



# Cambridge IGCSE™

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**CO-ORDINATED SCIENCES**

**0654/05**

Paper 5 Practical Test

**For examination from 2025**

SPECIMEN PAPER

**2 hours**

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

## INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

## INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].
- Notes for use in qualitative analysis are provided in the question paper.

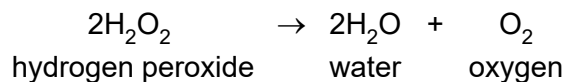
For Examiner's Use	
1	
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<b>Total</b>	

This document has **20** pages. Any blank pages are indicated.



- 1 You are going to investigate an enzyme-catalysed reaction using celery cells and hydrogen peroxide,  $\text{H}_2\text{O}_2$ .

Hydrogen peroxide is broken down by catalase which is an enzyme found in celery cells. Oxygen gas is released during the reaction.

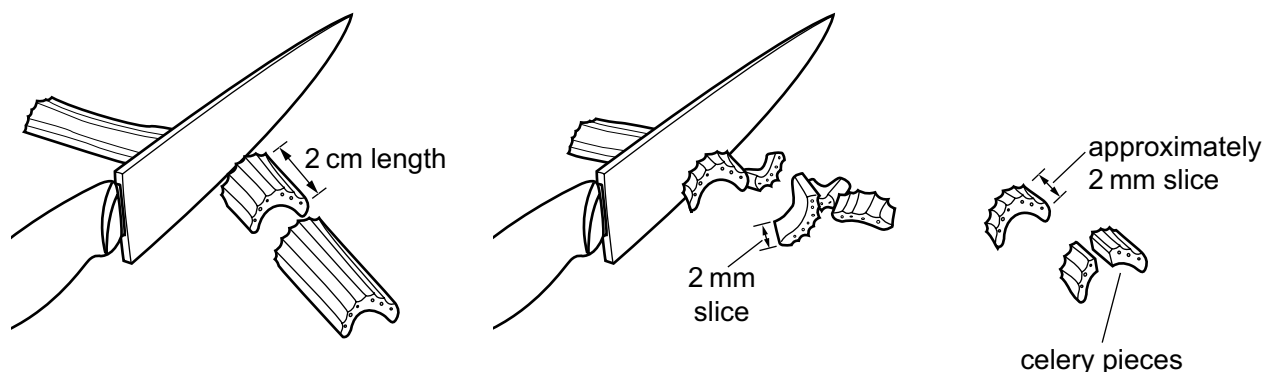


**Read all the steps in the procedure but DO NOT CARRY THEM OUT until you have drawn a table for your results in the space provided in (a)(i).**

You should use the safety equipment provided while you are carrying out the practical work.

### Procedure

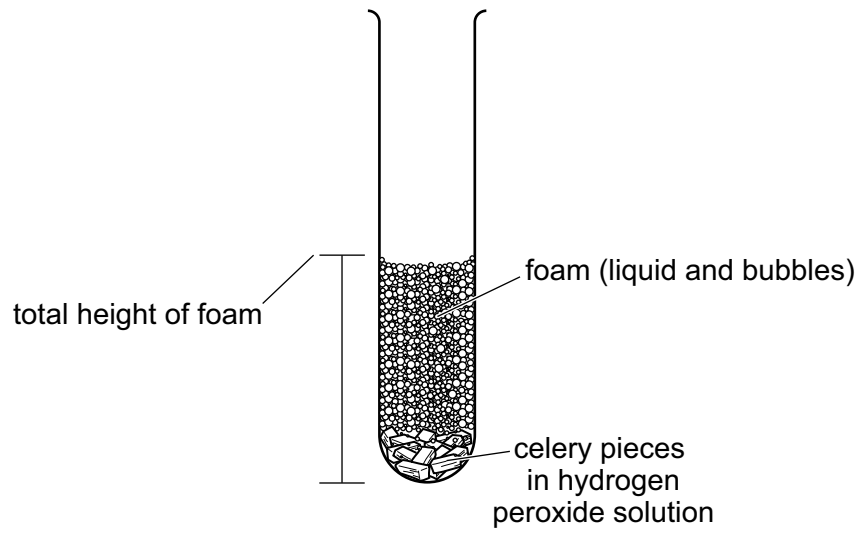
- Step 1 Use the syringe to put  $4\text{ cm}^3$  of hydrogen peroxide solution into the boiling tube.
- Step 2 Add a drop of detergent to the boiling tube and use the stirring rod to mix.
- Step 3 Cut a 2 cm length of the celery stick.
- Step 4 Cut this 2 cm length into approximately 2 mm slices and then cut these slices in half as shown in Fig. 1.1.



