

# STOICHIOMETRY (MASS, MOLAR MASS)

**EXAMPLE**

Iron can be oxidised by oxygen in air. If 7.00g of Fe<sub>2</sub>O<sub>3</sub> was produced, **what is the mass of oxygen that was required?**

$$M(\text{Fe}) = 55.8 \text{ g mol}^{-1}, M(\text{O}) = 16.0 \text{ g mol}^{-1}$$

**PROCESS****STEP ONE**

Calculate the amount (moles) for the species which has the **known mass**

$$\begin{aligned} n(\text{Fe}_2\text{O}_3) &= \frac{m}{M} \\ &= \frac{7.00 \text{ g}}{(2 \times 55.9 + 3 \times 16.0)} \\ &= 0.0439 \text{ mol} \end{aligned}$$

**STEP TWO**

Use the equation to write a mole ratio



$$2 \times n(\text{O}_2) = 3 \times n(\text{Fe}_2\text{O}_3)$$

**STEP THREE**

Convert the ratio to an equation

**STEP FOUR**

Use the answer from Step 1 to solve the equation in step three

$$\begin{aligned} 2 \times n(\text{O}_2) &= 3 \times 0.0439 \text{ mol} \\ 2 \times n(\text{O}_2) &= 0.132 \text{ mol} \\ n(\text{O}_2) &= 0.0658 \text{ mol} \end{aligned}$$

**STEP FIVE**

Finally, find the mass of the **unknown** (what the question asked for)

$$\begin{aligned} m(\text{O}_2) &= n \times M \\ &= 0.0658 \text{ mol} \times (2 \times 16.0 \text{ g mol}^{-1}) \\ &= 2.11 \text{ g} \end{aligned}$$

A very short summary of steps performed:

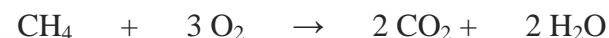
$$n = \frac{m}{M} \longrightarrow \text{mol ratio} \longrightarrow m = n \times M$$

**HOW IT LOOKS ON PAPER**

4.32g of methane is completely combusted with excess oxygen.

**What was the mass of water produced?**

$$M(\text{C}) = 12.0 \text{ g mol}^{-1}, M(\text{O}) = 16.0 \text{ g mol}^{-1}, M(\text{H}) = 1.00 \text{ g mol}^{-1}$$



$$\begin{aligned} n(\text{CH}_4) &= \frac{m}{M} \\ &= \frac{4.32 \text{ g}}{(12.0 + 4 \times 1.00)} \\ &= 0.270 \text{ mol} \end{aligned}$$



$$2 \times n(\text{CH}_4) = 1 \times n(\text{H}_2\text{O})$$

$$2 \times (0.270) = n(\text{H}_2\text{O})$$

$$0.540 = n(\text{H}_2\text{O})$$

$$n(\text{H}_2\text{O}) = 0.540 \text{ mol}$$

$$m(\text{H}_2\text{O}) = n \times M$$

$$= 0.540 \text{ mol} \times (2 \times 1.00 + 16.0)$$

$$= 9.72 \text{ g}$$

