Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0274402191

CO-ORDINATED SCIENCES **0654/62**

Paper 6 Alternative to Practical **February/March 2024**

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 effect of catalase on the breakdown of hydrogen peroxide.

Catalase is an enzyme found in living cells such as potato cells.

Catalase speeds up the breakdown of hydrogen peroxide into oxygen gas and water.

hydrogen peroxide → oxygen + water

(a) (i) Procedure

The student:

- assembles the apparatus shown in Fig. 1.1

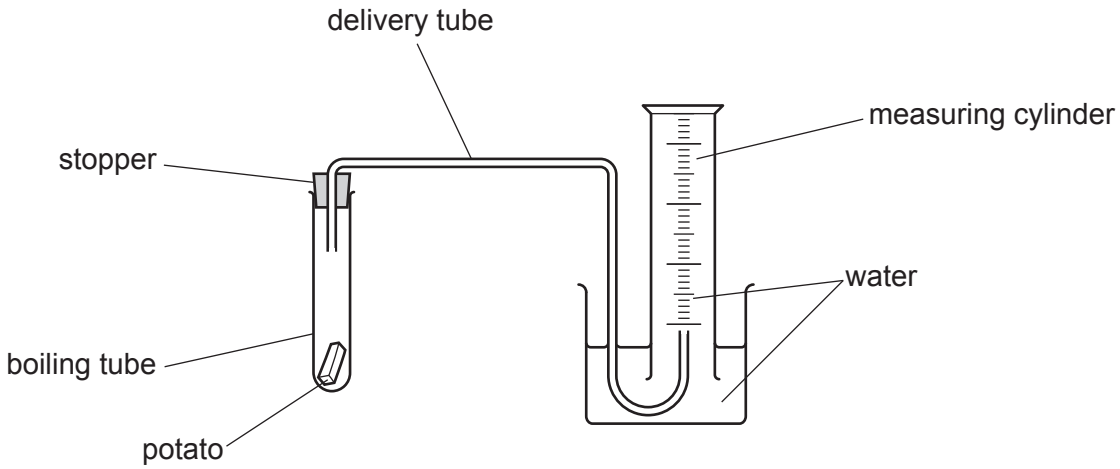


Fig. 1.1

- adds 2 cm^3 of hydrogen peroxide solution to the potato in the boiling tube
- quickly replaces the stopper
- immediately starts a stop-watch
- records in Table 1.1 the **total** volume of gas collected in the measuring cylinder every 2 minutes for 10 minutes.

Table 1.1

time / min	**total** volume of gas collected / cm^3	volume of gas collected in each interval of 2 minutes / cm^3
0	0.0	0.0
2	11.0	11.0
4		
6		
8	21.0	1.0
10	21.5	0.5

Fig. 1.2 shows the total volume of gas collected at 4 and 6 minutes.

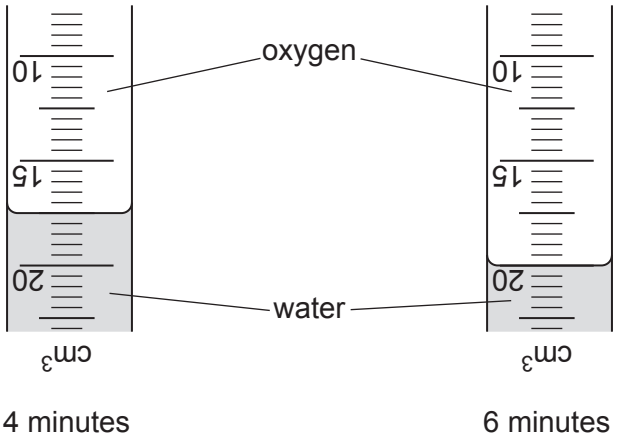


Fig. 1.2

Record in Table 1.1 these values to the nearest 0.5 cm^3. [2]

(ii) Calculate the volume of gas collected in each interval of 2 minutes for 4 minutes and 6 minutes.

Use the equations shown.

The value for 4 minutes = total volume at 4 minutes – the total volume at 2 minutes.

The value for 6 minutes = total volume at 6 minutes – the total volume at 4 minutes.

Record your values in Table 1.1.

[2]

(b) Name a piece of apparatus suitable for measuring 2 cm^3 of hydrogen peroxide solution.

..... [1]

(c) Hydrogen peroxide is corrosive.

