Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2025

Physics

Unit 3 Practical Skills

Booklet B

Higher Tier

[GPY34]

GPY34

MONDAY 23 JUNE, MORNING

TIME

1 hour 15 minutes.

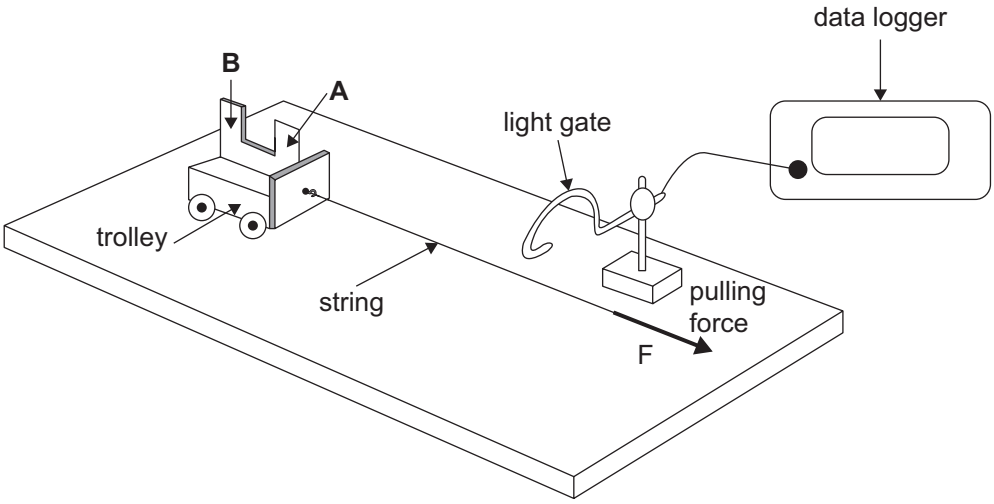
INSTRUCTIONS TO CANDIDATES

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 and use a dark HB pencil for drawings and graphs.
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.
You may use a scientific calculator.

1 (a) A light gate connected to a data logger can be used to measure the velocity of an object. A card placed on a moving trolley is used. When parts A and B pass through a light gate a laser beam is blocked and a time is measured.



Source: "Reproduced from spark.iop.org with permission of the Institute of Physics."

The time between A and B passing through the light gate is also measured and recorded by the data logger. The widths of parts A and B are measured using a ruler.
The table below shows the results of one use of this apparatus.

Width of part A	0.03 m
Width of part B	0.03 m
Time for A to pass through the light gate	300 ms
Time for B to pass through the light gate	200 ms
Time between A and B passing the light gate	250 ms

1 ms (millisecond) = 0.001 s

(i) Using the values shown in the table, calculate the velocity of part A.
Show your working out.

Velocity of part A = _____ m/s [1]

(ii) Using the values shown in the table, calculate the velocity of part B.
Show your working out.

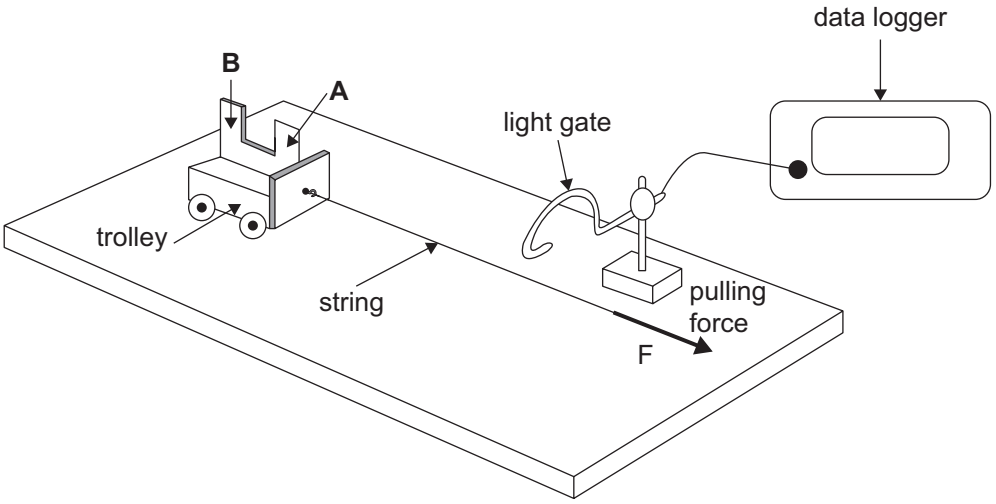
Velocity of part B = _____ m/s [1]

(iii) Using your answers to parts **(i)** and **(ii)**, calculate the acceleration of the trolley.
Show your working out.

