CAMBRIDGE
International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CO-ORDINATED SCIENCES **0654/62**

Paper 6 Alternative to Practical **February/March 2026**

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. Do **not** use correction fluid or tape.
- 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 **24** pages. Any blank pages are indicated.

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[Turn over

1 A student investigates okra and star fruit.

Figure 1.1 shows a photograph of a slice of okra at its actual size.

Figure 1.1

(a) In the box, make a large, detailed, pencil drawing of the slice of okra shown in Figure 1.1.

[3]

(b) (i) Draw a line to join points **A** and **B** on Figure 1.1.

Record the length of this line **AB** in millimetres to the nearest millimetre.

length of line **AB** on Figure 1.1 = ... mm [1]

(ii) Draw the line **AB** on your drawing in **1(a)**.

Record the length of this line in millimetres to the nearest millimetre.

length of line **AB** on your drawing = ... mm [1]

(iii) Calculate the magnification m of your drawing.

Use your measurements in **1(b)(i)** and **1(b)(ii)** and the equation shown.

$$m = \frac{\text{length of line } \mathbf{AB} \text{ on your drawing}}{\text{length of line } \mathbf{AB} \text{ on Figure 1.1}}$$

Record your value to **two** significant figures.

magnification m = ... [2]

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(c) Figure 1.2 is a photograph of a slice of star fruit shown actual size.

Figure 1.2

Describe **two** visible differences and **one** visible similarity between the slice of okra in Figure 1.1 and the slice of star fruit in Figure 1.2.

difference 1 .....

.....

difference 2 .....

.....

similarity .....

.....

[3]

[Total: 10]

2 A student tests the nutrient content of yogurt.

(a) Procedure

The student:

step 1 adds equal amounts of yogurt to two test-tubes

step 2 adds Benedict's solution to one of the test-tubes of yogurt

step 3 stirs with a glass rod to mix the contents of the test-tube

step 4 places the test-tube into a hot water-bath

step 5 adds biuret solution to the other test-tube of yogurt

step 6 stirs with a clean glass rod to mix the contents of the test-tube

step 7 observes the final colour in each test-tube.

(i) Draw a results table to record the results.

[2]

(ii) The test-tube with Benedict's solution gives a positive result.

The test-tube with the biuret solution gives a positive result.

Record in your Table in **2(a)(i)** the final colours observed by the student in each test-tube. [2]

(iii) Use the results to state a conclusion for the nutrient content of yogurt.

.....

..... [2]

(b) **(i)** Explain why it is important in **step 3** and **step 6** to stir to mix the contents of the test-tubes.

.....

..... [1]

(ii) Explain why it is important in **step 6** to use a clean stirring rod.

.....

..... [1]

(c) A student tests a food sample for the presence of fat.

State the reagents needed and the observation for a positive result.

reagents ..... and .....

observation for a positive result .....

[2]

[Total: 10]

3 A student investigates the rate of reaction of calcium carbonate with dilute hydrochloric acid.

Calcium carbonate reacts with dilute hydrochloric acid forming carbon dioxide gas.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

(a) Procedure

The student:

- uses the apparatus shown in Figure 3.1

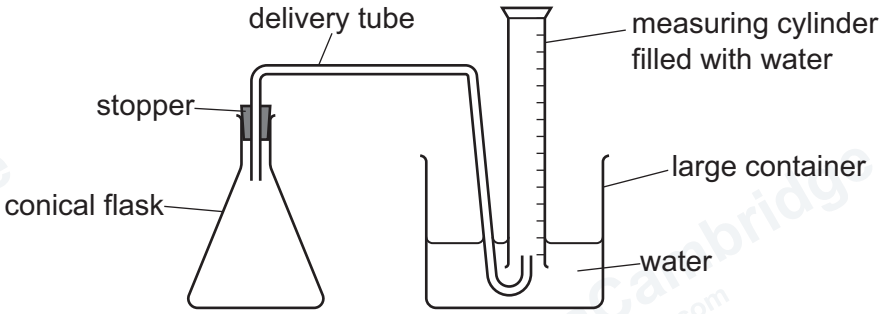


Figure 3.1

- removes the conical flask from the apparatus
- adds 25 cm^3 of dilute hydrochloric acid into the conical flask
- adds calcium carbonate to the conical flask
- quickly replaces the conical flask into the apparatus and starts a stop-watch
- measures the total volume of carbon dioxide gas in the measuring cylinder every 30 seconds for 5 minutes
- records in Table 3.1 these values to the nearest 0.5 cm^3.

