

A carbon-hydrogen compound 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?

100.00 g compound

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

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

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

$$\downarrow \qquad \qquad \downarrow$$

$$1 : 2.499$$

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

$$2 : 5$$

Empirical
Formula: C_2H_5

C_2H_5 Empirical Formula

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

Molecular Formula: $C_{2n}H_{5n}$
 $n = \text{some integer}$

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

Molecular Formula: C_4H_{10}

58.12 g compound

$$58.12 \text{ g } (82.66\%) = 58.12 \text{ g } (0.8266) \\ = 48.04 \text{ g C}$$

$$58.12 \text{ g } (17.34\%) = 58.12 \text{ g } (0.1734) \\ = 10.08 \text{ g H}$$

$$\begin{array}{r} 48.04 \text{ g C} \\ + 10.08 \text{ g H} \\ \hline 58.12 \text{ g} \end{array}$$

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

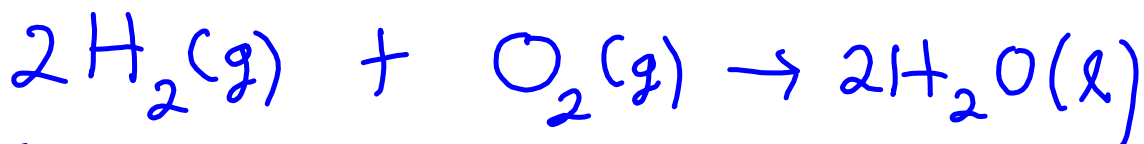
$$10.08 \text{ g H} \left(\frac{1 \text{ mol H}}{1.008 \text{ g H}} \right) = 10 \text{ mol H}$$

Molecular Formula: C_4H_{10}

REACTION STOICHIOMETRY

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



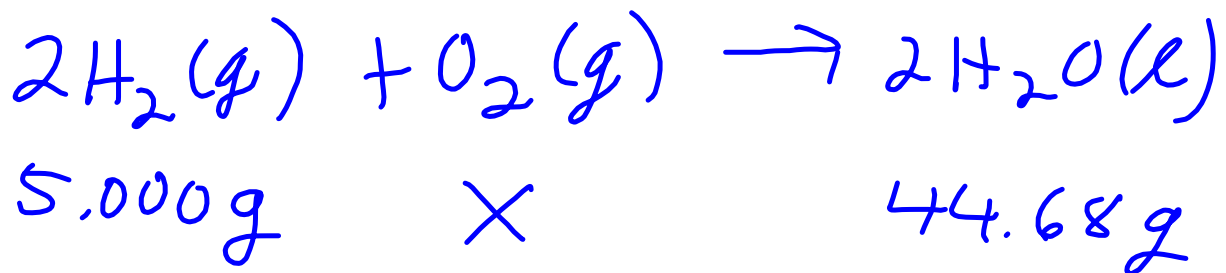
5.000 g excess ? g



$$\frac{5.000 \text{ g H}_2}{1} \left(\frac{1 \text{ mol H}_2}{2.016 \text{ g H}_2} \right) \left(\frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol H}_2} \right) \left(\frac{18.016 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \right)$$

$$= 44.68 \text{ g H}_2\text{O}$$

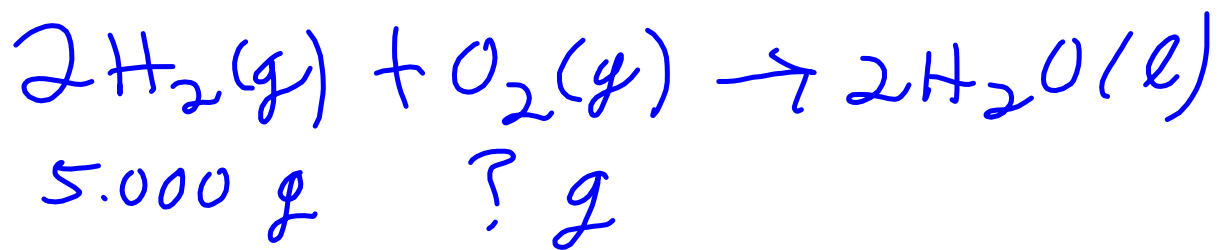
What mass of oxygen was consumed in the previous problem?



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

↓ solve

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



$$\frac{5.000 \text{gH}_2}{1} \left(\frac{1 \text{ molH}_2}{2.016 \text{gH}_2} \right) \left(\frac{1 \text{ molO}_2}{2 \text{ molH}_2} \right) \left(\frac{32.00 \text{gO}_2}{1 \text{ molO}_2} \right)$$

$$= 39.68 \text{gO}_2$$