Stoichiometry Limiting Reagent

1 Consider the following reaction:

$$N_2 + 3\,H_2 \longrightarrow 2\,NH_3$$
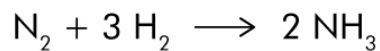
a How many grams of NH_3 can be produced from the reaction of 28 g of N_2 and 25 g of H_2?

b How much of the excess reagent is left over?

2 Consider the following reaction:

$$Mg + 2\,HCl \longrightarrow MgCl_2 + H_2$$
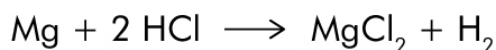
What volume of H_2 at STP is produced from the reaction of 50 g of Mg and 75 g of HCl?

3 Zinc and sulfur react to form zinc sulfide according to the following equation:

$$Zn + S \longrightarrow ZnS$$
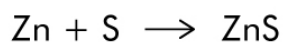
Suppose 25 g of zinc and 30 g of sulfur react. Which reagent is limiting?

Stoichiometry Limiting Reagent
Answers

1 Consider the following reaction:

$$N_2 + 3\,H_2 \longrightarrow 2\,NH_3$$

a How many grams of NH_3 can be produced from the reaction of 28 g of N_2 and 25 g of H_2?

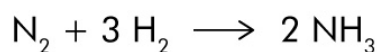$$28\text{ g }N_2 \times \frac{1\text{ mol }N_2}{28\text{ g }N_2} \times \frac{2\text{ mol }NH_3}{1\text{ mol }N_2} \times \frac{17\text{ g }NH_3}{1\text{ mol }NH_3} = 34\text{ g }NH_3$$

$$25\text{ g }H_2 \times \frac{1\text{ mol }H_2}{2\text{ g }H_2} \times \frac{2\text{ mol }NH_3}{3\text{ mol }H_2} \times \frac{17\text{ g }NH_3}{1\text{ mol }NH_3} = 142\text{ g }NH_3$$
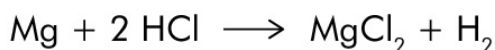
34 g of NH_3 can be produced.

b How much of the excess reagent is left over?

$$28\text{ g }N_2 \times \frac{1\text{ mol }N_2}{28\text{ g }N_2} \times \frac{3\text{ mol }H_2}{1\text{ mol }N_2} \times \frac{2\text{ g }H_2}{1\text{ mol }H_2} = 6\text{ g }H_2\text{ used}$$

25 g H_2 – 6 g H_2 = 19 g H_2 remains

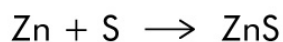**2** Consider the following reaction:

$$Mg + 2\,HCl \longrightarrow MgCl_2 + H_2$$

What volume of H_2 at STP is produced from the reaction of 50 g of Mg and 75 g of HCl?

$$50\text{ g Mg} \times \frac{1\text{ mol Mg}}{24.3\text{ g Mg}} \times \frac{1\text{ mol }H_2}{1\text{ mol Mg}} \times \frac{22.4\text{ L }H_2}{1\text{ mol }H_2} = 46\text{ L }H_2$$

$$75\text{ g HCl} \times \frac{1\text{ mol HCl}}{36.5\text{ g HCl}} \times \frac{1\text{ mol }H_2}{2\text{ mol HCl}} \times \frac{22.4\text{ L }H_2}{1\text{ mol }H_2} = 23\text{ L }H_2$$

23 L H_2 is produced.

3 Zinc and sulfur react to form zinc sulfide according to the following equation:

$$Zn + S \longrightarrow ZnS$$

Suppose 25 g of zinc and 30 g of sulfur react. Which reagent is limiting?

$$25\text{ g Zn} \times \frac{1\text{ mol Zn}}{65.4\text{ g Zn}} \times \frac{1\text{ mol ZnS}}{1\text{ mol Zn}} \times \frac{97.48\text{ g ZnS}}{1\text{ mol ZnS}} = 37.3\text{ g ZnS}$$

$$30\text{ g S} \times \frac{1\text{ mol S}}{32\text{ g S}} \times \frac{1\text{ mol ZnS}}{1\text{ mol S}} \times \frac{97.48\text{ g ZnS}}{1\text{ mol ZnS}} = 91.2\text{ g ZnS}$$

Zn is the limiting reagent.