Table 3.1

time / s	total volume of carbon dioxide gas / cm^3
0	0.0
30	
60	42.5
90	48.0
120	
150	52.0
180	53.0
210	54.0
240	55.0
270	55.0
300	55.0

(i) Figure 3.2 shows the reading on the measuring cylinder at 30 seconds and 120 seconds.

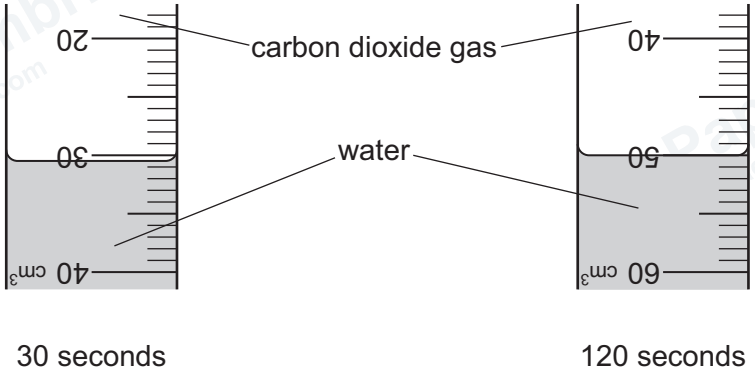
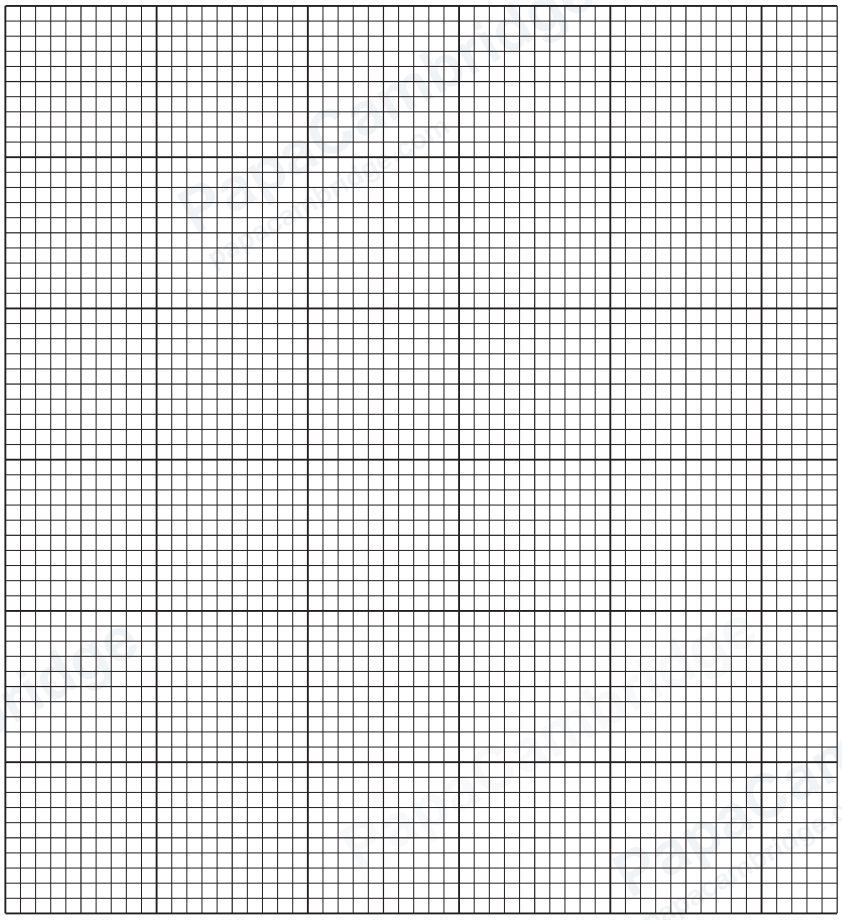


Figure 3.2

Record these volumes in Table 3.1. [2]

(ii) On the grid, plot total volume of carbon dioxide gas (vertical axis) against time.