State a safety precaution the student takes when doing the procedure.

Explain your answer.

precaution .....

explanation .....

.....
[1]

(d) A student suggests that the volume of gas collected in the final interval of 2 minutes is less than the volume of gas collected in the first interval of 2 minutes.

(i) Explain why the student expects the volume of gas collected in each 2 minute interval to decrease during the experiment.

.....

..... [1]

(ii) State if the results support the student's suggestion.

Use values from Table 1.1 to explain your answer.

statement .....

explanation .....

.....
[1]

(e) The student has difficulty in replacing the stopper quickly enough after adding the hydrogen peroxide.

Suggest how this affects the results. State an improvement to overcome this difficulty.

effect on results .....

.....

improvement .....

.....
[2]

(f) Explain why repeating the procedure increases confidence in the results.

.....

..... [1]

(g) Describe a test to confirm the gas collected is oxygen.

State the observation for a positive result.

test .....

observation .....

.....
[2]

[Total: 13]

2 Fertilisers contain nutrients that are added to crops to help them grow.

A farmer has a choice of three fertilisers, **A**, **B** and **C** for use on his rice crop.

Plan an investigation to find out which fertiliser produces the highest rate of growth of the rice plants.

You are provided with:

- rice plant seedlings
- fertilisers **A**, **B** and **C**.

You may also use any common laboratory apparatus.

Include in your plan:

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

You may include a results table if you wish, you are not required to enter any readings in the table.

You may include a labelled diagram if you wish.

[7]

3 A student investigates which metal ions catalyse a reaction.

When aqueous sodium thiosulfate reacts with aqueous iron(III) nitrate the reaction mixture immediately turns dark purple.

The colour of this mixture slowly fades.

A catalyst will make the purple colour fade more quickly.

Fig. 3.1 shows the experiment.

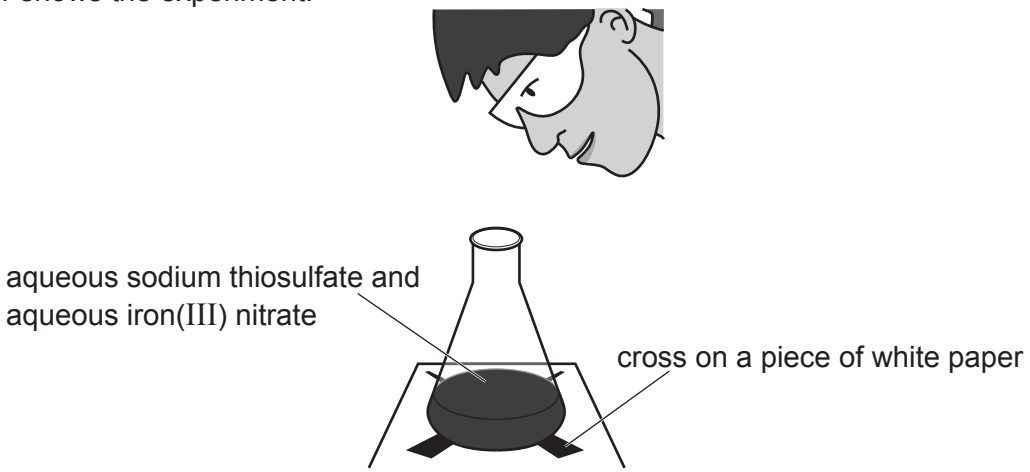


Fig. 3.1

When the purple colour fades it is possible to see the cross through the reaction mixture.

(a) Procedure

The student:

Step **1** adds 20 cm^3 of aqueous sodium thiosulfate to a conical flask
Step **2** puts the conical flask on a cross on a piece of paper
Step **3** adds 1 drop of distilled water to the conical flask
Step **4** adds 20 cm^3 of aqueous iron(III) nitrate to the conical flask, immediately swirls the flask and starts a stop-watch
Step **5** looks through the mixture and when the cross becomes visible as shown in Fig. 3.2, the student stops the stop-watch

