



# Cambridge IGCSE™

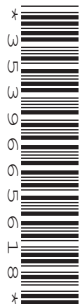
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## CO-ORDINATED SCIENCES

0654/61

Paper 6 Alternative to Practical

May/June 2021

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 A student investigates the movement of coloured water in a celery stem.

(a) Procedure

- The student places the freshly cut end of a celery stem in some coloured water as shown in Fig. 1.1.

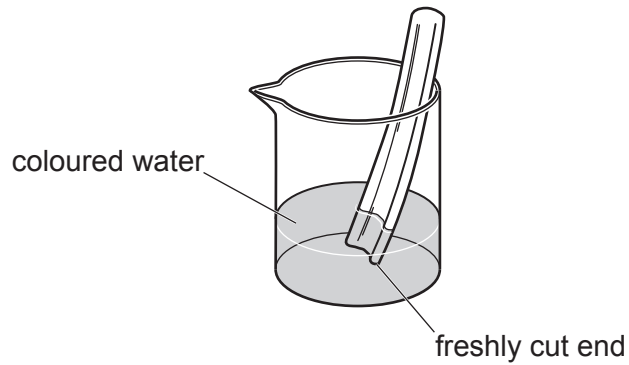


Fig. 1.1

- After five minutes, the student removes the celery stem from the coloured water.

Fig. 1.2 shows the cut end **before** it was placed in the coloured water and **after** it was placed in the coloured water.

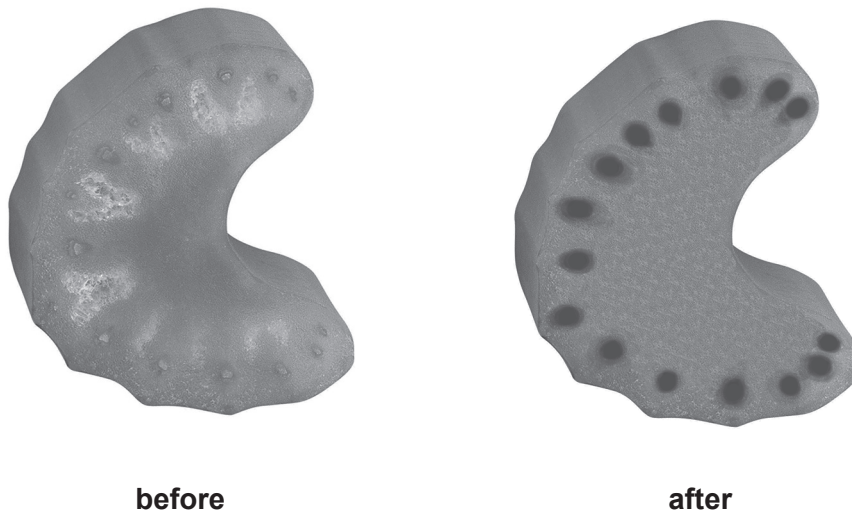
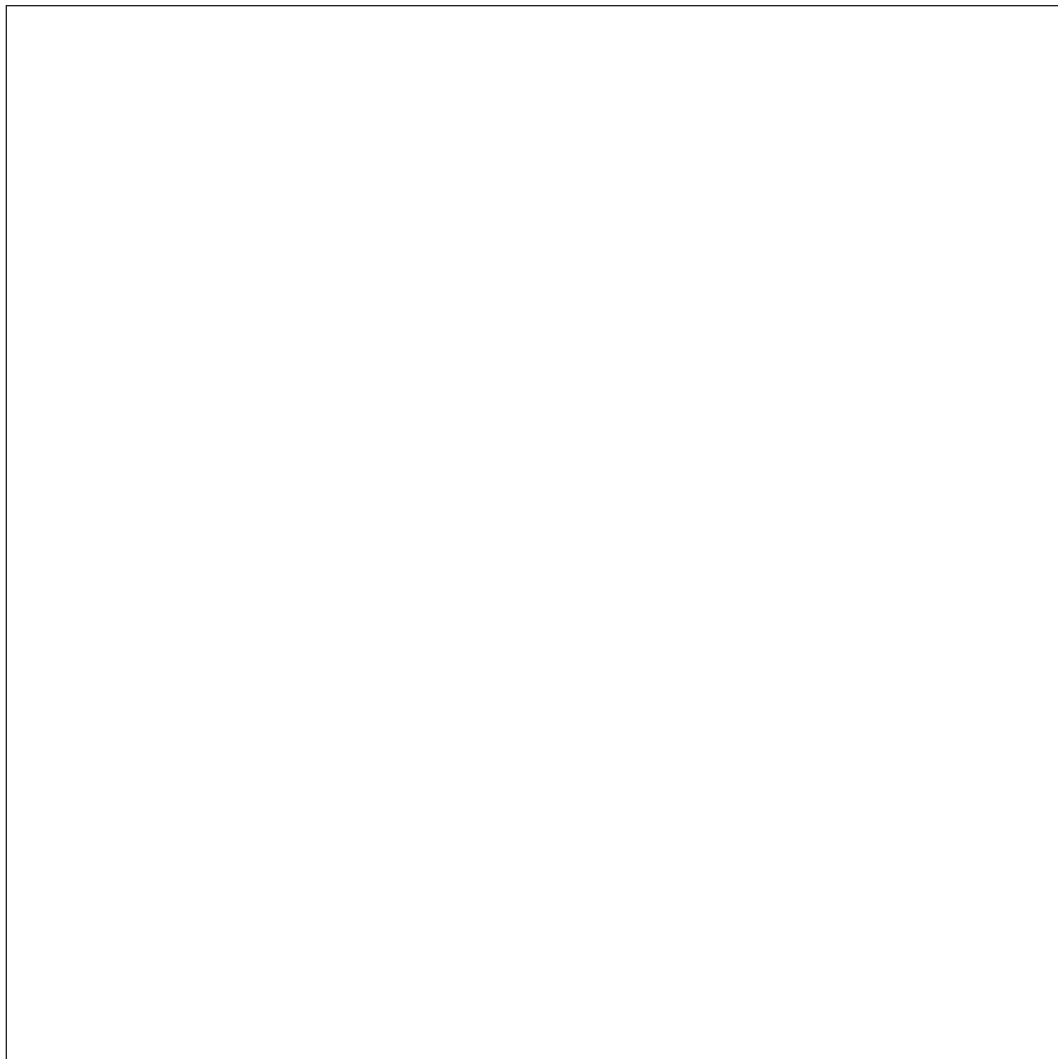


