{g Cr}}{51.99 \text{g Cr}} \cdot \frac{1 \text{ mol}}{1} = 0.01327 / 0.01327 = 1$$

$$\frac{0.84 \text{g O}}{16 \text{g O}} \cdot \frac{1 \text{ mol}}{1} = 0.0525 / 0.01327 = 4$$



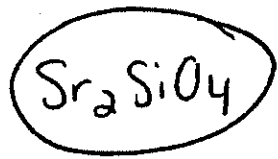
4. Calculate the empirical formulas of the compounds with the following percentage compositions:

a) 65.7% Sr, 10.4% Si, 23.9% O

$$\frac{65.7 \text{g Sr}}{87.62 \text{g Sr}} \cdot \frac{1 \text{ mol Sr}}{1} = 0.7498 / 0.3702 = 2$$

$$\frac{10.4 \text{g Si}}{28.09 \text{g Si}} \cdot \frac{1 \text{ mol Si}}{1} = 0.3702 / 0.3702 = 1$$

$$\frac{23.9 \text{g O}}{16.00 \text{g O}} \cdot \frac{1 \text{ mol O}}{1} = 1.494 / 0.3702 = 4$$

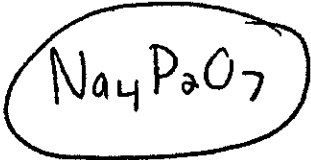


b) 34.58% Na, 23.3% P, 42.12% O

$$\frac{34.58 \text{g Na}}{22.99 \text{g Na}} \cdot \frac{1 \text{ mol}}{1} = 1.504 / 0.7523 = 2 \times 2 = 4$$

$$\frac{23.3 \text{g P}}{30.97 \text{g P}} \cdot \frac{1 \text{ mol}}{1} = 0.7523 / 0.7523 = 1 \times 2 = 2$$

$$\frac{42.12 \text{g O}}{16.00 \text{g O}} \cdot \frac{1 \text{ mol}}{1} = 2.6325 / 0.7523 = 3.5 \times 2 = 7$$



Molecular formulas

Determine the molecular formulas for the following:

1. empirical formula is CH; molecular mass is 26g

$$13.018$$

$$26 \mid 13.018 = 2$$



2. empirical formula is C_2H_5 ; molecular mass is 58g

$$29.06$$

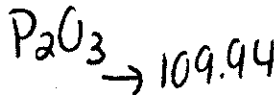
$$\frac{58}{29.06} = 2$$



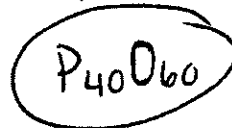
- 3) A compound of phosphorus and oxygen contains 56.36% phosphorus. If the molecular mass is 2204 g, what is the molecular formula?

$$\frac{56.36\text{g P}}{30.97\text{g P}} \mid \frac{1\text{ mol}}{1\text{ mol}} = 1.8198 / 1.8198 = 1 \times 2 = 2$$

$$\frac{43.64\text{g O}}{16.00\text{g O}} \mid \frac{1\text{ mol}}{1\text{ mol}} = 2.7275 / 1.8198 = 1.5 \times 2 = 3$$



$$\frac{2204}{109.94} = 20$$

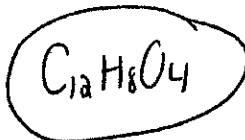


Determine the molecular formulas for the following:

4. empirical formula is $\text{C}_3\text{H}_8\text{O}$; molecular mass is 216g

$$54.046$$

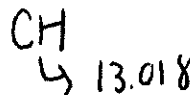
$$\frac{216\text{g}}{54.046\text{g}} = 4$$



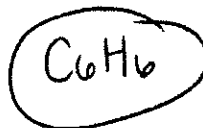
5. compound contains 0.240 g C and 0.020 g H; molecular mass is 78g

$$\frac{0.240\text{g C}}{12.01\text{g C}} \mid \frac{1\text{ mol C}}{1\text{ mol C}} = 0.01998 / 0.0198 = 1$$

$$\frac{0.020\text{g H}}{1.008\text{g H}} \mid \frac{1\text{ mol H}}{1\text{ mol H}} = 0.0198 / 0.0198 = 1$$



$$\frac{78}{13.018} = 6$$



CW: Hydrates

★ Assume 100g of 100g

1. What is the formula and name of a hydrate that is 85.3% barium chloride and 14.7% water?



$$\frac{85.3 \text{ g}}{208.28 \text{ g BaCl}_2} \times \frac{1 \text{ mol BaCl}_2}{1} = 0.4095 \text{ mol} / 0.4095 = 1$$

$$\frac{14.7 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2\text{O}}{1} = 0.8159 \text{ mol} / 0.4095 = 2$$

