



# Cambridge IGCSE™

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**CO-ORDINATED SCIENCES**

**0654/61**

Paper 6 Alternative to Practical

**May/June 2022**

**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.

1 Fig. 1.1 shows a leaf.



**Fig. 1.1**

(a) In the box, make an enlarged detailed pencil drawing of the leaf.

[3]

- (b) (i) Measure the longest length of the leaf in Fig. 1.1.

Record this length in millimetres to the nearest millimetre.

length of leaf in Fig. 1.1 = ..... mm [1]

- (ii) Draw a line to show this length on your drawing in (a).

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

length on drawing = ..... mm [1]

- (iii) Use your measurements in (b)(i) and (b)(ii) to calculate the magnification  $m$  of your drawing.

Use the equation shown.

$$m = \frac{\text{length on drawing}}{\text{length of leaf in Fig. 1.1}}$$

$m =$  ..... [1]

(c) **Procedure**

The student:

- Step 1 places a green leaf into hot water  
 Step 2 takes the leaf out of the hot water and places it into a test-tube of hot ethanol for 5 minutes  
 Step 3 takes the leaf out of the ethanol and rinses with water  
 Step 4 places the leaf, which is now white, on a white tile  
 Step 5 cuts the leaf in half  
 Step 6 places one piece in biuret solution  
 Step 7 places iodine solution on the other piece.

- (i) State the name of the nutrient tested by each reagent.

biuret solution .....

iodine solution .....

[2]

(ii) The leaf tests negative with the biuret solution.

The leaf tests positive with the iodine solution.

State the **final colour** observed in each test.

biuret solution .....

iodine solution .....

[2]

(iii) Ethanol removes the green colour from the leaves.

Suggest why the green colour needs to be removed from the leaf before doing nutrient tests.

.....

..... [1]

(iv) The ethanol used in step 2 is flammable.

Suggest a safety precaution the student takes.

Explain your answer.

safety precaution .....

explanation .....

.....

[1]

(v) The student uses ethanol and water to test a leaf for the presence of fat.

State the observation for a positive result.

..... [1]

[Total: 13]



- 2 Water from the soil enters a plant through its roots, travels up the plant in xylem vessels and exits through holes in the leaves.

Plan an investigation to show that the mass of water lost from the leaves of a plant is greater when it is windy compared to when it is not windy.

You are provided with several plants in pots.

You may use any common laboratory apparatus.

Include in your plan:

- the apparatus needed
- a brief description of the method
- the measurements you will make including how to make them as accurate as possible
- the variables you will control
- how you will process your results to draw a conclusion.

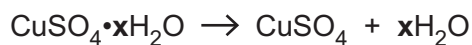
You may include a labelled diagram if you wish.

You may include a results table if you wish. You are **not** required to include any results.



- 3 A student does an experiment to find the value of  $x$  in the formula of blue copper sulfate crystals,  $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ .

The student heats the blue copper sulfate **crystals** to remove the water.



Dry white copper sulfate **powder**,  $\text{CuSO}_4$ , is formed and the water evaporates into the air.

**(a) Procedure**

The student:

- uses a balance to find the mass of an empty evaporating basin and records this mass in Table 3.1
  - adds some blue copper sulfate **crystals** into the evaporating basin
  - finds the total mass of the evaporating basin and copper sulfate crystals and records this mass in Table 3.1
  - places the evaporating basin on top of a tripod and gauze
  - heats the crystals until all of the water has gone and just white copper sulfate **powder** is left in the evaporating basin
  - lets the evaporating basin cool
  - finds the total mass of the evaporating basin and dry white copper sulfate powder and records this mass in Table 3.1.
- (i) Draw a diagram of the assembled apparatus showing the heating of the copper sulfate crystals.

Label the apparatus **and** the copper sulfate crystals.

