



CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0653/61

May/June 2024

1 hour

No additional materials are needed.

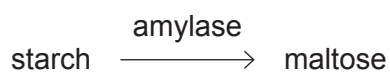
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction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

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [].

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

- 1 (a) A student investigates the effect of copper sulfate on the enzyme amylase.

Amylase speeds up the breakdown of starch into the sugar maltose. The word equation is shown.



The progress of this reaction can be followed by using iodine solution to test for the presence of starch.

Procedure

The student:

- Step 1** adds 2 drops of iodine solution to 12 labelled wells on a spotting tile, as shown in Fig. 1.1

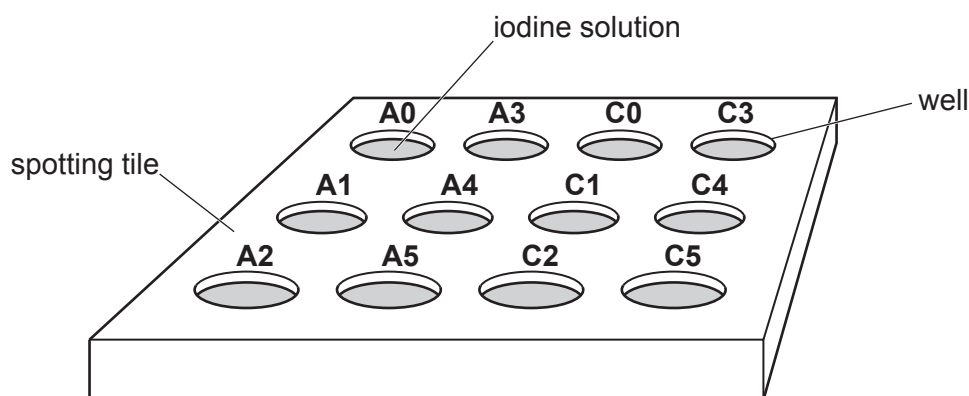


Fig. 1.1

- Step 2** puts three test-tubes, one containing starch solution, one containing amylase solution and one containing copper sulfate solution, into a water-bath for 3 minutes

Fig. 1.2 shows the reading on a thermometer in the water-bath.

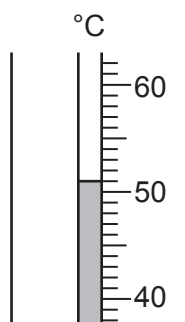


Fig. 1.2

- (i) Record the temperature of the water-bath to the nearest 0.5°C.

temperature = ... °C [1]

Step 3 puts 2 cm^3 of starch solution into each of two test-tubes labelled **A** and **C**

(ii) Suggest a piece of apparatus suitable for measuring 2 cm^3 of starch solution.

..... [1]

Step 4 adds 2 cm^3 of amylase solution to each test-tube **A** and **C**

Step 5 adds 1 cm^3 of copper sulfate solution to test-tube **C** only

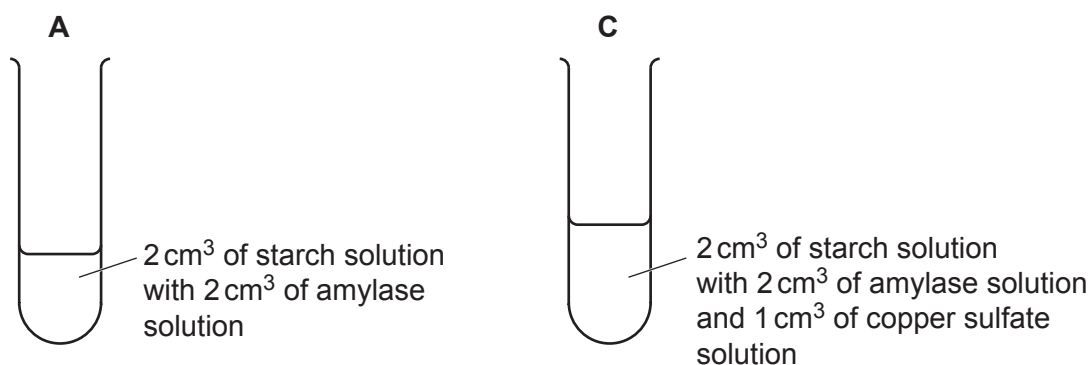


Fig. 1.3

Step 6 puts a drop of solution from test-tube **A** into well **A0** of the spotting tile (0 min)

Step 7 puts a drop of solution from test-tube **C** into well **C0** of the spotting tile (0 min)

Step 8 starts a stop-watch and repeats **step 6** and **step 7** for test-tubes **A** and **C** at one minute, using well **A1** and **C1**

Step 9 repeats **step 6** and **step 7** for test-tubes **A** and **C** at one minute intervals for a further 4 minutes, using wells **A2–A5** and **C2–C5**.

Fig. 1.4 shows the spotting tile at the end of the investigation.

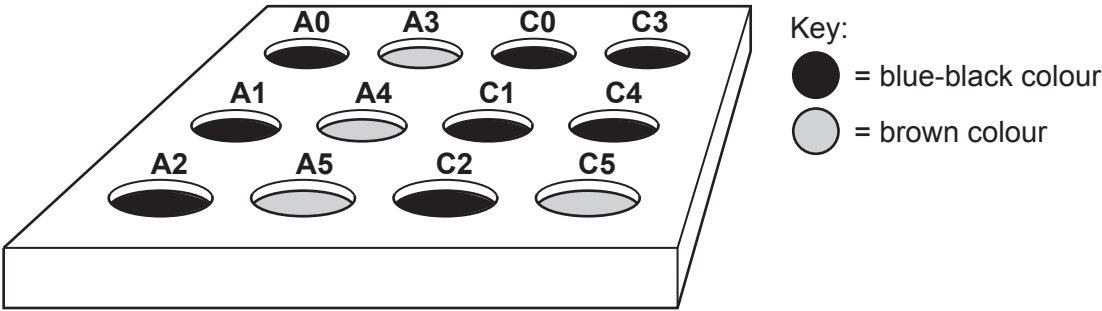


Fig. 1.4

(iii) Use Fig. 1.4 and the key to record in Table 1.1, the colour of the solution in each well for test-tubes **A** and **C**.

Table 1.1

time / minutes	colour in the well after adding solution from test-tube A		colour in the well after adding solution from test-tube C	
	well	colour	well	colour
0	A0		C0	
1	A1		C1	
2	A2		C2	
3	A3		C3	
4	A4		C4	
5	A5		C5	

[2]

(iv) Explain the results for test-tube **A**.

.....

.....

.....

..... [2]

(v) Describe the effect of copper sulfate on the reaction.

.....

..... [1]

- (vi) Calculate the difference in volume of the solution in test-tube **A** and the solution in test-tube **C** at the end of **step 5**.

Use the information from **steps 3, 4** and **5**.

volume of solution in test-tube **A** = ... cm³

volume of solution in test-tube **C** = ... cm³

difference in volume = ... cm³
[1]

- (vii) The difference in volume of solution you calculated in (a)(vi) identifies a limitation in this investigation.

Suggest a change to the procedure that removes this limitation.

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

- (viii) Explain why the test-tubes were left for 3 minutes in a water-bath in **step 2**.

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

- (b) Amylase is extracted from the fungus *Aspergillus*.

Fig. 1.5 shows a photograph of the fruiting body of the fungus taken using a microscope.

