Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

0186656675

CO-ORDINATED SCIENCES **0654/53**

Paper 5 Practical Test **October/November 2023**

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	
2	
3	
4	
5	
Total	

This document has **16** pages. Any blank pages are indicated.

1 You are going to investigate an enzyme controlled reaction.

An enzyme found inside living cells of some plants catalyses (speeds up) the breakdown of hydrogen peroxide releasing oxygen gas.

The oxygen gas released forms a foam with liquidised samples of beans and apples.

(a) Procedure

- Stir the liquidised beans.
- Place approximately 1 cm depth of liquidised beans in a test-tube.
- Add 1 cm^3 of hydrogen peroxide solution to the test-tube.
- Immediately start the stop-watch.
- Measure the time it takes for the foam produced to reach the top of the test-tube.
- This is trial 1.
- If the foam does **not** reach the top of the test-tube in 2 minutes, record this as '120+'.

(i) Record in Table 1.1 the time for trial 1 to the nearest second. [1]

Table 1.1

sample	time taken to fill test-tube / s		
	trial 1	trial 2	average
liquidised beans			
liquidised apples			

(ii)
- Empty the test-tube into the beaker labelled waste and rinse with distilled water.
- Repeat the procedure. This is trial 2.
- Record in Table 1.1 the time for trial 2.
- Repeat the procedure two more times using the liquidised apples instead of liquidised beans (remember to empty the liquidised beans into the waste beaker and rinse before starting and between the 2 trials).
- Record in Table 1.1 the times for trials 1 and 2 for the liquidised apples. [3]

(iii) Complete Table 1.1 by calculating and recording the average times.

[1]

(b) Use Table 1.1 to state a conclusion about the amount of enzyme present in the samples of beans **and** apples.

....

.... [1]

(c) Liquidising the beans and apples breaks open the cells.

Suggest why the cells need to be broken open.

....

.... [1]

(d) Suggest why it is important to stir to mix the liquidised beans before using them.

....

.... [1]

(e) Explain why the test-tube must be rinsed to clean it before repeating with the liquidised apple.

....

.... [1]

(f) **(i)** Fig. 1.1 shows a test-tube containing liquidised beans and hydrogen peroxide solution.

The oxygen gas produced can be collected and its volume measured.

Complete Fig. 1.1 to show the assembled apparatus used to collect and measure the **volume** of oxygen gas produced.

Label the apparatus.

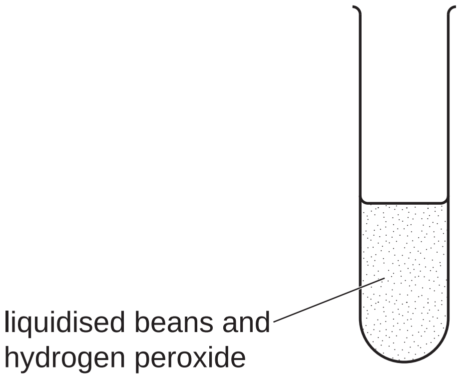


Fig. 1.1

[3]

(ii) Suggest why measuring the volume of gas produced is a more accurate method than measuring the time taken for the foam to reach the top of the test-tube.

....

.... [1]

[Total: 13]

2 Amylase is a digestive enzyme that breaks down starch into sugars.

The presence of starch in a solution is confirmed by adding iodine solution.

When starch is present, the iodine solution turns from brown to blue-black.

Plan an investigation to determine the relationship between temperature and the time taken for the starch to be completely broken down by the enzyme.

You are provided with:

- starch solution
- amylase solution
- iodine solution.

You may also use any common laboratory apparatus.

You are not required to do this investigation.

Include in your plan:

- the apparatus needed
- a brief description of the method, explaining any safety precautions
- the measurements you will take
- the variables you will control
- how you will process your results to reach a conclusion.

You may include a results table if you wish, you are **not** required to enter any readings in the table.

You may include a labelled diagram in your answer.

.... [7]

3 You are going to determine the percentage purity of a sample of compound **F** and identify the ions it contains.

When compound **F** is heated it decreases in mass because it gives off a gas.

(a) Procedure

- Measure the mass of a hard-glass test-tube and record the value in Table 3.1.
- Add three spatula loads of compound **F** into the hard-glass test-tube.
- Measure the total mass of the hard-glass test-tube and compound **F** and record the value in Table 3.1.
- Heat compound **F** gently at first and then more strongly until there is no further change, approximately two minutes.
- Allow the test-tube to cool.

Continue with **(b)**, **(c)** and **(d)** while you wait for the test-tube to cool. You will complete the data processing for this experiment in section **(e)**.