**Fig. 1.1** (not to scale)

- Step 5 Add these pieces of celery to the hydrogen peroxide solution in the boiling tube.
- Step 6 Use the stirring rod to push the pieces of celery into the solution and immediately start the stop-watch.
- Step 7 Measure the total height of the foam in the boiling tube to the nearest 0.1 cm as shown in Fig. 1.2. Continue to measure the height every 2 minutes for 10 minutes.

4



**Fig. 1.2**

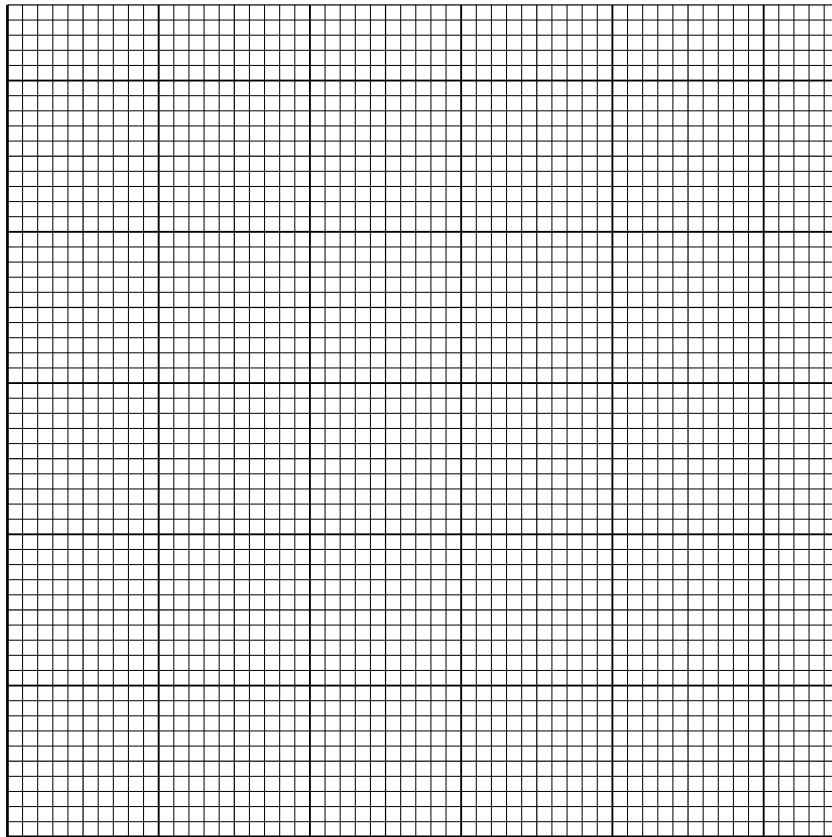
**(a) (i)** Draw a table to record your results in the space provided.

[2]

**(ii)** Record your results in the table in **(a)(i)**.

[3]

(b) (i) On the grid, plot a graph of total height of foam (vertical axis) against time.



[3]

(ii) Draw the best-fit curve.

[1]

(iii) Use your graph to determine the total height of the foam at 3 minutes.

height = ..... cm [1]

(iv) Describe the relationship between the total height of the foam and the time taken.

.....  
..... [1]

(c) Explain why repeating the procedure several times allows you to be more confident in your results.

.....  
..... [1]

(d) Suggest why it was difficult to measure the height of the foam.