Acceleration = _____ m/s^2 [2]

[Turn over

(iv) A student investigates force and acceleration using the apparatus shown below. The trolley is pulled along by a constant force F.
The mass of the trolley can be changed by adding 0.1 kg masses to it.



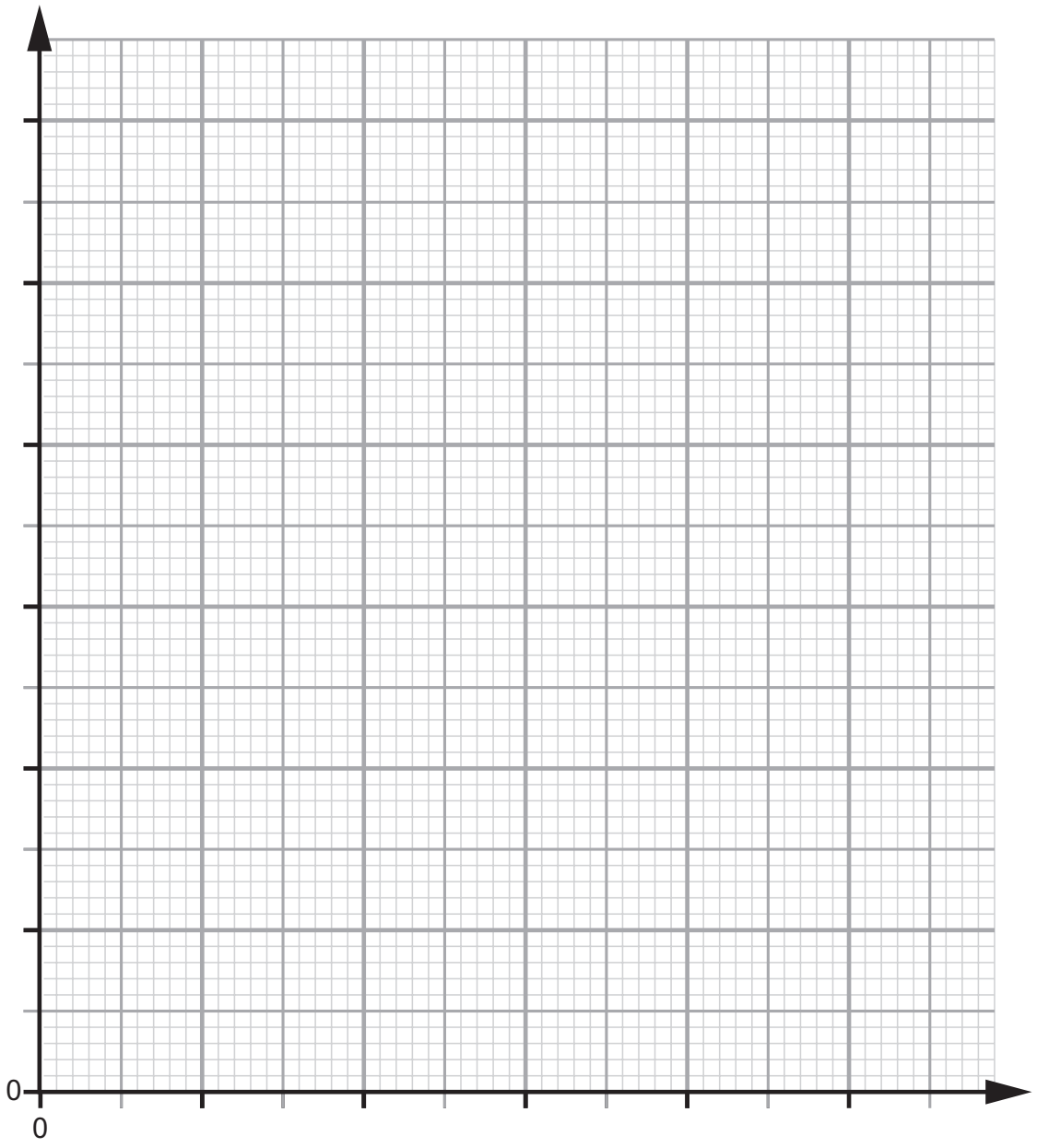
Source: "Reproduced from spark.iop.org with permission of the Institute of Physics."

