Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/62**

Paper 6 Alternative to Practical **October/November 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.

1 A student investigates the effect of light intensity on the rate of photosynthesis.

During photosynthesis, a plant produces oxygen gas.

Procedure

The student:

step 1 assembles the apparatus shown in Fig. 1.1.

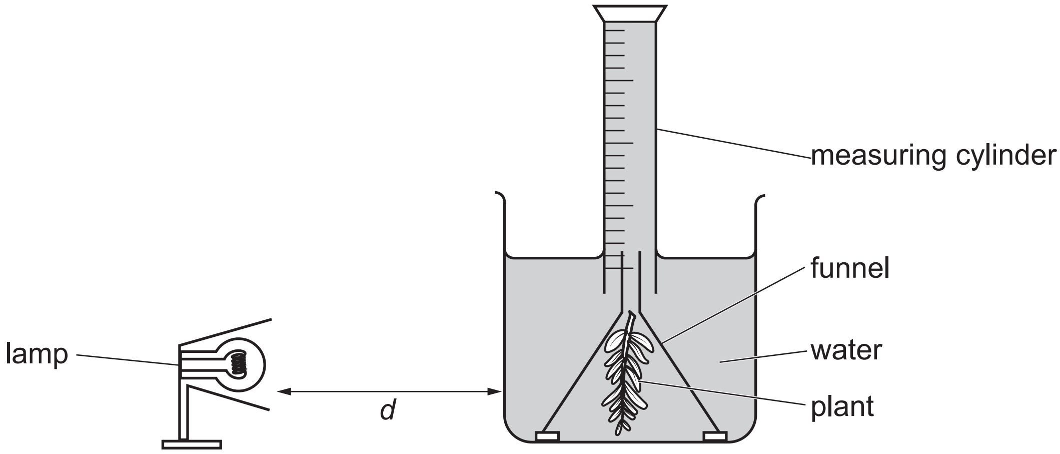

Fig. 1.1

step 2 turns on the lamp
step 3 sets distance *d* to 10 cm
step 4 waits for 5 minutes
step 5 records the volume of gas in the measuring cylinder
step 6 waits a further 10 minutes
step 7 records the volume of gas in the measuring cylinder
step 8 repeats **step 3** to **step 7** for *d* = 20 cm, 30 cm, 40 cm and 50 cm by moving the lamp but leaving the rest of the apparatus unchanged.

Table 1.1 shows some of the student's data.

Table 1.1

d / cm	volume of gas at **step 5** / cm^3	volume of gas at **step 7** / cm^3	change in volume of gas between **step 5** and **step 7** / cm^3
10	15	47	32
20	57	78	21
30	85	99	14
40	104	113	
50			

(a) Fig. 1.2 shows the volumes of gas in the measuring cylinder at **step 5** and at **step 7** for d = 50 cm.

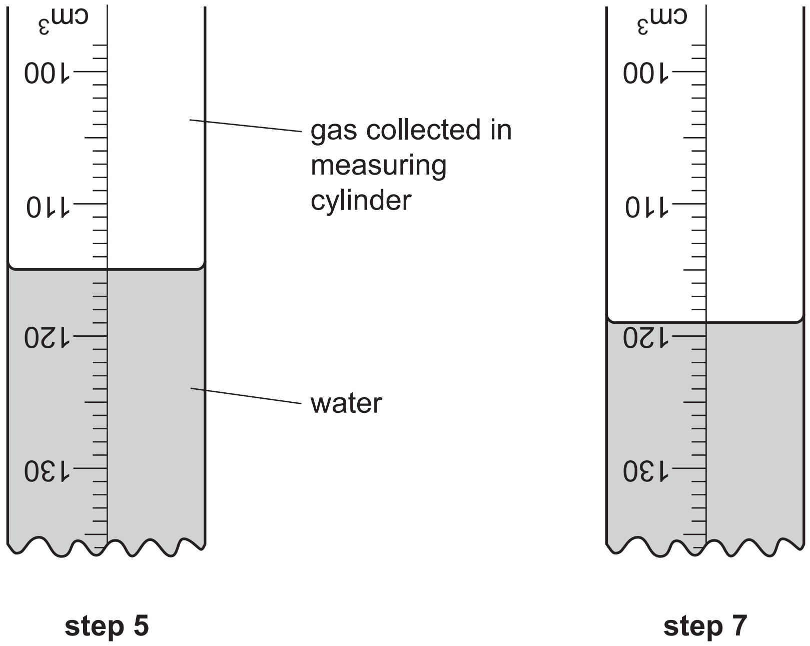

Fig. 1.2

(i) Record these values in Table 1.1. [2]

(ii) Calculate the change in volume of gas between **step 5** and **step 7** for d = 40 cm and d = 50 cm.

