Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0123456789

CO-ORDINATED SCIENCES **0973/06**

Paper 6 Alternative to Practical **For examination from 2025**

SPECIMEN PAPER **1 hour 30 minutes**

You must answer on the question paper.

No additional materials are needed.

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.

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

1 A student investigates an enzyme-catalysed reaction using celery cells and hydrogen peroxide, H_2O_2.

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

$$\underset{\text{hydrogen peroxide}}{2H_2O_2} \rightarrow \underset{\text{water}}{2H_2O} + \underset{\text{oxygen}}{O_2}$$

(a) Procedure

The student:

- puts 2 cm^3 of hydrogen peroxide solution into a boiling tube
- adds a drop of detergent and uses the stirring rod to mix
- adds some chopped celery pieces to the hydrogen peroxide solution in the boiling tube and immediately starts a stop-watch
- observes a foam produced at the top of the liquid which rises up the boiling tube as oxygen is released
- records the total height of the foam to the nearest 0.1 cm in the boiling tube every 2 minutes for 12 minutes, as shown in Fig. 1.1. The first reading is taken at 0 minutes.

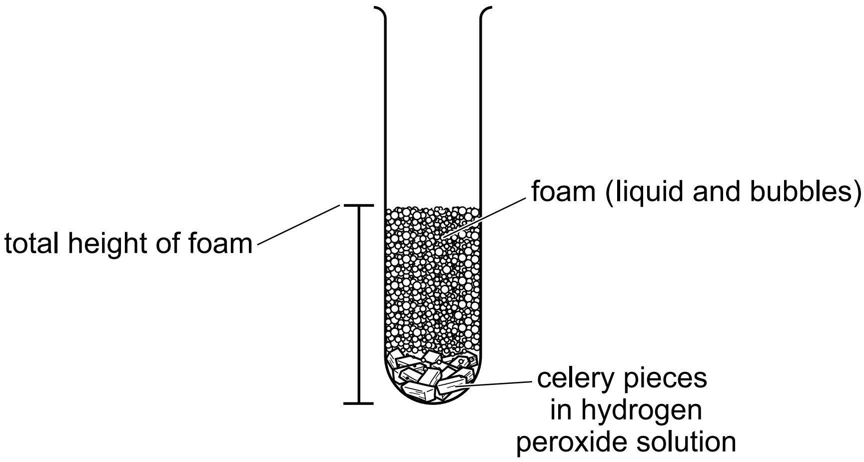


Fig. 1.1

(i) State the name of the apparatus suitable to measure 2 cm^3 of hydrogen peroxide solution.

.... [1]

(ii) Table 1.1 shows some of the student's results.

Complete the column heading.

Table 1.1

.... /	total height of foam / cm
0	3.0
2	
4	7.6
6	
8	9.6
10	9.9
12	9.9

[1]

(iii) Fig. 1.2 shows the boiling tube and its contents at 2 and 6 minutes.

Use Fig. 1.2 to complete Table 1.1.

