Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3424613494

CO-ORDINATED SCIENCES **0654/63**

Paper 6 Alternative to Practical **October/November 2023**

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 [ ].

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

DC (KS/SG) 320846/4

1 A student investigates 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

The student:

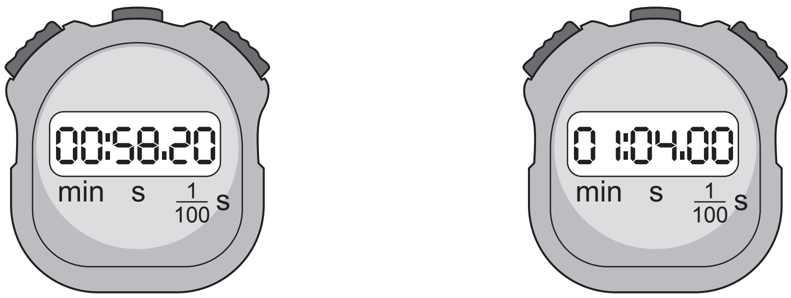
- stirs the liquidised beans
- adds 1 cm^3 of liquidised beans to a test-tube
- adds 1 cm^3 of hydrogen peroxide solution to the test-tube of liquidised beans
- measures the time it takes for the foam produced to reach the top of the test-tube.

If the foam does **not** reach the top of the test-tube in 2 minutes, the student records this time as 'more than 120'.

The student repeats the procedure with a fresh sample of liquidised beans.

The student repeats the procedure two more times using liquidised apple instead of liquidised beans.

(i) Fig. 1.1 shows the student's results for the liquidised beans.



trial 1 trial 2

Fig. 1.1

Record in Table 1.1 the times on the stop-watches for the beans to the nearest second.

Table 1.1

sample	time taken for foam to reach top of test-tube / s		
	trial 1	trial 2	average
beans			
apples	more than 120	more than 120	more than 120

[2]

(ii) Complete Table 1.1 by calculating the average time for beans.

[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 the liquidised beans before using them.

....

.... [1]

(e) Name a piece of apparatus suitable for measuring 1 cm^3 of liquidised beans.

.... [1]

(f) **(i)** Fig. 1.2 shows a test-tube containing liquidised beans and hydrogen peroxide solution.

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

Complete Fig. 1.2 to show the assembled apparatus used to collect and measure the **volume** of oxygen gas produced.

Label the apparatus.

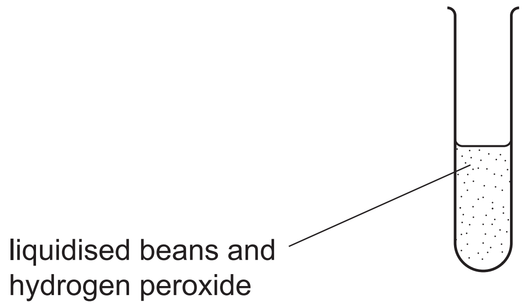


Fig. 1.2

[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]

(iii) Describe a test to confirm that the gas collected is oxygen.

Include the observation for a positive result.

test ....

observation ....
[2]

[Total: 13]

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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.

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 in your answer. You are **not** required to enter any readings in the table.

You may include a labelled diagram in your answer.

[7]

3 A student determines the percentage purity of a sample of compound **F** and identifies the ions it contains.

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

(a) (i) Procedure

The student:

- measures the mass of a hard-glass test-tube and records the value in Table 3.1
- adds compound **F** into the hard-glass test-tube
- measures the mass of the hard-glass test-tube and compound **F** and records the value in Table 3.1
- heats the test-tube containing compound **F** strongly for approximately three minutes
- allows the test-tube to cool
- measures the mass of the hard-glass test-tube and mixture and records the value in Table 3.1.

Table 3.1

mass of empty hard-glass test-tube / g	25.64
mass of hard-glass test-tube and compound **F** / g	
mass of hard-glass test-tube and mixture after heating / g	

Fig. 3.1 shows the student's other two balance readings.

27.624 g	27.058 g
mass of hard-glass test-tube and compound **F**	mass of hard-glass test-tube and mixture after heating

Fig. 3.1

Record in Table 3.1 these values to **two** decimal places. [2]

(ii) Explain **one** safety precaution needed when heating compound **F**.