[3]



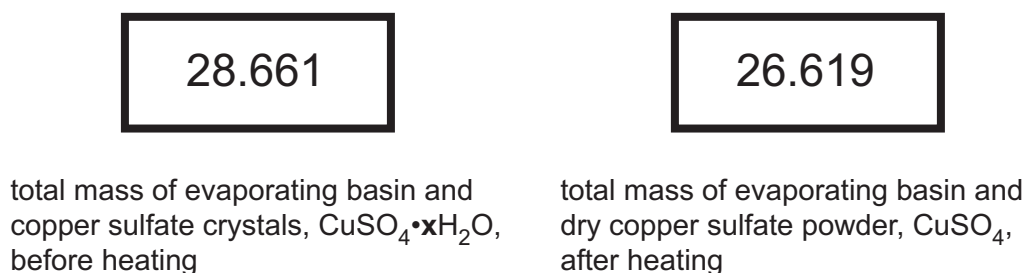
- (ii) Copper sulfate crystals,  $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ , are blue.

Copper sulfate powder,  $\text{CuSO}_4$ , is white.

Suggest how the student knows when all of the water has been removed from the crystals.

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

- (b) Fig. 3.1 shows the student's balance readings.



**Fig. 3.1**

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

**Table 3.1**

mass of empty evaporating basin /g	22.77
total mass of evaporating basin and blue copper sulfate crystals, $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ , before heating /g	
total mass of evaporating basin and dry white copper sulfate powder, $\text{CuSO}_4$ , after heating /g	

[2]

- (c) (i) Calculate the mass of water lost by the crystals.

Use the equation shown.

$$\boxed{\text{mass of water}} = \boxed{\text{total mass of evaporating basin and blue copper sulfate crystals before heating}} - \boxed{\text{total mass of evaporating basin and dry white copper sulfate powder after heating}}$$

$$\text{mass of water} = \dots\dots\dots \text{ g [1]}$$

- (ii) Calculate the amount of water in the copper sulfate crystals.

Use the equation shown.

$$\text{amount of water} = \frac{\text{mass water}}{18}$$

$$\text{amount of water} = \dots\dots\dots [1]$$

- (iii) Calculate the mass of dry copper sulfate powder.

Use the equation shown.

$$\boxed{\text{mass of dry copper sulfate powder}} = \boxed{\text{total mass of evaporating basin and dry copper sulfate powder}} - \boxed{\text{mass of empty evaporating basin}}$$

$$\text{mass of dry copper sulfate powder} = \dots\dots\dots \text{ g [1]}$$

- (iv) Calculate the amount of dry copper sulfate powder.

Use the equation shown.

$$\text{amount of dry copper sulfate powder} = \frac{\text{mass of dry copper sulfate powder}}{160}$$

$$\text{amount of dry copper sulfate powder} = \dots\dots\dots [1]$$

- (v) Use the answers to (c)(ii) and (c)(iv) to calculate the value of  $x$  in  $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ .

Use the equation shown.

$$x = \frac{\text{amount of water}}{\text{amount of dry copper sulfate powder}}$$

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

$$x = \dots\dots\dots [2]$$

- (d) Suggest what the student can do to have more confidence in the value of  $x$ .

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

- (e) Another student does the same experiment.

The value for the mass of the dry copper sulfate powder is **larger** than expected.

Suggest why the mass of dry copper sulfate powder after heating is **larger** than expected.

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

- (f) Describe how the student can change the **white** copper sulfate powder back into **blue** copper sulfate.

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

[Total: 15]

- 4 A student does some tests on solutions **R**, **S** and **T**.

The student's results are shown in Table 4.1.

**Table 4.1**

test	observations		
	<b>R</b>	<b>S</b>	<b>T</b>
add universal indicator solution	green	green	green
add a few drops of aqueous sodium hydroxide	white ppt.	white ppt.	colourless solution
add excess aqueous sodium hydroxide	white ppt.	white ppt.	colourless solution
add a few drops of aqueous ammonia	colourless solution	colourless solution	colourless solution
add excess aqueous ammonia	colourless solution	colourless solution	colourless solution
add methyl orange	orange	orange	orange
add dilute nitric acid and a few drops of aqueous barium nitrate	colourless solution	colourless solution	colourless solution
add dilute nitric acid and a few drops of aqueous silver nitrate	white ppt.	cream ppt.	white ppt.
flame test colour	red	red	yellow

- (a) Use the results in Table 4.1 to describe **two** tests you could use to identify a sample of solution **T**.