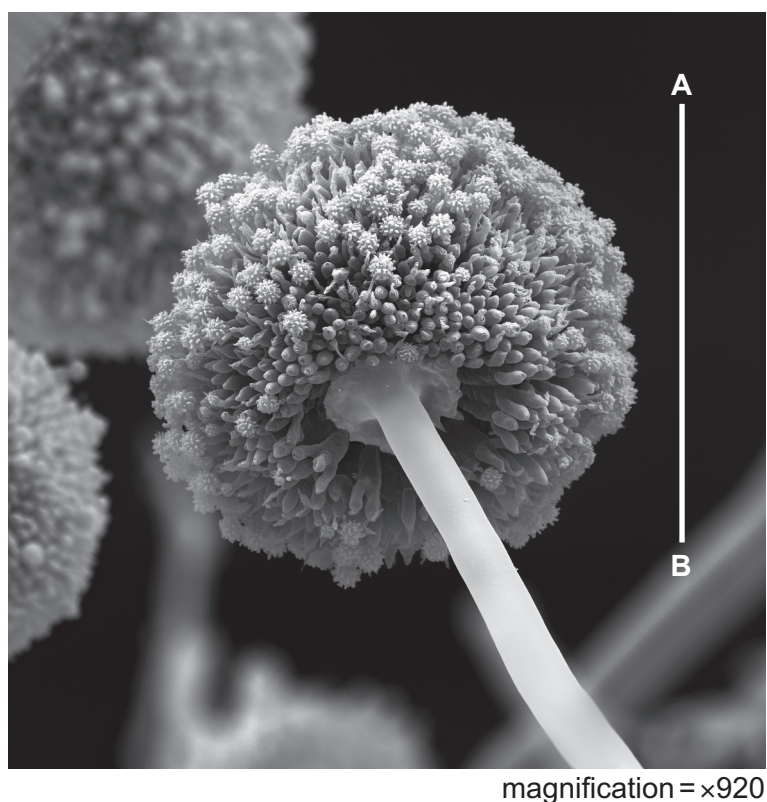


Fig. 1.5

Line **AB** represents the diameter of the fruiting body.

- (i) Measure the length of line **AB** on Fig. 1.5.

length of line **AB** = ... mm [1]

- (ii) Calculate the actual diameter of the fruiting body.

Use the equation shown.

$$\text{actual diameter} = \frac{\text{length of line AB}}{\text{magnification}}$$

Give your answer to **one** significant figure.

actual diameter = ... mm [2]

[Total: 13]

BLANK PAGE

- 2 A student investigates the reaction of sodium hydrogencarbonate with dilute sulfuric acid.

This reaction produces carbon dioxide gas.

Procedure

The student:

Step 1 pours 50.0 cm^3 of dilute sulfuric acid into a beaker

Step 2 adds one spatula of sodium hydrogencarbonate to the acid

Step 3 immediately starts a stop-watch

Step 4 stirs the mixture until it stops fizzing

Step 5 stops the stop-watch

Step 6 records in Table 2.1 this reaction time.

The student repeats the procedure four more times with the number of spatulas of sodium hydrogencarbonate shown in Table 2.1.

Table 2.1

number of spatulas of sodium hydrogencarbonate	reaction time /s
1	
2	37
3	55
4	75
5	

- (a) Fig. 2.1 shows the stop-watch readings for 1 spatula and 5 spatulas of sodium hydrogencarbonate.



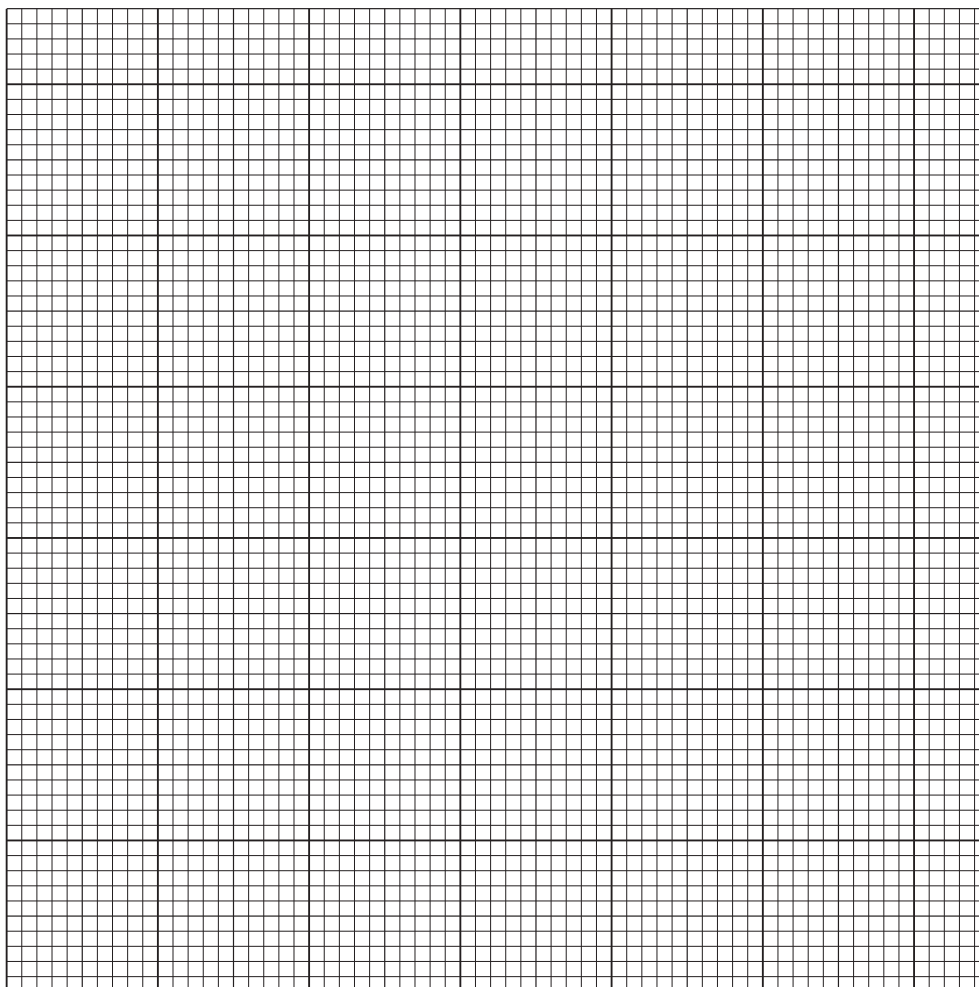
Fig. 2.1

Record in Table 2.1 these reaction times to the nearest second.

[2]

- (b) (i) On the grid, plot reaction time (vertical axis) against the number of spatulas of sodium hydrogencarbonate.

The x -axis must include 6 spatulas of sodium hydrogencarbonate. You should also extend your y -axis.



[3]

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

- (iii) Describe the relationship between the number of spatulas of sodium hydrogencarbonate and the reaction time.

.....

..... [1]

- (iv) Use your graph to predict the reaction time for 6 spatulas of sodium hydrogencarbonate.

Show your working on the graph.

reaction time = ... s [2]

- (c) (i) Suggest why it is difficult to measure the reaction time accurately.

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

- (ii) The student repeats the measurement for each number of spatulas of sodium hydrogencarbonate.

Suggest how repeating the measurements allows the student to evaluate the quality of the data.

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

- (iii) Suggest a change to **step 2** to improve the procedure.

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

- (d) The gas given off is carbon dioxide.

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

test

observation [1]

[Total: 13]

BLANK PAGE

3 A student determines the density of a wooden block.

(a) The student determines the volume of the wooden block.

Fig. 3.1 shows the wooden block drawn to actual size.