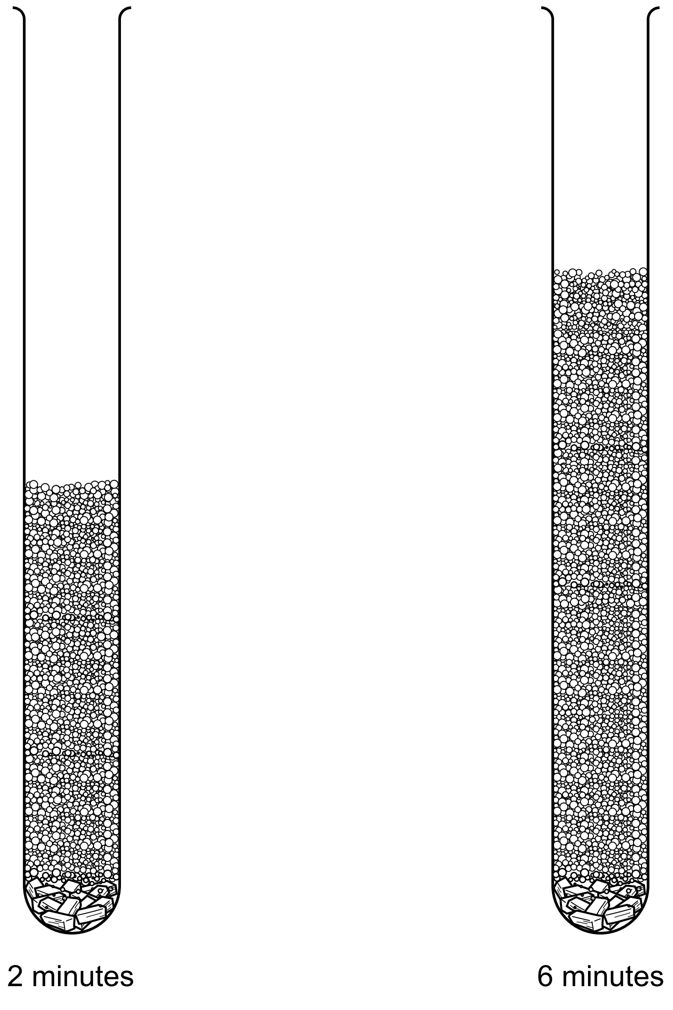
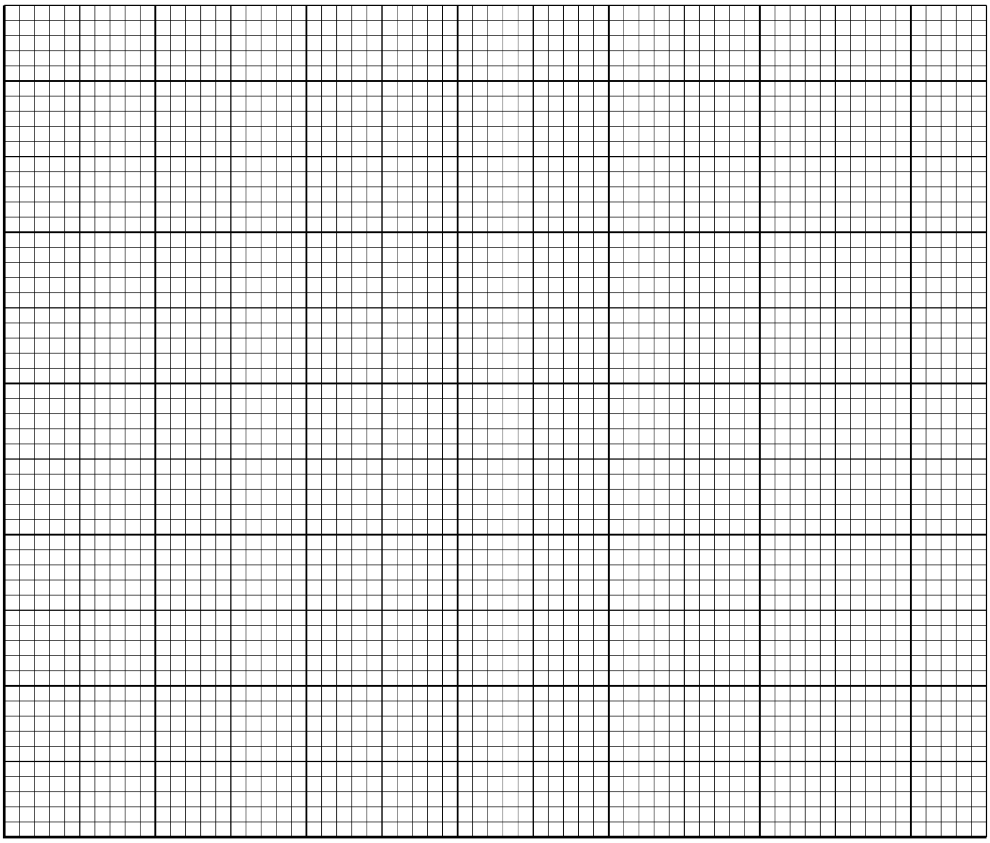


Fig. 1.2 (actual size) [2]

(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 5 minutes.

height = ... cm [1]

(iv) Describe how the total height of the foam changes:

between 2 and 4 minutes ....

between 10 and 12 minutes. .... [2]

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

....

.... [1]

(d) Suggest why it is difficult to measure the height of the foam in Fig. 1.2.

....

.... [1]

[Total: 13]

2 A student tests celery for its nutrient content.

Procedure

The student:

- puts some chopped celery pieces into each of three boiling tubes
- adds 1 cm depth of Benedict’s solution to one boiling tube and heats it
- adds 1 cm depth of biuret solution to the second boiling tube
- adds a few drops of iodine solution to the third boiling tube.

Table 2.1

testing solution	nutrient being tested	final colour observed
Benedict’s		
biuret		
iodine		

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

(ii) The celery tests positive with the Benedict’s solution and negative with the biuret and iodine solutions.

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 A student investigates the thermal energy released when metals react with dilute hydrochloric acid.

