Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICAL SCIENCE **0652/61**

Paper 6 Alternative to Practical **October/November 2020**

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 [ ].

This document has **16** pages. Blank pages are indicated.

1 A student investigates the reaction between magnesium ribbon and hydrochloric acid.

When magnesium reacts with hydrochloric acid, hydrogen gas is given off.

The magnesium ribbon gets smaller as it reacts and, if the **acid** is in excess, the magnesium reacts until the ribbon can no longer be seen.

(a) Procedure

The student:

- measures $25\,cm^3$ of hydrochloric acid using a measuring cylinder and pours it into a boiling tube
- measures the initial temperature of the hydrochloric acid and records this temperature to the nearest $0.5\,°C$ in Table 1.1
- adds one piece of magnesium ribbon to the hydrochloric acid in the boiling tube and measures the highest temperature reached. The student records this temperature to the nearest $0.5\,°C$ in Table 1.1
- rinses the boiling tube and thermometer
- repeats the procedure using 2, 3, 4 and 5 pieces of magnesium ribbon. All of the pieces of magnesium ribbon are the same shape and size.

(i) Fig 1.1 shows the thermometer readings for the highest temperature reached when 2 pieces of magnesium ribbon are added and when 5 pieces of magnesium ribbon are added.

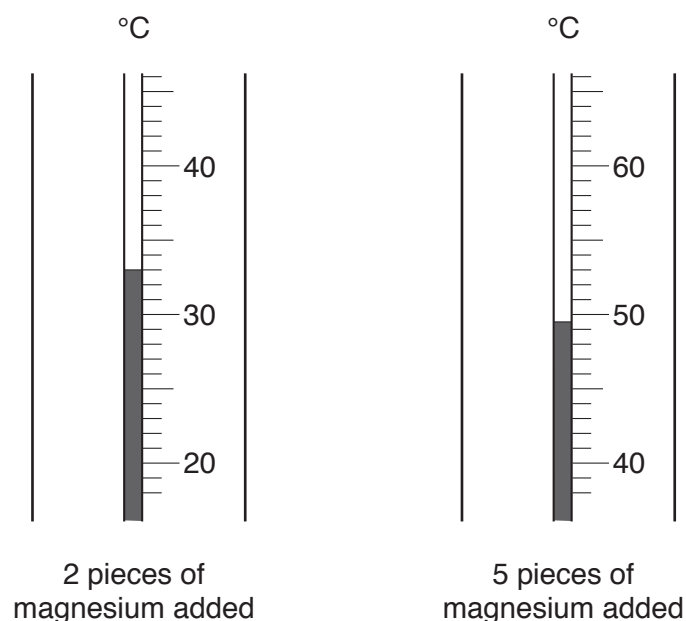Record these temperatures in Table 1.1.   [2]

Fig. 1.1

Table 1.1

number of pieces of magnesium ribbon	initial temperature of hydrochloric acid / °C	highest temperature reached / °C	temperature rise / °C
1	22.0	27.5	5.5
2	22.0		
3	22.0	38.0	16.0
4	22.5	44.5	22.0
5	23.0		

    (ii) Calculate the temperature rise when 2 and when 5 pieces of magnesium ribbon are added. Record these values in Table 1.1. [1]

(b) Describe **one** observation the student makes that shows that the magnesium has reacted completely with the hydrochloric acid.

....

.... [1]

(c) Describe the relationship between the number of pieces of magnesium ribbon and the temperature rise of the reaction.

....

.... [1]

(d) State **one** variable that must be controlled during this reaction.

.... [1]

(e) Suggest **one** improvement that would increase the accuracy of the experiment.

.... [1]

(f) A student repeats the experiment with 10 pieces of magnesium ribbon and $25 \, cm^3$ of hydrochloric acid. The acid is still in excess.

Suggest the temperature rise for this reaction.

.... [1]

(g) When 15 pieces of magnesium are added the **magnesium** is in excess.

