



General Certificate of Secondary Education  
2022

Centre Number

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Candidate Number

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# Physics

Unit 3 Practical Skills

**Booklet B**



Foundation Tier

**[GPY32]**

\*GPY32\*

**TUESDAY 28 JUNE, MORNING**

## TIME

1 hour.

## INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

**You must answer the questions in the spaces provided.**

**Do not write outside the boxed area on each page or on blank pages.**

Complete in black ink only. **Do not write with a gel pen.**

Answer **all** questions.

## INFORMATION FOR CANDIDATES

The total mark for this paper is 70.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question **1(b)**.

You should have a ruler and a protractor.

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\*20GPY3201\*

- 1 (a) A student measures the time it takes for a ball bearing to fall various distances from rest and obtains the results shown in the incomplete table below.

Time/s	Distance fallen /cm Trial 1	Distance fallen /cm Trial 2	Average distance fallen/cm
0.0	0.0	0.0	0.0
0.05	1.2	1.4	1.3
0.10	5.0	5.0	5.0
0.15	12.0	10.0	11.0
0.20	18.0	22.0	20.0
0.25	31.0	29.0	
0.30	43.0	45.0	
0.35	58.0	60.0	
0.40	82.0	78.0	

- (i) Complete the last column of the table, writing the average distance fallen to one decimal place. [2]
- (ii) Suggest how you can tell from inspection of the table, and without doing any calculations, that the ball bearing was moving faster as it fell.

\_\_\_\_\_ [1]

\_\_\_\_\_



- (iii) Write, in words, in the box below, the equation you would use to find the average speed of the ball bearing.

Average speed =

[1]

- (iv) Show that the **average speed** of the ball bearing in **cm/s** between times  $t = 0$  and  $t = 0.40$  s is 200 cm/s.

[2]

- (v) The average speed of the ball bearing between 0 s and 0.40 s is 200 cm/s. Using the equation below calculate the final speed of the ball at 0.40 s. Remember the ball bearing started from rest.

$$\text{Average speed} = \frac{(\text{initial speed} + \text{final speed})}{2}$$

Final speed = \_\_\_\_\_ cm/s [3]

[Turn over

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\*20GPY3203\*

(vi) Explain what is meant by a rate of change of speed of  $5 \text{ m/s}^2$ .

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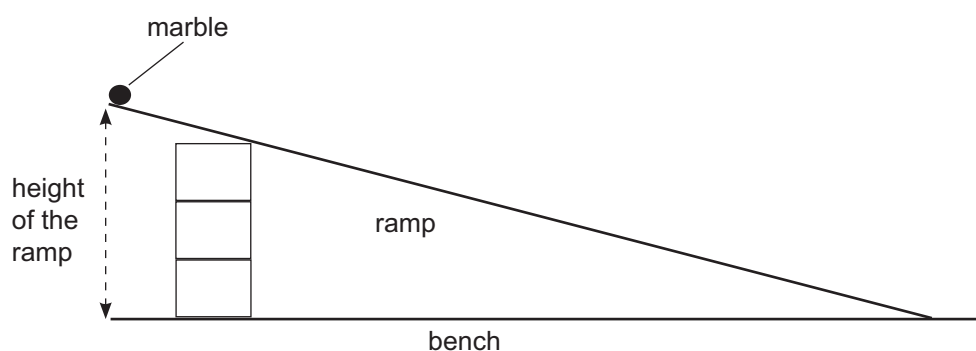
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[2]

(b) A hypothesis has been suggested that:

**the average speed of a marble rolling down a ramp is directly proportional to the height of the ramp.**

A diagram of the ramp set up for the investigation of this hypothesis is shown below.



Source: Principal Examiner

**In this question you will be assessed on your written communication skills including the use of specialist science terms.**

Describe the planning you would carry out for this investigation.  
Write your answers on the page opposite.

In your plan you must:

- state the dependent and independent variables;
- state one controlled variable;
- identify **two** additional pieces of laboratory apparatus you would need to carry out the investigation;
- state the graph you would plot to test if the hypothesis was true or false;
- state the appearance of the graph if the hypothesis was true.