(a) Procedure

The student:

- adds 10 cm^3 of dilute hydrochloric acid to a clean boiling tube
- records in Table 3.1 the initial temperature of the dilute hydrochloric acid in the boiling tube to the nearest 0.5 °C
- adds two spatulas of magnesium powder to the dilute hydrochloric acid in the boiling tube
- stirs and measures the temperature of the mixture after one minute
- records this temperature in Table 3.1.

The student repeats the procedure using copper powder and then zinc powder instead of magnesium powder.

Table 3.1

metal powder	initial temperature of dilute hydrochloric acid / °C	temperature of mixture at one minute / °C	change in temperature / °C	thermal energy released / J
magnesium	23.5			
copper	22.0	22.0	0.0	0.0
zinc	22.5			

Fig. 3.1 shows the thermometer readings for the temperature of the mixture at one minute for magnesium powder and zinc powder.

Record these values to the nearest 0.5 °C in Table 3.1.

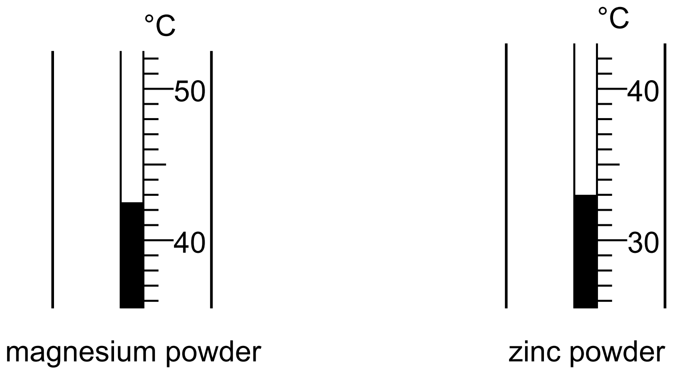


Fig. 3.1

[2]

(b) Calculate the change in temperature for magnesium and zinc.

Record these values in Table 3.1. [1]

(c) Calculate the thermal energy released for magnesium and zinc.

Use the equation shown.

thermal energy released = 42.2 × 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) Before the procedure in **(a)**, the student makes three predictions about the experiments.

Prediction 1 Effervescence will be observed in all three experiments.

Prediction 2 The reaction of magnesium with dilute hydrochloric acid will produce a larger temperature change than the reaction of zinc with dilute hydrochloric acid.

Prediction 3 Mixing zinc with dilute hydrochloric acid will produce a chemical change.

(i) State which prediction is **not** correct.

Explain your answer.

incorrect prediction ....

explanation..

....
[1]

(ii) The reaction of magnesium with dilute hydrochloric acid produced a gas. The gas was tested with a lighted splint and a 'squeaky' pop was heard.

Identify the gas.

....

.... [1]

[Total: 11]

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4 A student completes a series of tests on solutions **F** and **H**.

(a) Procedure

The student:

- adds 2 cm depth of solution **F** into each of four test-tubes
- completes the tests shown in Table 4.1
- records the observations in Table 4.1
- repeats the procedure with solution **H**
- records the observations in Table 4.1.

The results of the tests are shown in Table 4.1.

Table 4.1

	observations	
tests	with solution **F**	with solution **H**
add a few drops of aqueous sodium hydroxide add excess aqueous sodium hydroxide	blue precipitate blue precipitate	blue precipitate blue precipitate
flame test	blue-green	blue-green
add dilute nitric acid followed by aqueous silver nitrate	blue solution white precipitate	blue solution blue solution
add dilute nitric acid followed by aqueous barium nitrate	blue solution blue solution	blue solution white precipitate

(i) The student is given a third solution which is either solution **F** or solution **H**.

State **two** tests from Table 4.1 which could identify whether the third solution is solution **F**.

test 1 ....

observation ....

test 2 ....

observation ....
[4]

(ii) Identify the **two** ions present in the solution of **F**.

cation ....

anion ....
[1]

(b) Describe how to do a flame test on a salt solution.

....

....

.... [2]

(c) A student separates the blue precipitate from the solution in the first test in Table 4.1.

Draw a labelled diagram of the assembled apparatus the student uses.