For each mass of the trolley, the data logger measures the acceleration.
The results are shown in the table below.

Mass/kg	$\frac{\textbf{1}}{\textbf{mass}} / \frac{\textbf{1}}{\textbf{kg}}$	**Acceleration/ m/s²**
0.4		12.5
0.5		10.0
0.6		8.3
0.7		7.1
0.8		6.3

Complete the table above by calculating $\frac{1}{\text{mass}}$ and add your values to the table. Give your values to **1 decimal place**. [1]

(v) On the grid below, plot a graph of acceleration on the y-axis against $\frac{1}{\text{mass}}$ on the x-axis.
Choose a scale for each axis.
Label each axis with the quantity and unit.
Plot the points on the grid, using × or ⊙ to clearly show the plotted points.
Draw the best fit line through the points. [6]



[Turn over

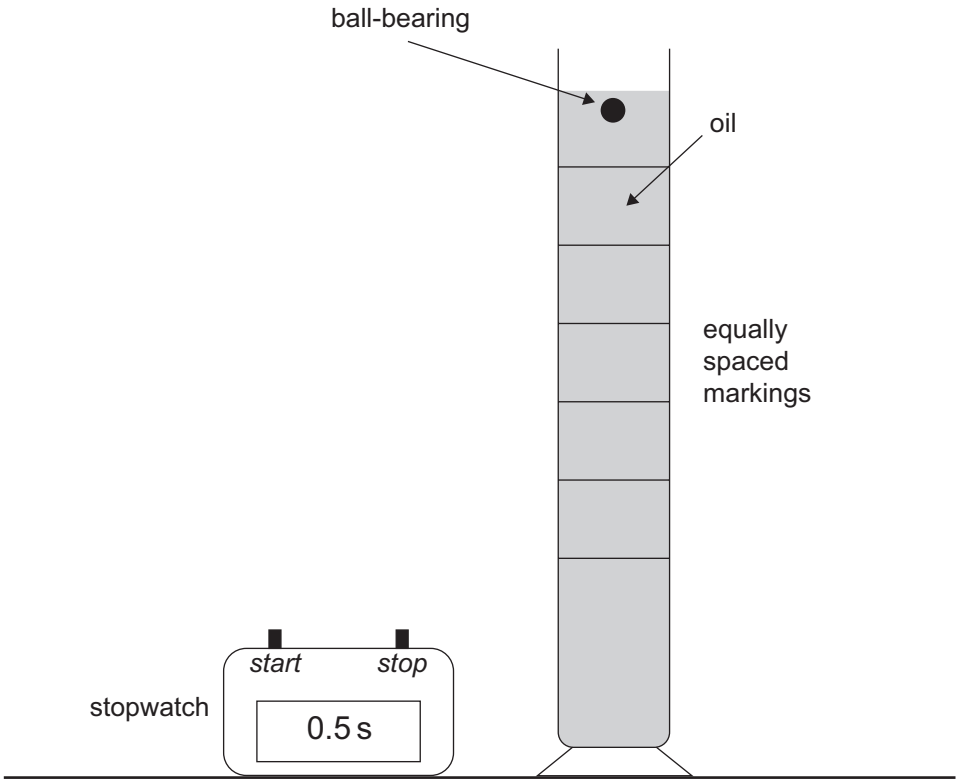
(vi) Newton's second law states that the relationship between the force F, acceleration a and mass m is given by the equation

$$a = F \times \frac{1}{m}$$

Use the graph to calculate the value of the constant force F.
Show your working out.

Constant force F = _____ N [3]

(b) Another student investigates Newton's first law by studying the motion of a ball-bearing as it falls through a cylinder of oil, as shown in the diagram below.
The markings on the cylinder are equally spaced.
The student is provided with a stopwatch.
The oil exerts a friction force on the ball-bearing.



(i) The ball-bearing is released from rest and eventually travels down through the oil with a **constant speed**.
How would you use the markings on the cylinder to show this?