The student measures the temperature rise when 15 pieces of magnesium are added and again when 20 pieces of magnesium are added.

Suggest the relationship between these two temperature rises.

.... [1]

(h) Procedure

The student then:

- measures $10\,cm^3$ of hydrochloric acid and pours it into a boiling tube
- adds 5 drops of universal indicator (full range indicator)
- records the colour of the solution in the boiling tube
- adds small pieces of magnesium until no more will react
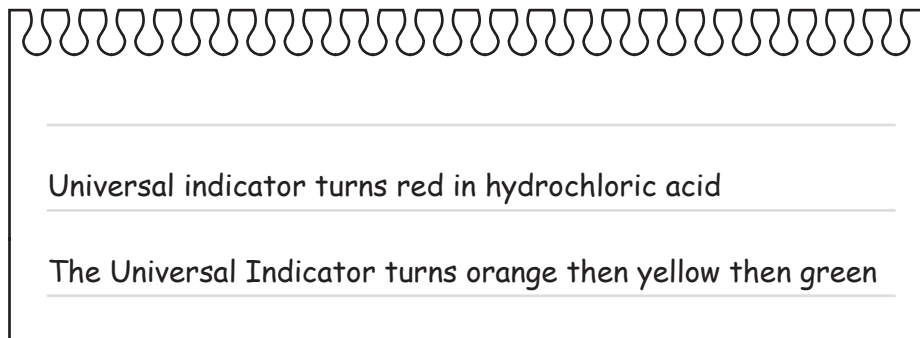- records the changes to the colour of the solution in the boiling tube.

Universal indicator turns red in hydrochloric acid

The Universal Indicator turns orange then yellow then green

Fig. 1.2

The student's record of colour changes is shown in Fig. 1.2.

(i) Describe what happens to the hydrochloric acid as it reacts with magnesium.

.... [1]

(ii) Describe the test that identifies the gas given off as hydrogen.

test ....

observation...
[1]

(i) One way to investigate the rate of this reaction is to collect the gas and measure the volume of gas collected every minute.

Draw a **labelled** diagram of the assembled apparatus used for this experiment.

[2]

[Total: 13]

2 A student investigates the magnification produced by a converging lens.

Fig. 2.1 shows the apparatus used.
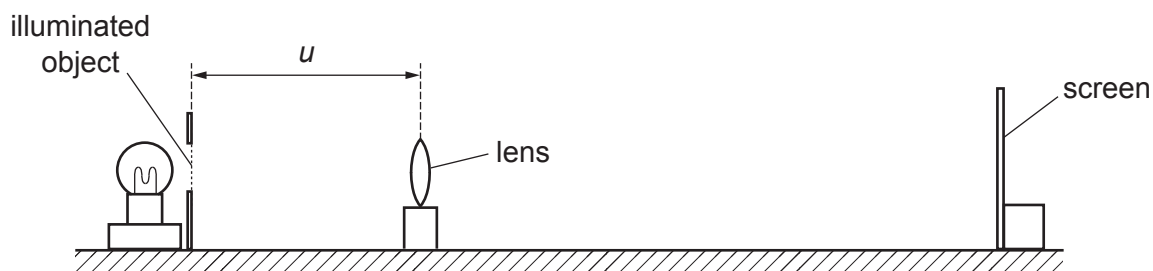
Fig. 2.1

(a) • The illuminated object is a triangular hole in a piece of card, as shown in Fig. 2.2.
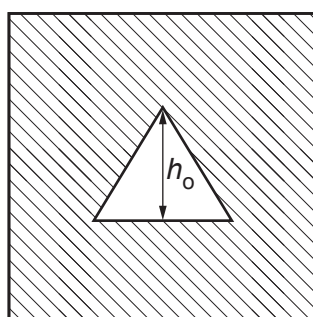
Fig. 2.2

