Cambridge Assessment International Education

Cambridge IGCSE™

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COMBINED SCIENCE **0653/62**

Paper 6 Alternative to Practical **May/June 2025**

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 [ ].
- Notes for use in qualitative analysis are provided in the question paper.

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

DC (DE/SW) 346282/3

1 A student investigates a root vegetable.

Fig. 1.1 shows a section cut through the root of a carrot.

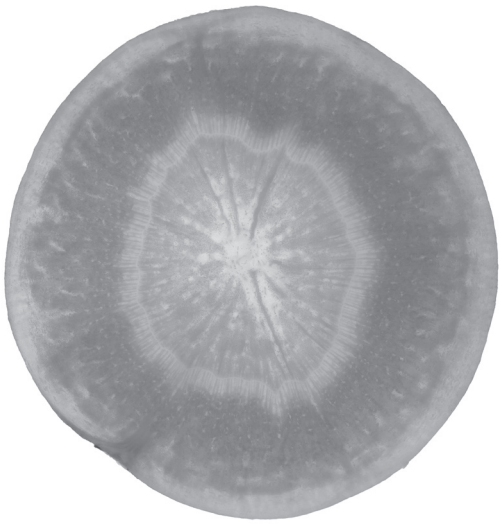


Fig. 1.1

(a) In the box, make a large pencil drawing of the cut surface of the carrot root.

[3]

(b) Fig. 1.2 shows a magnified photograph of a section of a lotus root.

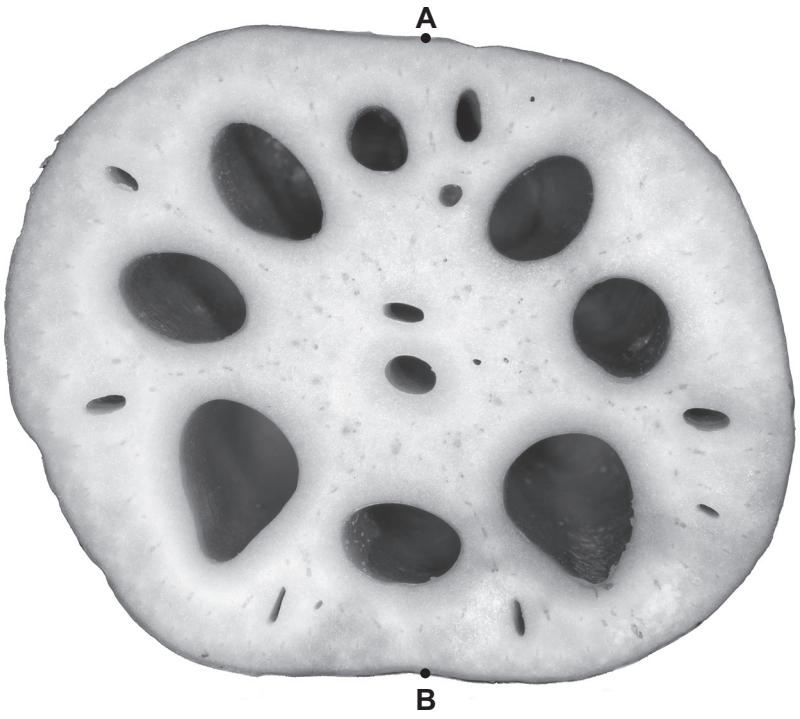


Fig. 1.2

(i) The distance **AB** represents the diameter of the lotus root section.

Measure the distance **AB** on Fig. 1.2.

Record your answer to the nearest mm.

distance **AB** = ... mm [1]

(ii) The actual diameter of the lotus root section is 75 mm.

Calculate the magnification of the photograph in Fig. 1.2.

Use the equation shown.

$$\text{magnification} = \frac{\text{length of line } \mathbf{AB}}{\text{actual diameter of lotus root section}}$$

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

magnification = ... [2]

(iii) Distance **AB** shows the smallest diameter of the lotus root section.