Table 3.1

mass of empty hard-glass test-tube / g	
mass of hard-glass test-tube and compound **F** / g	
mass of hard-glass test-tube and mixture after heating / g	

[3]

(b) (i) Describe the appearance of compound **F**.

....

.... [1]

(ii) Describe the appearance of the mixture in the test-tube **after** heating

....

.... [1]

(iii) Explain **one** safety precaution you must take when heating compound **F**.

....

.... [1]

(c) Procedure

You need to test the gas made in this procedure.

- Add one spatula load of compound **F** into a boiling tube.
- Add 4 cm depth of dilute hydrochloric acid.
- Test the gas given off.
- **Keep the solution formed for use in (d).**

The procedure may need to be done more than once if you are not certain of the result.

(i) Identify the gas given off in the reaction.

Describe the test used to identify the gas.

Include the observation for a positive result.

identity of gas ....

test ....

observation ....
[2]

(ii) Use the results of the gas test in **(c)(i)** to identify the anion (negative ion) in compound **F**.

.... [1]

(d) (i) Procedure

- Dip the end of a wooden splint into the solution formed in **(c)**.
- Place the wooden splint into the blue part of the Bunsen burner flame.
- Record the initial colour of the flame observed.
- If no colour is seen, repeat the test.

colour of flame .... [1]

(ii) Procedure

- Place 1 cm depth of the solution from **(c)** into a clean test-tube.
- Add aqueous ammonia to the solution slowly until it is in excess.
- Put a stopper on the test-tube and shake it gently to check if soluble or not in excess.
- Record your observations.

....

....

.... [2]

(iii) Use your results from **(d)(i)** and **(d)(ii)** to identify the metal ion in compound **F**.

.... [1]

(e) Go back to **(a)** and measure the mass of the hard-glass test-tube and mixture after heating.

Record this mass in Table 3.1.

(i) Calculate the mass of compound **F** added to the hard-glass test-tube.

Use the equation shown.

mass of compound **F**	=	mass of hard-glass test-tube and compound **F**	–	mass of empty hard-glass test-tube

mass of compound **F** = ... g [1]

(ii) Calculate the decrease in mass of compound **F**.

Use the equation shown.

decrease in mass	=	mass of hard-glass test-tube and compound **F**	–	mass of hard-glass test-tube and mixture after heating

decrease in mass = ... g [1]

(iii) Calculate the percentage purity of compound **F**.

Use the equation shown.

$$\text{percentage purity} = \frac{\text{decrease in mass}}{\text{mass of compound } \mathbf{F}} \times 280$$

Give your answer to **three** significant figures.

percentage purity = ... [2]

(iv) Suggest **two** improvements to the experiment which will allow you to have more confidence in your value for the percentage purity of compound **F**.

1 ....

....

2 ....

....
[2]

(f) An unknown acid is added to compound **F** and a solution is formed.

When nitric acid and barium nitrate are added to this solution a white precipitate is formed.

Identify the acid added to compound **F**.

.... [1]

[Total: 20]

4 You are going to investigate the oscillations of a simple pendulum.

The period of a pendulum is the time for one complete oscillation (swing) of the pendulum. This is shown in Fig. 4.1, where the period is the time taken for the bob to swing from **X** to **Y** and back to **X** again.

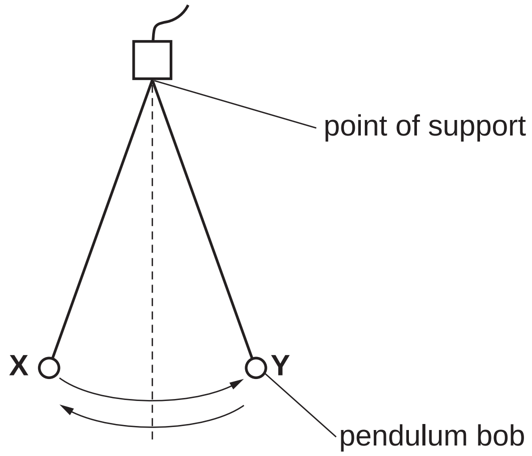


Fig. 4.1

The pendulum has been set up for you as shown in Fig. 4.2.