_____

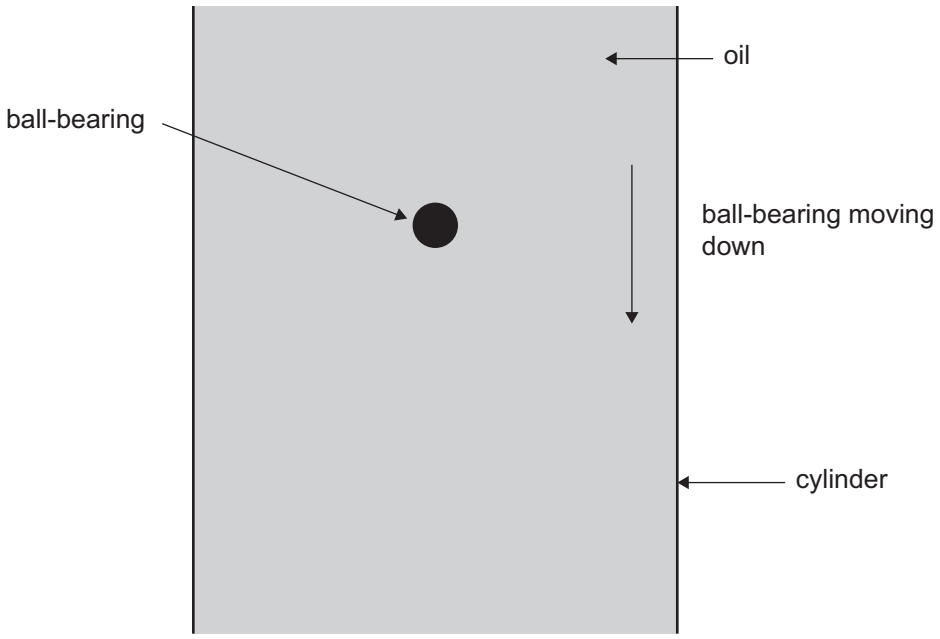
_____

_____

_____ [2]

[Turn over

(ii) On the diagram below, mark and label the forces acting on the ball-bearing.



[1]

(iii) When the ball-bearing is moving with constant speed, what does this tell the student about these two forces?

_____

_____ [1]

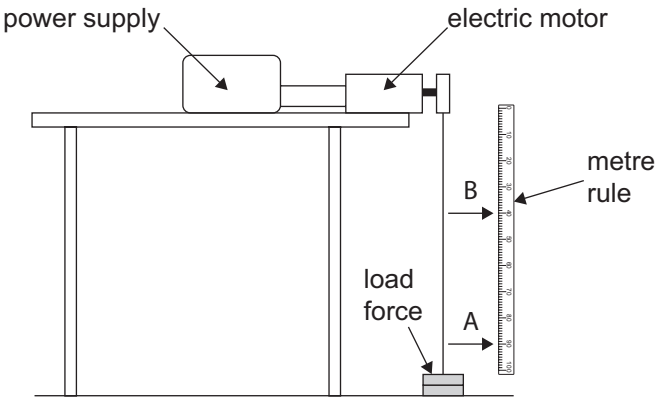
BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

[Turn over

2 To measure the output power of a small electric motor, the experimental arrangement in the diagram was used. The distance between the two markers A and B was measured using a metre rule.



Source: Principal Examiner

(a) (i) A risk assessment is needed before starting the task.
Suggest **one** precaution that should have been taken.

_____ [1]

(ii) In the school laboratory the load is comprised of masses labelled in grams.
Explain how the load force would be calculated.

_____ [1]

(iii) What additional piece of equipment is required to measure the time to lift the load?

_____ [1]

(b) The results of the experiment are shown in the table below.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Mass/g	**Load force/**	**Distance A to B/**		**Time taken/**	
150		0.50		0.41	
150		0.60		0.46	
150		0.75		0.61	
150		1.10		0.90	
150		1.25		1.18	

(i) Complete the column headings in the table by inserting the units for the load force in column 2, distance A to B in column 3 and the time taken in column 5. [3]

(ii) Calculate the load force being lifted by the motor and insert its value in all the spaces of column 2 in the table. [1]

(iii) Using the equation below, calculate the work done for each set of readings and insert your answers in column 4 of the table.
Insert a **heading** with unit at the top of this column.
Record your answers to **1 decimal place**.
Show your working out.

work done = force × distance

[4]

[Turn over

(iv) Use the equation below to calculate the output power for each set of readings and insert your answers in column 6 of the table.
Insert a **heading** with unit at the top of this column.
Record your answers to **1 decimal place**.
Show your working out.

$$\textbf{power} = \frac{\textbf{work done}}{\textbf{time taken}}$$

[4]

(v) Use your calculated data to find the most reliable value of the output power of the motor.
Show your working out.

