

## Identifying the products of combustion

In this demonstration a solid **hydrocarbon burns** and a pump is used to draw the gaseous combustion products over a piece of **cobalt chloride** paper and through limewater to show the presence of **water** and **carbon dioxide** respectively.

[Read our standard health & safety guidance](#)

### Lesson organisation

With this demonstration, the apparatus can be left running for some time and students can file past in small groups to see it more closely. Alternatively a flexicamera can be used - linked to a projector.

If students are not familiar with the cobalt chloride paper and limewater tests, either demonstrate these separately or allow students to try the tests themselves.

Assuming everything is already set up, this demonstration takes only a few minutes.

### Apparatus and chemicals

Eye protection

Glass funnel, about 6 cm in diameter

Boiling tubes, 2

Two-holed rubber bungs, 2, to fit the boiling tubes, and fitted with one long and one short piece of glass tubing (see diagram)

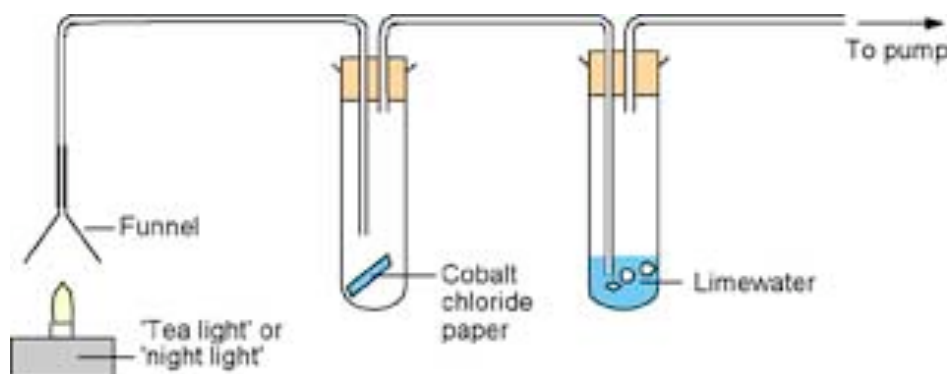
Pump, see Standard procedure: [Filter pumps](#).

Glass or plastic tubing for connections (see note 3)

Candle

Piece of blue cobalt chloride paper (Toxic) (see note 1)

About 20 cm<sup>3</sup> of limewater (treat as Irritant) (see note 2)



## Technical notes

Cobalt chloride/cobalt chloride paper (**Toxic, Danger to the environment**) (see note 1)  
Refer to CLEAPSS Hazcard 25 and CLEAPSS Recipe card 46

Calcium hydroxide solution, 'limewater' (treat as **Irritant**) (see note 2) Refer to CLEAPSS Hazcard 18 and CLEAPSS Recipe card 15

**1** Cobalt chloride paper can be stored in a desiccator. Minimise handling of cobalt chloride paper (**Sensitiser**) and wash hands after use (cobalt chloride is a **category 2 carcinogen**).

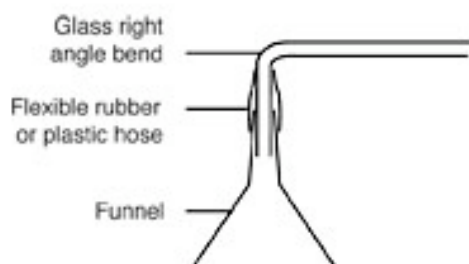
See Standard procedure: [Make your own cobalt chloride paper.](#)

**2** Ideally, the limewater (a saturated solution of calcium hydroxide,  $\text{Ca}(\text{OH})_2$ ) should be made fresh on the day.

**3** Care should be taken with the right-angle bend connected to the funnel. If this is made of flexible tubing, it can get hot and melt.

Ideally, the glass stem of the funnel should be bent into a right-angle. Alternatively, join a standard funnel onto a right angled piece of glass tubing using epoxy resin.