Fig. 1.2

- (i) In the box provided, make an enlarged detailed pencil drawing of the cut end of the celery stem **after** it was placed in the coloured water, as shown in Fig. 1.2.



[3]

- (ii) On your drawing from (a)(i), use a label line to label with an **X** one of the areas that is stained. [1]

- (iii) The stained areas are xylem tissue.

State what can be concluded about the function of the xylem tissue.

..... [1]

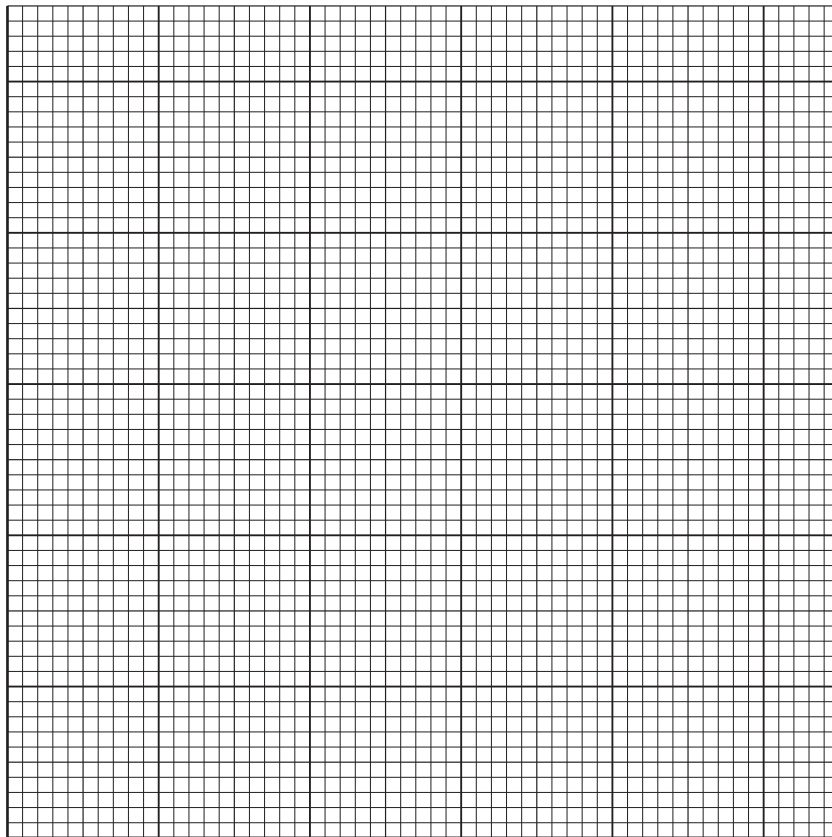
- (b) Another student measures and records the movement of coloured water into a celery stem over five hours.

Their results are shown in Table 1.1.

**Table 1.1**

time taken/hours	distance moved/mm
0	0
1	21
2	39
3	60
4	82
5	97

- (i) On the grid provided, plot a graph of distance moved (vertical axis) against time taken.



[3]

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

(iii) Use your graph to determine the distance moved by the coloured water after 1.5 hours.

Indicate on your graph how you arrived at your answer.

distance moved = ..... mm [2]

(iv) Describe the relationship between the distance moved by the coloured water and the time taken.

.....

..... [1]

[Total: 12]

2 A student tests some celery for its nutrient content.

(a) The student puts some crushed celery into each of three test-tubes.

The student does the food tests shown in Table 2.1.

**Table 2.1**

food test	final colour observed	conclusion
Benedict's solution	orange	
biuret solution	blue	
iodine solution	brown	

(i) Complete Table 2.1 by writing a conclusion for each of the three tests. [3]

(ii) State which test requires the use of heat.

..... [1]

(iii) Name a piece of apparatus suitable for measuring 2.0 cm<sup>3</sup> of the test solutions.

..... [1]

(b) (i) The student tests the celery for the presence of fat.

State the two substances needed for the fat test.

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

(ii) State the observation for a positive result.

..... [1]

(iii) Explain why there should be no flames in the laboratory when doing this test.

..... [1]

[Total: 8]

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- 3 In this investigation a student designs a test to distinguish between sodium hydrogencarbonate and sodium carbonate.

### Procedure

The student:

- places aqueous sodium hydrogencarbonate into each of four test-tubes
- does the tests described in Table 3.1
- records their results in Table 3.1.

The student repeats the procedure using aqueous sodium carbonate instead of aqueous sodium hydrogencarbonate.

**Table 3.1**

	aqueous sodium hydrogencarbonate	aqueous sodium carbonate
colour with methyl orange	yellow	yellow
observation when dilute hydrochloric acid added	bubbles quickly	bubbles quickly
identity of gas made	carbon dioxide	carbon dioxide
observation when aqueous magnesium chloride added	colourless solution	white precipitate (ppt.)
flame test colour	yellow	yellow

- (a) A colourless solution is either sodium hydrogencarbonate or sodium carbonate.

Use the results in Table 3.1 to describe a test to identify the solution as either sodium hydrogencarbonate or sodium carbonate.

Explain your answer.

.....

.....

..... [2]



(b) Describe the test for carbon dioxide.

State the observation for a positive result.

test .....

observation .....

[1]

(c) Describe how to do a flame test.

.....

.....

..... [2]

[Total: 5]

- 4 A student investigates the effect of surface area on the rate of reaction between marble chips and dilute hydrochloric acid.

The student measures the time it takes the reaction to make enough carbon dioxide gas to fill a test-tube.