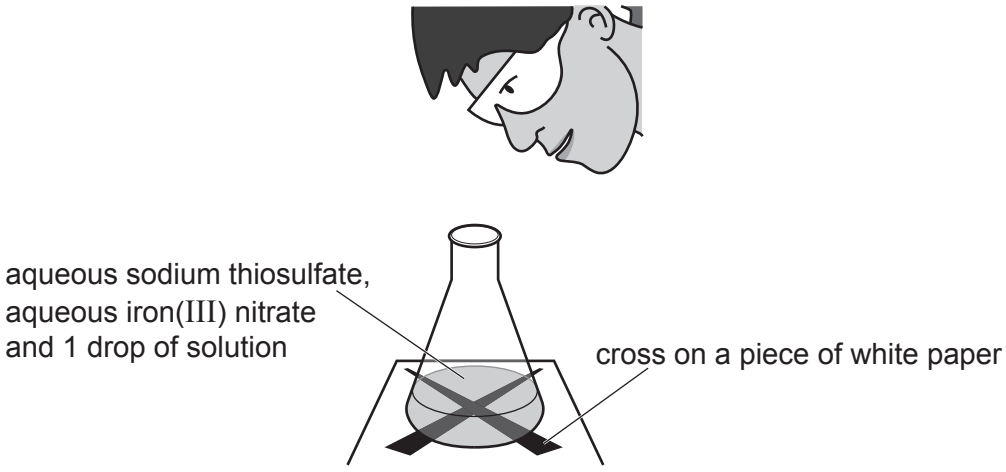


Fig. 3.2

Step **6** records in Table 3.1 the time taken to the nearest 0.1 second.

The student repeats the procedure four times. Each repeat has a drop of a different solution added in Step **3** as shown in Table 3.1.

The results are shown in Table 3.1.

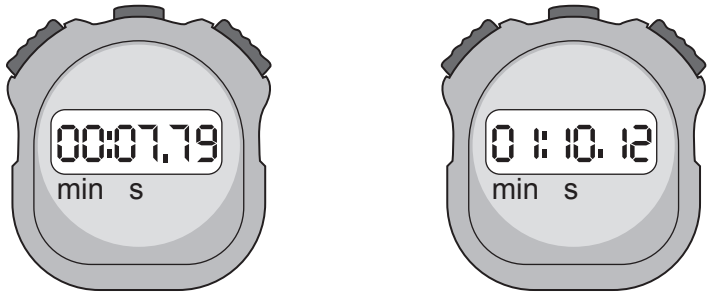
Table 3.1

aqueous solution added in Step **3**	time taken for the cross to become visible / s	rate of reaction / per 100 s
distilled water	75.2	1.3
copper(II) ions		
iron(II) ions	6.4	16
sodium ions	73.4	1.4
zinc ions		

Suggest why in Step **4** the student swirls the flask.

..... [1]

(b) Fig. 3.3 shows the readings on the stop-watch when the cross becomes visible for aqueous copper(II) ions and aqueous zinc ions.



aqueous copper(II) ions aqueous zinc ions

Fig. 3.3

Record in Table 3.1 these times in seconds to the nearest 0.1 s. [2]

(c) **(i)** Calculate the rate of the reaction with aqueous copper(II) ions and with aqueous zinc ions.

Use the equation shown.

$$\text{rate of reaction} = \frac{100}{\text{time taken}}$$

Record in Table 3.1 your values to **two** significant figures. [2]

(ii) Distilled water is **not** a catalyst for this reaction.

The experiment with distilled water is a control for the investigation.

Explain why a control is used.

.....

..... [1]

(iii) Use the values in Table 3.1 to place the aqueous copper(II) ions, aqueous iron(II) ions, aqueous sodium ions and aqueous zinc ions in order of the rates of reaction.

highest rate (best catalyst) .....

.....

.....

lowest rate .....

[1]

(d) Two values of **time** are considered to be the same if they are within 10% of each other.

Consider the times for distilled water and for aqueous sodium ions.

Deduce if sodium ions are a catalyst for this reaction. Include a calculation in your answer.

.....

..... [2]

(e) (i) The student repeats the procedure in **(a)** but adds 5 drops of aqueous copper(II) ions instead of 1 drop.

The time taken for the cross to become visible is 0.6 seconds.

Suggest why 5 drops of aqueous copper(II) ions are **not** used in the procedure in **(a)**.

.....

..... [1]

(ii) The student repeats the experiment at a higher temperature which increases the rate of reaction.

Suggest how the results of this experiment differ from those in Table 3.1.

.....

..... [1]

(iii) Another student repeats the procedure in **(a)**.

The results show the time for the cross to become visible for aqueous copper(II) ions is 72.3 seconds. All the other times are similar to the results in Table 3.1.

Suggest an error in this student's procedure that produces this reading.