A more temporary arrangement is to slide one arm of a right-angled piece of glass tubing inside the stem of the funnel and seal the join on the outside with a piece of flexible tubing.



Temporary right-angled bend

**4** A 'tealight' or 'nightlight' is more squat and so is more stable than a table candle.

## Procedure

HEALTH & SAFETY: Wear eye protection

**a** Before the demonstration, assemble the apparatus as shown in first diagram. Ensure that the connections to the boiling tubes are the correct way round.

**b** Place a piece of blue cobalt chloride paper into the first boiling tube and half-fill the second boiling-tube with limewater.

**c** At the start of the demonstration, turn on the pump so that a gentle stream of air is drawn through the apparatus.

**d** Light the candle and leave for a few minutes until the cobalt chloride paper turns pink (from blue) and the limewater goes milky. This indicates the presence of water and carbon dioxide respectively.

## Teaching notes

Some students will know that air contains both water vapour and carbon dioxide. To show that the changes observed are not due to these alone, repeat the experiment without the candle and note how much longer it takes for any changes to be observed.

Understanding the process of burning is important at all levels of chemistry. Emphasise that burning in air is a reaction with oxygen. The elements hydrogen and carbon are present in hydrocarbons, such as candle wax. Students will quite readily appreciate that carbon reacts with oxygen to form carbon dioxide, but often need help to grasp that hydrogen combines with oxygen to form water.

The production of carbon dioxide could lead to discussion of the role of this gas in the greenhouse effect.

The experiment could be extended to burning alcohols with a spirit burner.

Health and Safety checked, November 2006

## Standard techniques

[Making and using cobalt chloride paper](#)

## Additional activity:

### Acid in the air

Burning fossil fuels such as petrol releases acidic substances into the atmosphere, and these can corrode metals.

<http://www.practicalchemistry.org/experiments/introductory/air-and-atmosphere/acid-in-the-air,289,EX.html>

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## Further information



### Gemma – Automotive Apprentice

Modern motor vehicles are very sophisticated machines with electronics responsible for most of the major advances in engine performance and safety. After starting an Apprenticeship, which includes achieving a Level 2 national vocational qualification (NVQ), the obvious next step is to consider moving onto an Advanced Apprenticeship, which will get you to an NVQ Level 3. While on an apprenticeship scheme you will be working for an employer which could hold a major car franchise or be a smaller organisation working on multiple franchises. Many of the apprentices attend local colleges on a part time basis whilst some will attend special training centres owned by the car manufacturers. Having completed your advanced

apprenticeship you can become an associate member of the Institute of Motor Industries.

<http://www.motor.org.uk/> Membership with IMI allows you to identify further training opportunities and plan your career within the motor industry.

For more information on qualifications see our Beyond School page at:

[http://www.futuremorph.org/16-19/beyond\\_school.cfm](http://www.futuremorph.org/16-19/beyond_school.cfm).

More information on automotive apprenticeships across the United Kingdom can be found at:

<http://www.motor.org.uk/standards-and-qualifications/apprenticeships.html>.

Once your Apprenticeship is complete, there is a well recognised progression from service technician through jobs such as master technician, workshop controller, diagnostic technician MOT examiner and service reception. Specialisms other than light vehicle mechanic include electrics, heavy vehicle mechanic, parts consultant, fast fit technician and body repair specialist. Motorcycle maintenance and repair is another possibility. There are plenty of options. For more information on these jobs, visit:

<http://www.motor.org.uk/careers/index.html>.

An obvious but important point about the vehicle maintenance and repair sector, is that it is a branch of engineering. You could decide to take a BTEC Diploma (full time) in Vehicle Technology. That could, in turn, lead to a Foundation Degree in Automotive Engineering or an Honours degree in mechanical engineering, automotive engineering or a combination of the two. Accredited degrees can lead to becoming a Chartered Engineer through the Institute of Motor Industries

Deciding which route to take is down to personal choice, but there is a route to suit most people's learning style, whether it's practical or more theoretical.



Studying science and maths can transform your career options.  
Future Morph: become someone.