.....  
..... [1]

[Total: 13]  
[Turn over

2 You are going to test celery for its nutrient content.

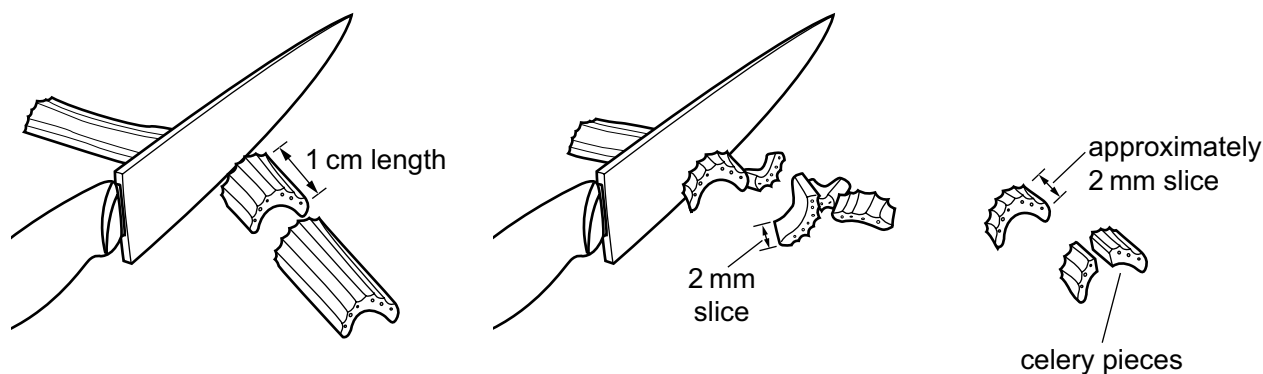
You should use the safety equipment provided while you are carrying out the practical work.

### Procedure

Step 1 Label three boiling tubes **A**, **B** and **C**.

Step 2 Cut a 1 cm length of the celery stick.

Step 3 Cut this 1 cm length into approximately 2 mm slices and then cut these slices in half as shown in Fig. 2.1.



**Fig. 2.1** (not to scale)

Step 4 Place the celery pieces in boiling tube **A**.

Step 5 Repeat Step 2 and Step 3 and place the celery pieces in boiling tube **B**.

Step 6 Repeat Step 2 and Step 3 and place the celery pieces in boiling tube **C**.

Step 7 Add approximately 2 cm depth of Benedict's solution to boiling tube **A** and place it in a hot water-bath for about 5 minutes.

Step 8 Add approximately 2 cm depth of biuret solution to boiling tube **B**.

Step 9 Add a few drops of iodine solution to boiling tube **C**.

Table 2.1

boiling tube	testing solution	nutrient being tested	final colour observed
<b>A</b>	Benedict's		
<b>B</b>	biuret		
<b>C</b>	iodine		

(a) (i) In Table 2.1, state the nutrient being tested in each boiling tube. [3]

(ii) In Table 2.1, state the final colour observed in each boiling tube. [3]

(b) State which of the nutrients are present in celery. Use the information in Table 2.1.

.....  
 ..... [1]

[Total: 7]

3 You are going to investigate the reaction of three metals with dilute hydrochloric acid.

(a) Procedure

- Use a measuring cylinder to add  $10\text{ cm}^3$  of dilute hydrochloric acid to a clean boiling tube.
- Record in Table 3.1 the initial temperature of the dilute hydrochloric acid in the boiling tube to the nearest  $0.5\text{ }^\circ\text{C}$ .
- Add two spatulas of magnesium powder to the dilute hydrochloric acid in the boiling tube and start a stop-watch.
- Stir and measure the temperature of the mixture after one minute.
- Record this temperature in Table 3.1 to the nearest  $0.5\text{ }^\circ\text{C}$ .

Repeat the procedure using copper powder and then zinc powder instead of magnesium powder.

Table 3.1

metal powder	initial temperature of dilute hydrochloric acid / $^\circ\text{C}$	temperature of mixture at one minute / $^\circ\text{C}$	change in temperature / $^\circ\text{C}$	thermal energy released / J
magnesium				
copper				
zinc				

[4]

(b) Calculate the change in temperature for each metal.

Record these values in Table 3.1.

[1]

(c) Calculate the thermal energy released for each metal.

Use the equation shown.

$$\text{thermal energy released} = 42.2 \times \text{change in temperature}$$

Record these values to **three** significant figures in Table 3.1.

[2]



(d) Table 3.2 shows the order of reactivity of some metals.

**Table 3.2**

sodium	most reactive
magnesium	↓
aluminium	
zinc	
iron	
lead	
copper	least reactive

The procedure is repeated using aluminium powder instead of magnesium powder.

Suggest a value for the thermal energy released.