• The student measures and records the height h_o of the triangular-shaped hole of the illuminated object. The measurement is shown in Fig. 2.3.

$$h_o = 1.5 \text{ cm}$$
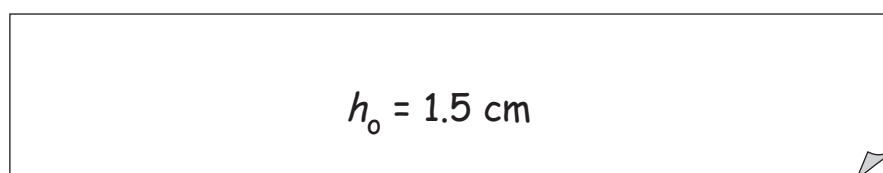
Fig. 2.3

The student then:

• sets the distance u (shown on Fig. 2.1) between the illuminated object and the lens to 25.0 cm
• moves the screen until a sharp image of the triangle is seen on the screen, as shown in Fig. 2.4 on page 6.
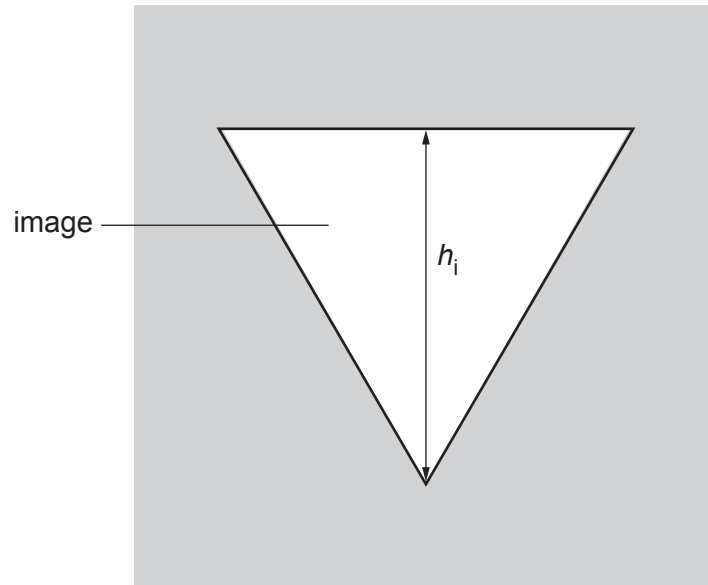
Fig. 2.4

(i) Measure the height h_i of the image and record it in Table 2.1.

Table 2.1

u / cm	h_i / cm	J
25.0		
30.0	2.7	0.56
35.0	2.0	0.75
40.0	1.5	1.00
45.0	1.2	1.25

[1]

(ii) The student repeats the procedure for values of u = 30.0 cm, 35.0 cm, 40.0 cm and 45.0 cm.

The results are shown in Table 2.1.

Calculate J for u = 25.0 cm. Use the value of h_o on page 5 and your measurement of h_i from **(i)**. Record the answer in Table 2.1.

Use the equation:

$$J = \frac{h_o}{h_i}$$ [1]

(b) (i) Plot a graph of u (vertical axis) against J.