.....

..... [1]

[Total: 12]

4 A student investigates some reactions of an aqueous copper(II) salt and an aqueous zinc salt.

Procedure

The student:

Step **1** adds an aqueous copper(II) salt to 3 test-tubes
Step **2** adds a few drops and then excess of aqueous ammonia to the first test-tube
Step **3** adds dilute nitric acid and aqueous barium nitrate to the second test-tube
Step **4** adds dilute nitric acid and aqueous silver nitrate to the third test-tube
Step **5** records the observations of each experiment
Step **6** repeats Steps **1** to **5** with the aqueous zinc salt instead of the aqueous copper(II) salt.

Fig. 4.1 shows the notes in the student's notebook.

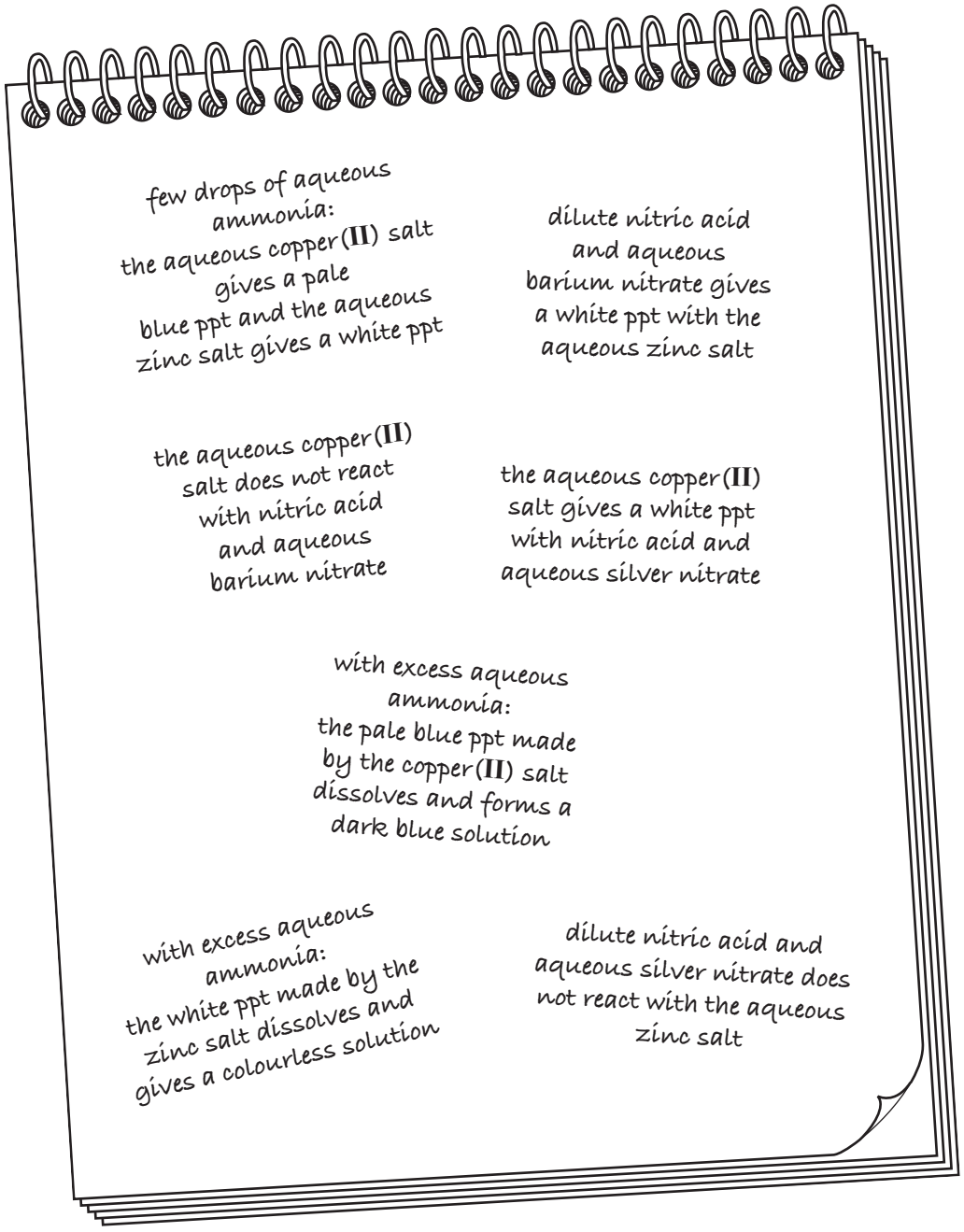


Fig. 4.1

(a) Draw a results table suitable for the student's results shown in Fig. 4.1.