Include the observations in your answer.

Explain why each test can be used to identify **T** and **not R** and **S**.

test 1 .....

observation .....

explanation .....

.....

test 2 .....

observation .....

explanation .....

.....

[4]

(b) Use the results in Table 4.1 to describe **one** test you could use to identify a sample of solution **S**.

Include the observation in your answer.

test .....

observation .....

[1]

[Total: 5]

- 5 A student determines the volume of glass used to make a beaker.

Fig. 5.1 shows the external diameter  $d$  and the height  $h$  of the beaker.

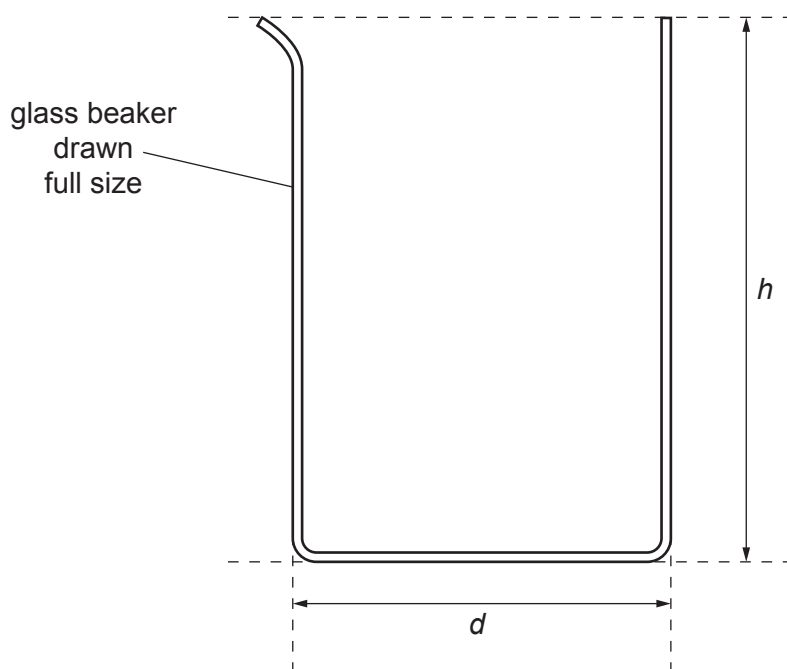


Fig. 5.1

- (a) Use a ruler to measure the external diameter  $d$  of the beaker in Fig. 5.1 in centimetres to the nearest 0.1 cm.

external diameter  $d = \dots\dots\dots$  cm [1]

- (b) The student uses two wooden blocks to help obtain an accurate answer for the external diameter.

The beaker is placed between the blocks, and touching them, as shown in Fig. 5.2.

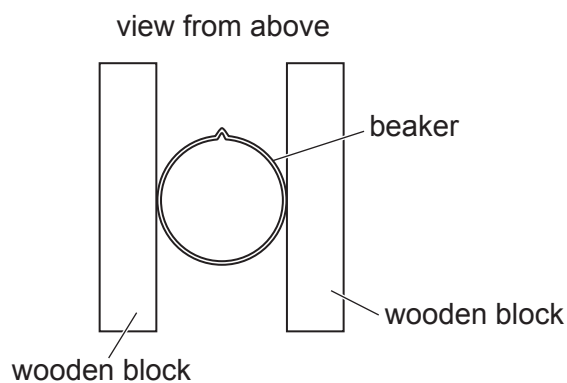


Fig. 5.2

- (i) Explain why it is important to ensure that the wooden blocks are parallel to each other before measuring the diameter of the beaker.

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

- (ii) Draw a double-headed arrow ( $\longleftrightarrow$ ) on Fig. 5.2 to show the distance that the student measures. [1]

- (c) Use a ruler to measure the height  $h$  of the beaker in Fig. 5.1 in centimetres to the nearest 0.1 cm.

height  $h =$  ..... cm [1]

- (d) Calculate the external volume  $V_{\text{EXT}}$  of the beaker.

