

How much energy comes from burning fuels?

In this experiment you are going to find out how much energy comes from one burning fuel and compare this with other fuels. You should work in pairs.

Equipment

- Spirit burner containing an alcohol
- Splints
- Calorimeter
- Heat shield
- 100-200 cm³ water
- 50 cm³ or 100 cm³ measuring cylinder or 50 cm³ pipette
- Protective mat
- Eye protection
- Thermometer reading 0-110 °C in 0.1 °C increments
- Access to a balance
- Retort stand, boss and clamp.

What you do

- Put 100 cm³ of water in the calorimeter.
- Record the temperature of the water.
- Clamp the calorimeter in position about 10 cm above the protective mat.
- Find the mass of a spirit burner containing an alcohol.
- Place the burner under the calorimeter and light the wick.
- Place the heat shield around the apparatus.
- Stir the water with the thermometer.
- Stop heating when the temperature has risen by 20 °C.
- Replace the cap on the burner.
Reweigh the burner as soon as possible.
- Keep noting the temperature – record the highest value reached.

If you can, repeat the experiment with other alcohols.
Try to keep all the factors the same.

Working out the amount of energy released

The energy change that happens when a fuel burns is called **the enthalpy change of combustion**. You are going to calculate the enthalpy change of combustion for the alcohols you burned.

1. You need to know:
 - the mass of alcohol burned
 - the temperature rise of the water
 - the mass of the water (if you used 100 cm³ this will be 100 g).
2. Find out the amount of energy transferred to the water.

energy (J) = mass of water x specific heat capacity of water x temperature rise

energy (J) = 100 x 4.2 x temperature rise you measured

3. Convert your mass of alcohol to moles of alcohol.
4. Divide the energy transferred to the water by the number of moles of alcohol to find the enthalpy change of combustion.

Plotting a graph

Plot a graph of the energy changes of combustion.

Put the enthalpy change of combustion along the side.

Put the number of carbon atoms in the alcohols along the bottom.

What is really happening?

1. Write a word equation for the reaction between the alcohol and oxygen.
2. Use a molecular model.
 - Make a molecular model of one of the alcohols and some molecules of oxygen (O_2). These molecules are there at the start.
 - Tear the molecules to pieces. Where does this energy come from in the reaction?
 - Now put the molecules back together to make the products. Make sure that all the atoms are used up in making new molecules. You may need to make more oxygen and alcohol molecules to make the equation 'balance'.
3. Now write a balanced equation for the reaction showing the numbers of molecules involved.
4. Where did the energy come from that was transferred to the water?

Discussion and summary

After the discussion about this experiment, write a summary to show that you understand where energy comes from in a combustion reaction.