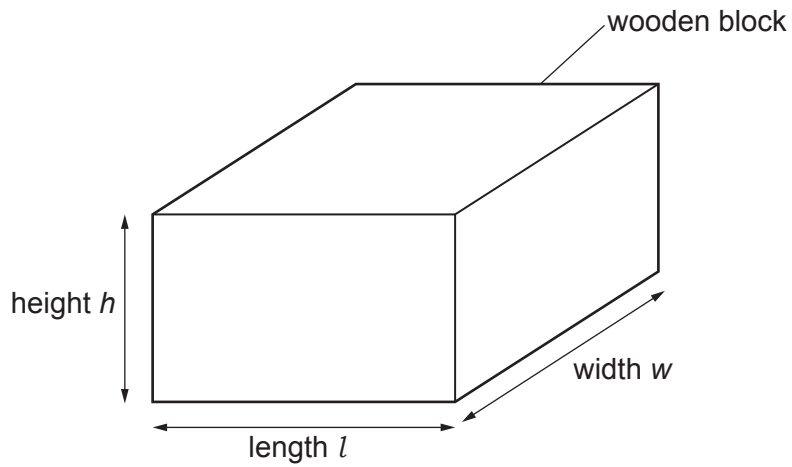


Fig. 3.1

(i) Measure the height h , width w and length l of the wooden block.

Record each measurement to the nearest 0.1 cm.

$h =$ cm

$w =$ cm

$l =$ cm
[1]

(ii) Calculate the volume V_{block} of the wooden block.

Use the equation shown.

$$V_{\text{block}} = h \times w \times l$$

$V_{\text{block}} =$ cm³ [1]

- (b) The student uses a displacement method to measure the mass of the wooden block.

The student has two identical beakers labelled **A** and **B**, each containing 100 cm^3 of water. The student also has a measuring cylinder containing water.

Procedure

The student:

- carefully places the wooden block in beaker **A**.

The water level in beaker **A** rises as the wooden block displaces water and the block floats as shown in Fig. 3.2.

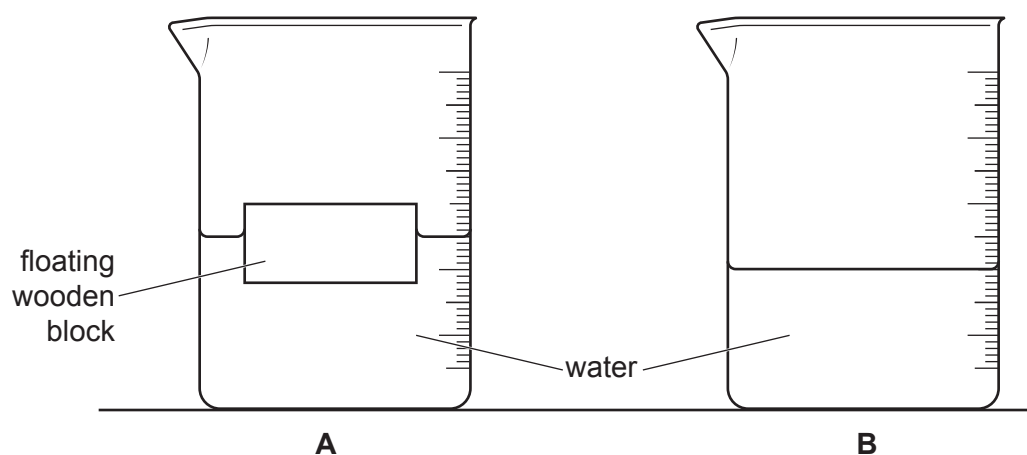


Fig. 3.2

The student:

- records the initial volume of water V_1 in the measuring cylinder
- slowly pours water from the measuring cylinder into beaker **B** until the water level is the same in both beakers
- records the final volume of water V_2 in the measuring cylinder.

- (i) Fig. 3.3 shows the water level in the measuring cylinder before and after pouring the water into beaker **B**.

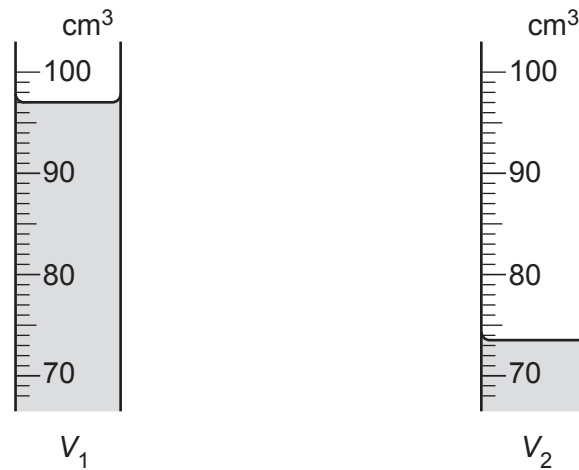


Fig. 3.3

Record V_1 and V_2 as shown in Fig. 3.3.

$$V_1 = \dots\dots\dots \text{cm}^3$$

$$V_2 = \dots\dots\dots \text{cm}^3$$

[2]

- (ii) The mass M of the wooden block is equal to the mass of water displaced by the block when it is placed in beaker **A**.

1.0 cm³ of water has a mass of 1.0 g.

Calculate the mass M .

Use the equation shown.

$$M = (V_1 - V_2) \times 1.0$$

$$M = \dots\dots\dots \text{g} \quad [1]$$

- (c) Calculate the density ρ of the wooden block.

Use your answers to (a)(ii) and (b)(ii) and the equation shown.

$$\rho = \frac{M}{V_{\text{block}}}$$

$$\rho = \dots\dots\dots \text{g/cm}^3 \quad [1]$$

- (d) Another student repeats the experiment and makes an error when reading V_2 . Their value of V_2 is too small.

State the effect this has on the calculated density ρ of the wooden block.

Give a reason for your answer.

effect

reason

..... [1]

[Total: 7]

4 A thermistor is a type of variable resistor.

A thermistor is used to measure changes in the temperature of water in a beaker. The resistance of the thermistor changes as the water temperature changes.

The resistance R of the thermistor at temperature T is calculated using the equation:

$$R_T = \frac{V}{I}$$

where V is the potential difference across the thermistor and I is the current through the thermistor.

Plan an investigation to find the relationship between the temperature of the water and the resistance of the thermistor.

You are provided with:

- a supply of hot and cold water
- extra connecting wires (or leads)
- the assembled apparatus shown in Fig. 4.1.

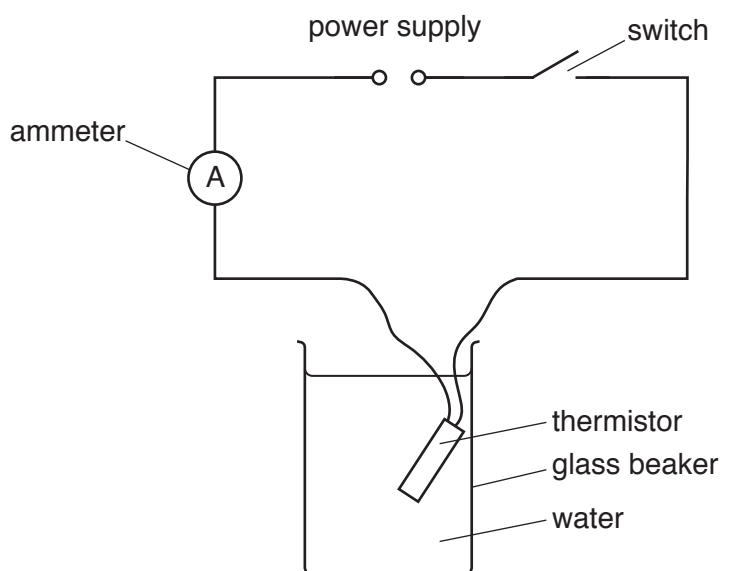


Fig. 4.1

You may use any common laboratory apparatus in your plan.

In your plan, include:

- a brief description of how you will use the assembled apparatus shown in Fig. 4.1
- any other apparatus needed
- what you will measure and how you will make sure your measurements are accurate
- a results table to record your measurements (you do **not** need to enter any readings in the table)
- how you will process your results to draw a conclusion.

..... [7]

BLANK PAGE

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.