Use the equation shown.

$$V_{\text{EXT}} = 0.79d^2h$$

$V_{\text{EXT}} =$  ..... cm<sup>3</sup> [2]

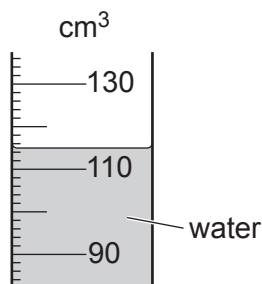
**(e) Procedure**

The student:

- fills the beaker to the top with water
- uses a measuring cylinder to measure the volume of water that the beaker contains.

This is the internal volume  $V_{\text{INT}}$  of the beaker.

Fig. 5.3 shows the level of the water in the measuring cylinder.



**Fig. 5.3**

Read the measuring cylinder and record the internal volume  $V_{\text{INT}}$  of the beaker.

$V_{\text{INT}} =$  ..... cm<sup>3</sup> [1]

(f) Calculate the volume  $V_G$  of glass used to make the beaker.

Use the equation shown.

$$V_G = V_{\text{EXT}} - V_{\text{INT}}$$

$$V_G = \dots\dots\dots \text{cm}^3 \quad [1]$$

(g) Your answer for  $V_G$  is approximate. State one source of error in measuring:

(i) the external volume  $V_{\text{EXT}}$  of the beaker.

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

(ii) the internal volume  $V_{\text{INT}}$  of the beaker.

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

[Total: 10]



- 6 A student investigates how the resistance  $R$  of a lamp changes as the potential difference  $V$  across it changes.

The student sets up the circuit shown in Fig. 6.1.

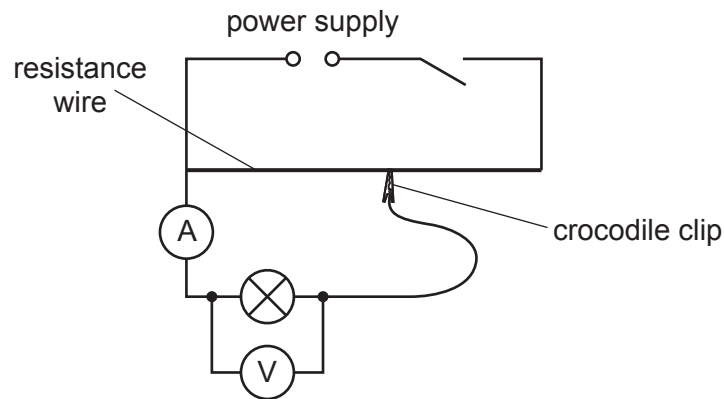


Fig. 6.1

### Procedure

The student:

- closes the switch
- adjusts the position of the crocodile clip on the resistance wire until the potential difference  $V$  across the lamp is 0.3 V
- records in Table 6.1 the current reading  $I$  on the ammeter
- opens the switch.

The student repeats the procedure for values of potential difference  $V = 0.8\text{ V}$ ,  $1.3\text{ V}$ ,  $1.8\text{ V}$ ,  $2.1\text{ V}$  and  $2.5\text{ V}$ .

The student's results are shown in Table 6.1.

- (a) Fig. 6.2 shows the ammeter reading when the potential difference  $V$  across the lamp is 0.3 V.

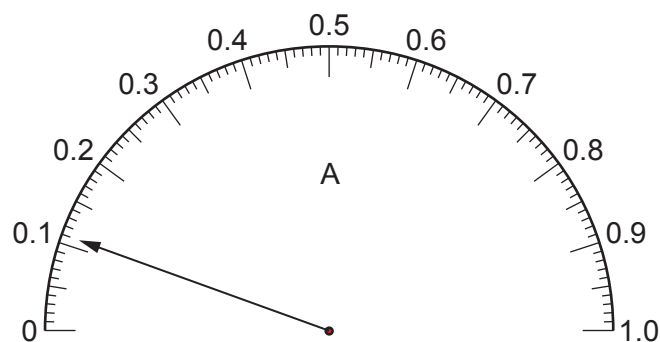


Fig. 6.2

Record in Table 6.1 the value of the current  $I$ .