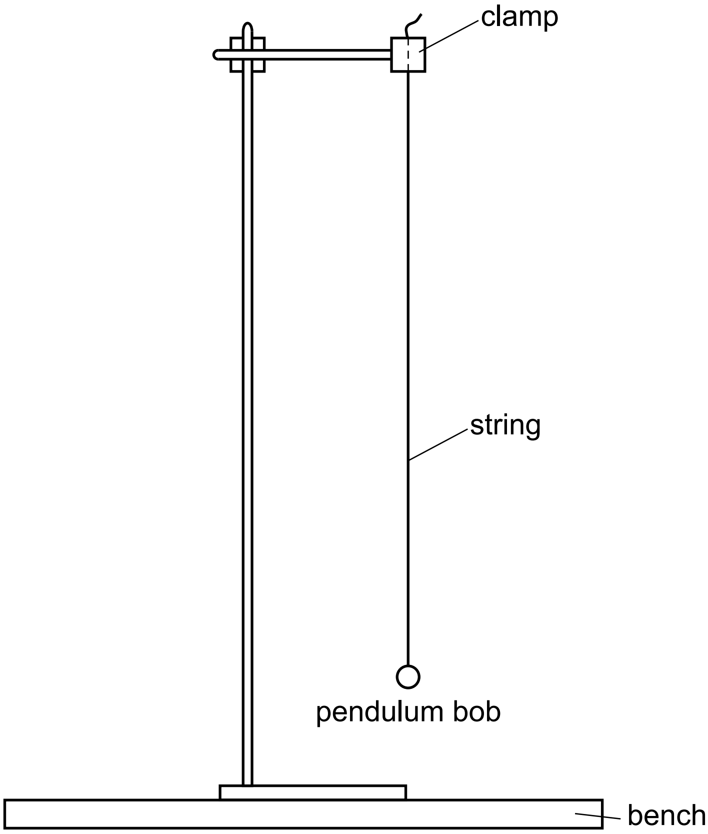
Label the residue and the filtrate.

[2]

[Total: 9]

5 A student investigates the oscillations of a simple pendulum.

The student sets up a pendulum in a clamp, as shown in Fig. 5.1.



scale: 1 cm = 5 cm

Fig. 5.1

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

(a) **(i)** Using a ruler, draw an accurate line on Fig. 5.1 to show the length of the pendulum.

The exact start point and end point of the line should be marked with arrows.

Label the length of the line with the letter l. [1]

(ii) Measure the length l of the line you have drawn.

Record l in centimetres to the nearest 0.1 cm.

l = ... cm [1]

(b) The diagram in Fig. 5.1 is drawn to a scale of 1 : 5 cm.

Calculate the actual length L of the pendulum.

L = ... cm [1]

(c) The student pulls back the bob a small suitable distance and releases it so that it oscillates.

(i) The student measures the time t_1 for 20 complete oscillations, then repeats the procedure to measure t_2 and records the readings in Table 5.1.
The student repeats the procedure a third time.

Fig. 5.2 shows the reading on the stop-watch.

Fig. 5.2

In Table 5.1, record the reading on the stop-watch for t_3 to the nearest 0.1 s.

Table 5.1

reading	time / s
t_1	25.6
t_2	25.4
t_3	

[1]

(ii) Use t_1, t_2 and your value of t_3 from **(c)(i)** to calculate the average time t_{AV} for 20 oscillations.

t_{AV} = ... s [1]

(iii) Suggest why the student repeats the timing measurement and takes the average.

....

.... [1]

(d) **(i)** Use your value of t_{AV} from **(c)(ii)** to calculate the time T for **one** oscillation of the pendulum.

T = ... s [1]

(ii) Calculate T^2.

T^2 = ... s^2 [1]

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

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

Use this equation with your value of L in cm from **(b)** and your value of T^2 in s^2 from **(d)(ii)** to calculate a value g_1 for the acceleration of free fall.

g_1 = ... m / s^2 [1]

(f) The student adjusts the string until the length L of the pendulum is 80.0 cm and repeats the experiment.

The results are shown.

$$t_{AV} = 35.9\,\text{s}$$
$$T = 1.80\,\text{s}$$
$$T^2 = 3.24\,\text{s}^2$$

The student calculates a second value g_2 for the acceleration of free fall.

$$g_2 = 9.75\,\text{m/s}^2$$

Calculate an average value for the acceleration of free fall g_{AV} using your answer to **(e)** and the student's answer for g_2.

g_{AV} = ... 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, $g = 9.8\ m / s^2$.

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) 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.

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

anion	*test*	*test result*
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
ammonium, NH_4^+	ammonia produced on warming	–
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper(II), Cu^{2+}	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), 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), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, Zn^{2+}	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	*test and test result*
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	turns limewater milky
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	‘pops’ with a lighted splint
oxygen, O_2	relights a glowing splint

Flame tests for metal ions

metal ion	*flame colour*
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
copper(II), Cu^{2+}	blue-green

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