

### Percent Composition by Mass Worksheet

Show all work, including the correct units and sig figs with your answer.

#### Experimental Percent Composition by Mass

1. A chemist determines that 1.26 g of iron reacts with 0.54 g of oxygen to form rust. What is the percent composition of each element in the new compound?

$$1.26 + 0.54 = 1.8 \text{ g}$$

$$\text{Fe} = \frac{1.26}{1.8} = 70\% \text{ Fe}$$

$$\text{O} = \frac{0.54}{1.8} = 30\% \text{ O}$$

2. In the lab, a chemist analyzed a sample of methanol and found that it was made of 6.2 g of carbon, 4.1 g of hydrogen, and 15.9 g of oxygen. What is the percent composition of each element?

$$\begin{array}{r} 6.2 \\ 4.1 \\ + 15.9 \\ \hline 26.2 \text{ g} \end{array}$$

$$\text{C} = \frac{6.2}{26.2} = 0.24$$

$$\text{H} = \frac{4.1}{26.2} = 0.156$$

$$\text{O} = \frac{15.9}{26.2} = 0.607$$

3. In an experiment, a student took a 12.2 g sample of table salt and chemically separated the chlorine from the sodium. He determined that there were 5.2 g of chlorine in the sample. What is the percent composition of each element in the table salt?  $\text{NaCl}$

total mass = 12.2 g

$$\text{Cl} = \frac{5.2}{12.2} = 43\%$$

$$\text{Na} = \frac{7}{12.2} = 57.4\%$$

4. A compound contains 1.2 moles of carbon and 3.2 moles of hydrogen. What is the percent composition by mass of each element in the compound?

$$\frac{1.2 \text{ mol C} \mid 12 \text{ g}}{1 \text{ mol C}} = 14.4 \text{ g C}$$

$$\frac{3.2 \text{ mol H} \mid 1 \text{ g H}}{1 \text{ mol}} = 3.2 \text{ g H}$$

$$\text{C} = \frac{14.4}{17.6} = 82\% \text{ C}$$

$$\text{H} = \frac{3.2}{17.6} = 18\% \text{ H}$$

5. In an experiment, 0.05 moles of iron and 0.05 moles of sulfur are heated in a test tube to create a new substance. What is the percent composition by mass of each element in the new compound?

$$\frac{0.05 \text{ mol Fe} \mid 55.85}{1 \text{ mol}} = 2.79 \text{ g}$$

$$\text{Fe} = \frac{2.79}{4.39} = 63.5\% \text{ Fe}$$

$$\frac{0.05 \text{ mol S} \mid 32 \text{ g}}{1 \text{ mol}} = 1.6 \text{ g}$$

$$\text{S} = \frac{1.6}{4.39} = 36.4\% \text{ S}$$

$$\begin{array}{r} \text{total mass} \\ 2.79 \\ + 1.6 \\ \hline 4.39 \text{ g} \end{array}$$

6. A chemist breaks down a compound into 3.4 moles of carbon and 6.8 moles of oxygen. What is the percent composition by mass of each element in the compound?

$$\frac{3.4 \text{ mol C} \mid 12 \text{ g}}{1 \text{ mol}} = 40.8 \text{ g}$$

$$\text{C} = \frac{40.8}{149.6} = 27.27\% \text{ C}$$

$$\frac{6.8 \text{ mol O} \mid 16 \text{ g}}{1 \text{ mol}} = 108.8 \text{ g}$$

$$\text{O} = \frac{108.8}{149.6} = 72.72\% \text{ O}$$

$$\begin{array}{r} \text{total Mass} \\ 108.8 \\ + 40.8 \\ \hline 149.6 \text{ g} \end{array}$$

7. In an experiment, 2.0 moles of oxygen atoms reacts with 80.1 g of calcium to form a new compound. What is the percent composition by mass of each element in the new compound?