Most reliable value of output power = _____ [2]

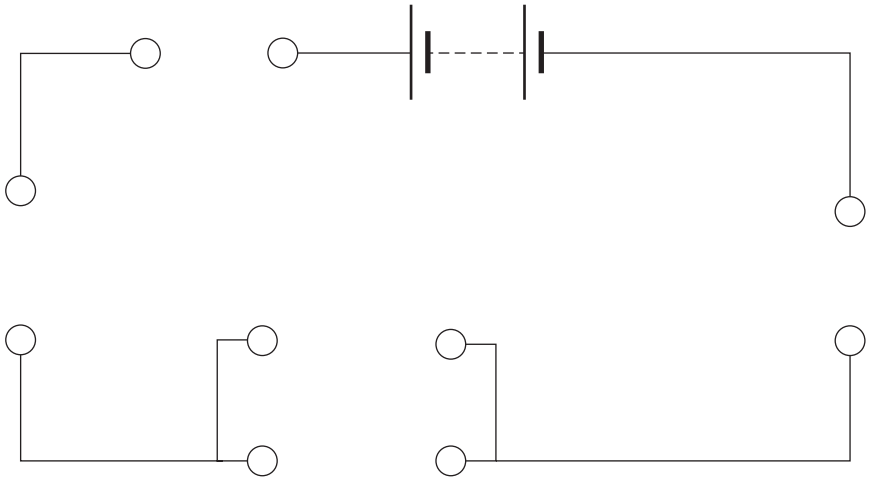
BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

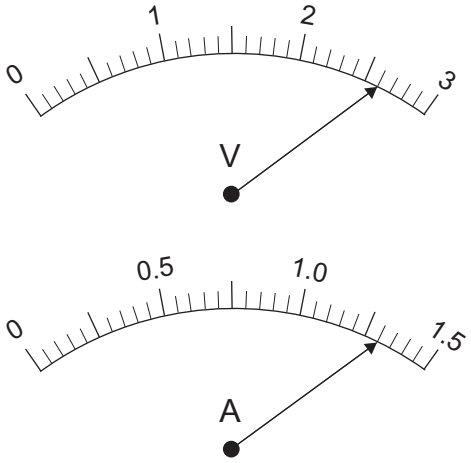
3 **(a)** To investigate how the current passing through a filament bulb depends on the voltage across it, the circuit below is to be used.

(i) Complete the circuit diagram so that the current and voltage can be measured. Include a switch and the component that will allow the voltage and current to be varied.
Use the correct symbol for each component.



[5]

The readings on the meters in the completed circuit when the switch is closed are shown below.



(ii) Using the voltage and current values, calculate the resistance of the bulb. Use the equation below.

voltage = current × resistance

Resistance = _____ Ω [4]

[Turn over

(b) The variable resistor is used to change the current. The values of voltage and current obtained are shown below.

Voltage/V	Current/A	Power/Unit
0	0	0
0.5	0.4	
1.0	0.7	
1.5	1.2	
2.0	2.0	
2.5	3.0	

(i) Using the equation below, calculate the power of the bulb.
Add your calculated values for power to the table.
Give your answers to **1 decimal place**.
Show your working out.

power = current × voltage

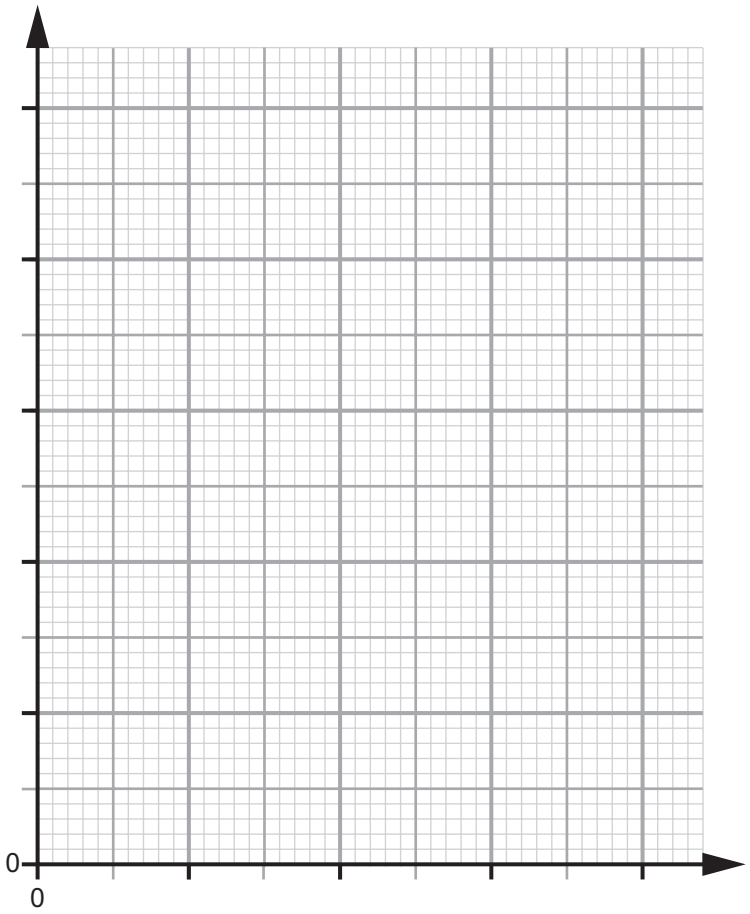
[2]