Enter the tests and observations into your table.

[5]

(b) **(i)** Circle the anion (negative ion) that is in the aqueous copper(II) salt.

bromide ion **carbonate ion** **chloride ion** **nitrate ion** **sulfate ion** [1]

(ii) Circle the anion (negative ion) that is in the aqueous zinc salt.

bromide ion **carbonate ion** **chloride ion** **nitrate ion** **sulfate ion** [1]

(c) A student does a flame test by putting a sample of an aqueous metal salt into a blue Bunsen burner flame.

The blue Bunsen burner flame is hotter than a yellow flame.

Suggest another reason why a blue Bunsen burner flame is used instead of a yellow flame.

.....

..... [1]

[Total: 8]

5 A student measures the focal length *f* of a converging lens.

The student assembles the apparatus as shown in Fig. 5.1.

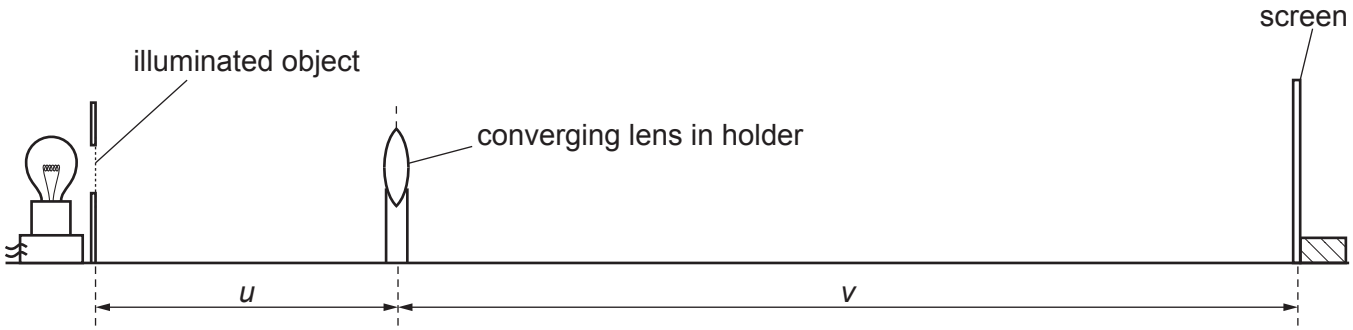


Fig. 5.1

(a) Procedure

The student:

- places the lens a distance $U = 20.0$ cm from the illuminated object. The illuminated object is a triangular hole in a card
- adjusts the position of the screen until a sharp image of the illuminated object is formed on the screen
- measures, to the nearest 0.1 cm, the image distance *v* from the screen to the lens.

(i) Measure the image distance *v* shown in Fig. 5.1.

Record the value in centimetres to the nearest 0.1 cm.

v = ... cm [1]

(ii) Fig. 5.1 is drawn to a scale of one-fifth full size.

Calculate the actual image distance *V* from the lens to the screen.

Record your answer in Table 5.1.

Table 5.1

actual object distance *U* / cm	actual image distance *V* / cm	magnification *m*
20.0		
30.0	30.0	1.0
40.0	24.0	0.6
50.0	21.4	0.4
60.0	20.0	0.3

[1]

(b) (i) Calculate the magnification m of the image.

Use the equation shown.

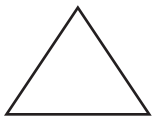
$$m = \frac{\text{actual image distance}}{\text{actual object distance}}$$

Record m to **one** decimal place in Table 5.1. [1]

(ii) Fig. 5.2 shows the illuminated object.

The image seen by the student on the screen is enlarged and inverted.

In the blank space on the right-hand side of the illuminated object, draw a diagram of the image seen by the student.



illuminated object

Fig. 5.2

[2]

(c) The student repeats the procedure described in **(a)** for values of U = 30.0 cm, 40.0 cm, 50.0 cm, and 60.0 cm.

The results are shown in Table 5.1.

Use the results to describe what happens to the image distance V and the magnification m of the image as the object distance U from the lens increases.

image distance V

.....

magnification m

.....