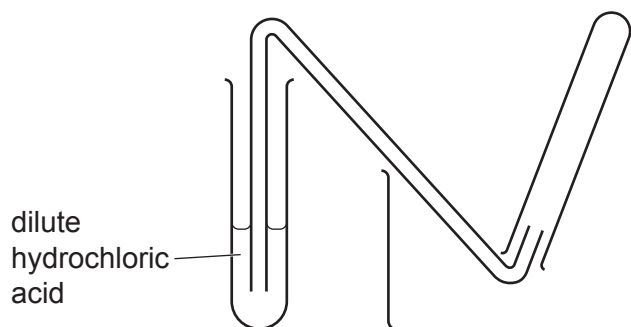
There are three forms of marble chips. Each form has a different surface area.

large marble chips	small surface area
small marble chips	↓
powdered marble chips	large surface area

**(a) Procedure**

The student:

- places dilute hydrochloric acid into a boiling tube (large test-tube)
- sets up the apparatus shown in Fig. 4.1.



**Fig. 4.1**

- (i) There are three mistakes in the apparatus shown in Fig. 4.1.

Circle each mistake on the diagram **and** explain how each mistake can be corrected by the teacher.

mistake 1 .....

.....

mistake 2 .....

.....

mistake 3 .....

.....

[3]

- (ii) The teacher corrects the apparatus.

### Procedure

The student:

- adds 3 large marble chips to the acid and quickly replaces the bung
- records in Table 4.1 the time it takes to fill the test-tube with gas.

The student repeats the procedure two more times using small marble chips and then powdered marble chips.

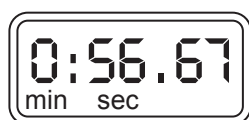
The results are recorded in Table 4.1.

**Table 4.1**

	time to fill one test-tube with gas/s
large marble chips	
small marble chips	
powdered marble chips	4.6

The timer readings for large marble chips and small marble chips are shown in Fig. 4.2.

Record these times in Table 4.1.



large marble chips



small marble chips

**Fig. 4.2**

[2]

- (b) (i) State the relationship between surface area and **rate** of reaction.

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

- (ii) Suggest a different method of collecting and measuring the gas produced.

Name the apparatus and explain how the rate of reaction is measured.

.....  
 .....  
 ..... [2]

[Total: 8]

5 Pure water has a fixed boiling temperature of 100 °C.

When an impurity such as salt is added to water the boiling temperature increases.

Plan an experiment to find out if the amount of salt added to water is proportional to the increase in boiling temperature of the water.

You may use any common laboratory apparatus and samples of water and salt.

Include in your plan:

- the apparatus needed
- a brief description of the method, explaining any safety precautions
- 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 and use them to draw a conclusion.

You may include a labelled diagram if you wish.

You may also include a table that can be used to record results if you wish. You are **not** required to include any results.



- 6 A student investigates how the potential difference  $V$  across a lamp and the power  $P$  of the lamp change as the length  $l$  of a resistance wire in series with the lamp changes.

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

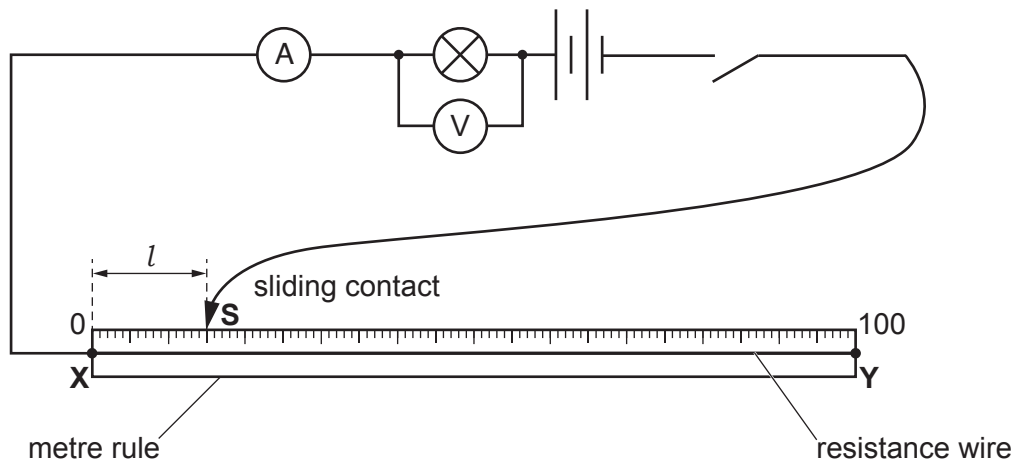


Fig. 6.1

(a) Procedure

The student:

- closes the switch
- places the sliding contact **S** on the resistance wire at a distance  $l = 15.0$  cm from **X**
- measures the current  $I$  flowing through the lamp
- measures the potential difference  $V$  across the lamp
- opens the switch.

The readings on the ammeter and voltmeter are shown in Fig. 6.2.

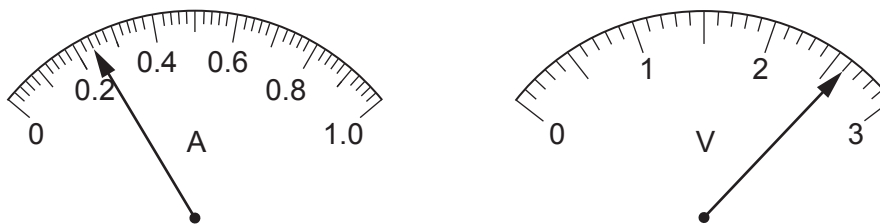


Fig. 6.2

- (i) Record in Table 6.1 the current  $I$  and the potential difference  $V$  for the 15.0 cm length of wire.

Table 6.1

length $l$ /cm	current $I$ /A	potential difference $V$ /V	power $P$ /.....
15.0			
30.0	0.22	2.4	0.53
45.0	0.20	2.1	0.42
60.0	0.17	1.8	0.31

[2]

- (ii) Suggest why the student opens the switch between taking readings.

..... [1]

- (b) The student repeats the procedure in (a) for values of  $l = 30.0$  cm, 45.0 cm and 60.0 cm.

The results are shown in Table 6.1.

- (i) Calculate the power  $P$  of the lamp for the 15.0 cm length of wire.

Use the equation shown.

$$P = V \times I$$

Record in Table 6.1 your value of  $P$  to an appropriate number of significant figures. [2]

- (ii) Complete the column heading in Table 6.1 by giving the unit for power. [1]
- (iii) State how the results in Table 6.1 show that the brightness of the lamp decreases as the length  $l$  of resistance wire increases.

..... [1]

- (c) Another student suggests that the potential difference  $V$  across the lamp is proportional to the length  $l$  of resistance wire in the circuit.

State if the values in Table 6.1 support this suggestion.

Justify your statement by referring to the values.

statement .....

justification .....

..... [1]

- (d) The student decides to repeat the investigation, but replaces the resistance wire with a variable resistor.

Complete the circuit diagram in Fig. 6.3 to show how the variable resistor and a voltmeter are connected so that the current in the lamp and the potential difference across the lamp can be varied.

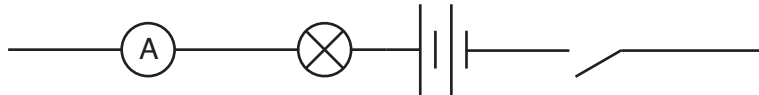


Fig. 6.3

[2]

[Total: 10]



7 A student uses a spring to measure the mass and density of a stone.

(a) Fig. 7.1 shows a full-size diagram of the spring.

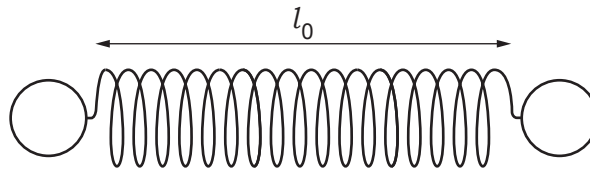


Fig. 7.1

(i) Measure and record the length  $l_0$  of the unstretched spring in centimetres to the nearest millimetre.

$l_0 = \dots\dots\dots$  cm [1]

(ii) The student sets up the spring in a clamp, as shown in Fig. 7.2.