[3]

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

(iv) Describe how the rate of the reaction changes during the 300 seconds.

Explain how your graph shows these changes.

.....

.....

.....

..... [2]

(v) Use the graph to estimate the volume of carbon dioxide gas evolved at 75 seconds.

volume of carbon dioxide gas = ... cm^3 [1]

(vi) Suggest an observation from the investigation which shows that the reaction has finished.

.....

..... [1]

(b) Calculate the average rate of reaction.

Use the equation shown.

$$\text{average rate} = \frac{\text{total volume of carbon dioxide gas given off}}{300}$$

average rate = ... cm^3/s [1]

(c) The student repeats the experiment using the same amounts of calcium carbonate and dilute hydrochloric acid but at a **higher** temperature.

The rate of reaction is faster than in the first experiment.

Draw a line on the grid in **3(a)(ii)** to show the results expected for this faster reaction.

Label the line **F**. [2]

(d) A systematic error in an experiment causes all readings to differ from the true reading by a similar amount or similar proportion. Repeating does **not** correct for a systematic error.

(i) One systematic error is the loss of gas when replacing the conical flask into the apparatus.

Explain why this is a systematic error.

.....

..... [1]

(ii) Suggest one method of reducing this systematic error.

.....

..... [1]

(e) A random error in an experiment is due to changes in the environment or the misreading of a measurement. Repeating and calculating an average may reduce the effect of the random error.

One random error in this experiment is the reading of volume on the measuring cylinder.

Describe how this random error is reduced. Do **not** include repeating the procedure, repeating the readings or changes in the environment.

.....

..... [1]

(f) To determine the rate of a reaction at a particular time, a tangent is drawn on the curve at that time.

For example, the rate of reaction at 30 seconds is found by drawing a tangent at 30 seconds as shown on Figure 3.3.

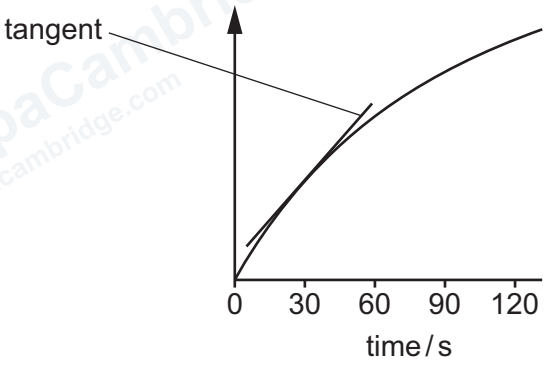


Figure 3.3

The rate of the reaction at 30 seconds is the gradient of the tangent in Figure 3.3.

A student does an experiment measuring the mass of gas given off in a reaction.

Figure 3.4 shows the graph of the student's results.