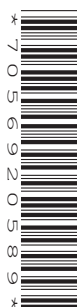
Cambridge IGCSE™

CANDIDATE
NAME
CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

**COMBINED SCIENCE****0653/62**

Paper 6 Alternative to Practical

May/June 2024**1 hour**

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 40.
- The number of marks for each question or part question is shown in brackets [].

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



- 1 A student investigates the effect of enzyme concentration on the breakdown of a substance.

Catalase is an enzyme found in peas that breaks down hydrogen peroxide into water and oxygen gas. The word equation for the reaction is shown.



When peas are added to a solution of hydrogen peroxide, the oxygen gas causes a frothy layer of bubbles to form on top.

The rate of this reaction can be estimated by measuring the height of the layer of bubbles formed. This is shown as h in Fig. 1.1.

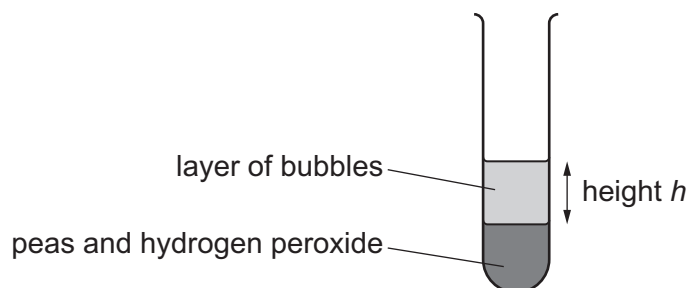


Fig. 1.1

(a) Procedure

The student:

Step 1 adds 10cm^3 of hydrogen peroxide to each of five boiling tubes, **A**, **B**, **C**, **D** and **E**

Step 2 adds different numbers of peas to each boiling tube

Step 3 waits 5 minutes and then measures the height h in each boiling tube.

Fig. 1.2 shows the boiling tubes at the end of 5 minutes. These are drawn to scale.



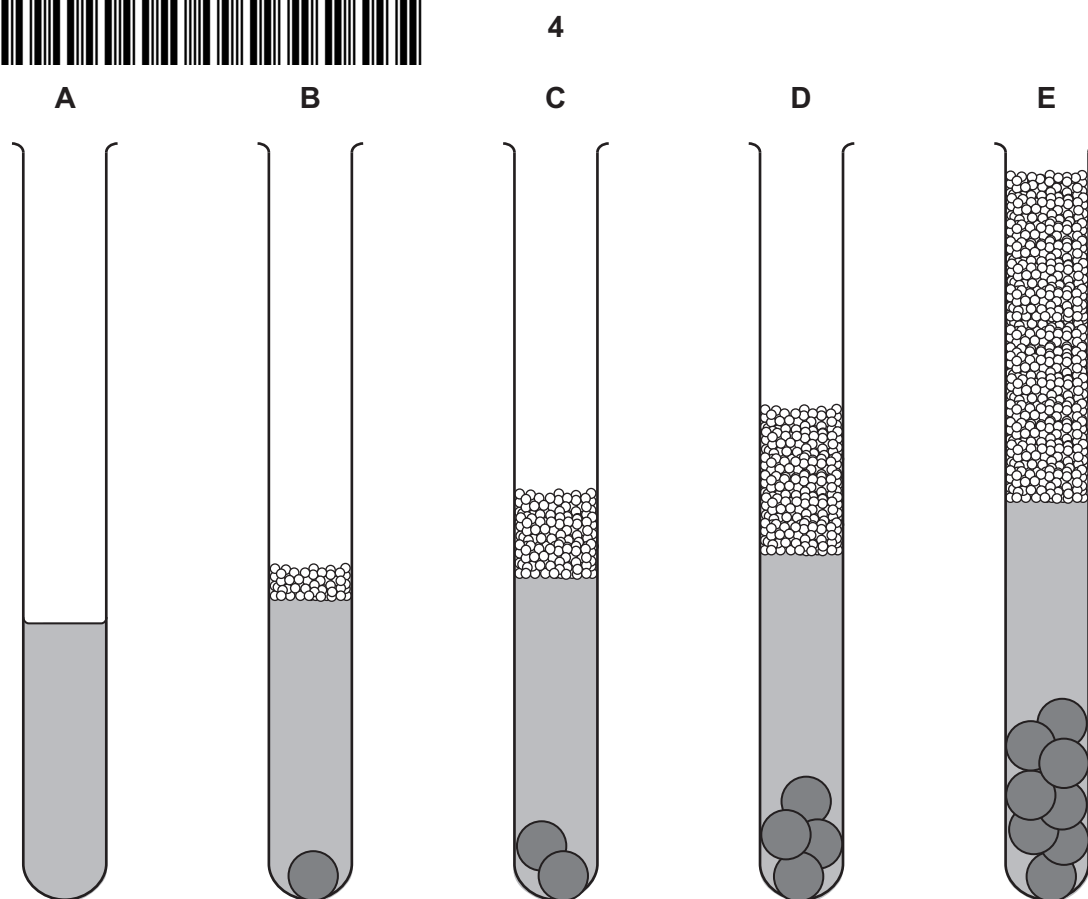


Fig. 1.2

- (i) Record in Table 1.1 the value of height h in each of the five boiling tubes.

Table 1.1

boiling tube	number of peas added	height h /mm
A	0	
B	1	
C	2	
D	4	
E	8	

[2]

- (ii) Explain why the height of the bubbles is measured from the top of the hydrogen peroxide rather than from the bottom of the test-tube.

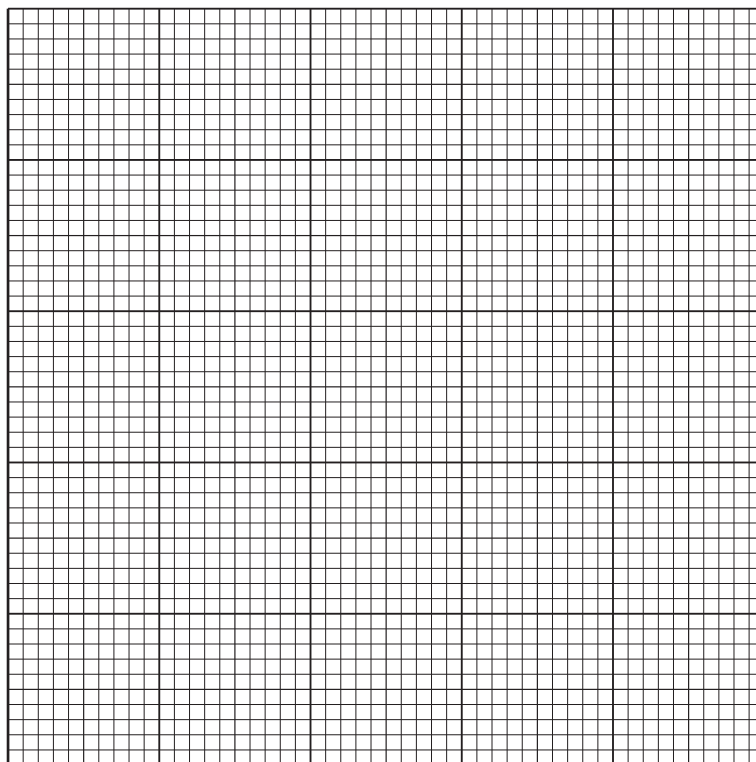
.....

..... [1]





- (iii) On the grid, plot a graph of height h (vertical axis) against the number of peas added.



[3]

- (iv) Draw the line of best fit.

[1]

- (v) Use your graph to estimate the height h when **six** peas are used.

Show on the graph how you obtain your value.

height h = ... mm [2]

- (vi) Describe the relationship between height h and the number of peas added.

.....
 [1]

- (vii) Use your answer to (a)(vi) to determine the relationship between the concentration of catalase and the rate of breakdown of hydrogen peroxide.