**Table 6.1**

potential difference $V/V$	current $I/A$	resistance $R/\Omega$
0.3		
0.8	0.14	5.6
1.3	0.16	8.0
1.8	0.18	10.1
2.1	0.20	10.6
2.5	0.23	11.0

[1]

- (b) Calculate the resistance  $R$  of the lamp when the potential difference  $V$  across the lamp is 0.3V.

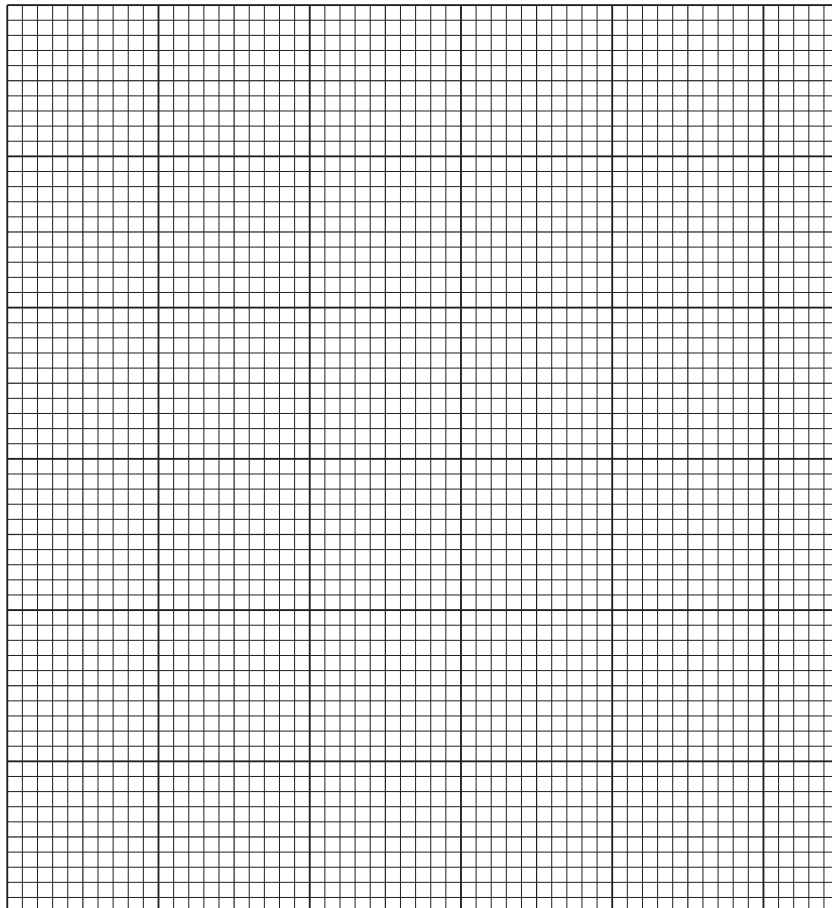
Use the equation shown.

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

Record your answer in Table 6.1.

[1]

- (c) (i) On the grid, plot a graph of  $R$  (vertical axis) against  $V$ .



[3]

- (ii) Draw the best-fit curve. [1]
- (iii) Use your graph to predict the current  $I$  in the lamp when the potential difference across it is 1.0V.

$I =$  ..... [1]

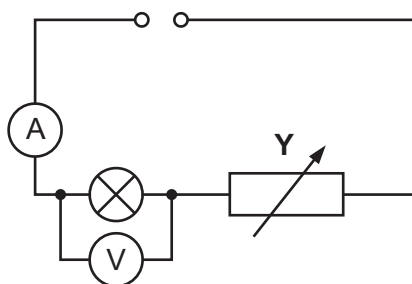
- (d) Use your graph to describe in detail how the resistance of the lamp changes as the potential difference across it increases.

.....

.....

..... [2]

- (e) Another method of changing the current and the potential difference in the circuit shown in Fig. 6.1 is shown in Fig. 6.3.



**Fig. 6.3**

State the name of the component labelled Y in this circuit.

..... [1]

[Total: 10]

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