Describe how to determine the **average** diameter of the lotus root section.

.....

..... [1]

(c) (i) Describe **one** way that the section of lotus root in Fig. 1.2 is **similar** to the section of carrot root in Fig. 1.1.

.....

..... [1]

(ii) Describe **two** differences between the section of lotus root in Fig. 1.2 and the section of carrot root in Fig. 1.1.

difference 1 .....

.....

.....

difference 2 .....

.....

.....
[2]

(d) A student tests the section of carrot root and a piece of potato for the presence of starch.

The student:

step 1 places the piece of potato and the section of carrot root onto a white tile

step 2 adds a few drops of iodine solution to the surface of the carrot and of the potato

step 3 observes the colour of the iodine solution.

Fig. 1.3 shows the results the student records.

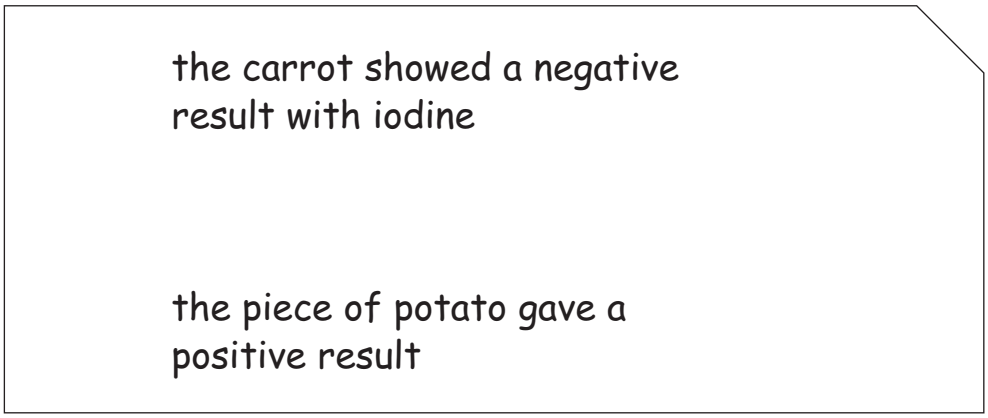


Fig. 1.3

Use the results in Fig. 1.3 to complete Table 1.1.

Table 1.1

	colour with iodine solution	conclusion
carrot		
potato		

[3]

[Total: 13]

2 A student investigates the reaction between aluminium and aqueous copper(II) chloride.

Aqueous copper(II) chloride is a blue solution.

Aluminium is a grey solid.

(a) Procedure

The student:

- assembles the apparatus shown in Fig. 2.1

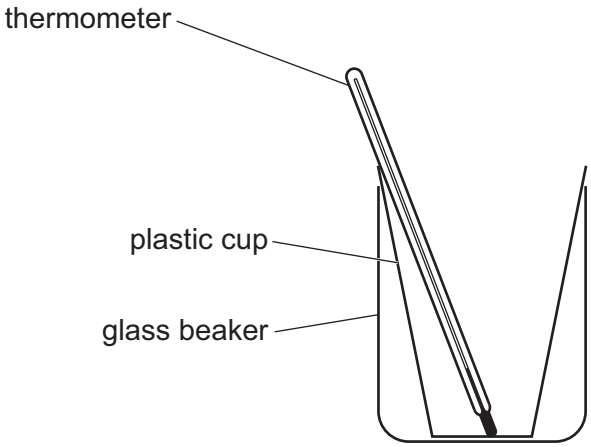


Fig. 2.1

- pours 25 cm^3 of aqueous copper(II) chloride into the plastic cup
- records in Table 2.1, the initial temperature of the aqueous copper(II) chloride
- adds 0.5 g of aluminium to the aqueous copper(II) chloride
- stirs the mixture in the plastic cup
- records in Table 2.1, the highest temperature reached by the reaction mixture.