Explain your answer.

thermal energy released = ..... J

explanation .....

.....

[2]

(e) Suggest **two** changes to the procedure that would give more confidence in the values for the thermal energy released by the metal powders.

change 1 .....

.....

change 2 .....

.....

[2]

(f) Draw a labelled diagram of the assembled apparatus used to separate the copper solid from the mixture at the end of the procedure in (a).

Label the residue and the filtrate.

[2]

[Total: 13]

4 You are going to identify the blue solution **H**.

(a) Procedure

- Add about 2 cm depth of solution **H** into each of five test-tubes.
- Add a splint to one test-tube and leave it to soak. Leave this solution and splint until **after** all the other tests are complete.
- Do the tests described in Table 4.1 to the other four separate samples of solution **H**. Record your observations in Table 4.1.
- Do the flame test using the splint that has been soaked in solution **H**. Record your observations in Table 4.1.

Table 4.1

test	observations
add a few drops of aqueous ammonia  add excess aqueous ammonia	
add a few drops of aqueous sodium hydroxide  add excess aqueous sodium hydroxide	
add 1 cm depth of dilute nitric acid followed by 10 drops of aqueous silver nitrate	
add 1 cm depth of dilute nitric acid followed by 1 cm depth of aqueous barium nitrate	
place the splint soaked in <b>H</b> into the top of a blue Bunsen burner flame and record the initial colour seen	

[6]

(b) Identify the **two** ions present in solution **H**.

cation .....

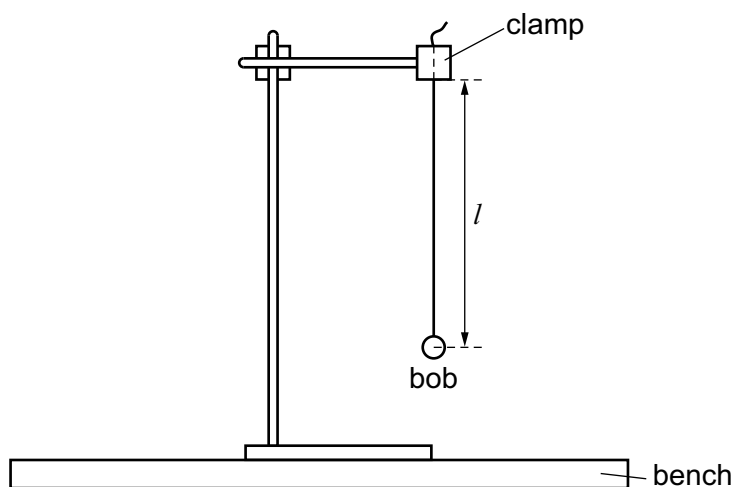
anion .....

[1]

[Total: 7]

- 5 You are going to use a pendulum to measure the acceleration of free fall  $g$ .

A pendulum has been set up in a clamp for you, as shown in Fig. 5.1.



**Fig. 5.1**

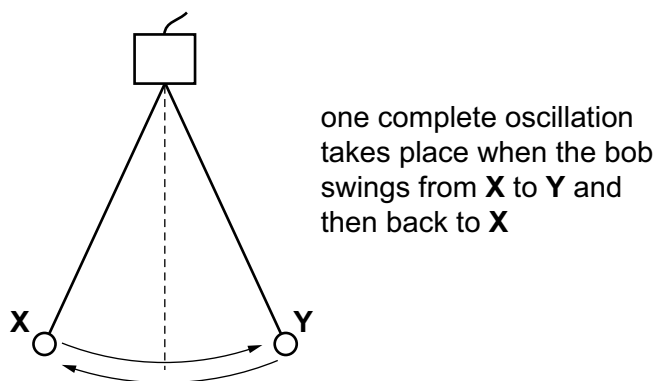
The length  $l$  of the pendulum is the distance from the bottom of the clamp to the centre of the pendulum bob.

- (a) Measure the length  $l$  of the pendulum.

Record your answer in centimetres to the nearest 0.1 cm.

$l = \dots\dots\dots$  cm [1]

- (b) Fig. 5.2 shows one complete oscillation of the pendulum.



**Fig. 5.2**

- (i) Pull the bob back a small suitable distance to position X. Release it so that it swings backwards and forwards.

Measure the time  $t$  for 20 complete oscillations.