.....
 [1]





(b) Identify **one** source of error when measuring height h in (a)(i).

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

(c) The student repeats the procedure several times for each boiling tube.

Suggest how repeating the procedure allows the student to evaluate the quality of the data.

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

[Total: 13]

DO NOT WRITE IN THIS MARGIN



* 0019655394707 *



7

BLANK PAGE



DO NOT WRITE IN THIS MARGIN





- 2 A student investigates the identity of unknown solution **X**.

Procedure

The student does each test described in Table 2.1 on separate samples of solution **X**.

The observations are shown in Table 2.1.

Table 2.1

test number	test	observations
1	Add aqueous sodium carbonate to solution X .	light blue precipitate
2	Add dilute nitric acid followed by aqueous barium nitrate to solution X .	remains a blue solution
3	Add dilute nitric acid followed by aqueous silver nitrate to solution X .	white precipitate in a blue solution
4	Soak a wooden splint in solution X and hold the splint in a blue Bunsen burner flame.	blue-green flame for a few seconds and then a yellow flame

- (a) Test 4 is called the flame test.

- (i) Explain why it is difficult to identify the positive ion (cation) present in solution **X** using the flame test in test 4.

.....
 [1]

- (ii) Explain why the student does **not** use a yellow Bunsen burner flame for the flame test.

.....
 [1]





(b) Solution **X** is blue.

In test **3**, the precipitate appears to be blue.

Describe what the student does to confirm the precipitate is white and not blue.

.....
 [1]

(c) Identify the negative ion (anion) present in solution **X**.

State which test you use to make this identification.

negative ion is
 test [2]

(d) Solution **X** contains Cu^{2+} ions.

The student adds aqueous ammonia to solution **X** until the ammonia is in excess.

Describe the observations made by the student.

.....
 [2]

[Total: 7]





- 3 When an aqueous salt solution is left in an open container, the mass of the solution decreases. This is because some of the water evaporates.

Plan an investigation to determine the relationship between the concentration of salt solution and the rate of evaporation of water from the salt solution.

You are provided with:

- distilled water
- solid salt.

You may use any other common laboratory apparatus in your plan.

In your plan, include:

- the apparatus you will use
- a brief description of the method
- what you will measure
- which variables you will keep constant
- how you will process your results to draw a conclusion.

You may include a labelled diagram if you wish.

You may include a table that can be used to record the results if you wish.

You do **not** need to include any results in the table.





[7]

- 4 A student compares the rate at which hot water cools in a beaker with and without a lid.

The apparatus used for the beaker without a lid is shown in Fig. 4.1.

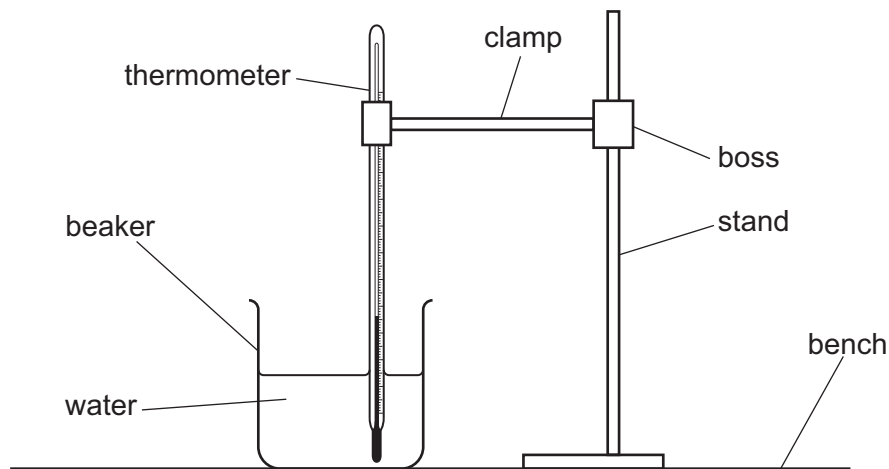


Fig. 4.1

(a) Procedure

The student:

- adds 100 cm^3 of hot water to a beaker
- places a thermometer in the hot water in the beaker
- waits for 30 s after placing the thermometer in the hot water
- measures the temperature θ_A on the thermometer at time $t = 0$ and immediately starts a stop-clock
- records θ_A at time $t = 0$ in Table 4.1
- measures and records θ_A every 30 s for 180 s
- empties the beaker.

The student repeats the procedure for the beaker with a cardboard lid on top, recording the temperatures as θ_B .



Fig. 4.2 shows the reading on the thermometer after 60 s in the beaker without a lid and after 60 s in the beaker with a lid.

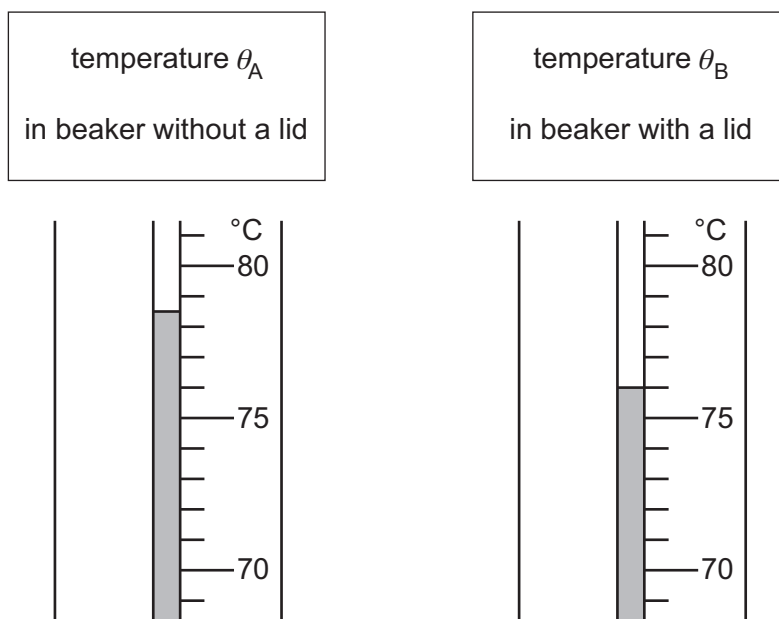


Fig. 4.2

- (i) Record in Table 4.1 the two temperatures for time $t = 60$ s.

Table 4.1

time t /s	temperature θ_A (without a lid) /°C	temperature θ_B (with a lid) /°C
0	84.0	79.0
30	81.0	77.5
60		
90	75.5	74.0
120	73.0	77.0
150	71.0	71.5
180	69.0	70.0

[2]

- (ii) Circle the anomalous result in Table 4.1.

[1]





- (b) (i) Calculate the total change in temperature between $t = 0$ and $t = 180$ s for the beaker without a lid $\Delta\theta_A$ and for the beaker with a lid $\Delta\theta_B$.

$$\Delta\theta_A = \dots\dots\dots\text{ }^{\circ}\text{C}$$

$$\Delta\theta_B = \dots\dots\dots\text{ }^{\circ}\text{C}$$

[1]

- (ii) Calculate the average rate of cooling R of the water for each experiment.

Use the equation shown.

$$R = \frac{\Delta\theta}{\Delta t} \quad \text{where } \Delta t = 180 \text{ s}$$

Give your answers to **two** significant figures.

Determine the unit for the rate of cooling.

$$R_A = \dots\dots\dots$$

$$R_B = \dots\dots\dots$$

$$\text{unit} = \dots\dots\dots$$

[3]





- (iii) Two results are equal within the limits of experimental accuracy if the values are within 10% of each other.

Use your answers to **(b)(ii)** to state whether the rate of cooling R_A in the beaker without a lid is equal to the rate of cooling R_B in the beaker with a lid.