(i) Fig. 2.2 shows the temperature readings for this experiment.

initial temperature **highest temperature reached**

Fig. 2.2

Record in Table 2.1, these temperatures to the nearest 0.5 °C.

Table 2.1

initial temperature of aqueous copper(II) chloride / °C	
highest temperature reached by reaction mixture / °C	
temperature increase / °C	

[2]

(ii) Calculate the temperature increase.

Record this value in Table 2.1. [1]

(b) At the end of the experiment the plastic cup contains:

- a colourless solution
- a pink solid
- a grey solid.

Explain how these observations show that the reaction has finished and that aluminium is in excess in this experiment.

.....

.....

.....

..... [2]

(c) There is an error in the experiment that causes a smaller temperature increase than expected.

Identify this error.

Suggest **one** improvement to the experiment to minimise this error.

error .....

improvement .....

.....

[2]

(d) Another student repeats the procedure using six different concentrations of aqueous copper(II) chloride.

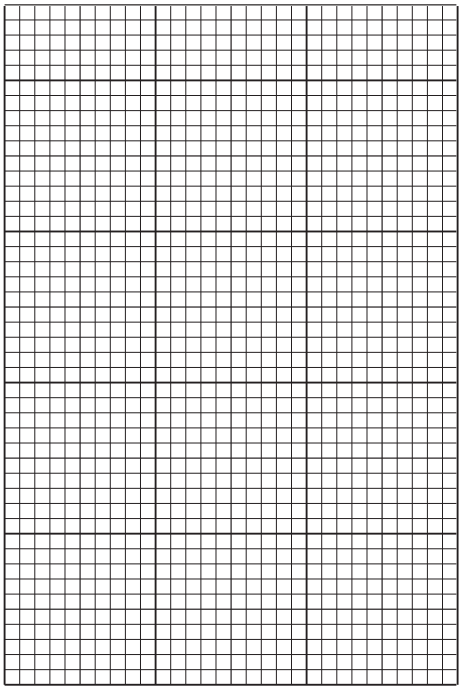
The unit of concentration is M.

Table 2.2 shows the results the student obtains.

Table 2.2

concentration of aqueous copper(II) chloride /M	temperature increase /°C
0.00	0
0.10	7.5
0.20	16.0
0.30	23.5
0.40	32.5
0.50	39.5

(i) On the grid, plot temperature increase (vertical axis) against the concentration of aqueous copper(II) chloride.



[3]

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

(e) Estimate using the graph, the concentration of aqueous copper(II) chloride that gives a temperature increase of 20.0 °C.

Show your working on the graph.

concentration = ... M [2]

[Total: 13]

3 A student investigates an electrical circuit with two identical resistors in series.

Procedure

The student:

