

## Worksheet 7-3

## Percent Composition &amp; Empirical Formulas

Glencoe Chemistry pp. 328-337

Name \_\_\_\_\_

Period \_\_\_\_\_

Show your work to receive credit. Circle your final answer.

A. Calculate the percent composition for the following compounds.

1.  $\text{Cr}_2\text{O}_3$ 

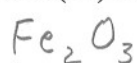
$$\text{Cr} = \frac{2(52)}{152} = \underline{68.4\%} \quad \text{O} = \frac{3(16)}{152} = \underline{32.6\%}$$

2.  $\text{Ca}_3(\text{PO}_4)_2$ 

$$\text{Ca} = \frac{3(40.1)}{310.3} = \underline{38.77\%} \quad \text{P} = \frac{2(31)}{310.3} = \underline{19.98\%} \quad \text{O} = \frac{8(16)}{310.3} = \underline{41.25\%}$$

B. Calculate the percent by mass of iron in each of the following compounds.

3. iron (III) oxide



$$\text{Fe} = \frac{2(55.8)}{159.6} = \underline{69.92\%} \quad \text{O} = \frac{3(16)}{159.6} = \underline{30.08\%}$$

4. iron (II) oxide



$$\text{Fe} = \frac{55.8}{71.8} = \underline{77.72\%} \quad \text{O} = \frac{16}{71.8} = \underline{22.28\%}$$

C. Determine the empirical formula for each compound.

5. A compound contains 0.0130 mol carbon, 0.0390 mol hydrogen, and 0.0065 mol oxygen.

$$\text{C} = \frac{0.0130}{0.0065} = 2 \quad \text{H} = \frac{0.0390}{0.0065} = 6 \quad \text{O} = \frac{0.0065}{0.0065} = 1$$



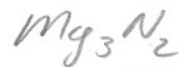
\* 6. A compound consists of 72.2% magnesium and 27.8% nitrogen by mass.

$$\text{Mg} = \frac{72.2}{24.3} = 2.97$$

$$\text{N} = \frac{27.8}{14} = 1.99$$

$$\frac{2.97}{1.99} = 1.5 \times 2$$

$$\frac{1.99}{1.99} = 1 \times 2$$



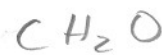
7. Glucose contains 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen by mass.

$$\text{C} = \frac{40}{12} = 3.33 \quad \text{H} = \frac{6.7}{1.01} = 6.63 \quad \text{O} = \frac{53.3}{16} = 3.33$$

$$\frac{3.33}{3.33} = 1$$

$$\frac{6.63}{3.33} = 2$$

$$\frac{3.33}{3.33} = 1$$



8. Phosphoric acid is found in some soft drinks. A sample of phosphoric acid contains 0.3086 g of hydrogen, 3.161 g of phosphorus, and 6.531 g of oxygen.

$$\text{H} = \frac{0.3086}{1.01} = 0.3055$$

$$\text{P} = \frac{3.161}{31} = 0.102$$

$$\text{O} = \frac{6.531}{16} = 0.4082$$

$$\frac{0.3055}{0.102} = 3$$

$$\frac{0.102}{0.102} = 1$$

$$\frac{0.4082}{0.102} = 4$$



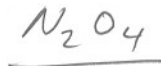
## Chemistry I

D. Determine the *molecular formula* for each compound described.

9. A compound has an empirical formula of
- $\text{NO}_2$
- and a molar mass of 92.02 g/mol.

$$\text{NO}_2 = 14 + 2(16) = 46$$

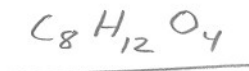
$$\frac{92.02 \text{ g/mol}}{46} = 2$$



10. A compound has an empirical formula of
- $\text{C}_2\text{H}_3\text{O}$
- and a molar mass of 172 g/mol.

$$\text{C}_2\text{H}_3\text{O} = 2(12) + 3(1.01) + 16 = 43.03$$

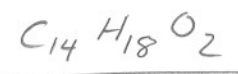
$$\frac{172 \text{ g/mol}}{43.03} = 4$$



11. Ibuprofen, a common headache remedy, has an empirical formula of
- $\text{C}_7\text{H}_9\text{O}$
- and a molar mass of approximately 215 g/mol.

$$\text{C}_7\text{H}_9\text{O} = 7(12) + 9(1.01) + 16 = 109.09$$

$$\frac{215 \text{ g/mol}}{109.09} = 2$$



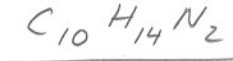
12. Nicotine is 74.1% carbon, 8.6% hydrogen, and 17.3% nitrogen by mass. Its molar mass is about 160 g/mol.

$$\text{C: } \frac{74.1}{12} = 6.175 \quad \text{H: } \frac{8.6}{1.01} = 8.515 \quad \text{N: } \frac{17.3}{14} = 1.236$$

$$\frac{6.175}{1.236} = 5 \quad \frac{8.515}{1.236} = 7 \quad \frac{1.236}{1.236} = 1$$

$$\text{C}_5\text{H}_7\text{N} = 5(12) + 7(1.01) + 14 = 81.07$$

$$\frac{160 \text{ g/mol}}{81.07} = 2$$



13. Epinephrine (adrenaline) is a hormone secreted into the bloodstream in times of danger and stress. It is 59.0% carbon, 7.1% hydrogen, 26.2% oxygen, and 7.7% nitrogen by mass. Its molar mass is about 180 g/mol.

$$\text{C: } \frac{59}{12} = 5$$

$$\text{H: } \frac{7.1}{1.01} = 7$$

$$\text{N: } \frac{7.7}{14} = .55$$

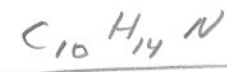
$$\frac{5}{.55} = 10$$

$$\frac{7}{.55} = 14$$

$$\frac{.55}{.55} = 1$$

$$\text{C}_{10}\text{H}_{14}\text{N} = 10(12) + 14(1.01) + 14 = 148.14$$

$$\frac{180 \text{ g/mol}}{148.14} = 1$$



## E. Questions

14. Can the molecular formula of a compound ever be the same as the empirical formula?

Explain your answer.

yes, the molar mass can be equal to the mass of the empirical formula

15. What is the empirical formula of a compound that has three times as many hydrogen atoms as carbon atoms, but only half as many oxygen atoms as carbon atoms?

$$\text{C: } \frac{x}{4.5x} = .222 \quad \text{H: } \frac{3x}{4.5x} = .667 \quad \text{O: } \frac{.5x}{4.5x} = .111$$

$$\frac{.222}{.111} = 2$$

$$\frac{.667}{.111} = 6$$

$$\frac{.111}{.111} = 1$$