Dependent variable: \_\_\_\_\_

\_\_\_\_\_

Independent variable: \_\_\_\_\_

\_\_\_\_\_

Controlled variable: \_\_\_\_\_

\_\_\_\_\_

Two additional pieces of laboratory apparatus: \_\_\_\_\_

\_\_\_\_\_

Graph to be plotted: \_\_\_\_\_

\_\_\_\_\_

Appearance of graph if hypothesis is true: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [6]

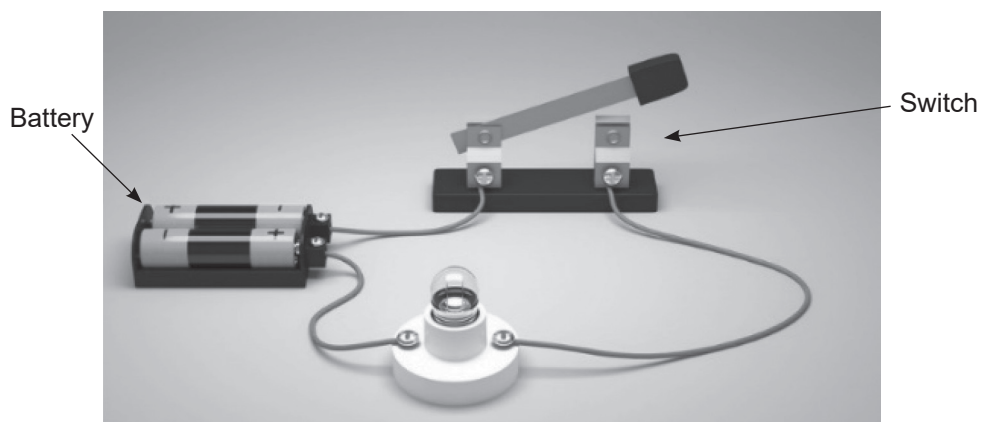
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\*20GPY3205\*

- 2 (a) The photograph below shows how a student connected a bulb in series with a battery of 2 cells and switch. However, he forgot to add an ammeter to the circuit in order to measure the current.



Source: © Getty Images

- (i) Draw the circuit diagram for the circuit shown above and add the ammeter to the circuit.  
Use the **correct symbols** for the components shown.  
Use the space below for your diagram.

[5]





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**(Questions continue overleaf)**

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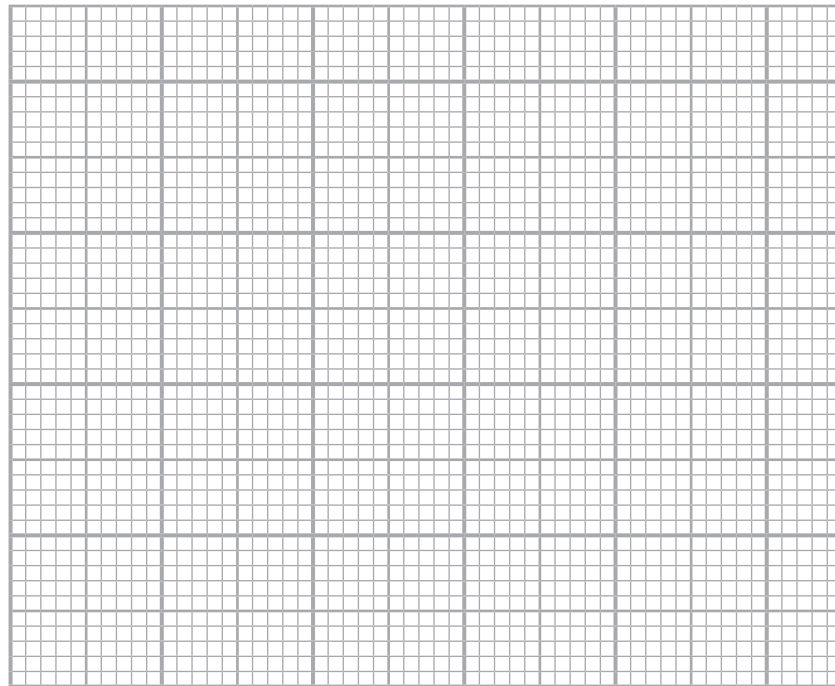
\*20GPY3207\*

More bulbs were added in series to the circuit shown on page 6.