step 1 connects the circuit shown in Fig. 3.1

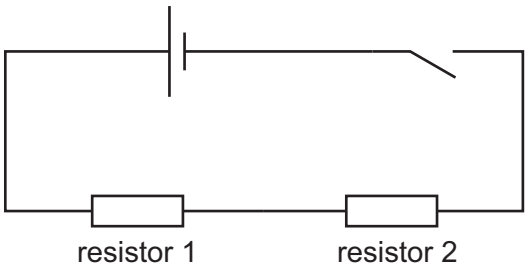


Fig. 3.1

step 2 connects a voltmeter to measure the voltage across resistor 1

step 3 closes the switch

step 4 records the voltmeter reading

step 5 opens the switch

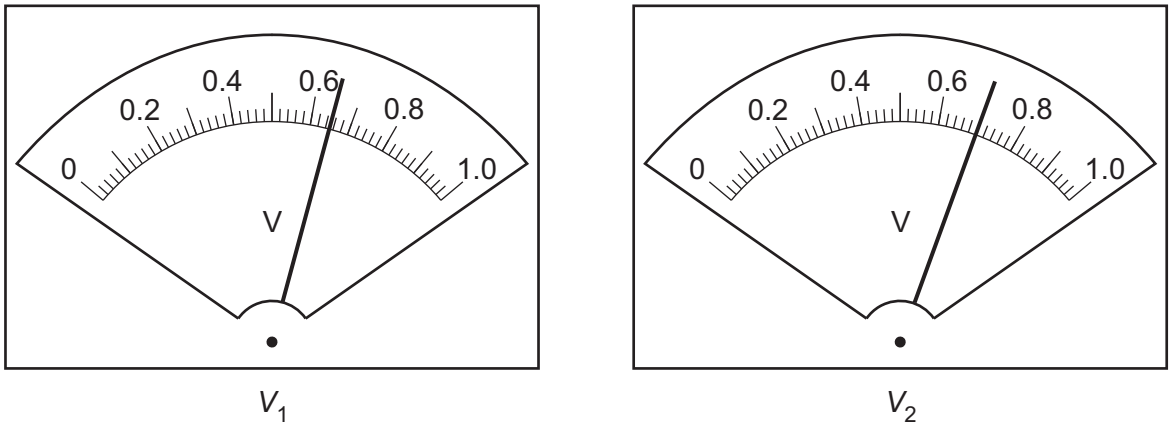
step 6 moves the voltmeter to measure the voltage across resistor 2

step 7 repeats **step 3** to **step 5**.

(a) Draw a voltmeter in Fig. 3.1 to show how the student measures the voltage across resistor 1 in **step 2**. [2]

(b) Fig. 3.2 shows the voltmeter readings V_1 and V_2.

Read and record V_1 and V_2 to the nearest 0.01 V.



V_1 V_2

Fig. 3.2

V_1 = ... V

V_2 = ... V [2]

(c) A student suggests that if resistor 1 has the same resistance as resistor 2 then $V_1 = V_2$.

Two values are considered equal within the limits of experimental accuracy if they are within 10% of each other.

State if your values of V_1 and V_2 support the student's suggestion.

Justify your answer with a calculation.

.....

..... [2]

(d) Suggest why the student opens the switch after each reading.

.....

..... [1]

[Total: 7]

4 Fig. 4.1 shows a metal rod placed in a box of sand.

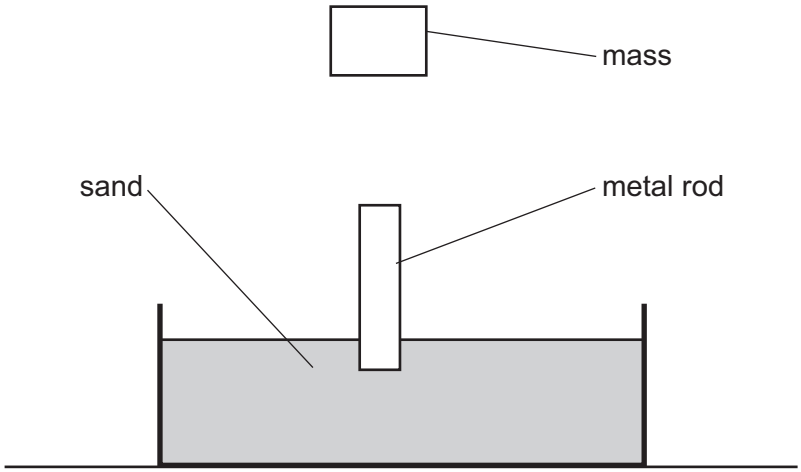


Fig. 4.1

When a mass is dropped onto the rod, the rod moves further into the sand.

A student predicts that the distance the rod moves into the sand is proportional to the mass dropped onto the rod.

Plan an investigation to test the student's prediction.

You are provided with:

- the apparatus in Fig. 4.1
- a number of different masses.

In your plan, include:

- any additional apparatus you will use
- a brief description of the method
- the variables you will control and the measurements you will take
- a table to record the results (you are **not** required to enter any readings in the table)
- how you will process your results to form a conclusion about the prediction.

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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.
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