Record these values in Table 1.1. [1]

(b) Increasing the value of d decreases the light intensity.

Use Table 1.1 to describe the relationship between light intensity and the rate of photosynthesis.

....

.... [1]

(c) Suggest why the student waits for 5 minutes in **step 4**.

....

.... [1]

(d) At the start of the procedure, the water has a temperature of 21.5 °C.

At the end of the procedure, the temperature of the water has increased.

(i) Fig. 1.3 shows the temperature reading at the end of the procedure.

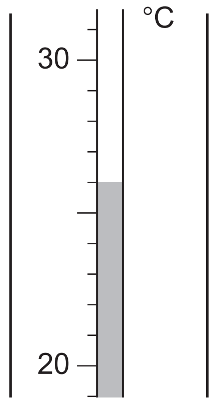

Fig. 1.3

Record this temperature to the nearest 0.5 °C.

temperature = ... °C [1]

(ii) The student thinks that the increase in temperature is caused by heat from the lamp.

Suggest a change to the apparatus to overcome this problem.

....

.... [1]

[Total: 7]

2 The leaves of plants may be different colours.

When a leaf transpires, it loses water, and the mass of the leaf decreases.

A student states:

The colour of a leaf affects the rate of water loss from the leaf.

Plan an investigation to test this statement.

You are provided with leaves of different colours that have been removed from the same type of plant.

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
- what you will measure
- which variables you will control
- how you will process your results to form a conclusion.

You may include a results table (you are **not** required to enter any data into the table).

....

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....

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....

....

.... [7]

3 A student determines the percentage by mass of copper in copper oxide.

When heated, copper oxide reacts with methane gas to make copper, water and carbon dioxide.

(a) Procedure

The student:

step 1 measures the mass of an empty dish
step 2 puts some copper oxide into the dish
step 3 measures the total mass of the copper oxide and the dish
step 4 passes methane through the assembled apparatus shown in Fig. 3.1

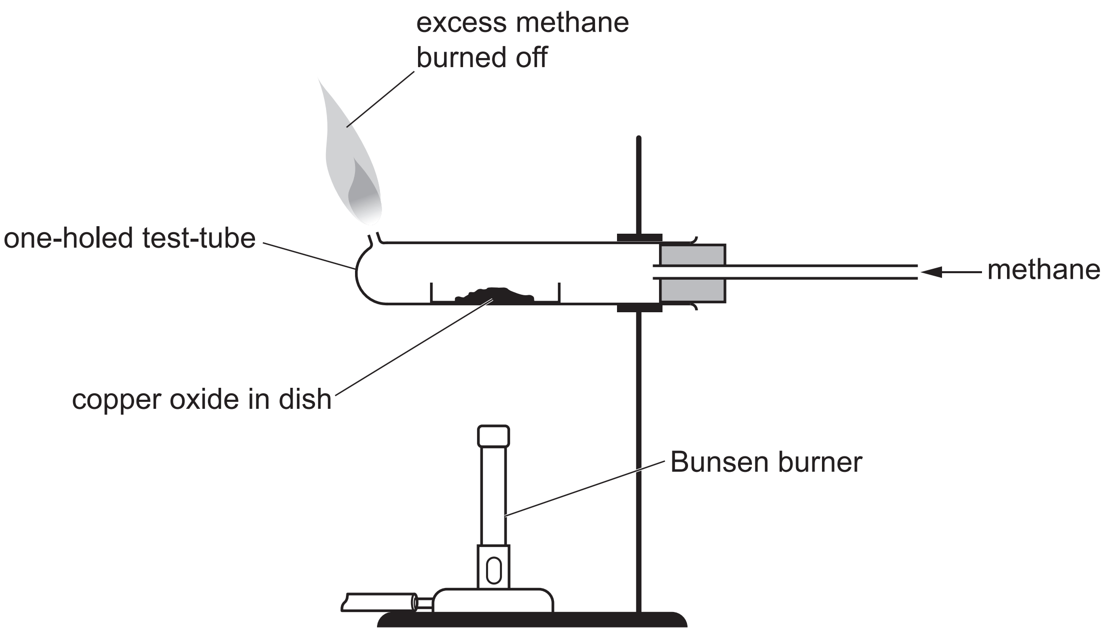


Fig. 3.1

step 5 ignites the methane gas leaving the test-tube
step 6 heats the test-tube for five minutes using a blue Bunsen burner flame so that copper oxide is made into copper
step 7 turns off the Bunsen burner
step 8 lets the apparatus cool down and then stops the methane passing through
step 9 measures the total mass of the copper and dish.

