

## MOLECULAR FORMULAS

A compound of carbon and hydrogen was found to contain 82.66% carbon by mass and have a molecular weight of 58.12 g/mol. What is the molecular formula of this compound?

82.66% C

100.00 g compound

$$82.66 \text{ g C} \left( \frac{1 \text{ mol C}}{12.01 \text{ g C}} \right) = 6.883 \text{ mol C}$$

$$17.34 \text{ g H} \left( \frac{1 \text{ mol H}}{1.008 \text{ g H}} \right) = 17.20 \text{ mol H}$$

$$\frac{6.883}{6.883} : \frac{17.20}{6.883} \text{ (C:H)}$$

$$\downarrow \qquad \qquad \downarrow$$
$$1 \qquad : \qquad 2.499$$

$$\downarrow \times 2 \qquad \qquad \downarrow \times 2$$
$$2 \qquad \qquad \qquad 5$$

Empirical Formula:  $\text{C}_2\text{H}_5$

$$\begin{aligned} \text{EFW} &= 2(12.01) + 5(1.008) \\ &= 24.02 + 5.040 \\ &= 29.06 \end{aligned}$$

Molecular Formula:  $\text{C}_{2n}\text{H}_{5n}$

$n = \text{some integer}$

$$n = \frac{\text{MWT}}{\text{EFW}} = \frac{58.12 \frac{\text{g}}{\text{mol}}}{29.06 \frac{\text{g}}{\text{mol}}} = 2$$

Molecular Formula:  $\text{C}_4\text{H}_{10}$

58.12 g compound

$$\text{C: } 82.66\% (58.12 \text{ g}) =$$

$$0.8266 (58.12 \text{ g}) = 48.04 \text{ g C}$$

$$\text{H: } 17.34\% (58.12 \text{ g}) =$$

$$0.1734 (58.12 \text{ g}) = 10.08 \text{ g H}$$

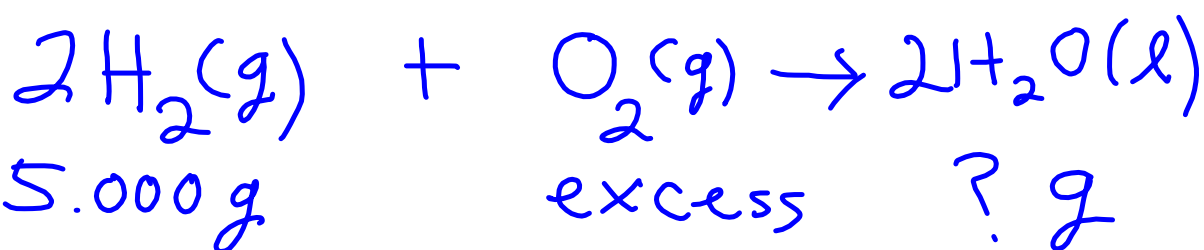
$$48.04 \text{ g C} \left( \frac{1 \text{ mol C}}{12.01 \text{ g C}} \right) = 4 \text{ mol C}$$

$$10.08 \text{ g H} \left( \frac{1 \text{ mol H}}{1.008 \text{ g H}} \right) = 10 \text{ mol H}$$

Molecular Formula:  $\text{C}_4\text{H}_{10}$

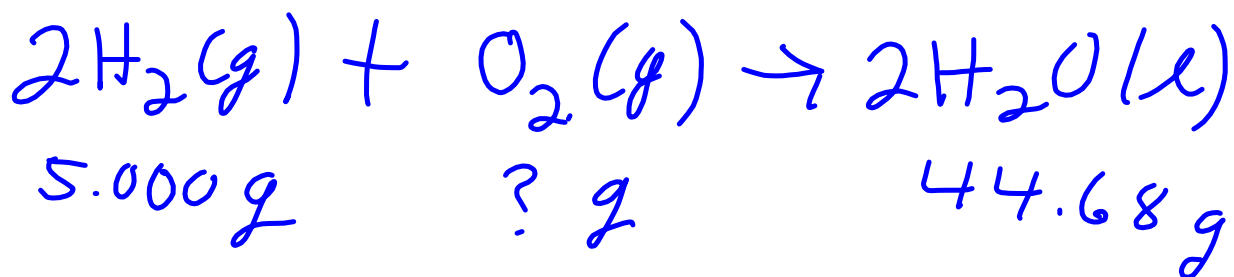
Hydrogen combines with oxygen to form water as the sole product of the reaction. What mass of water can be formed if 5.000 g of hydrogen is used in the reaction?

hydrogen + oxygen  $\rightarrow$  water



$$\begin{aligned}
 & \text{g H}_2 \rightarrow \text{mol H}_2 \rightarrow \text{mol H}_2\text{O} \rightarrow \text{g H}_2\text{O} \\
 & 5.000 \cancel{\text{g H}_2} \left( \frac{1 \cancel{\text{mol H}_2}}{2.016 \cancel{\text{g H}_2}} \right) \left( \frac{2 \cancel{\text{mol H}_2\text{O}}}{2 \cancel{\text{mol H}_2}} \right) \left( \frac{18.016 \text{g H}_2\text{O}}{1 \cancel{\text{mol H}_2\text{O}}} \right) \\
 & = 44.68 \text{ g H}_2\text{O}
 \end{aligned}$$

What mass of oxygen was consumed in the previous problem?



$$5.000\text{g} + X = 44.68\text{g}$$



$$\begin{aligned} X &= 44.68\text{g} - 5.000\text{g} \\ &= 39.68\text{g} \end{aligned}$$