$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
Barium chloride dihydrate

2. A 4.89 grams sample of a hydrate was heated, and after the water was driven off, 3.87 g of anhydrous calcium sulfate remained. Determine the formula of this hydrate and name the compound.



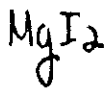
hydrate - 4.89g
salt - 3.87g
water - 1.02g

$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
calcium sulfate dihydrate

$$\frac{3.87 \text{ g CaSO}_4}{136.15 \text{ g CaSO}_4} \times \frac{1 \text{ mol CaSO}_4}{1} = 0.0284 / 0.0284 = 1$$

$$\frac{1.02 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2\text{O}}{1} = 0.0566 / 0.0284 = 2$$

3. A 1.628 grams sample of a hydrate of magnesium iodide is heated until its mass is reduced to 1.072 g and all water has been removed. What is the formula of the hydrate?



hydrate - 1.628g
salt - 1.072g
water - 0.556g

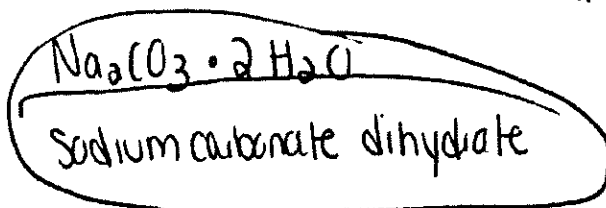
$\text{MgI}_2 \cdot 8\text{H}_2\text{O}$
magnesium octahydrate

$$\frac{1.072 \text{ g MgI}_2}{278.11 \text{ g MgI}_2} \times \frac{1 \text{ mol MgI}_2}{1} = 0.00385 / 0.00385 = 1$$

$$\frac{0.556 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2\text{O}}{1} = 0.0309 / 0.00385 = 8$$

4. A hydrate of Na_2CO_3 has a mass of 4.31 g before heating. After heating, the mass of the anhydrous compound is found to be 3.22 g. Determine the formula of the hydrate and then write out the name of the hydrate.

$$\begin{aligned} \text{hydrate} &= 4.31 \text{ g} \\ \text{salt} &= 3.22 \text{ g} \\ \text{water} &= 1.09 \text{ g} \end{aligned}$$



$$\frac{3.22 \text{ g Na}_2\text{CO}_3}{105.99 \text{ g Na}_2\text{CO}_3} \bigg| \frac{1 \text{ mol Na}_2\text{CO}_3}{105.99 \text{ g Na}_2\text{CO}_3} = 0.0304 / 0.0304 = 1$$

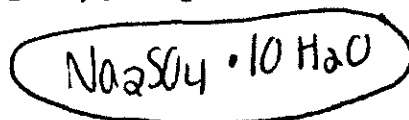
$$\frac{1.09 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \bigg| \frac{1 \text{ mol H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} = 0.0605 / 0.0304 = 2$$

5. Given that the molar mass of $\text{Na}_2\text{SO}_4 \cdot n\text{H}_2\text{O}$ is 322.1 g/mol, calculate the value of n.

① find percent of anhydrous salt and water

$$\frac{142.05 \text{ g}}{322.1 \text{ g}} \times 100 = 44.1\% \text{ Na}_2\text{SO}_4$$

$$100 - 44.1 = 55.9\% \text{ H}_2\text{O}$$

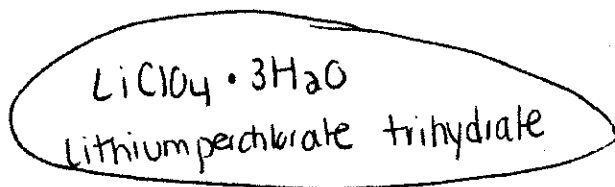


$$\frac{44.1 \text{ g Na}_2\text{SO}_4}{142.05 \text{ g Na}_2\text{SO}_4} \bigg| \frac{1 \text{ mol Na}_2\text{SO}_4}{142.05 \text{ g Na}_2\text{SO}_4} = 0.3105 / 0.3105 = 1$$

$$\frac{55.9 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \bigg| \frac{1 \text{ mol H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} = 3.1028 / 0.3105 = 10$$