You do not have to start your graph at the origin (0, 0).
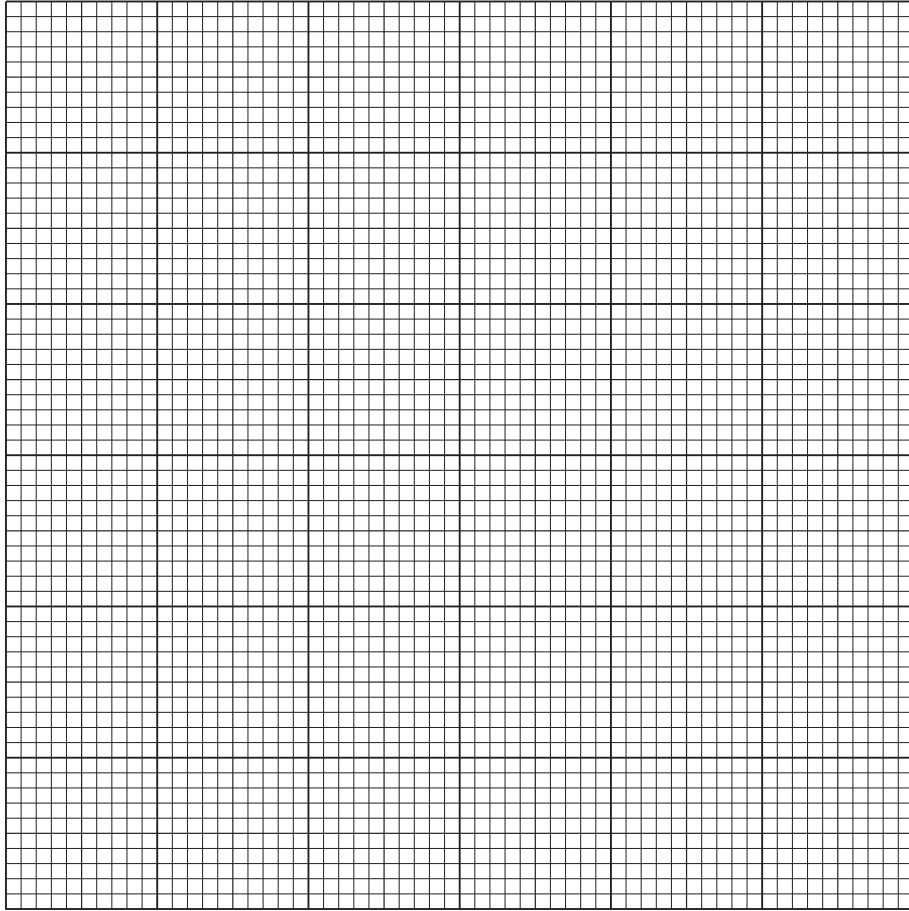
[3]

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

(c) Calculate the gradient G of your line drawn in **(b)(ii)**.

Show all working and indicate on your graph the points you use to calculate the gradient.

$G = $ .... [2]

(d) State **one** precaution that you would take in this experiment to obtain accurate readings.

....

.... [1]

(e) The student notices that one difficulty in measuring the height of the image is that the ruler used and the hand holding it cast a shadow over the image.

Suggest an improvement to the apparatus or the arrangement of the apparatus to overcome this difficulty.

....

.... [1]

[Total: 10]

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Question 3 starts over the page

[Turn over

3 A student investigates the stretching of two identical springs.

Fig. 3.1 shows the set-up of the apparatus used to investigate one of the springs.
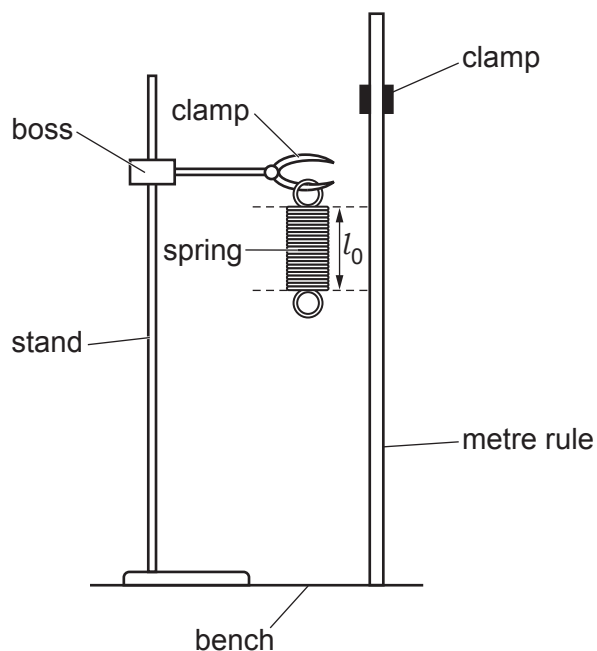
Fig. 3.1
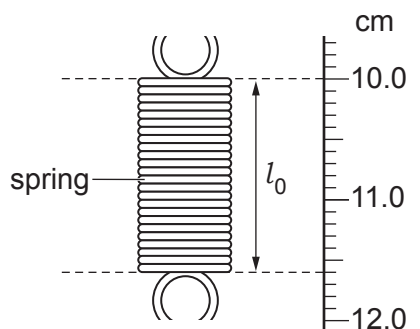
Fig. 3.2

