6.7: Using Chemical Formulas as Conversion Factors

Learning Objectives

- Use chemical formulas as conversion factors.

Figure 6.7.1 shows that 2 hydrogen atoms and 1 oxygen atom are required to make one water molecule, 4 hydrogen atoms and 2 oxygen atoms for two water molecules, and 6 hydrogen atoms and 3 oxygen atoms for three water molecules. To make any number of water molecules, the ratio is always the same: 2 hydrogen atoms to 1 oxygen atom.

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Figure 6.7.1: The ratio of hydr rdless of the number of water molecules.

By using formulas to indicate how ber of molecules to the number of atoms of each element. The possibl

1 molecule H_2O has:			Mole Relationships
2 H atoms			$\frac{2\text{ mol H}}{1\text{ mol }H_2O}$ or $\frac{1\text{ mol }H_2O}{2\text{ mol H}}$
1 O atom	1 dozen O atoms	1 mol O	$\frac{1\text{ mol O}}{1\text{ mol }H_2O}$ or $\frac{1\text{ mol }H_2O}{1\text{ mol O}}$

Therefore, with 30.2 mol H_2O, there would be:

$$30.2\ \text{mol}\ \cancel{H_2O} \times \frac{2\ \text{mol H}}{1\ \text{mol}\ \cancel{H_2O}} = \boxed{60.4\ \text{mol H}}$$

$$30.2\ \text{mol}\ \cancel{H_2O} \times \frac{1\ \text{mol O}}{1\ \text{mol}\ \cancel{H_2O}} = \boxed{30.2\ \text{mol O}}$$

The following example illustrates how we can use the relationships in Table 6.7.1 as conversion factors.

✅ Example 6.7.1: Ethanol

How many moles of hydrogen atoms are present in 2.5 mol of ethanol (C_2H_6O)?

Solution

Steps for Problem Solving	
Identify the "given" information and what the problem is asking you to "find."	Given: 2.5 mol C_2H_6O Find: mol H atoms
List known relationships.	1 mol C_2H_6O = 6 mol H
Prepare a concept map and use the proper conversion factor.	$\text{mol } C_2H_6O \xrightarrow{\frac{6\text{ mol H}}{1\text{ mol }C_2H_6O}} \text{mol H}$

Steps for Problem Solving	
Calculate the answer.	$2.5 \text{ mol } C_2H_6O \times \frac{6 \text{ mol H}}{1 \text{ mol } C_2H_6O} = \boxed{15 \text{ mol H}}$
Think about your result.	There 6 H atoms per C_2H_6O molecule, so the final answer should be 6 times as large.

Exercise 6.7.1

How many moles of sodium, sulfur, and oxygen atoms are in a sample containing 6.75 mol of Na_2SO_4, sodium sulfate?

Answer

13.5 mol Na atoms, 6.75 mol S atoms, and 27.0 mol O atoms

Summary

- In any given formula, the ratio of the number of moles of molecules (or formula units) to the number of moles of atoms can be used as a conversion factor.