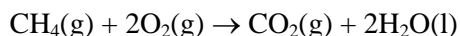


Practical 1 – Chapter 1

Methane rockets, a demonstration

This demonstration shows the importance of stoichiometry.

The reaction between methane and oxygen is demonstrated using two different ratios of methane to oxygen. The mixture which corresponds to the correct stoichiometric ratio should give the more spectacular reaction.



Safety

- Methane is extremely flammable.
- Wear eye protection throughout the demonstration and ear protection when lighting the rocket.
- Students should sit well back and cover their ears when the rockets are lit.
- Make sure there are no obstacles in the rockets' path, and no flammable materials behind the place where they will be lit.

What to do

- 1 Take two plastic bottles. Various sizes can be used but, if this is the first time you have carried out this experiment, it is probably best to use a maximum size of 500 ml.
- 2 Use a measuring cylinder and water to determine the volume of the first bottle. Then pour in half the volume of water and mark the level with a waterproof pen on the side of the bottle. This bottle will be used to produce a mixture of 1 part methane and 1 part oxygen.
- 3 Repeat with the second bottle, but mark the level of one-third of the bottle's volume. This bottle will be used to produce a mixture of 1 part methane and 2 parts oxygen.
- 4 Completely fill both bottles with water. Now invert them in a large trough of water, so that the opening of the bottle is below the water level. Then, using a rubber tube attached to the gas tap, fill each bottle with methane to the pen marks on the side of the bottles. Half of the first bottle should now be filled with methane (and the rest of the bottle still filled with water) and one-third of the second bottle should be filled with methane.
- 5 Displace the remaining water in the bottles with oxygen from an oxygen cylinder. Stop filling when the bottle is just full of gas – do not overfill. Place a rubber bung in each bottle. If an oxygen cylinder is not available, the oxygen may be generated by using the decomposition of hydrogen peroxide using MnO_2 as a catalyst. Remember to discard the initial gas produced as this will be mostly air.
- 6 The rockets can now be launched, either outside or out of a window. Set up some sort of 'launcher' (e.g. half of a drain pipe or a section of guttering) to keep the rocket on course.
- 7 You should wear ear protection and eye protection. All students should stand well back, away from the rockets. Students should not stand in front of the rockets or directly behind. Students should put their hands over their ears.
- 8 To launch the rockets remove the rubber bung and, using a lit splint held at arms length (or attached to a metre rule if preferred), ignite the gas at the neck of the bottle. Do not stand directly behind the bottle while you do this.
- 9 Launch the 1 : 1 rocket first – this should not do very much. Then launch the bottle containing methane and oxygen in the ratio 1 : 2; this should give a large explosion and travel quite a distance.