

## Exercise 7.4b

### Determining Molecular Formulas

Name: \_\_\_\_\_

Date: \_\_\_\_\_ Per: \_\_\_\_\_

Empirical formulas represent the simplest ratio of atoms that occur in a compound. That ratio may not, however, be the true formula of the compound because some formulas occur in ratios that can be reduced. For example, the formula of hydrogen peroxide is  $\text{H}_2\text{O}_2$ , but its empirical formula would be  $\text{HO}$ . The formula of glucose is  $\text{C}_6\text{H}_{12}\text{O}_6$ , but its empirical formula would be  $\text{CH}_2\text{O}$ . The true formula of the substance is called the **molecular formula** because it represents the actual formula of the molecule. The molecular formula may be found by comparing the molar mass of the actual compound (which will be given) to the molar mass of the empirical formula.

*Example: The empirical formula of a compound is  $\text{CH}$ . Its molecular mass is 78.1 g/mol. What is its molecular formula?*

1. Molar mass of  $\text{CH} = (12.011 \text{ g} + 1.008 \text{ g}) = 13.019 \text{ g}$ .
2. Compare the real mass to the mass of the empirical formula:  $78.1 \text{ g} \div 13.019 \text{ g} = 6$ .
3. The real formula weighs 6 x the mass of  $\text{CH}$ , so the subscripts all get multiplied by 6 :  **$\text{C}_6\text{H}_6$** .

1. A solvent is found to be 37.5% carbon, 12.5% hydrogen, and 50.0% oxygen. What is the empirical formula of this solvent?
  - a. If the molecular mass of the solvent is known to be 96.13g/mol, how does the mass of the empirical formula compare to the known mass?  
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2. The empirical formula of a compound is  $\text{NO}_2$ . Its molecular mass is 92.0 g/mol. What is its molecular formula?
3. Ethene, a gas used extensively in preparing plastics and other polymers, has a composition of 85.7% carbon and 14.3% hydrogen. Its molar mass is 28.1 g. Find the molecular formula for ethene.
4. A compound is found to be 40.0% carbon, 6.71% hydrogen and 53.5% oxygen. Its molecular mass is 60.1 g/mol. What is its molecular formula?
5. If 4.04 g of nitrogen combine with 11.46 g of oxygen to produce a compound with a molar mass of 108.0g, what is the molecular formula of this compound?