

Determining Percent Composition

Percentage composition is determined by finding the formula mass of a compound, multiplying the mass of each element by 100, and dividing the product by the formula mass of the compound. Use the periodic table to find the masses of individual elements. See the **Sample Problem** to the right.

Sample Problem: Find the percentage composition of MgCO_3 .

Formula Mass	Percentage Composition
$\text{Mg} = 24 \times 1 = 24$	$\% \text{Mg} = \frac{24}{84} \times 100 = 29$
$\text{C} = 12 \times 1 = 12$	$\% \text{C} = \frac{12}{84} \times 100 = 14$
$\text{O} = 16 \times 3 = \underline{48}$	$\% \text{O} = \frac{48}{84} \times 100 = \underline{57}$
84	100

1. What is the percentage composition of: Na, O, and H in the compound NaOH?

Na _____, O _____, H _____.

2. Calculate the percentage composition of baking soda (NaHCO_3).

Na _____, H _____, C _____, O _____.

3. Calculate the percentage of each of the elements within acetic acid ($\text{HC}_2\text{H}_3\text{O}_2$), the substance found in vinegar.

H _____, C _____, O _____.

4. What is the percentage composition of a soap ($\text{C}_{17}\text{H}_{35}\text{COONa}$)?

C _____, H _____, O _____, Na _____.

5. Which of the following has the highest percentage of nitrogen? (✓)

____ $\text{Ca}(\text{NO}_3)_2$ _____ ____ $(\text{NH}_4)_2\text{SO}_4$ _____

CHEMICAL FORMULAS and EQUATIONS

Percentages can refer to different portions of a compound. In hydrated crystals, for example, it is possible to calculate the percentage of water. Find the formula mass of each portion of the compound separately. Add them together to get the mass of the compound. Then multiply the mass of the water by 100, and divide the product by the formula mass of the compound. See the **Sample Problem** to the right.

Sample Problem: What is the percentage of water in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?

<u>Formula Mass of CuSO_4</u>		<u>Formula Mass of H_2O</u>	
Cu = $64 \times 1 = 64$		H = $1 \times 2 = 2$	
S = $32 \times 1 = 32$		O = $16 \times 1 = 16$	
O = $16 \times 4 = 64$			18
	160	Mass of Water: $5 \times 18 = 90$	TOTAL: $160 + 90 = 250$
<u>Percentage</u>			
$\% \text{H}_2\text{O} = 90 \times 100 \div 250 = 36 \%$			

6. Calculate the percentage of water in the compound $\text{CaSO}_4 \cdot 6\text{H}_2\text{O}$.

7. Calculate the percentage of water in the compound $\text{CaCl}_2 \cdot 10\text{H}_2\text{O}$.

Once you know the percentage composition of a compound, you can figure out the mass of any component of the compound in a sample of any mass simply by multiplying the sample mass by the percentage. See the **Sample Problem** to the right.

8. How many milligrams of iron are delivered from a 250. mg tablet of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$?

Sample Problem: A 40.0 g sample of $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ is heated to dryness. What is the mass of the remaining calcium chloride.

<u>Formula Mass of CaCl_2</u>		<u>Formula Mass of H_2O</u>	
Ca = $40 \times 1 = 40$		H = $1 \times 2 = 2$	
Cl = $35 \times 2 = 70$		O = $16 \times 1 = 16$	
O = $16 \times 4 = 64$			18
	110	Mass of Water: $2 \times 18 = 36$	TOTAL: $110 + 36 = 146$
<u>Percentage</u>			
$\% \text{CaCl}_2 = 110 \times 100 \div 146 = 75 \%$			
<u>Mass</u>			
$0.75 \times 40.0 \text{ g} = 30. \text{ g}$			

9. What is the yield of uranium from 2.50 kg U_3O_8 ?