Number of bulbs connected in series	Current/A
1	2.0
2	1.0
3	0.7
4	0.5
5	0.4

- (ii) On the grid below plot the data from this table.  
Mark your data points clearly using  $\odot$  or  $\times$ .  
Draw a smooth curve through the points.

Current/A



Number of bulbs in series

[5]



- (iii) The battery used in the experiment provided **4.0V**.  
Complete the table below by inserting the unit for resistance in the column heading.  
Calculate the resistance for each number of bulbs connected in series.  
Insert the values in the table.

Number of bulbs connected in series	Current/A	Resistance/ _____
1	2.0	
2	1.0	
3	0.7	
4	0.5	
5	0.4	

← Add the unit for resistance here

Use the space below for your calculation of resistance showing clearly how you get your answer.

[4]

- (iv) What conclusion does your calculations of resistance suggest about the resistance of the circuit as the number of bulbs increases?

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[1]

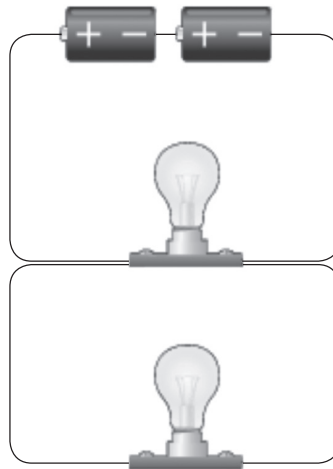
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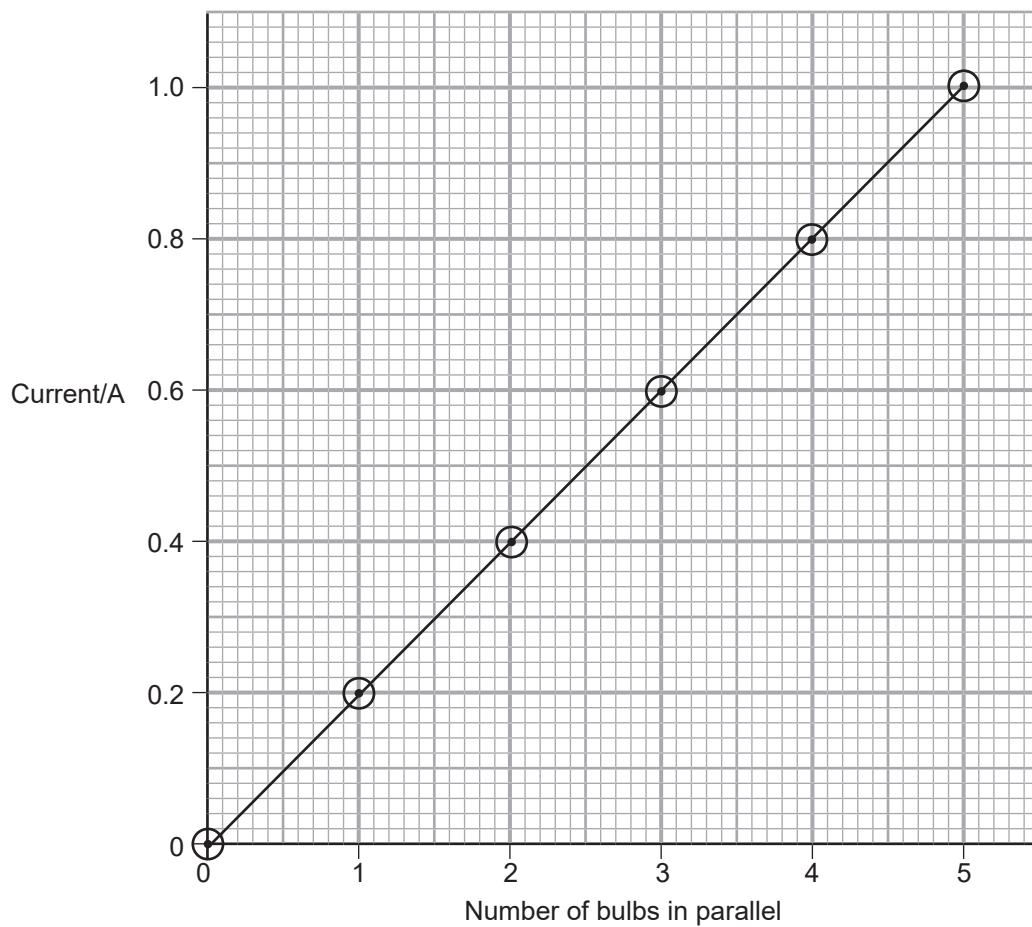
\*20GPY3209\*