(ii) On the grid below, plot a graph of voltage (y-axis) against power (x-axis).
Use ⊙ or × to mark your plotted points.
Label each axis with the quantity and unit.
Draw the best fit curve through the points. [5]

(iii) Is the voltage of the bulb proportional to the power?
Explain your answer.

_____

_____ [2]

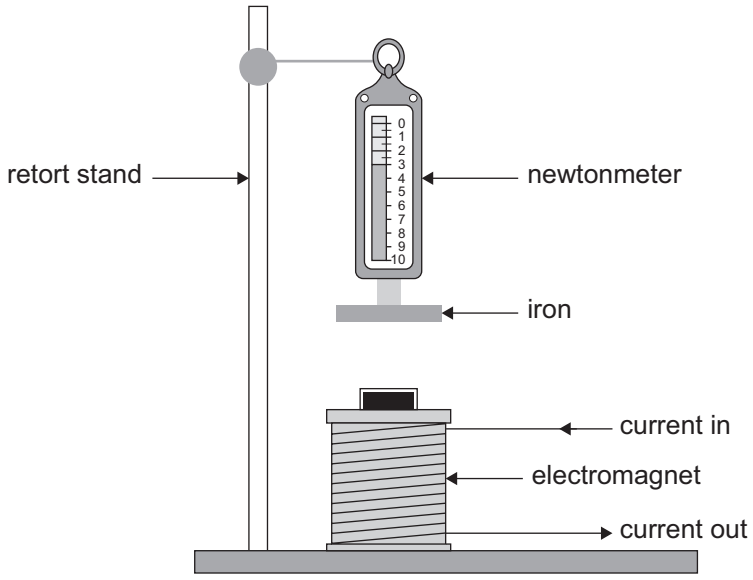


[Turn over

4 (a) To investigate the strength of an electromagnet a student set up the apparatus shown below.

A piece of iron is attached to a newtonmeter.

An electromagnet is placed under the iron.