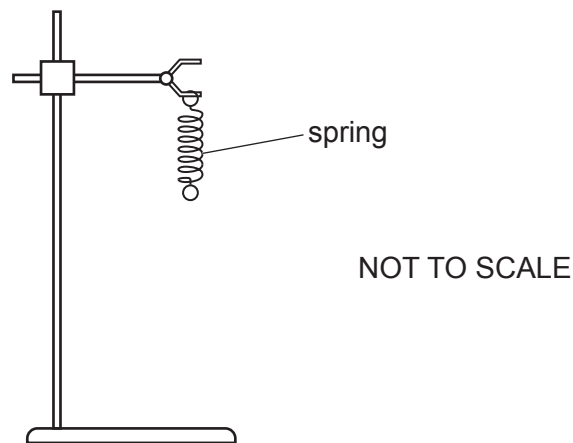


Fig. 7.2

### Procedure

The student:

- suspends a mass  $m$  of 200 g on the spring
- measures the new length  $l_M$  of the spring in centimetres to the nearest millimetre.

The student's result is shown.

$l_M = \dots\dots\dots 13.7 \dots\dots\dots$  cm

Calculate the extension  $e$  of the spring.

Use the equation shown.

$$e = (l_M - l_0)$$

$e = \dots\dots\dots$  cm [1]

**(b) Procedure**

The student:

- removes the 200 g mass from the spring
- attaches the stone to the spring
- measures the new length  $l_A$  of the spring.

The student's result is shown.

$$l_A = \dots\dots\dots 14.2 \dots\dots\dots \text{ cm}$$

- (i) Calculate the extension  $e_A$  of the spring caused by the stone.

Use the equation shown.

$$e_A = (l_A - l_0)$$

$$e_A = \dots\dots\dots \text{ cm [1]}$$

- (ii) Calculate the mass  $m$  of the stone.

Use the equation shown.

$$m = \frac{200 \times e_A}{e}$$

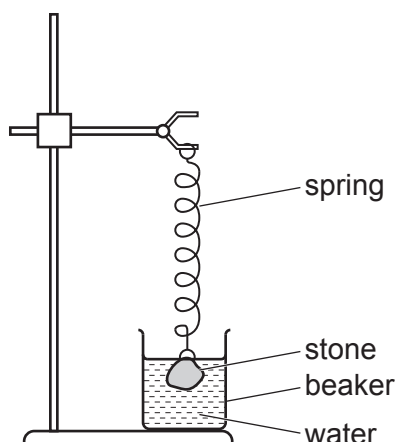
Give your answer to **three** significant figures.

$$m = \dots\dots\dots \text{ g [2]}$$

**(c) Procedure**

The student:

- places a beaker of water under the stone
- slowly lowers the clamp until the stone is just completely immersed in the water, as shown in Fig. 7.3



**Fig. 7.3**

- measures the length  $l_W$  of the spring.

The student's result is shown.

$$l_W = \dots\dots\dots 10.7 \dots\dots\dots \text{ cm}$$

Calculate the extension  $e_W$  of the spring.

Use the equation shown.

$$e_W = (l_W - l_0)$$

$$e_W = \dots\dots\dots \text{ cm [1]}$$

**(d)** Use your answers to **(b)(i)** and **(c)** to calculate the density  $d$  of the stone.

Use the equation shown.

$$d = \frac{e_A}{(e_A - e_W)}$$

$$\text{density } d \text{ of stone} = \dots\dots\dots \text{ g/cm}^3 \text{ [1]}$$

**(e) (i)** It is important to avoid a line-of-sight (parallax) error when measuring the length of the spring.

Describe how the student avoids this error.

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

**(ii)** Suggest how the reliability of the measurements can be improved.

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

**(f)** The student decides to check their value for the density  $d$  of the irregularly shaped stone by using the mass  $m$  calculated in **(b)(ii)** and measuring the volume  $V$  of the stone.

Suggest a piece of apparatus that the student can use to determine the volume of the stone.

..... [1]

[Total: 10]

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