

Solutions

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

2.1

- moles from mass:

$$n = \frac{m}{M} = \frac{8.0 \text{ g}}{16 \text{ g mol}^{-1}} \quad \text{M1}$$

- $n = \mathbf{0.50}$ mol

2.2

- the coefficients give $\text{N}_2 : \text{NH}_3 = 1 : 2$:

$$n(\text{NH}_3) = n(\text{N}_2) \times \frac{2}{1} = (2 \text{ mol}) \times 2 \quad \text{M1}$$

- $n(\text{NH}_3) = \mathbf{4}$ mol

2.3

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

3.1 B

- the balanced-equation coefficients

3.2

(a)

- the coefficients give $\text{Al} : \text{AlCl}_3 = 2 : 2$:

$$n(\text{AlCl}_3) = n(\text{Al}) \times \frac{2}{2} = 4.0 \text{ mol} \times 1 \quad \text{M1}$$

- $n(\text{AlCl}_3) = \mathbf{4.0}$ mol

(b)

- the coefficients give $\text{Al} : \text{Cl}_2 = 2 : 3$:

$$n(\text{Cl}_2) = n(\text{Al}) \times \frac{3}{2} = (4.0 \text{ mol}) \times \frac{3}{2} \quad \text{M1}$$

- $n(\text{Cl}_2) = \mathbf{6.0}$ mol

3.3

(a)

- hydrogen needed to use all the nitrogen, from $\text{N}_2 : \text{H}_2 = 1 : 3$:

$$n(\text{H}_2)_{\text{needed}} = 3 \times n(\text{N}_2) = 3 \times 3.0 \text{ mol} = 9.0 \text{ mol}$$

- only 6.0 mol is present, so **H₂** is limiting

(b)

- work from the limiting reactant, $\text{H}_2 : \text{NH}_3 = 3 : 2$:

$$n(\text{NH}_3) = n(\text{H}_2) \times \frac{2}{3} = (6.0 \text{ mol}) \times \frac{2}{3} \quad \text{M1}$$

- $n(\text{NH}_3) = \mathbf{4.0}$ mol