Support your answer with a calculation.

calculation

statement

 [2]

- (c) (i) State how to avoid parallax (line of sight) error when reading the thermometer.

 [1]

- (ii) State the name of a piece of apparatus suitable for measuring the 100 cm^3 of hot water.
 [1]

- (iii) Suggest **two** improvements to the procedure described in **(a)**.
 1

 2
 [2]

[Total: 13]





Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.





CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0653/63

May/June 2024

1 hour

No additional materials are needed.

- 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.

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [].

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

- 1 A student investigates the growth of plants.

Procedure

The student:

- Step 1** measures the mass of three potted plants **A**, **B** and **C**
- Step 2** gives each plant 50 cm³ of different concentrations of plant nutrients as shown in Table 1.1
- Step 3** puts the plants near a window for 2 weeks giving each plant an equal volume of water each day
- Step 4** measures the final mass of each potted plant.

Fig. 1.1 shows the plants after 2 weeks.

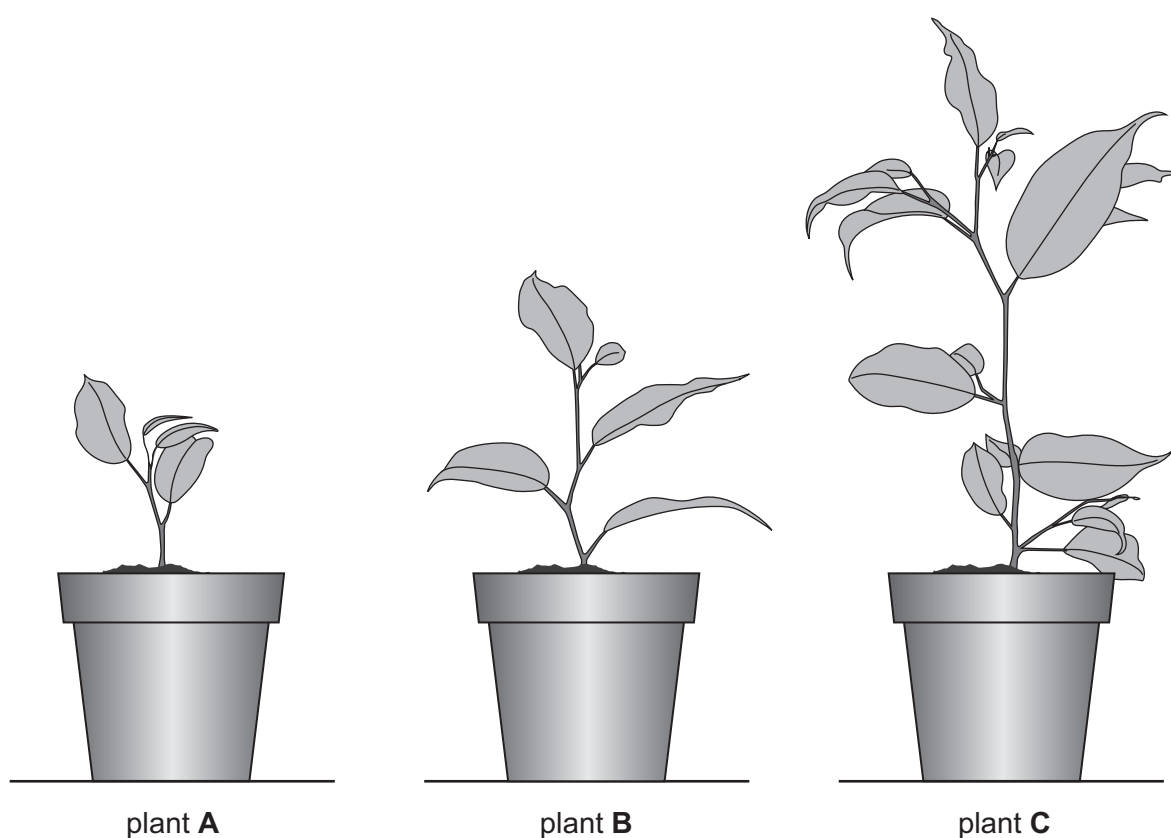


Fig. 1.1

Table 1.1

plant	percentage concentration of nutrients given	mass at start /g	final mass /g	change in mass /g
A	0	330	339	9
B	5	334		
C	10	328		

- (a) Fig. 1.2 shows the readings of final mass for plant **B** and plant **C**.

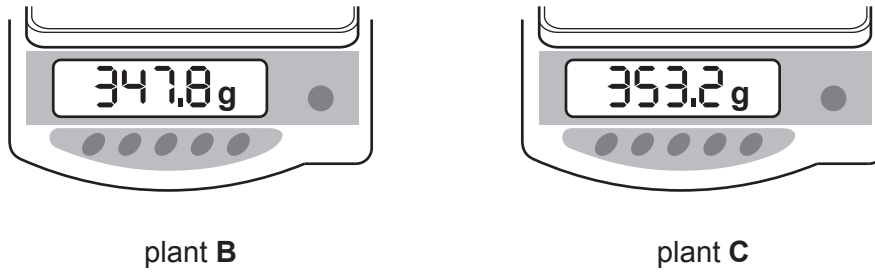


Fig. 1.2

- (i) Record in Table 1.1 the final mass of plants **B** and **C** to the nearest whole number. [2]
- (ii) Calculate the change in mass for plants **B** and **C**.

Record your values in Table 1.1.

[1]

- (iii) State the dependent variable in this investigation.

..... [1]

- (iv) State a conclusion about the growth of the plants.

..... [1]

- (b) (i) The student repeats the procedure three times and calculates an average value for the change in mass.

State one **other** reason for repeating the procedure three times.

..... [1]

- (ii) In another investigation, the height of the plants is measured.

Suggest why it is better to measure the mass of the plants rather than the height.

..... [1]

[Total: 7]

- 2 When seeds germinate, they use oxygen gas for aerobic respiration.



When placed in a test-tube as shown in Fig. 2.1, the seeds use up oxygen and the drop of liquid in the capillary tube moves towards the test-tube.

The greater the rate of respiration the faster the drop of liquid moves.

Plan an investigation to determine the relationship between temperature and the rate of respiration of germinating seeds.

You are provided with:

- the apparatus shown in Fig. 2.1
- 100 germinating seeds.

You may use any other common laboratory apparatus.

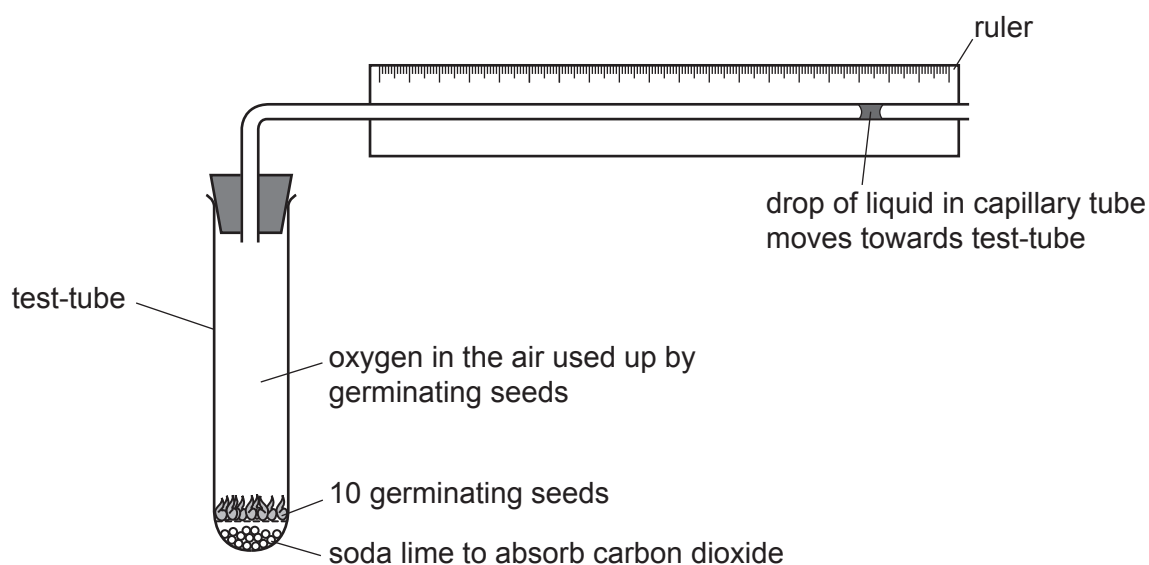


Fig. 2.1

In your plan, include:

- any additional apparatus needed
- a brief description of the method and an explanation of any safety precautions you will take
- what you will measure
- which variables you will keep constant
- how you will process your results to draw a conclusion.