....

.... [1]

(b) **(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 that allow the student to have more confidence in their value for the percentage purity of compound **F**.

1 ....

....

2 ....

....
[2]

(c) Procedure

The student:

- adds compound **F** to a boiling tube
- adds hydrochloric acid to compound **F**
- tests the gas given off and identifies it as carbon dioxide
- keeps the solution formed for use in **(d)**.

(i) Describe the observation the student makes that shows a gas is given off in the reaction.

.... [1]

(ii) Describe the test for carbon dioxide. Include the observation for a positive result.

test ....

observation ....
[1]

(iii) Identify the anion (negative ion) in compound **F**.

.... [1]

(d) Procedure

The student:

- does a flame test on some of the solution formed in **(c)**
- places some of the solution from **(c)** into a clean test-tube
- adds aqueous ammonia to the solution slowly until it is in excess.

(i) Describe how to do a flame test on the solution formed in **(c)**.

....

....

.... [2]

(ii) The student identifies the metal ion as a copper(II) ion.

State the colour of the flame the student observes.

.... [1]

(iii) State the observations made when aqueous ammonia is added to the solution formed in **(c)**.

....

.... [2]

(e) The student adds an unknown acid to compound **F**.

A solution is formed and a black solid sinks to the bottom of the beaker.

The student adds dilute nitric acid and barium nitrate to the solution.

A white precipitate is formed.

(i) Identify the unknown acid the student adds to compound **F**.

.... [1]

(ii) The student separates the black solid from the solution by filtration.

Draw a labelled diagram of the assembled apparatus used in this filtration.

Label the residue and the filtrate.

[2]

[Total: 20]

4 A student investigates the oscillations of a simple pendulum.

The student sets up a pendulum as shown in Fig. 4.1.

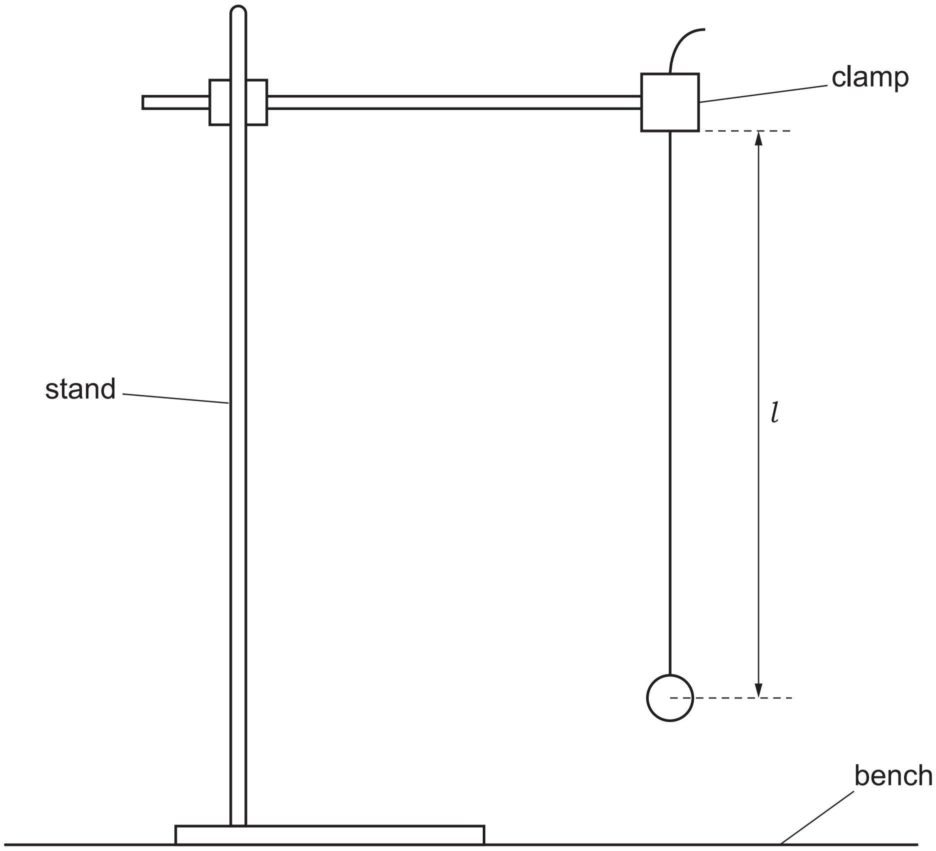


Fig. 4.1

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 in Fig. 4.1 to the nearest 0.1 cm.

l = ... cm [1]

(ii) Fig. 4.1 is drawn to a scale of **one-tenth** full size.