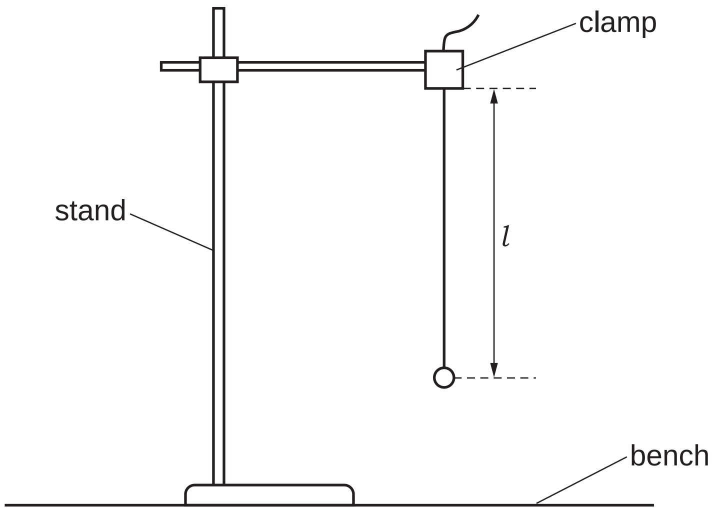


Fig. 4.2

The length l of the pendulum is the distance from the point of support to the centre of the pendulum bob.

(a) **(i)** Measure the length l of the pendulum to the nearest 0.1 cm.

Record your result in the first row of Table 4.1. [1]

Table 4.1

l / cm	time for 20 oscillations / s	period T / s
60.0		
50.0		
40.0		
30.0		
20.0		

(ii) Describe **one** practical technique you use to measure l as accurately as possible.

....

.... [1]

(b) **Procedure**

(i)
- Give the bob a small sideways displacement (between 5 cm and 10 cm).
- Release the bob so that it oscillates.

Measure and record in Table 4.1 the time taken for 20 oscillations. [1]

(ii)
- Adjust the length l of the pendulum until it is 60.0 cm.

Repeat the procedure described in **(b)(i)**. [1]

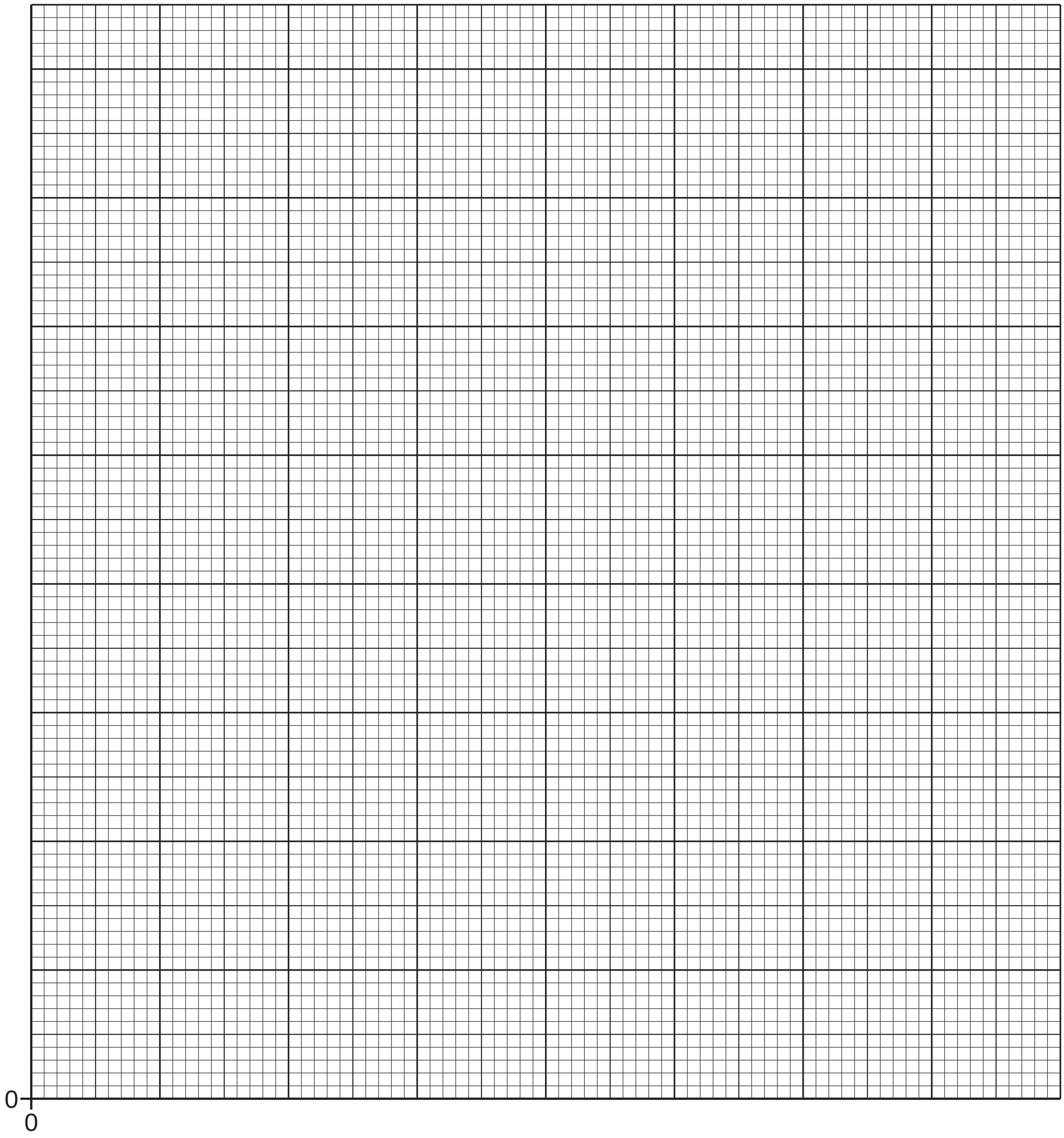
(iii) Repeat this procedure for lengths l of 50.0 cm, 40.0 cm, 30.0 cm and 20.0 cm. [1]