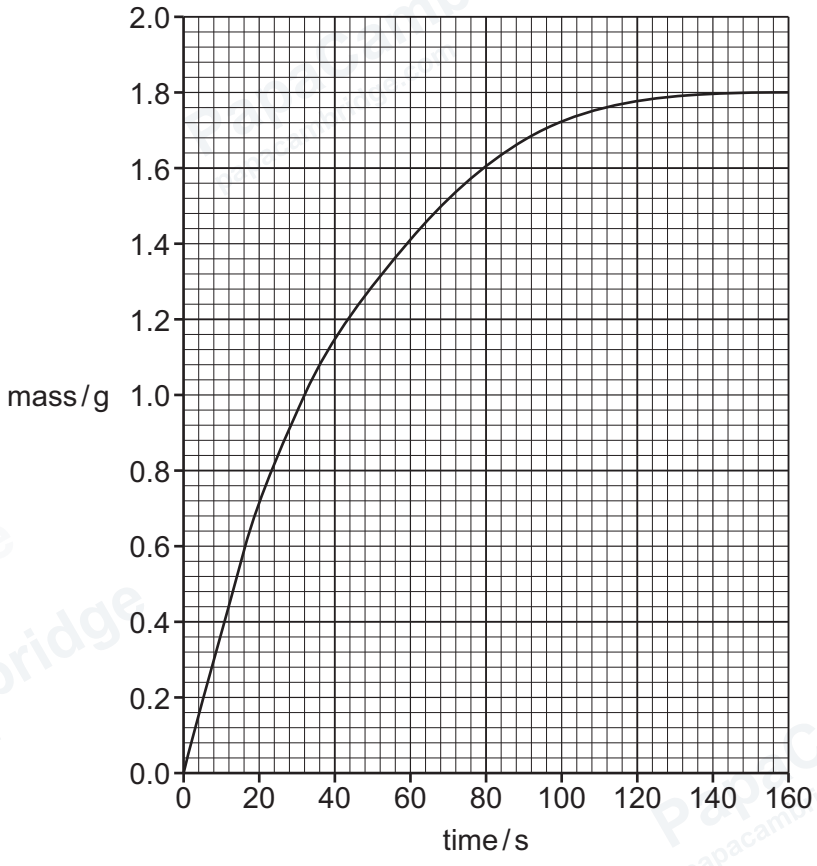


Figure 3.4

(i) Draw a tangent at 40 seconds on the graph in Figure 3.4. [1]

(ii) Calculate the gradient of your tangent.

This is the rate of reaction at 40 seconds.

gradient = ... [1]

[Total: 18]

4 A student investigates the identity of aqueous **H**.

(a) Procedure

The student:

- adds aqueous **H** into each of three test-tubes
- completes the tests detailed in Table 4.1
- records their observations in Table 4.1.

Table 4.1

test	reagents added	observations
1	universal indicator	red colour
2	dilute nitric acid followed by aqueous silver nitrate	white ppt
3	dilute nitric acid followed by aqueous barium nitrate	colourless solution

Explain why dilute nitric acid is added in tests **2** and **3**.

.....

..... [1]

(b) State the identity of solution **H**.

..... [1]

[Total: 2]

Turn over

5 A student determines the power *P* of a burning candle by heating two different liquids.

(a) Procedure

The student:

step 1 places a beaker on a balance and zeroes the balance

step 2 pours water into the beaker

step 3 records the mass in Table 5.1

step 4 stirs the water with a stirring thermometer

step 5 records in Table 5.1 the initial temperature of the water using the thermometer

step 6 assembles the apparatus shown in Figure 5.1 and lights the candle

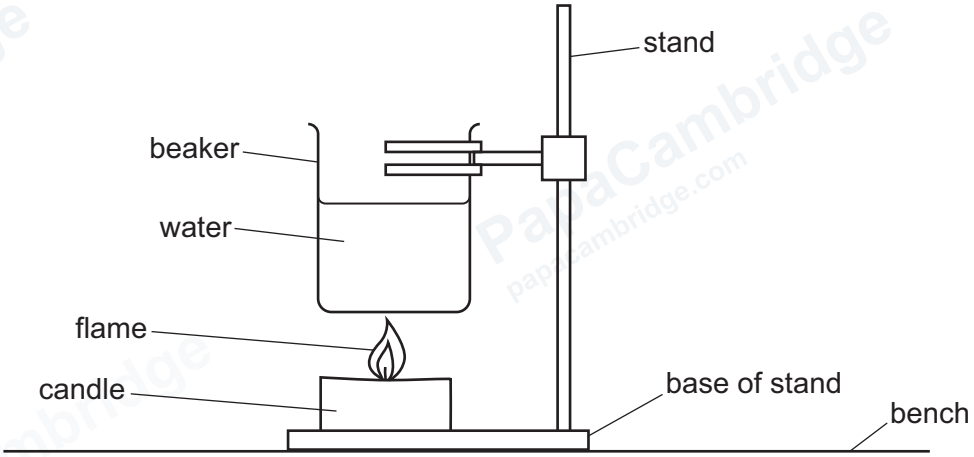


Figure 5.1

step 7 immediately starts a stop-watch and waits for 120 s

step 8 blows out the candle, stirs the water and records in Table 5.1 the final temperature of the water.

Repeats **step 1** to **step 8** using oil instead of water.

Table 5.1

liquid	mass / g	initial temperature / °C	final temperature / °C	change in temperature / °C
water	50.8	16.0	24.0	
oil				

(i) Figure 5.2 shows the reading on the balance in **step 3** when oil is used.