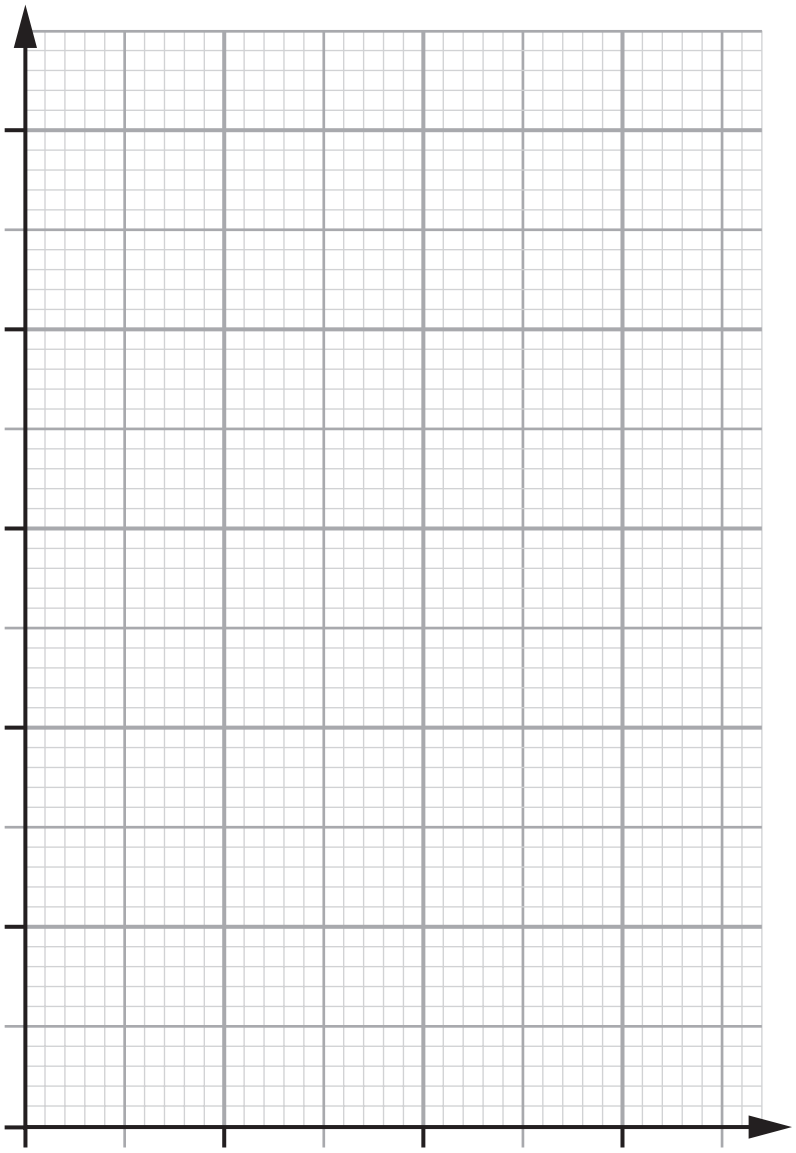


The electromagnet exerts a downward attractive force on the iron when a current flows through the electromagnet.

The student varied the current through the electromagnet and recorded the reading on the newtonmeter for each value of current.
The results of this investigation are shown in the table below.

Current/A	Reading on the newtonmeter/N
1.0	2.3
1.5	3.0
2.0	3.7
2.5	4.3
3.0	5.0

(i) On the grid below, plot a graph of newtonmeter reading (y-axis) against current (x-axis).
Use ⊙ or × to mark your plotted points.
Label each axis with the quantity and unit.
Draw the line of best fit through the points. [5]

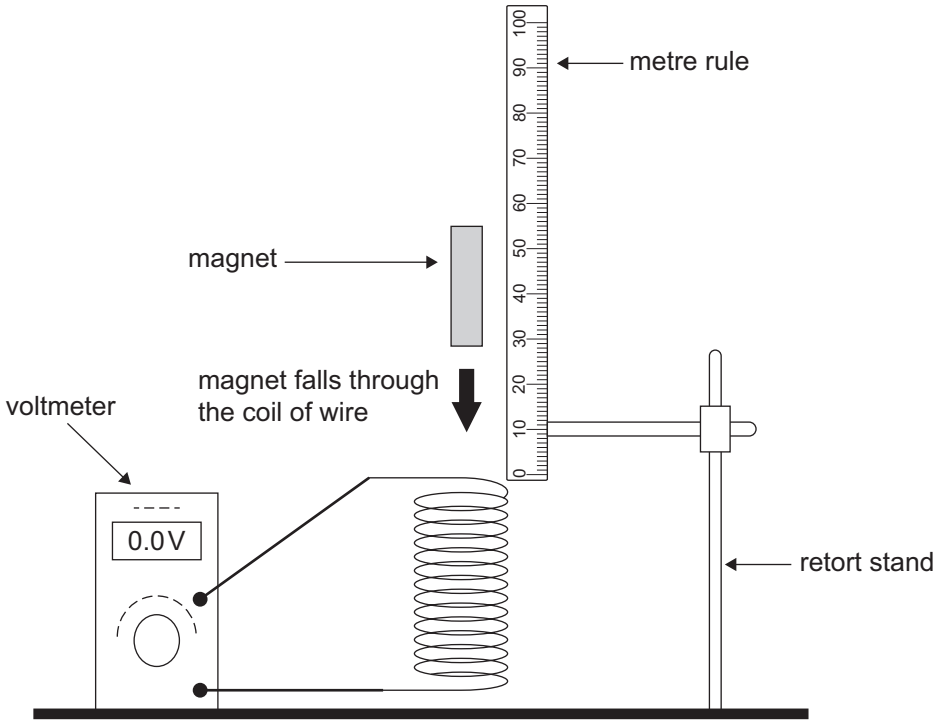


(ii) Use the graph to determine the weight of the iron when no current flows through the electromagnet.
Show clearly on the graph how you get your answer.

Weight of the iron = _____ N [2]

[Turn over

(b) When a magnet is dropped into a coil of wire a voltage is induced in the coil. This is known as electromagnetic induction.
To investigate how the induced voltage depends on the height from which the magnet is dropped, a student set up the apparatus shown below.