Record in Table 4.1 the actual length *L* of the pendulum.

Table 4.1

L / cm	time for 20 oscillations / s	period *T* / s
	34.8	1.7
60.0	31.0	1.6
50.0		
40.0	25.4	1.3
30.0	22.1	1.1
20.0	18.2	0.9

[1]

(iii) Describe **one** practical technique needed to measure *L* as accurately as possible.

....

.... [1]

(b) Procedure

(i) The student:

- gives the bob a small sideways displacement
- releases the bob so that it oscillates
- measures the time taken for 20 oscillations
- records the time in Table 4.1.

The student repeats this procedure for lengths *L* = 60.0 cm, 50.0 cm, 40.0 cm, 30.0 cm and 20.0 cm.

The reading on the stop-watch when *L* = 50.0 cm is shown in Fig. 4.2.

Fig. 4.2

Record in Table 4.1 the reading on the stop-watch to **one** decimal place. [1]

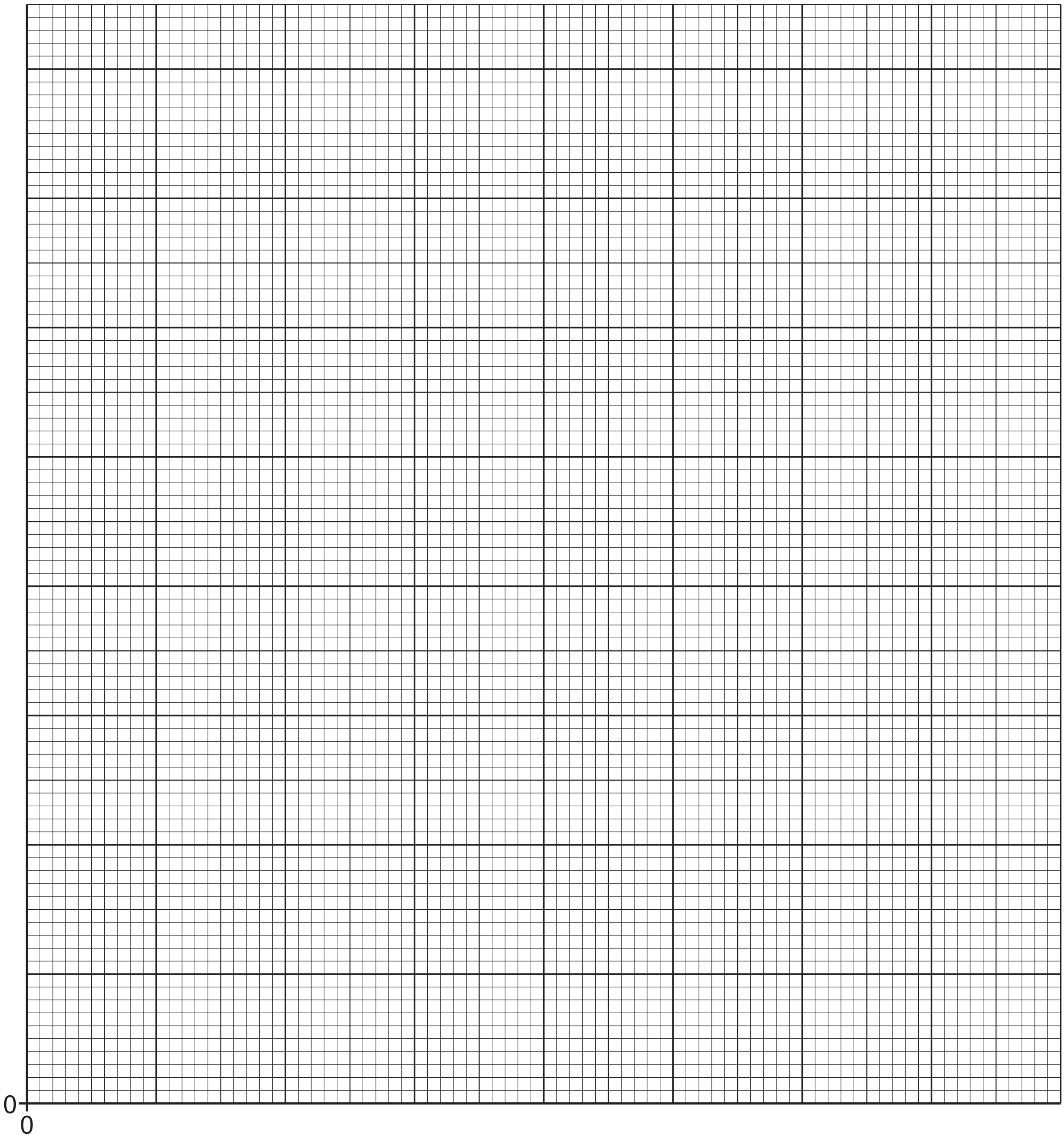
(ii) Calculate the period *T* of the pendulum when *L* = 50.0 cm.

