Example

What mass (g) of Al_2O_3 is formed if 75.89 g of Al (s) (26.98 g/mol) is reacted with 112.25 g O_2 (g)?

$$4\,Al\,(s) + 3\,O_2\,(g) \rightarrow 2\,Al_2O_3\,(s)$$

a. Balance the chemical equation for the reaction.

b. Find moles of Al (s) available.

$75.89\,g \cdot \frac{1\,mol}{26.98\,g} = 2.81\,mol$

c. Find moles O_2 (g) available.

$112.25\,g \cdot \frac{1\,mol}{32\,g} = 3.51\,mol$

d. Determine if Al (s) or O_2 (g) is the *limiting reactant.*

The reactant that is used up first

$2.81\,mol\,Al \cdot \frac{3\,O_2}{4\,Al} = 2.11\,mol\,O_2$

Example

e. Determine moles of Al_2O_3 that can be produced based on the limiting reactant.

$2.81\,mol\,Al \cdot \frac{2\,Al_2O_3}{4\,Al} = 1.41\,mol\,Al_2O_3$

f. Calculate the mass of Al_2O_3 (101.96 g/mol) that will be produced.

$1.41\,mol \cdot \frac{101.96\,g}{1\,mol} = 143.76\,g$

Example

What mass (g) of $Al_2(SO_4)_3$ (342.15 g/mol) is formed if 31.2 g of $Al(OH)_3$ (78.0 g/mol) is combined with 0.500 mol H_2SO_4?

$2\ Al(OH)_3\ (s) + 3H_2SO_4\ (aq) \rightarrow Al_2(SO_4)_3\ (aq) + 6\ H_2O\ (l)$

a. Balance the chemical equation for the reaction.

b. Find moles of $Al(OH)_3$ (s) available.

$31.2\,g \cdot \frac{1\,mol}{78\,g} = 0.4\ mol$

c. Determine if $Al(OH)_3$ (s) or H_2SO_4 (aq) is the *limiting reactant*.

$0.4\ mol\ Al(OH)_3 \cdot \frac{3\ H_2SO_4}{2\ Al(OH)_3} = 0.6\ mol\ H_2SO_4$

Example

d. Determine moles of $Al_2(SO_4)_3$ that can be produced based on the limiting reactant.

$0.5\ mol\ H_2SO_4 \cdot \frac{1\ Al_2(SO_4)_3}{3\ H_2SO_4} = 0.17\ mol\ Al_2(SO_4)_3$

e. Calculate the mass of $Al_2(SO_4)_3$ that will be produced.

$0.17\ mol \cdot \frac{342.15\,g}{1\,mol} = 58.17\ g$ *Theoretical yield*

f. When the reaction was performed 41.2 g of $Al_2(SO_4)_3$ was produced. Calculate the *percent yield* for the reaction.

$\frac{41.2}{58.17} = 70.8\%$