Edexcel Chemistry GCSE

CP 8: Investigate the temperature rise produced in a known mass of water by the combustion of the alcohols ethanol, propanol, butanol and pentanol

Notes

Combustion of alcohols

Aim

Investigate the temperature rise produced in a known mass of water by the combustion of the alcohols ethanol, propanol, butanol and pentanol.

Equipment list

- Copper can
- Clamp stand
- 100 cm^3 measuring cylinder
- Thermometer
- Digital balance
- Wooden splint and matches
- Heatproof mat
- Access to a tap

Chemicals required

- Ethanol
- Propanol
- Butanol
- Pentanol

Method

1. Place a copper can in a clamp stand. Adjust the height so that the copper can will sit just above the flame of the spirit burner.
2. Using a measuring cylinder, pour 100 cm^3 of water into the copper can. Record the initial temperature.
3. Measure the initial mass of the spirit burner and lid containing the first alcohol.
4. Place the spirit burner under the copper can. Take off the lid and light with a wooden splint.
5. Replace the lid of the spirit burner when the temperature has risen about 20°C. Make sure to stir the water constantly. Record the final temperature.
6. Measure the final mass if the spirit burner and lid.
7. Repeat steps 2 to 6 with the other alcohols. Make sure fresh water is used in each experiment.

Key points

- Possible sources of error in this experiment are: heat loss to surroundings, not all flames are the same height from different spirit burners, incomplete combustion and evaporation of alcohol while weighing.
- A digital temperature probe is more precise than a thermometer and can measure the temperature to two decimal places.
- For a fair comparison, the following variables must be controlled: mass/volume of water, height of copper can above wick, height of flame, shape of copper container and (higher only) the number of moles of alcohol.
- The equation for the combustion of ethanol is: $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

Safety precautions

- Use a wooden splint to light the spirit burner rather than a match to reduce risk of burns.
- Don't move the spirit burner when lit.
- Ensure the room is well ventilated.
- Tie back long hair.
- Don't leave the flame unattended.

Analysis of Results

The results from this experiment can be recorded in a table similar to the one below:

	Initial temperature of water (°C)	Final temperature of water (°C)	Temperature change of water (°C)	Initial mass of spirit burner (g)	Final mass of spirit burner (g)	Change in mass of spirit burner (g)
Ethanol						
Propanol						
Butanol						
Pentanol						

Increasing the number of carbons in a molecule means a greater temperature increase.