

Exercise walk-through

# 4.5

## Stoichiometry

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AP Chemistry

# Stoichiometry

Use the **mole ratio** from the balanced equation: **moles**  $\rightarrow$  **ratio**  $\rightarrow$  **moles**.

## Worked example

8.0 g  $\text{H}_2$  burns ( $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ ):

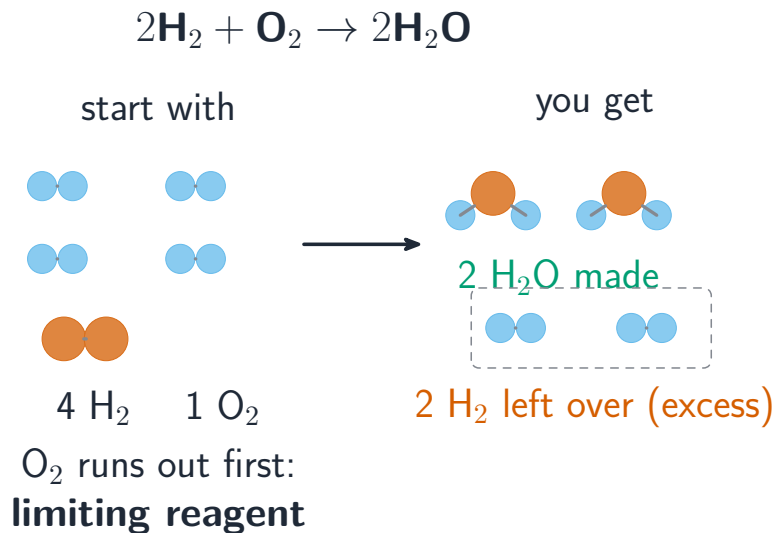
$$n = \frac{8.0}{2.02} = 3.96 \text{ mol} \Rightarrow 71 \text{ g H}_2\text{O}$$

The **limiting reactant** runs out first and caps the product.

## Percent yield

$$\frac{\text{actual}}{\text{theoretical}} \times 100\%$$

# The limiting reactant runs out first and caps the product



The limiting reactant runs out first and decides how much product forms

## Exercises 2.1-2.3

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**2.1** How many moles are in 8.0 g of  $\text{CH}_4$  ( $M = 16 \text{ g/mol}$ )? [2]

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**2.2** For  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , how many moles of  $\text{NH}_3$  form from 2 mol  $\text{N}_2$  (excess  $\text{H}_2$ )? [2]

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**2.3** State what “limiting reactant” means. [1]

## Exercises 2.1-2.3

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**2.1** How many moles are in 8.0 g of  $\text{CH}_4$  ( $M = 16 \text{ g/mol}$ )? [2]

**2.1**

- $8.0 \div 16 = 0.50 \text{ mol}$
- 

**2.2** For  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , how many moles of  $\text{NH}_3$  form from 2 mol  $\text{N}_2$  (excess  $\text{H}_2$ )? [2]

**2.2**

- ratio  $\text{N}_2 : \text{NH}_3 = 1 : 2$ , so  $2 \times 2 = 4 \text{ mol NH}_3$
- 

**2.3** State what “limiting reactant” means. [1]

**2.3**

- The reactant that runs out first, limiting how much product forms

## Exercise 3.1

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**3.1** The mole ratio in a reaction comes from

[1]

☐

**A** the molar masses

**B** the balanced-equation coefficients

**C** the masses given

**D** Avogadro's number

## Exercise 3.1

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**3.1** The mole ratio in a reaction comes from

[1]

☐

**A** the molar masses

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**3.1 B**

- the balanced-equation coefficients

## Exercise 3.2 (a)

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**3.2** For  $2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$ , start with 4.0 mol Al and excess  $\text{Cl}_2$ .

(a) Find the moles of  $\text{AlCl}_3$  produced.

[2]

## Exercise 3.2 (a)

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**3.2** For  $2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$ , start with 4.0 mol Al and excess  $\text{Cl}_2$ .

(a) Find the moles of  $\text{AlCl}_3$  produced.

[2]

(a)

- ratio  $\text{Al} : \text{AlCl}_3 = 2 : 2$ , so 4.0 mol  $\text{AlCl}_3$

## Exercise 3.2 (b)

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**3.2** For  $2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$ , start with 4.0 mol Al and excess  $\text{Cl}_2$ .

(b) Find the moles of  $\text{Cl}_2$  consumed.

[2]

## Exercise 3.2 (b)

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**3.2** For  $2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$ , start with 4.0 mol Al and excess  $\text{Cl}_2$ .

(b) Find the moles of  $\text{Cl}_2$  consumed.

[2]

(b)

- ratio  $\text{Al} : \text{Cl}_2 = 2 : 3$ , so  $4.0 \times \frac{3}{2} = 6.0 \text{ mol Cl}_2$

## Exercise 3.3 (a)

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**3.3** For  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , you have 3.0 mol  $\text{N}_2$  and 6.0 mol  $\text{H}_2$ .

(a) Identify the limiting reactant.

[2]

## Exercise 3.3 (a)

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**3.3** For  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , you have 3.0 mol  $\text{N}_2$  and 6.0 mol  $\text{H}_2$ .

(a) Identify the limiting reactant.

[2]

(a)

- $\text{H}_2$  needs  $3 \times 3.0 = 9.0$  mol but only 6.0 present, so  $\text{H}_2$  is limiting

## Exercise 3.3 (b)

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**3.3** For  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , you have 3.0 mol  $\text{N}_2$  and 6.0 mol  $\text{H}_2$ .

(b) Find the moles of  $\text{NH}_3$  produced.

[2]

## Exercise 3.3 (b)

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**3.3** For  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ , you have 3.0 mol  $\text{N}_2$  and 6.0 mol  $\text{H}_2$ .

(b) Find the moles of  $\text{NH}_3$  produced.

[2]

(b)

- $6.0 \text{ mol H}_2 \times \frac{2}{3} = 4.0 \text{ mol NH}_3$