You may include a table that can be used to record the results if you wish.

You do **not** need to include any results in the table.

3 A student investigates a green liquid.

The green liquid is a mixture of substances dissolved in water.

Some of these substances are coloured and the others are colourless.

- (a) The student uses paper chromatography to find out how many coloured substances are in the green liquid.

Procedure

The student:

Step 1 draws a pencil line near the bottom of the chromatography paper

Step 2 places a spot of the green liquid on the pencil line.

- (i) Explain why the start line must be drawn in pencil and **not** in ink.

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

- (ii) State the name of a piece of apparatus suitable to put the spot of green liquid on the chromatography paper.

..... [1]

The student:

Step 3 lets the spot of green liquid dry

Step 4 assembles the apparatus shown in Fig. 3.1.

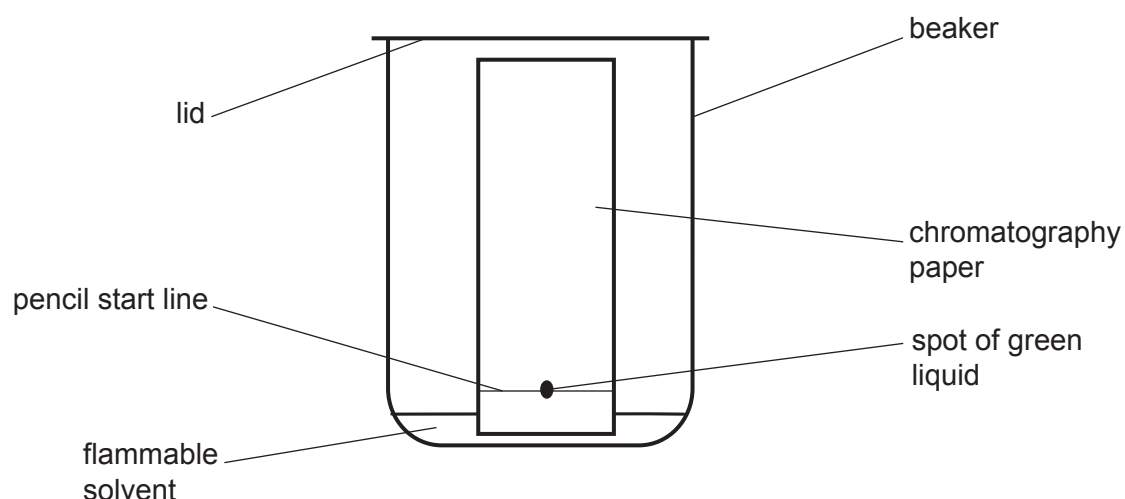


Fig. 3.1

- (b) After 15 minutes, the student takes the chromatography paper out of the beaker and lets the paper dry.

Fig. 3.2 shows the chromatography paper after it has dried.

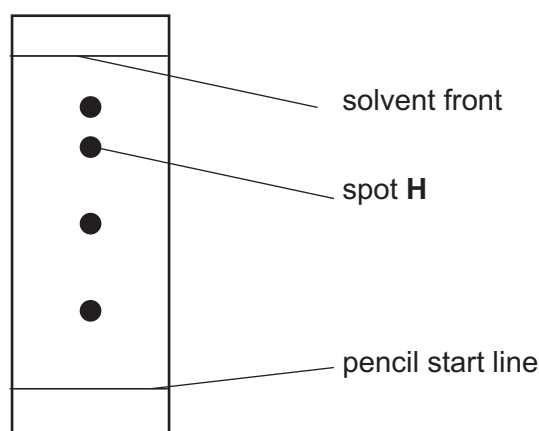


Fig. 3.2

- (i) State how many **coloured** substances are in the green liquid.

..... [1]

- (ii) Suggest why you **cannot** determine the number of **colourless** substances in the green liquid.

..... [1]

- (iii) Measure the distance from the pencil start line to the centre of the spot labelled **H** on Fig. 3.2.

Record this distance in centimetres to the nearest millimetre.

distance to **H** = ... cm [1]

- (iv) Measure the distance from the pencil start line to the solvent front on Fig. 3.2.

Record this distance in centimetres to the nearest millimetre.

distance to solvent front = ... cm [1]

- (v) Calculate the R_f value for spot **H**.

Use the equation shown.

$$R_f = \frac{\text{distance from the pencil start line to the centre of spot H}}{\text{distance from the pencil start line to the solvent front}}$$

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

$$R_f = \dots\dots\dots [2]$$

- (c) Describe and explain **one** safety precaution the student must take in **Step 4**.

safety precaution

explanation

..... [1]

- (d) The student does the chemical tests described in Table 3.1 on the green liquid.

Table 3.1

test		observations
1	acidify with dilute nitric acid, then add aqueous silver nitrate	no change to the green liquid
2	acidify with dilute nitric acid, then add aqueous barium nitrate	white precipitate
3	add excess aqueous sodium hydroxide then warm the mixture	green precipitate gas produced turns damp red litmus paper blue
4	add a few drops of aqueous ammonia then add excess aqueous ammonia	green precipitate green precipitate insoluble

- (i) Explain how the observations in Table 3.1 show that the green liquid contains iron(II) ions.

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

- (ii) Explain how the observations in Table 3.1 show that the green liquid contains sulfate ions.

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

- (iii) State the name of the gas formed in test 3.

..... [1]

- (iv) State the name of the cation (positive ion) present that causes the gas to be produced in test 3.

..... [1]

[Total: 13]

4 A student determines the mass M of a metre rule.

(a) The apparatus is shown in Fig. 4.1.

The metre rule rests on a pivot at the 20.0 cm mark.

The other end of the metre rule is supported by a newton meter at the 80.0 cm mark.

