

## 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 molecules.

rdless of the number of water

By using formulas to indicate how atoms of each element. The possibl

ber of molecules to the number of

1 molecule H <sub>2</sub> O has:			Mole Relationships	
2 H atoms			$\frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}}$ or $\frac{1 \text{ mol H}_2\text{O}}{2 \text{ mol H}}$	
1 O atom	1 dozen O atoms	1 mol O	$\frac{1 \text{ mol O}}{1 \text{ mol H}_2\text{O}}$ or $\frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol O}}$	

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Therefore, with 30.2 mol H<sub>2</sub>O, there would be:

$$30.2 \text{ mol H}_2\text{O} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} = \boxed{60.4 \text{ mol H}}$$

$$30.2 \text{ mol H}_2\text{O} \times \frac{1 \text{ mol O}}{1 \text{ mol H}_2\text{O}} = \boxed{30.2 \text{ mol O}}$$

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<sub>2</sub>H<sub>6</sub>O)?

#### Solution

##### Steps for Problem Solving

Identify the "given" information and what the problem is asking you to "find."

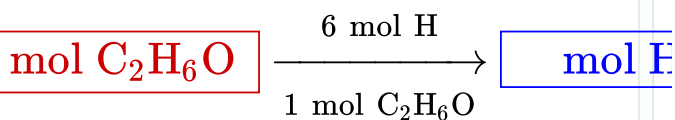
Given: 2.5 mol C<sub>2</sub>H<sub>6</sub>O

Find: mol H atoms

List known relationships.

1 mol C<sub>2</sub>H<sub>6</sub>O = 6 mol H

Prepare a concept map and use the proper conversion factor.



### Steps for Problem Solving

Calculate the answer.

$$2.5 \text{ mol } \cancel{\text{C}_2\text{H}_6\text{O}} \times \frac{6 \text{ mol H}}{1 \text{ mol } \cancel{\text{C}_2\text{H}_6\text{O}}} = \boxed{15 \text{ mol H}}$$

Think about your result.

There 6 H atoms per  $\text{C}_2\text{H}_6\text{O}$  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  $\text{Na}_2\text{SO}_4$ , 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.

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