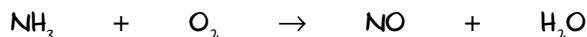


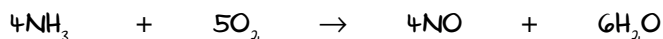
# Limiting reactants

## WORKIT!

In an experiment, 3.2 g of  $\text{NH}_3$  reacts with 3.5 g of  $\text{O}_2$ . Find the limiting reactant.



**Step 1** Balance the equation



**Step 2** Calculate the number of moles for each of the reactants

$$\text{NH}_3: 3.25 \text{ g} / 17 \text{ g mol}^{-1} = 0.19 \text{ moles}$$

$$\text{O}_2: 3.5 \text{ g} / 32 \text{ g mol}^{-1} = 0.11 \text{ moles}$$

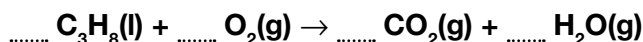
**Step 3** Compare the ratios of what we have versus what the balanced equation tells us we need:

From the equation we can see that 4 moles of  $\text{NH}_3$  react with 5 moles of  $\text{O}_2$ . This tells us that if we have 0.19 moles of  $\text{NH}_3$  we need 0.23 moles of  $\text{O}_2$ .

What we actually have is 0.19 moles of  $\text{NH}_3$  reacting with 0.11 moles of  $\text{O}_2$ .

This tells us that  $\text{NH}_3$  was added to excess and  $\text{O}_2$  is the limiting factor for the reaction.

Propane is a fuel that is commonly used in portable stoves and increasingly in vehicles, where it is known as liquid petroleum gas (LPG). It combusts in the presence of oxygen. The chemical equation is shown below:



To develop an efficient car engine, a manufacturer is testing mixes with different amounts of oxygen and propane. In this test, 14.8g of  $\text{C}_3\text{H}_8$  reacts with 3.44g of  $\text{O}_2$ .

- a Balance the equation above. (2 marks, ★★)
- b Calculate the mass of carbon dioxide produced in the reaction. (2 marks, ★★★)

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- c Identify the limiting reagent and suggest how the manufacturer could change the quantities of propane and oxygen to maximise the efficiency of an engine. (5 marks, ★★★★★)

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