Stoichiometry Practice — Answer Key

Instructor-reviewed worked solutions • Keep unrounded intermediate values.

Molar masses (g/mol): H_2 2.02 | O_2 32.00 | H_2O 18.02 | N_2 28.02 | NH_3 17.04 | $KClO_3$ 122.55 | $CaCO_3$ 100.09 | CH_4 16.05 | CO_2 44.01 | Al 26.98 | Al_2O_3 101.96 | Mg 24.31 | MgO 40.31

Unless a second reactant is specified, other reactants are in excess. All equations given are balanced.

1. $2\ H_2 + O_2 \rightarrow 2\ H_2O$. If 1.25 mol O_2 reacts with excess H_2, how many moles of H_2O can form?

1.25 mol O_2 × (2 mol H_2O / 1 mol O_2) = 2.50 mol H_2O.

Answer: 2.50 mol H_2O

2. $N_2 + 3\ H_2 \rightarrow 2\ NH_3$. Starting with 0.600 mol N_2 and excess H_2, find moles of NH_3.

0.600 mol N_2 × (2 mol NH_3 / 1 mol N_2) = 1.20 mol NH_3.

Answer: 1.20 mol NH_3

3. $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$. How many moles of O_2 can form from 0.800 mol $KClO_3$?

0.800 mol $KClO_3$ × (3 mol O_2 / 2 mol $KClO_3$) = 1.20 mol O_2.

Answer: 1.20 mol O_2

4. $CaCO_3 \rightarrow CaO + CO_2$. From 2.40 mol $CaCO_3$, calculate moles of CO_2 produced.

2.40 mol $CaCO_3$ × (1 mol CO_2 / 1 mol $CaCO_3$) = 2.40 mol CO_2.

Answer: 2.40 mol CO_2

Intermediate Solutions

5. $N_2 + 3\ H_2 \rightarrow 2\ NH_3$. Calculate grams of NH_3 from 3.00 mol H_2 (N_2 is excess).

3.00 mol H_2 × (2 mol NH_3 / 3 mol H_2) × (17.04 g NH_3 / mol NH_3) = 34.08 g → 34.1 g NH_3.

Answer: 34.1 g NH_3

6. $CaCO_3 \rightarrow CaO + CO_2$. Calculate moles of CO_2 produced from 50.0 g $CaCO_3$.

50.0 g $CaCO_3$ × (1 mol / 100.09 g) × (1 mol CO_2 / 1 mol $CaCO_3$) = 0.49955… mol → 0.500 mol CO_2.

Answer: 0.500 mol CO_2

7. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$. Calculate grams of CO_2 from 16.0 g CH_4 (O_2 excess).

16.0 g CH_4 × (1 mol CH_4 / 16.05 g) × (1 mol CO_2 / 1 mol CH_4) × (44.01 g/mol) = 43.87… g → 43.9 g CO_2.

Answer: 43.9 g CO_2

8. $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$. Calculate grams of Al_2O_3 from 5.40 g Al (O_2 excess).

5.40 g Al × (1 mol / 26.98 g) × (2 mol Al_2O_3 / 4 mol Al) × (101.96 g/mol) = 10.20… g → 10.2 g Al_2O_3.

Answer: 10.2 g Al_2O_3

Advanced Solutions

9. $N_2 + 3\ H_2 \rightarrow 2\ NH_3$. With 14.0 g N_2 and 2.00 g H_2, identify the limiting reactant and calculate theoretical grams of NH_3.

N_2: 14.0/28.02 = 0.4996 mol; H_2: 2.00/2.02 = 0.9901 mol. H_2 requires only 0.3300 mol N_2, so H_2 limits. NH_3 = 0.9901 × (2/3) × 17.04 = 11.25… g → 11.2 g.

Answer: H_2 limiting; 11.2 g NH_3

10. $2\ Mg + O_2 \rightarrow 2\ MgO$. With 12.0 g Mg and 10.0 g O_2, identify the limiting reactant and find theoretical grams of MgO.

Mg: 12.0/24.31 = 0.4936 mol; O_2: 10.0/32.00 = 0.3125 mol. Mg needs 0.2468 mol O_2, so Mg limits. MgO = (12.0/24.31) × 40.31 = 19.897… g → 19.9 g.

Answer: Mg limiting; 19.9 g MgO

11. Using the same reaction and reactant quantities as problem 10, suppose 16.5 g MgO is collected. Find percent yield.

Theoretical yield (unrounded) = (12.0/24.31) × 40.31 = 19.897… g. Percent yield = (16.5 / 19.897…) × 100% = 82.9%.

Answer: 82.9%

12. $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$. From 24.5 g $KClO_3$, find theoretical grams of O_2. If 8.40 g O_2 is collected, calculate percent yield.

Theoretical O_2 = (24.5/122.55) × (3/2) × 32.00 = 9.596… g → 9.60 g. Percent yield = (8.40 / 9.596…) × 100% = 87.5%.

Answer: 9.60 g O_2; 87.5%