(b) Another student investigated how the current supplied by the battery depends on the number of bulbs connected in parallel. The diagram below shows two bulbs connected in parallel.



Source: Chief Examiner

When the current was plotted against the number of bulbs in parallel, the graph below was obtained.



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\*20GPY3210\*

- (i) The current  $I$  and the number of bulbs in parallel  $N$  are related by the equation below:

$$I = kN$$

where  $k$  is a constant.

Using the graph, find the value of  $k$ .

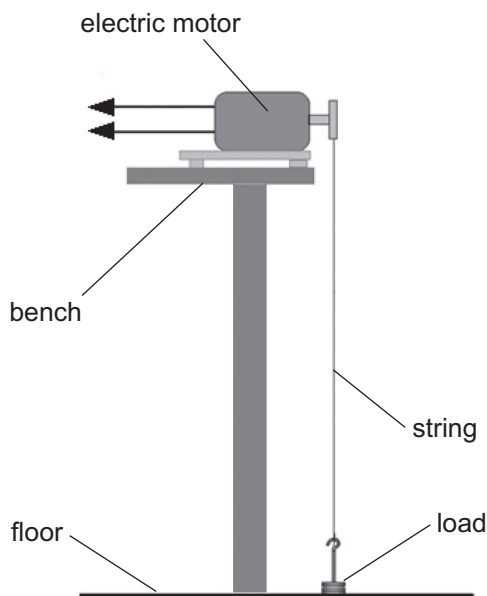
$$k = \text{_____} [3]$$

- (ii) What is the unit of  $k$ ?

$$\text{_____} [1]$$



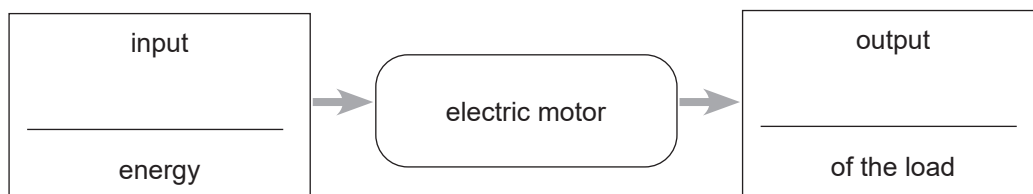
- 3 (a) An experiment has been carried out to measure the power output of an electric motor. The motor is used to lift a load. The experiment was repeated to obtain three values for the time taken to lift the load. The apparatus used and the results obtained are shown below.



Source: Chief Examiner

Load lifted/N	2
Height lifted/m	1.2
Time taken/s	0.80    0.81    0.83

- (i) Complete the energy flow diagram to show input and output energy when the load has been lifted and stopped. Write your answer in the boxes.



[2]



- (ii) Calculate an average value for time taken.  
Give your answer to 2 decimal places.

Average time = \_\_\_\_\_ s [2]

- (iii) Using the equation below, calculate the work done by the motor in lifting the load.

$$\text{work done} = \text{load lifted} \times \text{height lifted}$$

\_\_\_\_\_ J [2]

- (iv) Using your answer to parts (ii) and (iii), calculate the average power of the motor.  
Include the unit for power with your answer.  
Show clearly how you get your answer, starting with the equation you plan to use.

power = \_\_\_\_\_ [4]

[Turn over

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\*20GPY3213\*

(b) In another experiment the motor was used to lift different loads.

The efficiency of the electric motor was measured for each load.  
The results of this experiment are shown in the table below.

Load/N	2.0	2.5	3.0	4.0	5.0
Efficiency	0.6	0.8	0.85	0.86	0.87

(i) On the grid below, plot a graph of the load on the x-axis and efficiency on the y-axis.