(i) Fig. 3.2 shows the readings on the balance for the three masses measured during the procedure.

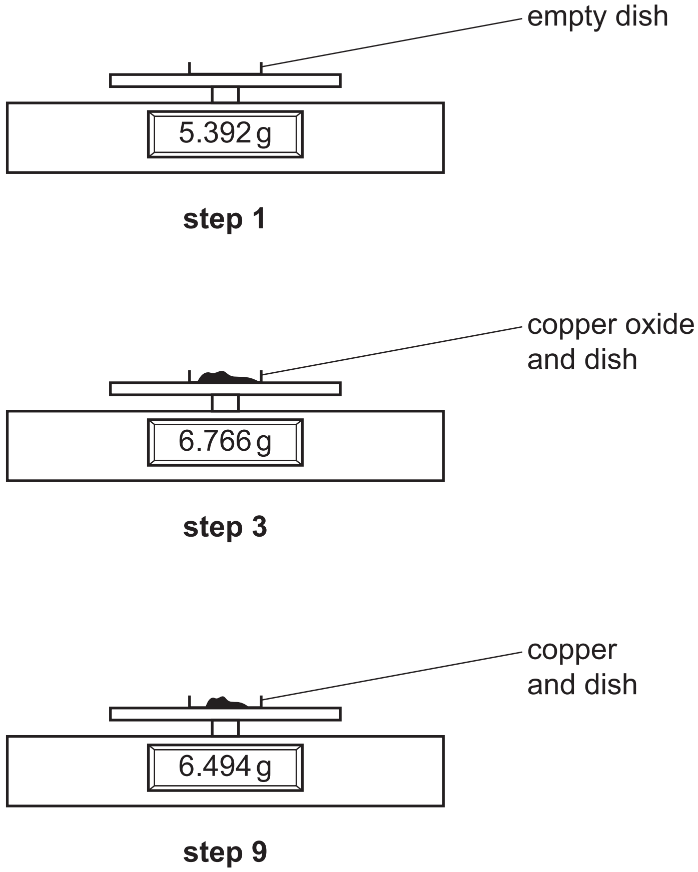


Fig. 3.2

Record in Table 3.1 these masses to **two** decimal places.

Table 3.1

mass of empty dish in **step 1** / g	
total mass of copper oxide and dish in **step 3** / g	
total mass of copper and dish in **step 9** / g	

[3]

(ii) Calculate the mass of copper oxide put into the dish at **step 2**.

Use data from Table 3.1.

mass of copper oxide = ... g [1]

(iii) Calculate the mass of copper that is in the dish at the end of the experiment.

Use data from Table 3.1.

mass of copper = ... g [1]

(iv) Calculate the percentage by mass of copper in copper oxide.

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

$$\text{percentage by mass} = \frac{\text{mass of copper}}{\text{mass of copper oxide}} \times 100$$

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

percentage by mass = ... % [2]

(v) The unreacted methane is burned instead of being allowed to escape into the air.

Suggest why.

....

.... [1]

(vi) Suggest why in **step 6** the test-tube is heated with a blue Bunsen burner flame instead of a yellow flame.

....

.... [1]

(vii) Suggest why in **step 8** the apparatus is left to cool down before the mass is measured in **step 9**.

....

.... [1]

(b) The student is **not** sure that all the copper oxide has reacted in the experiment.

Describe what the student does after **step 9** to check this.

Explain your answer.

description ....

....

explanation ....

....
[2]

(c) The student repeats the procedure in **(a)** using a much larger mass of copper oxide.

Suggest **one** advantage of using a larger mass of copper oxide.

....

.... [1]

[Total: 13]

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

The student uses the apparatus shown in Fig. 4.1.