(c) Use your results in Table 4.1 to calculate the period T of the pendulum for each set of readings. Remember that the period is the time for **one** oscillation.

Record in Table 4.1 your values for T to **one** decimal place. [1]

(d) **(i)** On the grid, plot a graph of T (vertical axis) against l.

Start both axes of your graph from the origin (0, 0).



[3]

(ii) Draw the best-fit curve. [1]

(e) Use your graph to:

(i) determine the length l of a pendulum that has a period of 1.0 s

l = ... cm [1]

(ii) describe what happens to the period T of a pendulum as its length l increases.

.... [1]

(f) State whether your graph shows that the period T of a pendulum is proportional to its length l.

Explain your answer.

....

.... [1]

[Total: 13]

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5 You are going to investigate the cooling of hot water in two beakers, **P** and **Q**.

Both insulation and a lid each reduce the loss of thermal energy.

Beaker **P** has a layer of insulation around it, but has no lid.

Beaker **Q** has a lid, but has no insulation around it.

These beakers are shown in Fig. 5.1.

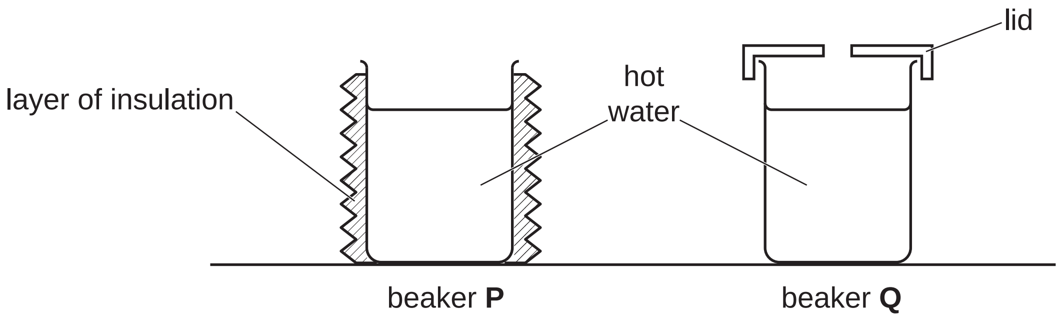

Fig. 5.1

(a) Procedure

- Pour 200 cm^3 of hot water into beaker **P**.
- Place the thermometer into the water and when the reading stops rising measure the temperature θ_0 of the hot water and start the stop-watch.

(i) Record in Table 5.1 this temperature at time t = 0 to the nearest 0.5 °C. [1]

Table 5.1

beaker **P**	
time t / s	temperature θ / °C
0	
180	

(ii) Measure the temperature of the hot water after 180 s.

Record in Table 5.1 your result to the nearest 0.5 °C. [1]

(b) **Procedure**

- Pour 200 cm^3 of hot water into beaker **Q** and replace the lid.

Repeat the measurements in **(a)** using beaker **Q** instead of beaker **P**.

Record your results in Table 5.2.

Table 5.2

beaker **Q**	
time t / s	temperature θ / °C
0	
180	

[1]

(c) State which of the two methods of reducing thermal energy loss from a beaker of hot water is the more effective.

Use data from Table 5.1 and Table 5.2 to explain how you reach this conclusion.

....

....

....

.... [2]

(d) State how the loss of thermal energy from beaker **P** can be reduced even further without adding a lid.

.... [1]

(e) State **one** condition which must be controlled to ensure that the comparison between beaker **P** and beaker **Q** is fair.

.... [1]

[Total: 7]

NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	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.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, 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	green ppt., insoluble in excess
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