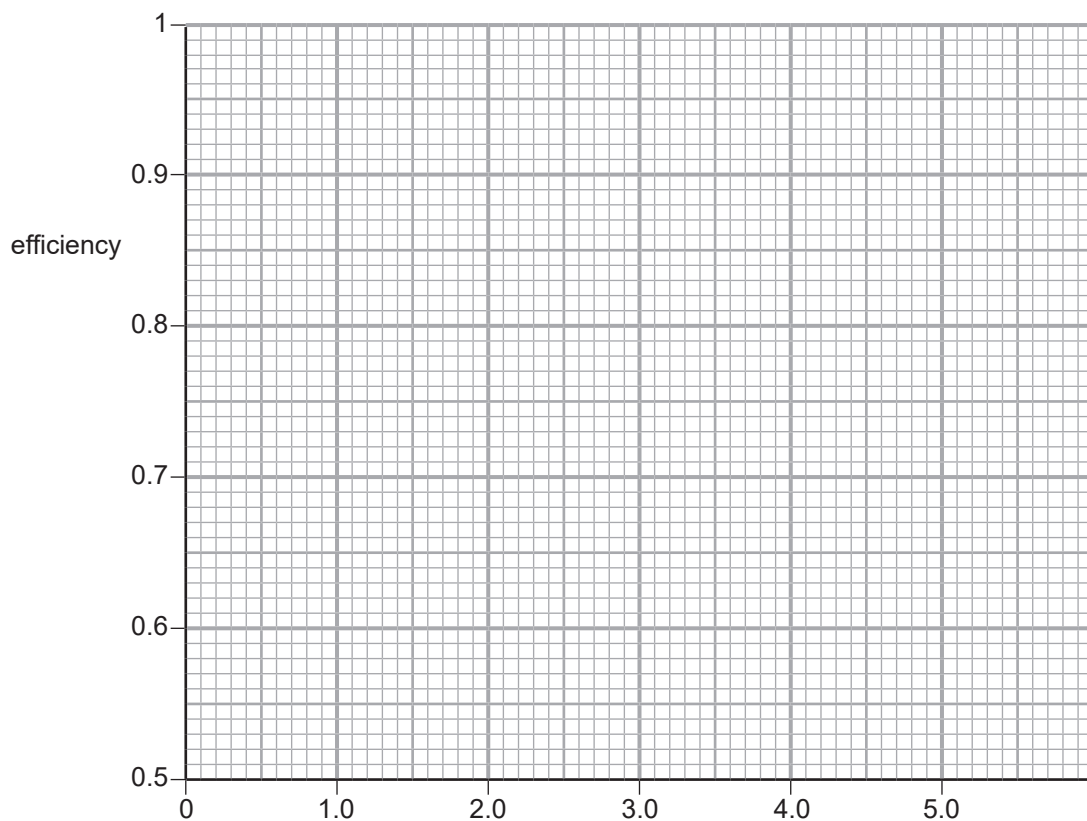
Add an appropriate label with unit to the x-axis.

Plot the points using the values from the table above.

Mark your points clearly on the grid using  $\odot$  or  $\times$ .

Draw a curve of best fit through the points.

[5]



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\*20GPY3214\*

(ii) Does the graph show that efficiency is proportional to load?  
Circle your answer.

Yes

No

State one feature of the graph which supports your answer.

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[2]

[Turn over

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\*20GPY3215\*

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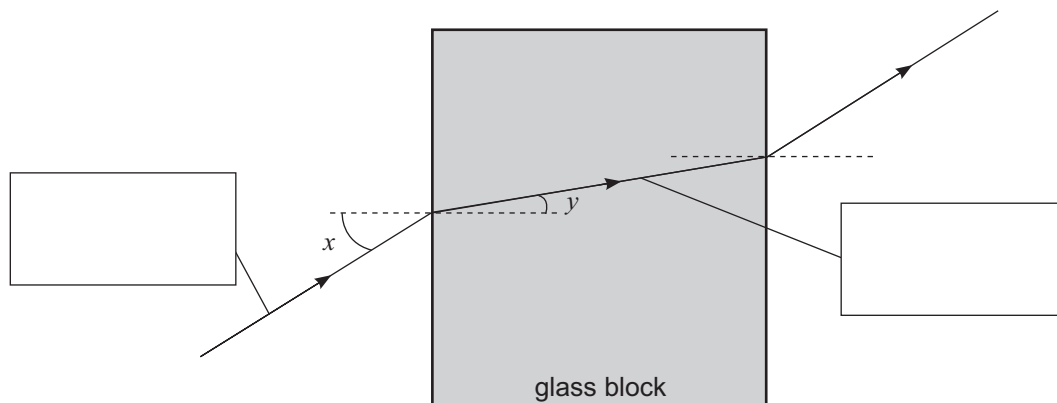
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\*20GPY3216\*