[1]

(d) **(i)** On the grid, plot a graph of V (vertical axis) against m.

[3]

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

(e) The gradient of the line is equal to the focal length f of the lens.

Calculate the gradient of your line.

Show on your graph the values you choose to calculate the gradient.

f = ... [2]

(f) The student does this experiment in a dark room.

Explain how this makes it easier to decide when the image is in focus.

.....

..... [1]

[Total: 13]

6 A student investigates the stretching of a spring.

The student assembles the spring and a metre ruler as shown in Fig. 6.1.

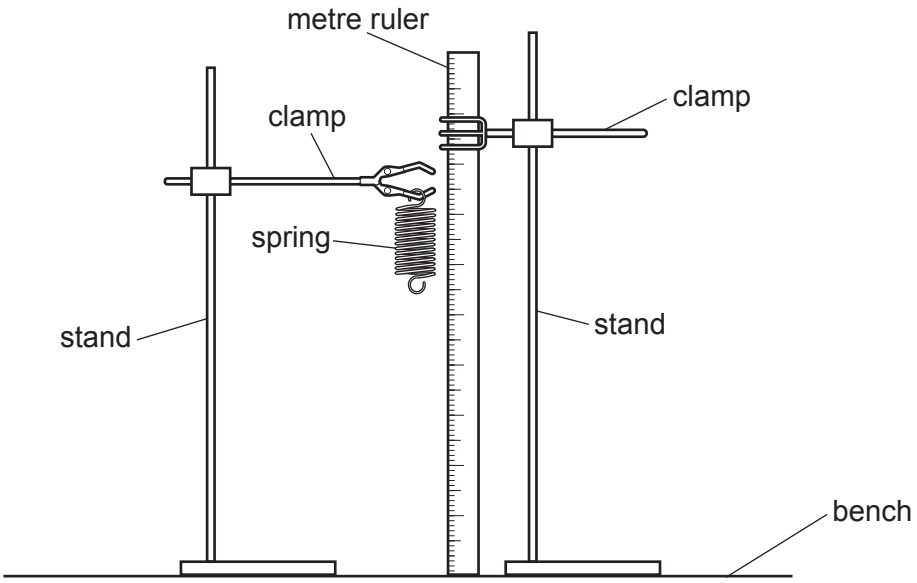


Fig. 6.1

(a) The student takes a reading *r* on the metre ruler at the bottom of the lower loop at the end of the spring.

(i) Draw a diagram to show how the student uses a set-square to make the reading *r* accurate.

[1]

(ii) State **one** other technique used to ensure that the reading *r* is accurate.

..... [1]

(b) Fig. 6.2 shows the bottom part of the spring.

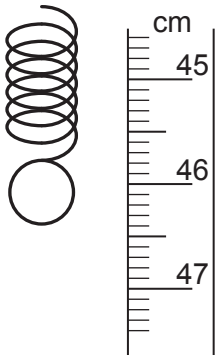


Fig. 6.2

Record in Table 6.1 the reading *r* at the bottom of the lower loop at the end of the spring to the nearest 0.1 cm for mass *m* = 0 g.

Table 6.1

mass *m* / g	0	100	200	400
reading *r* / cm		50.4	54.6	62.4

[1]

(c) Procedure

The student:

- suspends a mass *m* = 100 g from the spring
- records in Table 6.1, the reading *r* at the bottom of the lower loop at the end of the spring.

The student repeats this procedure for masses *m* = 200 g and 400 g.

The readings are shown in Table 6.1.

(i) Suggest how the procedure is improved to increase confidence in the student's readings.

.....

..... [1]

(ii) The student suggests that the reading *r* on the metre ruler is directly proportional to the mass *m*.

State if the readings support this suggestion.

Use values from Table 6.1 to justify your answer.

statement .....

justification .....

.....

..... [1]

(d) Procedure

The student:

- removes the 400 g mass from the spring
- suspends a stone of mass *M* from the spring
- records the reading *r* at the bottom of the lower loop at the end of the spring.

$r = 52.5\,\text{cm}$

Use Table 6.1 to predict the mass *M* of the stone.

M = ... g [1]

(e) Stretched springs are potentially dangerous because of the elastic potential energy stored in them.

State **one** safety precaution taken when investigating the stretching of a spring.

Explain your answer.

safety precaution .....

explanation .....

.....

[1]

[Total: 7]

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