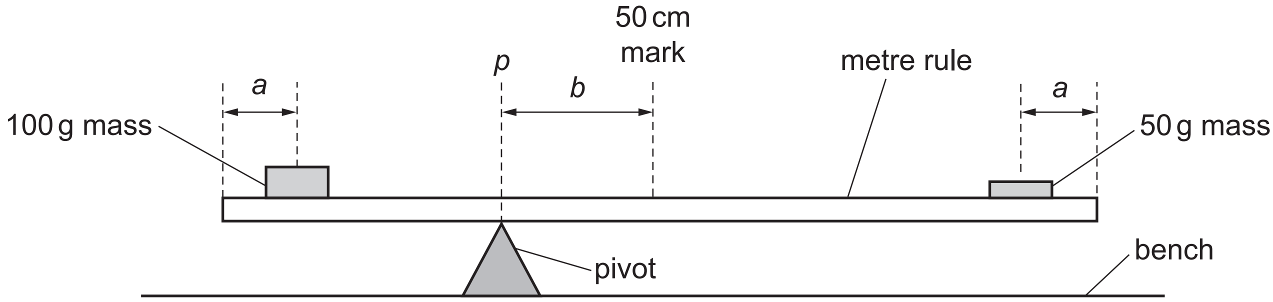


Fig. 4.1

Procedure

The student:

- places the 100 g mass and the 50 g mass at distance a from each end of the metre rule, where a = 5.0 cm
- balances the metre rule with the pivot at position p on the metre rule
- calculates b, the distance between the 50 cm mark of the metre rule and the pivot
- records the values of a, p and b in Table 4.1.

The student repeats the procedure for a = 10.0 cm, 15.0 cm, 20.0 cm and 25.0 cm.

(a) Fig. 4.2 shows a view from above of the metre rule balanced on the pivot when a = 15.0 cm.

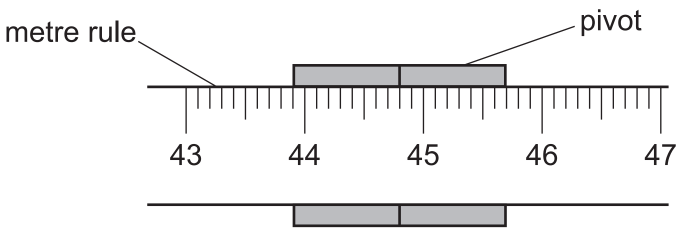


Fig. 4.2

(i) Record in Table 4.1 position p of the metre rule on the pivot. [1]

(ii) Calculate b using your answer to **(a)(i)** and the equation shown.

$$b = 50.0 - p$$

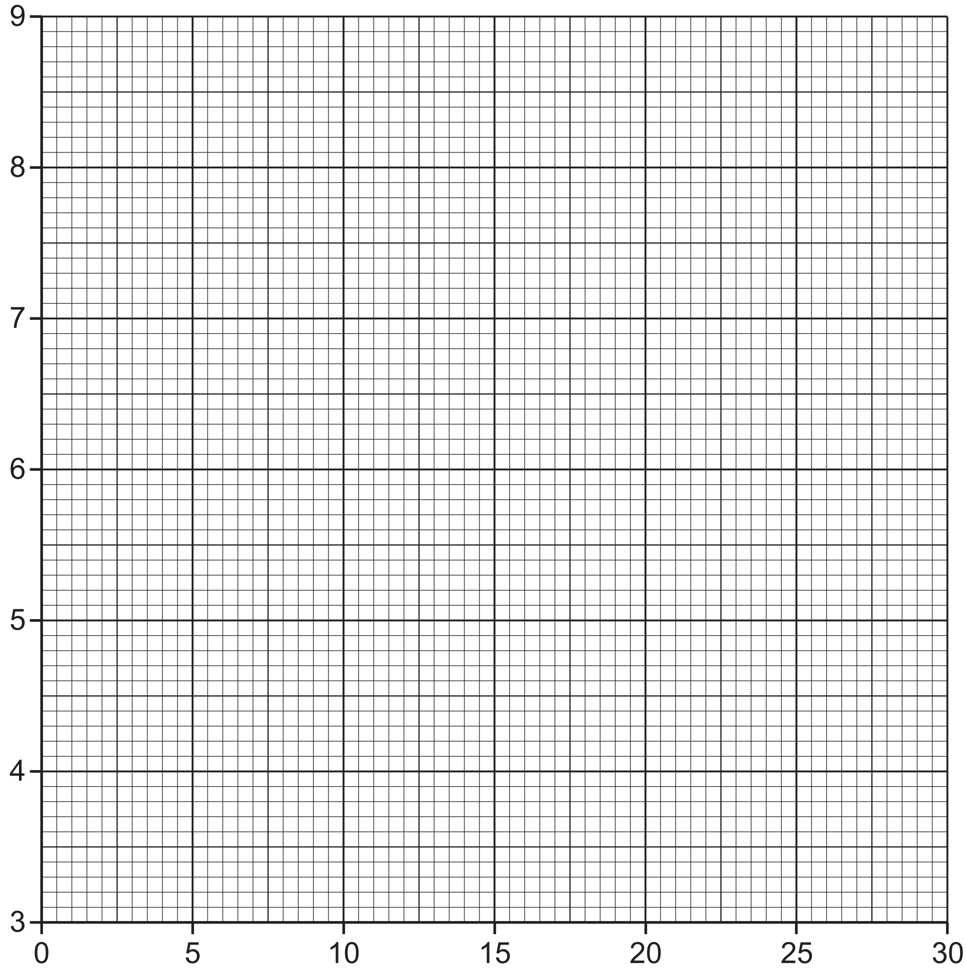
Record this value of b in Table 4.1. [1]

