

Splitting crude oil into alkanes and alkenes

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab

Name: _____ Date: _____ Class: _____

Cracking turns long, unreactive molecules into shorter, more useful ones. In this lab you crack liquid paraffin over a hot catalyst, collect the gas that forms and test it with bromine water to find out whether the product is saturated or unsaturated. You also analyse how the gas volume grows with time.

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Aim

To crack liquid paraffin using hot aluminium oxide, collect the gas that forms, and show that it is an alkene by its reaction with bromine water.

Equipment

- hard-glass boiling tube with a bung and a bent delivery tube
- mineral wool, liquid paraffin (a few drops), aluminium oxide pieces
- Bunsen burner, heat-proof mat, clamp and stand
- trough of water, two test tubes, stopwatch, dropper with dilute bromine water
- safety goggles

Safety

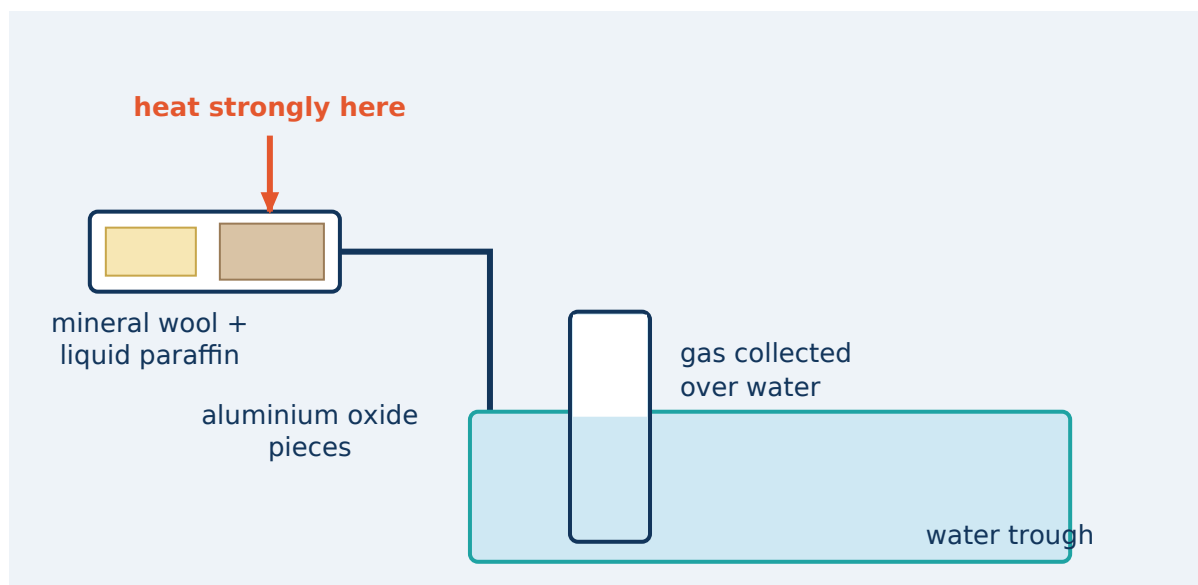
Safety

Wear goggles. Remove the delivery tube from the water **before** you stop heating, or cold water will suck back into the hot tube and crack it. Bromine water is toxic and irritating: use dilute solution, keep it away from your skin and work in a ventilated room. The gas formed is flammable: keep flames away from the collecting tube.

Method

1. Soak a piece of mineral wool in liquid paraffin and push it to the closed end of the boiling tube.
2. Place 4 to 5 aluminium oxide pieces in the middle of the tube, clamp the tube nearly horizontal and fit the bung and delivery tube.
3. Fill a test tube with water, invert it in the trough and put the end of the delivery tube under it.

- Heat the aluminium oxide strongly. Occasionally warm the mineral wool to send paraffin vapour over the hot pieces.
- Throw away the first test tube of gas (it contains air). Collect a second tube and record the total volume of gas every 2 minutes, using test tubes marked in cm^3 or a gas syringe.
- Remove the delivery tube from the water, then stop heating.
- Add 2 cm^3 of dilute bromine water to a tube of the gas, stopper it and shake. Repeat with 2 drops of liquid paraffin.



Set-up for cracking liquid paraffin and collecting the gas over water.

Results

A class recorded the total volume of gas collected and the bromine water test:

Time (min)	2	4	6	8	10
Total gas volume (cm^3)	4	11	18	24	28

Sample	Bromine water result
gas from cracking	orange to colourless at once
liquid paraffin	stays orange

Analysis questions

Question 1 Plot the data

Plot a graph of total gas volume (y axis) against time (x axis) and describe its shape.

Question 2 Average rate

Calculate the average rate of gas production over the full 10 minutes.

Question 3 Rate between two times

Calculate the average rate between 2 and 6 minutes and compare it with the rate between 8 and 10 minutes.

Question 4 Meaning of the bromine result

Explain what the bromine water result for the gas shows. Why was liquid paraffin tested as well?

Question 5 Write an equation

Liquid paraffin contains long alkanes. Write a balanced equation in which $C_{16}H_{34}$ cracks into one alkane with 8 carbon atoms and two molecules of the same alkene. Name the alkene.

Question 6 Safety step

Explain why the delivery tube must be taken out of the water before heating stops.

Question 7 Why discard the first tube

Give two reasons why the first test tube of gas is thrown away.

Question 8 Better gas measurement

Suggest two changes to the cracking lab that would make the gas volumes more trustworthy.