$t = \dots\dots\dots$  s [1]

(ii) Calculate the time  $T$  for **one** complete oscillation of the pendulum.

$$T = \dots\dots\dots \text{ s [1]}$$

(iii) Calculate  $T^2$ .

$$T^2 = \dots\dots\dots \text{ s}^2 \text{ [1]}$$

(c) The acceleration of free fall  $g$  is given by the equation shown.

$$g = \frac{0.395l}{T^2}$$

Use your value of  $l$  in centimetres from (a) and your value of  $T^2$  in  $\text{s}^2$  from (b)(iii) to calculate a value  $g_1$  for the acceleration of free fall.

$$g_1 = \dots\dots\dots \text{ m/s}^2 \text{ [1]}$$

(d) Adjust the string until the length  $l$  of the pendulum is 80.0 cm.

Repeat the procedure in (b)(i), (ii) and (iii).

$$t = \dots\dots\dots \text{ s}$$

$$T = \dots\dots\dots \text{ s}$$

$$T^2 = \dots\dots\dots \text{ s}^2 \text{ [2]}$$

(e) Use the equation shown in (c) with  $l = 80.0$  cm to calculate a second value  $g_2$  for the acceleration of free fall.

$$g_2 = \dots\dots\dots \text{ m/s}^2 \text{ [1]}$$

- (f) Calculate an average value for the acceleration of free fall  $g_{AV}$  using your answers to (c) and (e).

$g_{AV} = \dots\dots\dots \text{ m/s}^2$  [1]

- (g) Two quantities can be considered to be the same within the limits of experimental accuracy if their values are within 10% of each other.

Compare your value for  $g_{AV}$  in (f) with the expected value,  $g = 9.8 \text{ m/s}^2$ .

State whether your value agrees with the expected value of  $g$  within the limits of experimental error. Justify your answer with a calculation.

statement .....

justification .....

.....

.....

[2]

- (h) (i) State **one** precaution that you took while performing your experiment to get accurate readings.

.....

..... [1]

- (ii) Suggest why it is good experimental practice to use long lengths of pendulum when performing this experiment.

.....

..... [1]

[Total: 13]



- 6 Plan an investigation to find out whether the rate of cooling of hot water depends on the initial temperature of the water.

You are provided with:

- a beaker
- a measuring cylinder
- a supply of hot water.

You may suggest the use of any other common laboratory apparatus.

The student doing the experiment takes all the necessary safety precautions. You are **not** required to write about safety precautions.

You are **not** required to do this experiment.

In your plan, include:

- any other apparatus needed
- a brief description of the method, including what you will measure and how you will make sure your measurements are accurate
- the variables you will control
- a results table to record your measurements (you are **not** required to enter any readings in the table)
- how you will process your results to reach a conclusion.

You may include a labelled diagram in your answer.



..... [7]

## NOTES FOR USE IN QUALITATIVE ANALYSIS

## Tests for anions

<i>anion</i>	<i>test</i>	<i>test result</i>
carbonate, $\text{CO}_3^{2-}$	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, $\text{Cl}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, $\text{Br}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, $\text{I}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, $\text{NO}_3^-$ [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, $\text{SO}_4^{2-}$ [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

## Tests for aqueous cations

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
ammonium, $\text{NH}_4^+$	ammonia produced on warming	–
calcium, $\text{Ca}^{2+}$	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper(II), $\text{Cu}^{2+}$	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), $\text{Fe}^{2+}$	green ppt., insoluble in excess, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), $\text{Fe}^{3+}$	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, $\text{Zn}^{2+}$	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

## Tests for gases

<i>gas</i>	<i>test and test result</i>
ammonia, $\text{NH}_3$	turns damp red litmus paper blue
carbon dioxide, $\text{CO}_2$	turns limewater milky
chlorine, $\text{Cl}_2$	bleaches damp litmus paper
hydrogen, $\text{H}_2$	'pops' with a lighted splint
oxygen, $\text{O}_2$	relights a glowing splint

## Flame tests for metal ions

<i>metal ion</i>	<i>flame colour</i>
lithium, $\text{Li}^+$	red
sodium, $\text{Na}^+$	yellow
potassium, $\text{K}^+$	lilac
copper(II), $\text{Cu}^{2+}$	blue-green



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