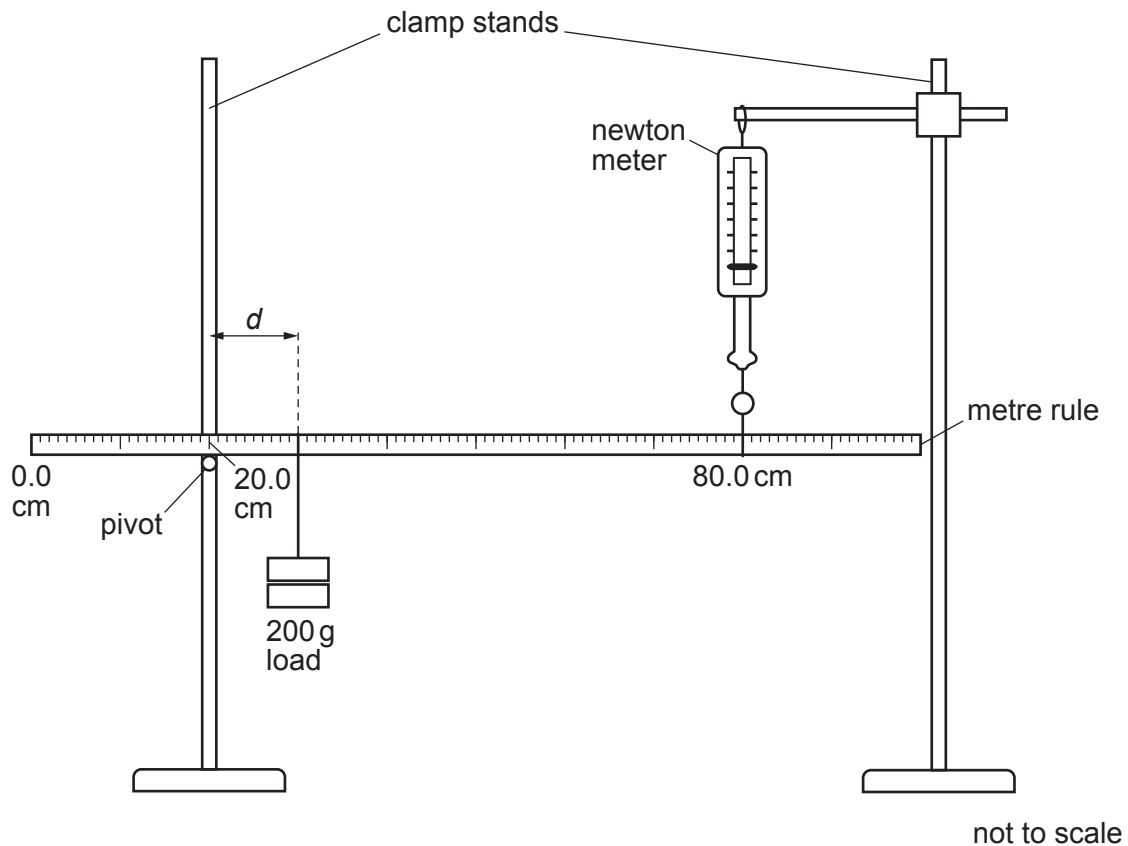


Fig. 4.1

Procedure

The student:

- hangs a load of mass 200 g at a distance $d = 10.0$ cm from the pivot
- measures the force F using the newton meter
- records in Table 4.1 the distance d and the force F .

The student repeats the procedure for values of $d = 20.0$ cm, 30.0 cm, 40.0 cm and 50.0 cm.

Fig. 4.2 shows the readings on the newton meter for $d = 30.0$ cm and $d = 40.0$ cm.

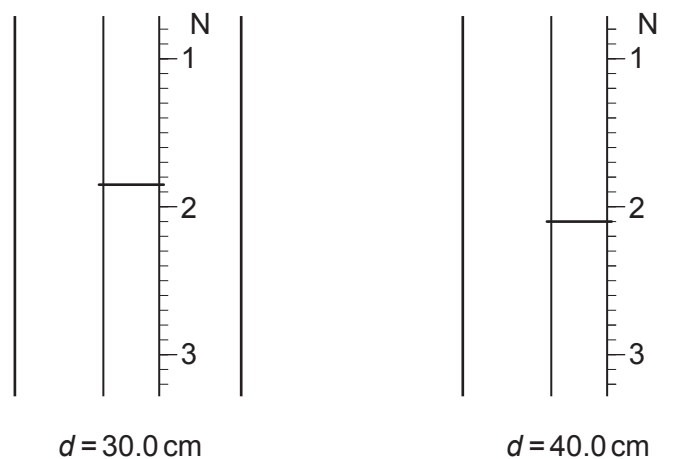


Fig. 4.2

- (i) Record the **two** values of F in Table 4.1.

Table 4.1

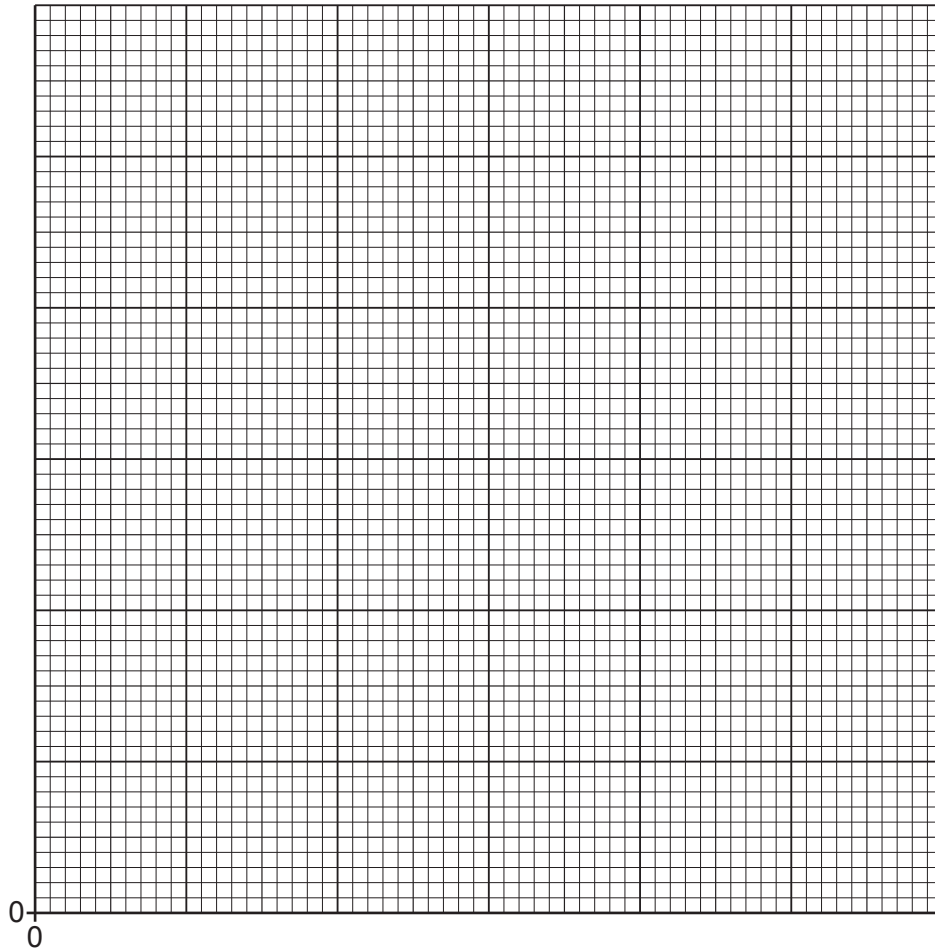
d /cm	F /N
10.0	0.95
20.0	1.40
30.0	
40.0	
50.0	2.45

[2]

- (ii) State **one** precaution the student takes to make the readings from the newton meter as accurate as possible.

.....
 [1]

- (b) (i) On the grid, plot a graph of F (vertical axis) against d .



[3]

- (ii) Draw the best-fit straight line.

Extend your best-fit line to cross the vertical axis.

[1]

- (iii) Use the graph to determine the value of the force F_0 when $d = 0.0\text{ cm}$.

$F_0 = \dots\dots\dots \text{ N}$ [1]

- (iv) The weight W of the metre rule is calculated using the equation shown.

$$W = 2 \times F_0$$

Calculate W .

$W = \dots\dots\dots \text{ N}$ [1]

- (v) The mass of the metre rule M is calculated using the equation shown.

$$M = \frac{W}{g}$$

Use $g = 10 \text{ N/kg}$ for your calculation.

Give your answer in grams.

$M = \dots\dots\dots$ grams
[2]

- (c) The teacher states that the value of F_0 can be measured directly by removing the 200 g load and taking a single reading of F_0 on the newton meter.

Suggest why the uncertainty in the value of F_0 is less using the graph than with taking a single reading.

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

- (d) Suggest an alternative piece of equipment to measure the mass of the metre rule.

..... [1]

[Total: 13]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.