- 4 (a) The diagram below shows the path of a ray of light as it enters, passes through and leaves a glass block.



Source: Chief Examiner

- (i) On the diagram, label the incident ray and the refracted ray.  
Write your answers in the boxes provided. [2]

- (ii) What name is given to the dotted lines?  
\_\_\_\_\_ [1]

- (iii) What names are given to the angles marked x and y on the diagram?

Angle x is the \_\_\_\_\_

Angle y is the \_\_\_\_\_ [2]

- (iv) Explain why the light changes direction as it enters the glass block.

\_\_\_\_\_  
\_\_\_\_\_ [2]

[Turn over



- (b) A student recorded the angles  $x$  and  $y$  for the ray of light entering the glass block.

The results are shown in the table below.

Angle $x / ^\circ$	Angle $y / ^\circ$	$\frac{x}{y}$
5	3	
10	7	
20	13	
30	19	
50	31	
65	37	
80	41	

- (i) Complete the table by calculating, to one decimal place, the ratio  $\frac{x}{y}$  for each pair of angles. [2]

- (ii) The angle of  $y$  increases as the angle  $x$  increases. However, they are not proportional. Explain how your calculated values in the table support this.

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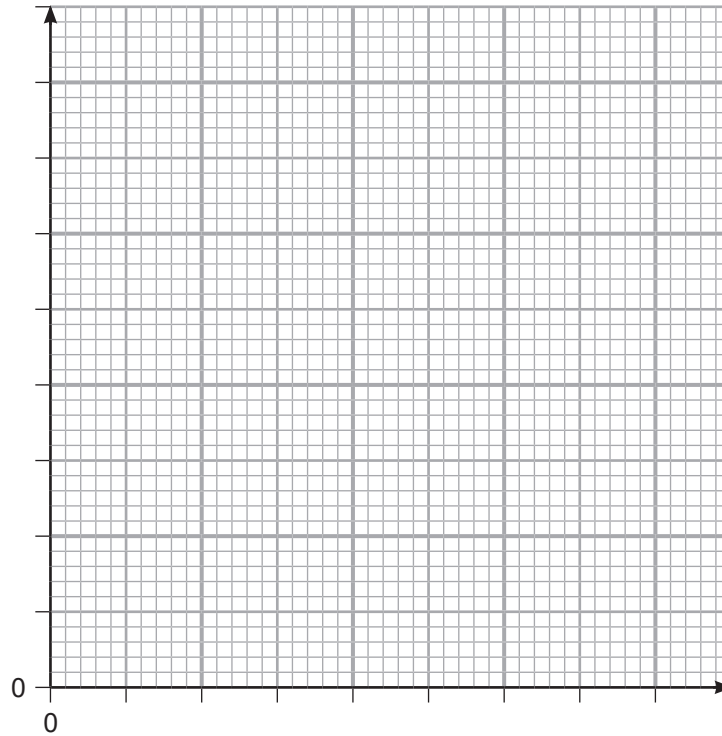
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[2]



- (iii) On the grid below, plot a graph of angle  $y$  (y-axis) against angle  $x$  (x-axis).  
Label each axis.  
Choose a suitable scale for each axis.  
Plot the points using  $\odot$  or  $\times$ .  
Draw the best fit line through the points.



[5]

- (iv) Explain what feature of the graph confirms that the angles  $x$  and  $y$  are not proportional.

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[1]

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**THIS IS THE END OF THE QUESTION PAPER**

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	

<b>Total Marks</b>	
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Examiner Number

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