

Alcohols, acids, esters and polymers explained

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

Name: _____ Date: _____ Class: _____

Fermentation is the biological way to make ethanol. In this lab you measure how much carbon dioxide yeast produces from sugar at six temperatures and decide the best temperature for the process, then link the gas volume to the amounts of glucose and ethanol involved.

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Aim

To find how temperature affects the rate of fermentation of sugar by yeast, by measuring the volume of carbon dioxide made in 10 minutes.

Equipment

- six 100 cm³ conical flasks with bungs and delivery tubes
- 100 cm³ gas syringe, stopwatch, thermometer
- dried yeast (5 g per flask), sugar (10 g per flask), warm water
- six water baths or beakers at 10, 20, 30, 40, 50 and 60 °C
- safety goggles

Safety

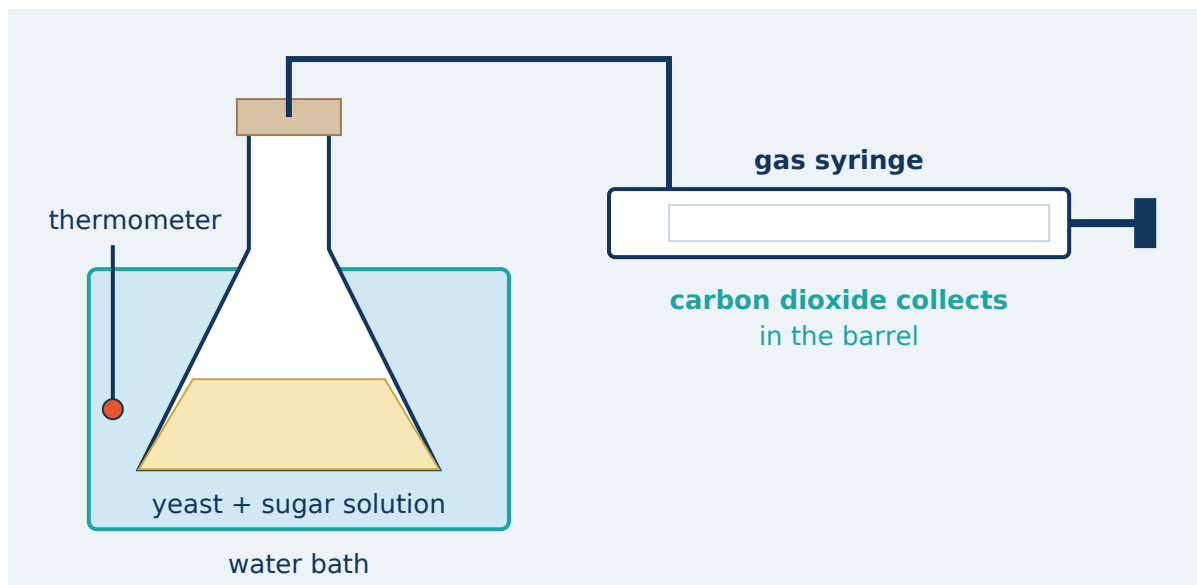
Safety

Wear goggles. Never taste or drink the mixture, even though it contains yeast and sugar, because it may contain bacteria and some ethanol. Hot water at 50 to 60 °C can scald: pour carefully and use a cloth to handle hot beakers. Wash your hands after the lab.

Method

1. Mix 5 g of yeast, 10 g of sugar and 50 cm³ of water at the test temperature in a flask, and swirl.
2. Stand the flask in the water bath for 3 minutes so the contents reach the bath temperature, then check it with the thermometer.
3. Fit the bung and delivery tube to the gas syringe and make sure the syringe reads 0 cm³.
4. Start the stopwatch. Read the gas volume after exactly 10 minutes.
5. Repeat at the other five temperatures with fresh mixtures, keeping the masses and volumes the same.

6. Test a sample of the gas with limewater in a separate tube.



Set-up for measuring the carbon dioxide made by yeast at different temperatures.

Results

A class recorded the volume of gas collected in 10 minutes:

Temperature (°C)	10	20	30	40	50	60
Volume of CO ₂ in 10 min (cm ³)	3	11	24	36	17	2

Analysis questions

Question 1 Plot and describe

Plot gas volume against temperature and describe the shape of the graph.

Question 2 Optimum temperature

State the best temperature in the data and calculate the average rate at that temperature.

Question 3 Compare 20 and 40

How many times faster is the reaction at 40 °C than at 20 °C?

Question 4 Explain the fall

Explain why the volume is lower at 50 and 60 °C than at 40 °C.

Question 5 Moles and mass at 40 °C

At room temperature 1 mol of gas occupies 24 000 cm³. Calculate the moles of carbon

dioxide at 40 °C, the moles and mass of glucose used ($M = 180 \text{ g/mol}$) and the mass of ethanol formed ($M = 46 \text{ g/mol}$).

Question 6 Control variables

Name three variables that must be controlled.

Question 7 Identify the gas

Name the gas and describe the test.

Question 8 Evaluate the method

Carbon dioxide is slightly soluble in water. Say how this affects the results and suggest two improvements.