6. Anhydrous lithium perchlorate (4.78 g) was dissolved in water and re-crystallized. Care was taken to isolate all the lithium perchlorate as its hydrate. The mass of the hydrated salt obtained was 7.21 g. What hydrate is it?

$$\begin{aligned} \text{hydrate} &= 7.21 \text{ g} \\ \text{salt} &= 4.78 \text{ g} \\ \text{H}_2\text{O} &= 2.43 \text{ g} \end{aligned}$$



$$\frac{4.78 \text{ g LiClO}_4}{106.39 \text{ g LiClO}_4} \bigg| \frac{1 \text{ mol LiClO}_4}{106.39 \text{ g LiClO}_4} = 0.0449 / 0.0449 = 1$$

$$\frac{2.43 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \bigg| \frac{1 \text{ mol H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} = 0.1349 / 0.0449 = 3$$

7. A substance was found to have the following percentages by mass: 23% zinc; 11% sulfur; 22% oxygen; 44% water. What is the empirical formula?

$$\frac{23 \text{ g Zn}}{65.39 \text{ g Zn}} \times \frac{1 \text{ mol Zn}}{1 \text{ mol Zn}} = 0.3517 / 0.343 = 1$$

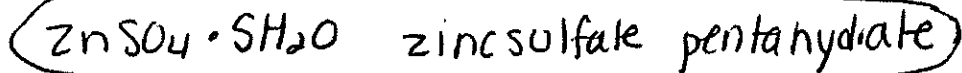
$$\frac{11 \text{ g S}}{32.07 \text{ g S}} \times \frac{1 \text{ mol S}}{1 \text{ mol S}} = 0.343 / 0.343 = 1$$

$$\frac{22 \text{ g O}}{16.00 \text{ g O}} \times \frac{1 \text{ mol O}}{1 \text{ mol O}} = 1.375 / 0.343 = 4$$



$$\frac{56 \text{ g ZnSO}_4}{113.46 \text{ g ZnSO}_4} \times \frac{1 \text{ mol ZnSO}_4}{1 \text{ mol ZnSO}_4} = 0.4936 / 0.493 = 1$$

$$\frac{44 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 2.44 / 0.493 = 5$$



8. A 5.00 g sample of hydrated barium chloride, $\text{BaCl}_2 \cdot n\text{H}_2\text{O}$, is heated to drive off the water. After heating, 4.26 g of anhydrous barium chloride, BaCl_2 , remains. What is the value of n in the hydrate's formula?

hydrate = 5.00 g
salt = 4.26 g
water = 0.74 g



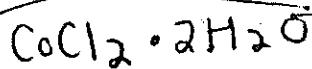
Barium chloride dihydrate

$$\frac{4.26 \text{ g BaCl}_2}{208.28 \text{ g BaCl}_2} \times \frac{1 \text{ mol BaCl}_2}{1 \text{ mol BaCl}_2} = 0.0205 / 0.0205 = 1$$

$$\frac{0.74 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 0.0411 / 0.0205 = 2$$

9. A 1.98 g sample of a cobalt(II) chloride hydrate is heated over a burner. When cooled, the mass of the remaining dehydrated compound is found to be 1.55 g. What is the formula for the original hydrate? How can you make sure that all of the water of hydration has been removed?

hydrate = 1.98 g
salt = 1.55 g
water = 0.43 g



cobalt(II) chloride dihydrate

$$\frac{1.55 \text{ g CoCl}_2}{124.83 \text{ g CoCl}_2} \times \frac{1 \text{ mol CoCl}_2}{1 \text{ mol CoCl}_2} = 0.0119 / 0.0119 = 1$$

$$\frac{0.43 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 0.0239 / 0.0119 = 2$$

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