The ‘whoosh’ bottle experiment

This experiment shows the power of the reaction that can take place when an alcohol burns.

Here is a method used by a teacher to show this experiment:

* Use an empty polycarbonate water bottle of
volume 20 dm3.

Source: Adrian Guy

* Add approximately 10cm3 of methanol into the bottle.
* Swirl the methanol inside the bottle.
* Then decant the excess methanol from the bottle.
* Place a rubber stopper or bung into the top of the bottle.
* Connect a wooden splint to the end of a metre rule, and light the end of the splint with a match.
* Carefully place the lighted splint (now at arm’s length) above the stopper on the bottle, and remove the stopper with the other hand.
* A spectacular reaction should now take place. Watch the reaction at <https://youtu.be/yl89heCsBpQ>.

Answer the questions below.

1. Explain why the methanol is swirled within the bottle before it is ignited.

Answer: To increase the surface area of the methanol so that it may form a vapour.

1. Define the following terms used in this method:
2. Decant

Answer: To pour off a liquid or to pour from one container to another.

1. Excess

Answer: More than that needed, or left over.

1. State the molecular formula of methanol.

Answer: CH4O.

1. Draw the structure of a methanol molecule in which all bonds are shown.



1. In the reaction in the bottle, methanol is burning to form carbon dioxide and water.

Write a chemical equation to show this reaction.

Answer: CH3OH + 3/2O2 🡪 CO2 + 2H2O or 2CH3OH + 3O2 🡪 2CO2 + 4H2O

1. Explain why this reaction produces a ‘whoosh’ when it takes place within a bottle.

Answer: Hot gases form and are forced out of the bottle opening under high pressure.

1. The internal volume of the bottle was 20 dm3.

Write this volume in the following units:

1. cm3.

Answer: 20,000 cm3.

1. m3.

Answer: 0.020 m3.

1. The mass of methanol vapour remaining in the bottle before ignition was 5.2 g.

Calculate the concentration of the methanol vapour in:

1. g / dm3.

Answer: $\frac{5.2 g}{20 dm^{3}}$ = **0.26 g / dm3**

1. mol / dm3, and writing this answer in standard form.

RAM data: C = 12, H = 1, O = 16.

Answer: RFM for methanol = 32

 Moles of methanol = $\frac{0.26 g}{32}$ = 8.125 x 10-3 mol / dm3

1. Calculate the mass of carbon dioxide formed when 5.2 g of methanol vapour is ignited.

You will need to use your chemical equation from question 5 to help you.

Show your working clearly.

Answer: CH3OH + 3/2O2 🡪 CO2 + 2H2O

 Moles of methanol = $\frac{5.2 g}{32}$ = 0.1625 mol.

 Moles of carbon dioxide formed = 0.1625 mol (1 : 1 ratio from the chemical equation) .

 Mass of carbon dioxide = 0.1625 × RFM of CO2
= 0.1625 × 44 = 7.15 g

1. After the reaction in a different bottle had taken place, it was allowed to cool.

A colourless liquid, A, is observed at the base of the bottle.

1. Name liquid A.

Answer: Water.

1. If the volume of liquid A was 4.50 cm3, calculate the mass of methanol that was burnt in the bottle.

Assume that the density of liquid A = 1 g / cm3.

Answer: CH3OH + 3/2O2 🡪 CO2 + 2H2O

As the density of water = 1 g/cm3, the mass of water formed = 4.50 g.

Moles of water formed = $\frac{4.50 g}{18}$ = 0.25 mol.

Moles of methanol used = $\frac{0.25 }{2}$ = 0.125 mol.

Mass of methanol = 0.125 × 32 = 4.0 g

Instructions for this teacher demonstration are available at [rsc.li/30q7C4S](https://rsc.li/30q7C4S).