(a) Fig. 3.2 shows the unstretched spring. Take measurements from Fig. 3.2 to determine the original length l_0. Record your value in Table 3.1 for $L = 0.0$ N and on the answer line.

l_0 = ... cm [1]

The student:

- hangs a 1.0 N load on the spring
- records the new length l of the spring in centimetres to the nearest millimetre
- repeats the procedure using loads of 2.0 N and 3.0 N.

The measurements are shown in Table 3.1.

(b) Describe **one** precaution which should be taken to ensure that the readings of length are as accurate as possible.

....

....[1]

(c) Calculate the extension x for each load. Record your values in the third column of Table 3.1.

Use the equation:

$$x = l - l_0$$

Table 3.1

L / N	l / cm	x / cm
0.0		
1.0	4.5	
2.0	8.0	
3.0	11.6	

[2]

(d) Predict the extension for a load L of 5.0 N. Use data from Table 3.1.

$x =$ .... cm [1]

(e) Calculate the spring constant k_1 of the spring when $L = 3.0$ N.

Use the equation:

$$k_1 = \frac{L}{x}$$

Give your answer to a suitable number of significant figures.

$k_1 =$ .... N/cm [2]

(f) The student removes the load from the spring and attaches a second identical spring to the bottom of the first.

Fig. 3.3 shows the arrangement of the two springs.

Fig. 3.3

The student determines the extension x_2 of the combined springs for a load L of 3.0 N. The value is shown in Fig. 3.4.

$$x_2 = 25.0 \text{ cm.}$$
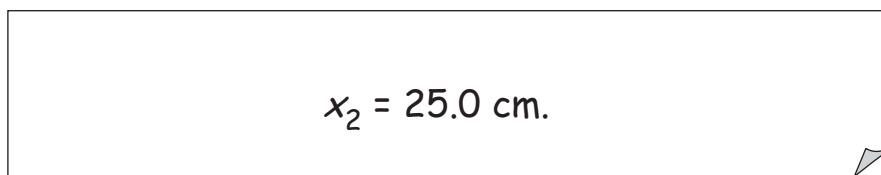
Fig. 3.4

(i) Calculate the spring constant k_2 of the combined springs.
Use the equation:

$$k_2 = \frac{L}{x_2}$$

k_2 = ... N/cm [1]

(ii) The student suggests that the spring constant k_2 of the combined springs is equal to half of the spring constant k_1 of just one of the springs.

Explain whether the calculated values of k_1 and k_2 support this suggestion within the limits of experimental error.

....

....

.... [1]

(g) The student plans to investigate the relationship between k_1 and k_2 in more detail.

Suggest **one** change to the procedure that will enable her to do this.

....

....

.... [1]

[Total: 10]

4 Lemon juice and lime juice both contain acid.

Acids are neutralised by alkalis.

Plan an experiment to compare the amount of acid in lemon juice and in lime juice.

You may use any common laboratory apparatus, aqueous sodium hydroxide, any test reagents and a lemon and a lime.

Your plan should include:
- a brief description of the method including the apparatus you would use
- safety precautions AND explain why these are needed
- the variables to control
- the measurements you will make
- an explanation of how you would use your results to reach a conclusion.

A diagram is not required but you may draw one if it helps to explain your plan.

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