$$\frac{2 \text{ mol O} \mid 16 \text{ g}}{1 \text{ mol}} = 32 \text{ g}$$

$$\text{Ca} = \frac{80.1}{112.1} = 71.45\% \text{ Ca}$$

$$\begin{array}{r} \text{total mass} \\ 80.1 \\ + 32 \\ \hline 112.1 \text{ g} \end{array}$$

$$\text{O} = \frac{32}{112.1} = 28.54\% \text{ O}$$

Theoretical Percent Composition by Mass

8. What is the percent composition by mass for each element in sodium phosphate,  $\text{Na}_3\text{PO}_4$ ?

$$\begin{array}{l} \text{Na} = 23(3) = 69 \\ \text{P} = 31 \\ \text{O} = 16(4) = 64 \\ \hline 164 \text{ g/mol} \end{array}$$

$$\text{Na} = \frac{69 \text{ g}}{164 \text{ g}} = \boxed{42.07\%}$$

$$\text{P} = \frac{31}{164} = \boxed{18.9\%}$$

$$\text{O} = \frac{64}{164} = \boxed{39.02\%}$$

9. What is the percent composition by mass for each element in hydrogen peroxide,  $\text{H}_2\text{O}_2$ ?

$$\begin{array}{l} 16(2) = 32 \\ 1(2) = 2 \\ \hline 34 \text{ g/mol} \end{array}$$

$$\text{H} = \frac{2 \text{ g}}{34 \text{ g}} = \boxed{5.8\% \text{ H}}$$

$$\text{O} = \frac{32 \text{ g}}{34 \text{ g}} = \boxed{94.11\% \text{ O}}$$

10. What is the percent composition by mass for each element in carbon dioxide,  $\text{CO}_2$ ?

$$\begin{array}{l} 12 \\ + 32 \\ \hline 44 \text{ g/mol} \end{array}$$

$$\text{C} = \frac{12 \text{ g}}{44 \text{ g}} = \boxed{27.27\% \text{ C}}$$

$$\text{O} = \frac{32 \text{ g}}{44 \text{ g}} = \boxed{72.72\% \text{ O}}$$

11. What is the percent composition by mass for each element in carbon monoxide,  $\text{CO}$ ?

$$\begin{array}{l} 12 \\ + 16 \\ \hline 28 \text{ g/mol} \end{array}$$

$$\text{C} = \frac{12 \text{ g}}{28 \text{ g}} = \boxed{42.8\% \text{ C}}$$

$$\text{O} = \frac{16}{28} = \boxed{57.14\% \text{ O}}$$

12. What is the percent composition by mass for each element in glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ ?

$$\begin{array}{l} 12(6) = 72 \\ 1(12) = 12 \\ 6(16) = 96 \\ \hline 180 \text{ g/mol} \end{array}$$

$$\text{C} = \frac{72}{180} = \boxed{40\% \text{ C}}$$

$$\text{H} = \frac{12}{180 \text{ g}} = \boxed{6.6\% \text{ H}}$$

$$\text{O} = \frac{96}{180} = \boxed{53.33\% \text{ O}}$$

13. What is the percent composition by mass for each element in aspirin,  $\text{C}_9\text{H}_8\text{O}_4$ ?

$$\begin{array}{l} 12(9) = 108 \\ 1(8) = 8 \\ 16(4) = 64 \\ \hline 180 \text{ g/mol} \end{array}$$

$$\text{C} = \frac{108}{180 \text{ g}} = \boxed{60\% \text{ C}}$$

$$\text{H} = \frac{8}{180} = \boxed{4.4\% \text{ H}}$$

$$\text{O} = \frac{64}{180} = \boxed{35.5\% \text{ O}}$$

14. What is the percent composition by mass for each element in ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ , which is used in fertilizers?

$$\begin{array}{l} 14(2) = 28 \\ 1(8) = 8 \\ 32(1) = 32 \\ 16(4) = 64 \\ \hline 132 \text{ g/mol} \end{array}$$

$$\text{N} = \frac{28}{132} = \boxed{21.21\% \text{ N}}$$

$$\text{S} = \frac{32}{132} = \boxed{24.24\% \text{ S}}$$

$$\text{H} = \frac{8}{132} = \boxed{6.06\% \text{ H}}$$

$$\text{O} = \frac{64}{132} = \boxed{48.48\% \text{ O}}$$

15. What is the percent composition by mass for each element in rubbing alcohol,  $\text{C}_3\text{H}_7\text{OH}$ ?

$$\begin{array}{l} 3(12) = 36 \\ 7(1) = 7 \\ 1(16) = 16 \\ 1(1) = 1 \\ \hline 60 \text{ g/mol} \end{array}$$

$$\text{C} = \frac{36}{60} = \boxed{60\% \text{ C}}$$

$$\text{H} = \frac{8}{60} = \boxed{13.3\% \text{ H}}$$

$$\text{O} = \frac{16}{60} = \boxed{26.6\% \text{ O}}$$