Solutions

Each answer shows the steps, then the **result**.

2.1

- $n = m/M_r$

$$n = \frac{8.0 \text{ g}}{40 \text{ g mol}^{-1}} = \mathbf{0.20} \text{ mol}$$

2.2

- at r.t.p., 1 mol of gas occupies 24 dm^3

$$V = 0.50 \text{ mol} \times 24 \text{ dm}^3\text{mol}^{-1} = \mathbf{12} \text{ dm}^{\mathbf{3}}$$

2.3

- $n = m/M_r$

$$n = \frac{8.8 \text{ g}}{44 \text{ g mol}^{-1}} = \mathbf{0.20} \text{ mol}$$

2.4

- $V = n \times 24 \text{ dm}^3\text{mol}^{-1}$

$$V = 0.25 \text{ mol} \times 24 \text{ dm}^3\text{mol}^{-1} = \mathbf{6.0} \text{ dm}^{\mathbf{3}}$$

- that is 6000 cm^3

2.5

- divide each % by A_r

$$\frac{52.2}{12} = 4.35, \quad \frac{13.0}{1} = 13.0, \quad \frac{34.8}{16} = 2.175$$

- divide by the smallest (2.175) → 2 : 6 : 1
- empirical formula $\mathbf{C_2H_6O}$

3.1 B

$$n = \frac{22 \text{ g}}{44 \text{ g mol}^{-1}} = \mathbf{0.50} \text{ mol}$$

- A is half of that; C and D treat 22 g as 1 or 2 mol

3.2

(a)

$$n(\text{Mg}) = \frac{12 \text{ g}}{24 \text{ g mol}^{-1}} = \mathbf{0.50} \text{ mol}$$

(b)

- ratio $Mg : MgO = 1 : 1$, so 0.50 mol MgO
- $M_r(MgO) = 24 + 16 = 40$

$$m = 0.50 \text{ mol} \times 40 \text{ g mol}^{-1} = \mathbf{20} \text{ g}$$

3.3

(a)

- $n = c \times V$ with V in dm^3

$$n(\text{HCl}) = 0.10 \text{ mol dm}^{-3} \times \frac{20.0}{1000} \text{ dm}^3 = \mathbf{0.0020} \text{ mol}$$

(b)

- ratio 1 : 1, so 0.0020 mol NaOH in 25.0 cm^3

$$c = \frac{0.0020 \text{ mol}}{25.0/1000 \text{ dm}^3} = \mathbf{0.080} \text{ mol dm}^{\mathbf{-3}}$$

3.4

(a)

- $M_r(CaCO_3) = 40 + 12 + 48 = 100$

$$n = \frac{25.0 \text{ g}}{100 \text{ g mol}^{-1}} = \mathbf{0.250} \text{ mol}$$

(b)

- ratio 1 : 1, so $n(\text{CaO}) = 0.250$ mol
- $M_r(CaO) = 40 + 16 = 56$

$$m = 0.250 \text{ mol} \times 56 \text{ g mol}^{-1} = \mathbf{14.0} \text{ g}$$

(c)

$$\text{percentage yield} = \frac{12.6 \text{ g}}{14.0 \text{ g}} \times 100\% = \mathbf{90.0}\%$$

(d)

- $n(CO_2) = 0.250$ mol

$$V = 0.250 \text{ mol} \times 24 \text{ dm}^3\text{mol}^{-1} = \mathbf{6.0} \text{ dm}^{\mathbf{3}}$$

(e)

$$n(\text{Ca(OH)}_2) = 0.0200 \text{ mol dm}^{-3} \times \frac{50.0}{1000} \text{ dm}^3 = \mathbf{1.00 \times 10^{-3}} \text{ mol}$$

- this is far less than 0.250 mol of CO_2, so the limewater is **not enough**