Enthalpy change of combustion

Equipment (per group)

- 100 cm^3 copper calorimeter or conical flask up to 250 cm^3
- Alcohol spirit burner with lid, containing pure ethanol or IDA*
- Mass balance – measuring to 2 decimal places
- 100 cm^3 measuring cylinder
- Clamp stand with 2 bosses and 2 clamps
- Alcohol thermometer reading +/- 1°C including a scale from -10 to +100°C
- Glass stirring rod or calorimeter stirrer
- Heatproof mat
- Water
- Matches or Bunsen burner and wooden splints to light the spirit burner
- Tongs
- Paper towels
- Eye protection: safety glasses to EN166 F

*Pure ethanol is preferable to industrial denatured alcohol (IDA) which contains 95% ethanol.

Find the full method in the supporting resources, available from: rsc.li/4a2Ko7l.

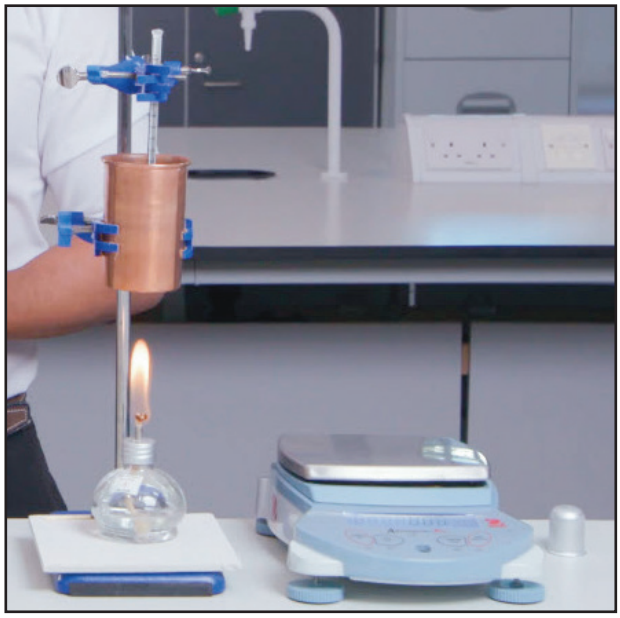
Additional optional equipment

To improve heat transfer to the water, learners can use a calorimeter lid, insulation and a draught shield made from heatproof mats.

Teachers may ask for spirit burners containing propan-1-ol, butan-1-ol and pentan-1-ol but this is optional, so you do not need to provide them as core requirement.

Preparation and tips

Ideally, use small spirit burners (50 cm^3 capacity). Check that you have spirit burners that are suitable for this experiment. Do not use aromatherapy diffusers. If the capacity of the spirit burner is more than 50 cm^3, reduce it, for instance by packing with mineral or cotton wool, partially filling with epoxy resin or ceramic beads.



It is important that the wick fits tightly in the wick holder and that the wick holder fits tightly in the burner, or it might cause an explosion. You may need to adjust the wicks of the spirit burners or put new wicks in. You can use a pair of forceps to do this. If you add a new wick, you cannot use the burner immediately as the wick needs time for the alcohol to soak into it.

Show the video or demonstrate the equipment set up. Place the spirit burner on a heatproof mat on the base of a clamp stand. Don't turn the stand round so that the burner is only sitting on the heatproof mat as the clamp stand is not very stable in this configuration.

Have the flame so it is touching the copper calorimeter or conical flask. Once alight, do not move the burner around the laboratory. Instruct learners to keep their spirit burner the correct way up to avoid spillages.

Learners will use tongs to put a lid onto the spirit burner to extinguish it, so each burner must have a lid. Tell learners not to blow out the flame or try to put it out by licking their fingers and pressing on the wick. The copper calorimeter or conical flask will get hot. They should let it cool before emptying the water.

The bottom of the calorimeter may be sooty. Ask the learners to wipe the bottom of the container with some paper towel to remove the soot after they have finished the experiment. Check the equipment both before and after the experiment to make sure they have cleaned the soot.

Safety

- Read our standard health and safety guidance (available from: rsc.li/3IAmFA0) and carry out a risk assessment before running any live practical.
- Refer to SSERC/CLEAPSS Hazcards and recipe sheets. Hazard classification may vary depending on supplier.
- Follow the notes above on how to prepare spirit burners for this experiment to mitigate risk of explosion. Ensure learners understand how to carry out this experiment safely to avoid burns and spills.
- Work in a well-ventilated laboratory.

Chemical supplied for the practical	Preparation
Ethanol $C_2H_6O(l)$  **DANGER** Highly flammable liquid and vapour. ***or*** IDA (Industrial Denatured Alcohol), 95% $C_2H_6O(l)$  **DANGER** Highly flammable liquid and vapour. Harmful if swallowed. May cause damage to organs. CLEAPSS Hazcard HC040A.	IDA is a cheaper alternative to pure ethanol.
Propan-1-ol (*optional*) $C_3H_8O(l)$  **DANGER** Highly flammable liquid and vapour. May cause drowsiness or dizziness. Causes serious eye damage. CLEAPSS Hazcard HC084A.	

Chemical supplied for the practical	Preparation
Butan-1-ol (*optional*) $C_4H_{10}O(l)$  **DANGER** Flammable liquid and vapour. Causes skin irritation. Causes serious eye damage. May cause respiratory irritation. May cause drowsiness or dizziness. Harmful if swallowed. CLEAPSS Hazcard HC084B.	
Pentan-1-ol (*optional*) $C_5H_{12}O(l)$  **WARNING** Flammable liquid and vapour. May cause respiratory irritation. May cause skin irritation. May cause eye damage. CLEAPSS Hazcard HC084C.	

Disposal

- Store full spirit burners in the flammable cupboard if you are going to need them again soon. Otherwise, empty the burners and keep the alcohols in properly labelled containers in the flammable cupboard. When refilling the spirit burners, remember to allow time for the wick to soak up the alcohol before use.
- Wipe any soot from the bottom of the calorimeters using paper towel or a damp cloth. If using paper, dispose of it in the general waste bin.