

Stoichiometry

Answer key with worked solutions

A. Mole ratios

1. Mole ratios in $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$.

(a) $\text{O}_2 : \text{Al} = 3 : 4$ (b) $\text{Al}_2\text{O}_3 : \text{Al} = 2 : 4 = 1 : 2$

2. O_2 for 6.0 mol Al.

$$6.0 \times \frac{3}{4} = 4.5 \text{ mol of O}_2$$

B. Mass calculations

3. MgO from 12.15 g Mg.

$n(\text{Mg}) = 12.15 \div 24.31 = 0.4998 \text{ mol} \rightarrow n(\text{MgO}) = 0.4998 \text{ mol} (2 : 2)$. $M(\text{MgO}) = 40.31 \text{ g/mol}$,
so mass = $0.4998 \times 40.31 = 20.15 \text{ g}$

4. O_2 from 24.5 g KClO_3 .

$M(\text{KClO}_3) = 122.55 \text{ g/mol}$; $n = 24.5 \div 122.55 = 0.1999 \text{ mol}$. $n(\text{O}_2) = 0.1999 \times 3/2 = 0.2999 \text{ mol}$.
Mass = $0.2999 \times 32.00 = 9.60 \text{ g}$

5. CO_2 from 8.02 g CH_4 .

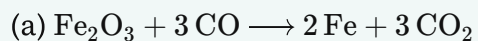
$n(\text{CH}_4) = 8.02 \div 16.04 = 0.500 \text{ mol} \rightarrow n(\text{CO}_2) = 0.500 \text{ mol} (1 : 1)$. Mass = $0.500 \times 44.01 = 22.0 \text{ g}$

6. H_2O from 11.0 g C_3H_8 .

$n(\text{C}_3\text{H}_8) = 11.0 \div 44.09 = 0.2495 \text{ mol} \rightarrow n(\text{H}_2\text{O}) = 0.2495 \times 4 = 0.998 \text{ mol}$. Mass = $0.998 \times 18.02 = 18.0 \text{ g}$

C. Challenge

7. Balance, then find mass of Fe from 100.0 g Fe_2O_3 .



(b) $n(\text{Fe}_2\text{O}_3) = 100.0 \div 159.70 = 0.62617 \text{ mol} \rightarrow n(\text{Fe}) = 0.62617 \times 2 = 1.2523 \text{ mol}$. Mass = $1.2523 \times 55.85 = \mathbf{69.94 \text{ g}}$

8. The 2 g : 1 g mistake.

Coefficients compare **moles**, not grams. 2 mol of Mg (48.62 g) reacts with 1 mol of O_2 (32.00 g); the mass ratio is not 2 : 1.