The period is the time for **one** oscillation.

Record your answer in Table 4.1. [1]

(c) (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]

(d) Use your graph to:

(i) determine the length *L* of the 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]

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

Explain your answer.

....

.... [1]

[Total: 12]

5 A student investigates 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.

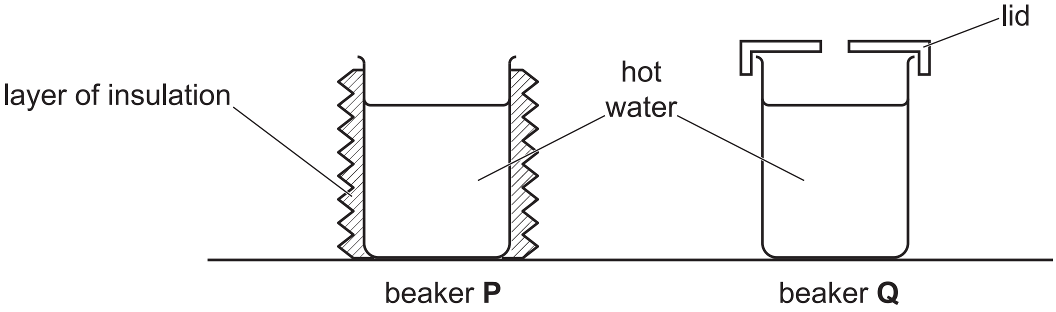


Fig. 5.1

(a) Procedure

The student:

- measures room temperature, which is 25.0 °C
- pours 200 cm^3 of hot water into beaker **P**
- places the thermometer into the water
- waits for 20 s and measures the temperature θ_0 of the hot water
- starts the stop-watch
- stirs the water and measures its temperature after a further 180 s.

Fig. 5.2 shows the reading on the thermometer when the stop-watch is started.

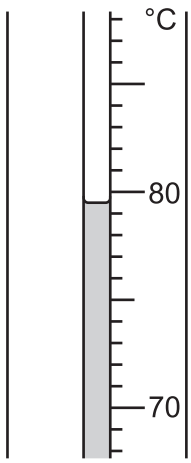


Fig. 5.2

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

Table 5.1

beaker **P** insulation, no lid	
time t / s	temperature θ / °C
0	
180	71.0

[1]

(ii) State why the student waits for 20 s before reading the initial temperature of the hot water.

....

.... [1]

(iii) State why the student stirs the water before taking its final temperature.

....

.... [1]

(b) Procedure

The student:

- repeats the procedure in **(a)** using beaker **Q**
- records the results in Table 5.2.

Table 5.2

beaker **Q** lid, no insulation	
time t/s	temperature θ/°C
0	79.0
180	74.5

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]

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

.... [1]

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

.... [1]

(e) Predict what the temperature of the water in beaker **Q** is 2 hours after the student has completed the investigation.

temperature of water = ... °C [1]

[Total: 8]

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