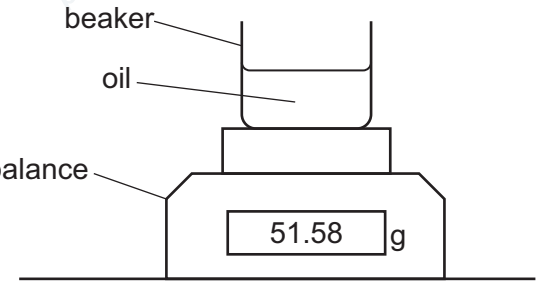


Figure 5.2

Record in Table 5.1 the mass in g to the nearest 0.1 g. [1]

(ii) Figure 5.3 shows the initial and final temperature readings on the thermometer when oil is used.

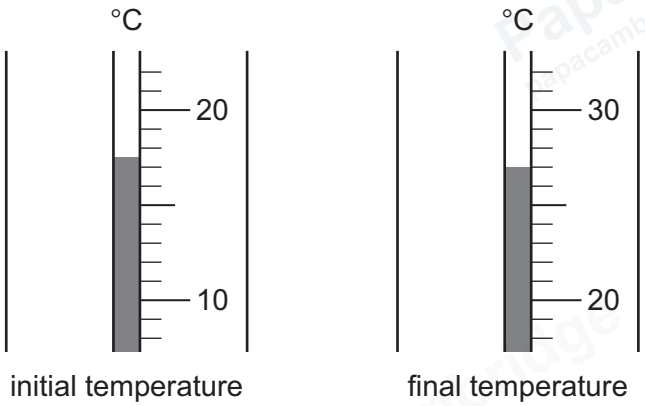


Figure 5.3

Record in Table 5.1 the temperatures in °C to the nearest 0.5 °C. [2]

(iii) Calculate the changes in temperature for the water and the oil.

Use the equation shown.

change in temperature = final temperature – initial temperature

Record these values in Table 5.1.

[1]

(iv) Calculate the power P of the burning candle for each liquid.

Use the equations shown.

water

$$P = \frac{4.2 \times \text{mass of water} \times \text{change in temperature}}{120}$$

$P =$ ..... W

oil

$$P = \frac{3.2 \times \text{mass of oil} \times \text{change in temperature}}{120}$$

$P =$ ..... W
[2]

(v) Two values are considered to be equal within the limits of experimental error if the difference between them is less than 10%.

Explain if your values of P from **5(a)(iv)** are considered equal within the limits of experimental error.

Justify your answer with a calculation.

(If you do not have values of P from **5(a)(iv)**, use $P = 15.5\,\text{W}$ for water and $P = 21.6\,\text{W}$ for oil.)

.....

..... [2]

(vi) To obtain accurate readings of temperature, it is important to stir the water in **step 4** and **step 8** of the procedure.

Explain how stirring improves accuracy.

.....

..... [1]

(b) (i) Another student repeats the procedure three times using 50.0 g of sand and then repeats it three times using 50.0 g of solid wax.

The student's changes in temperature are shown in Table 5.2.

Table 5.2

solid	change in temperature / °C		
	trial 1	trial 2	trial 3
sand	61.1	59.6	60.8
wax	22.2	13.9	14.6

The student concludes the average change in temperature for sand is 60.5 °C and for wax is 16.9 °C.

Explain why the student's conclusion is **not** correct.

.....

.....

..... [2]

(ii) The student moves the beaker upwards so that it is further away from the flame.

Suggest what effect this has on the calculated values of *P*.

Explain your answer.

effect .....

explanation .....

.....

[1]

(iii) Suggest why the student heats the liquid for 120 seconds instead of 30 seconds in **step 7**.

.....

..... [1]

[Total: 13]

6 A student investigates how the current in a series circuit changes with the number of lamps connected in the circuit.

Plan an investigation to determine the relationship between the current in a series circuit and the number of lamps connected in the circuit.

You are provided with:

- a number of identical lamps
- connecting wires.

You may use any common laboratory apparatus in your plan.

In your plan, include:

- the apparatus you will use
- a brief description of the method
- the variables you will control and how you will ensure your results are valid
- a results table for your measurements (you are **not** required to enter any readings into the table)
- how you will process your results to form a conclusion.

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..... [7]

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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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