Table 4.1

a/cm	p/cm	b/cm
5.0	43.2	6.8
10.0	44.1	5.9
15.0		
20.0	45.6	4.4
25.0	46.3	3.7

(b) **(i)** On the grid, plot b (vertical axis) against a.

Label the axes.



[2]

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

(iii) Determine the intercept I of your graph with the vertical axis.

Show your working on your graph.

I = ... [2]

(iv) Calculate the mass M of the metre rule using your answer to **(b)(iii)** and the equation shown.

$$M = \frac{2500}{I} - 150$$

M = ... g [1]

(c) The student moves the 50 g mass to a different position on the metre rule and takes another reading for *a*.

(i) Fig. 4.3 shows an enlarged section of the metre rule and the new position of the 50 g mass.

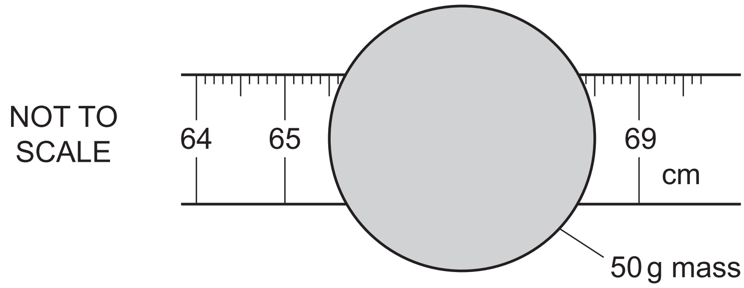


Fig. 4.3

Determine the position c of the centre of the 50 g mass on the metre rule.

Show your working.

c = ... cm [2]

(ii) Use your value of c and Fig. 4.1 to determine a.

a = ... cm [1]

(d) Another student suggests a different balancing method to determine the mass *M* of the metre rule using the apparatus shown in Fig. 4.4.

The metre rule and the masses are all suspended from strings.

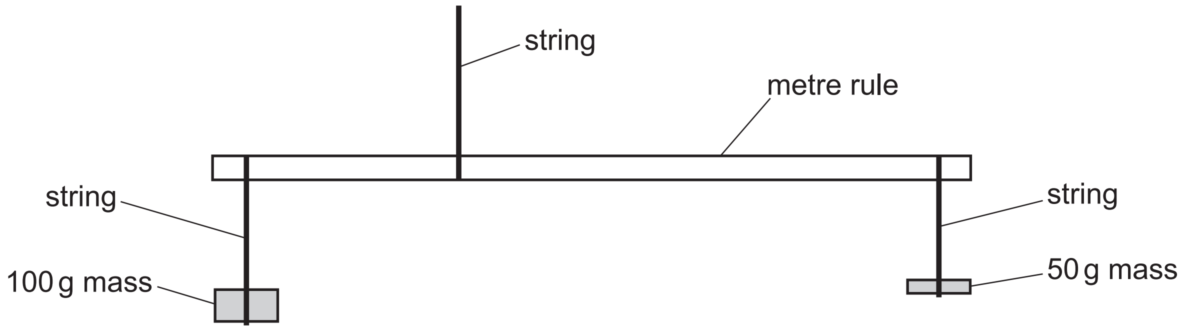


Fig. 4.4

Suggest **one** advantage and **one** disadvantage of using the apparatus in Fig. 4.4 compared with using the apparatus in Fig. 4.1.

advantage ....

....

disadvantage ....

....
[2]

[Total: 13]

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