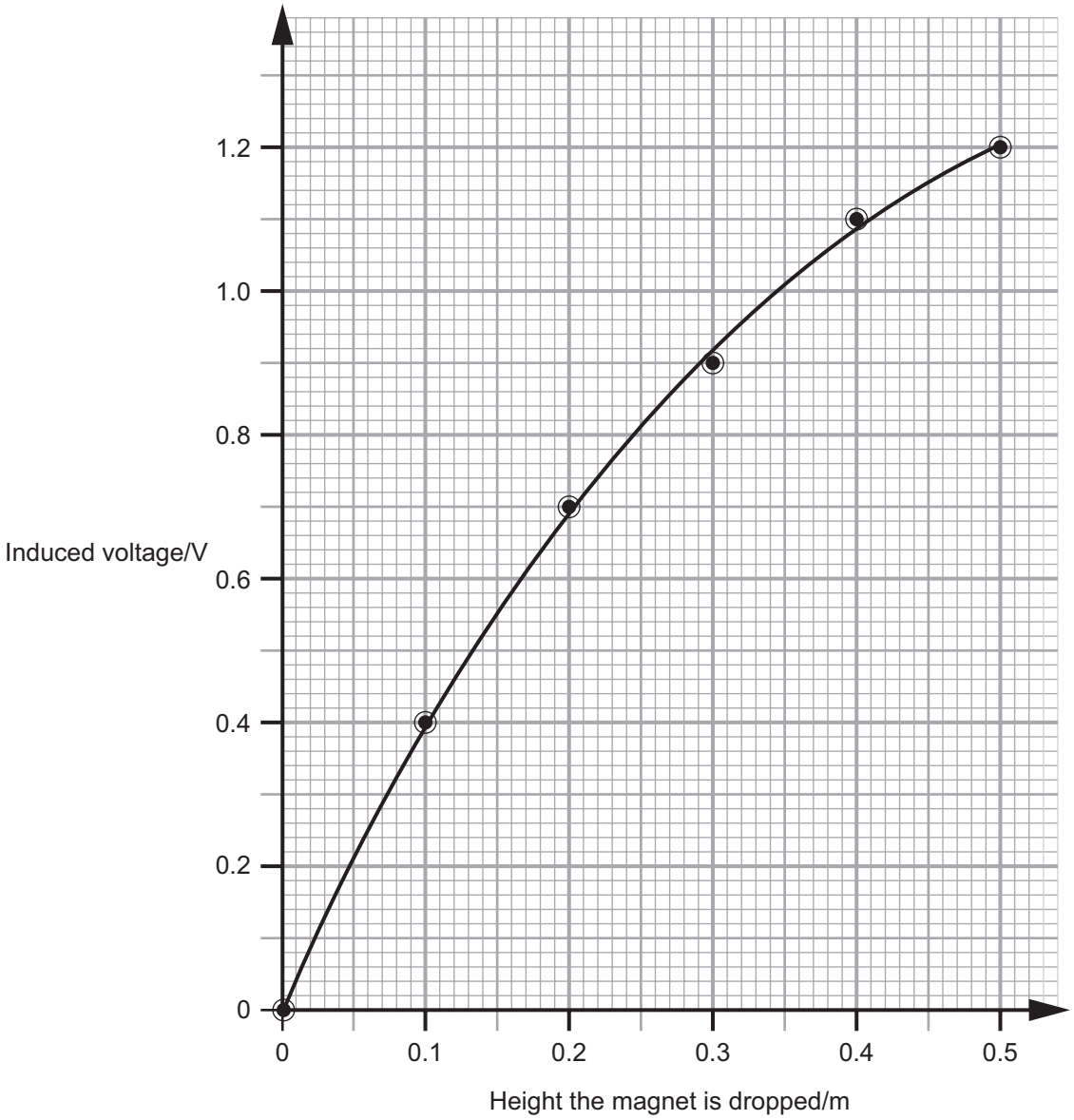


The coil is connected to a voltmeter.
The student records the voltage induced as the magnet enters the coil of wire.

(i) What should the student do to improve the reliability of their measurements?

_____ [1]

The results of this experiment are shown as a graph on the opposite page.


Induced voltage/V
1.2
1.0
0.8
0.6
0.4
0.2
0
0
0.1
0.2
0.3
0.4
0.5
Height the magnet is dropped/m

[Turn over

(ii) The induced voltage **V** and the height **H** the magnet is dropped are related by the equation below. In this equation **k** is a constant.

$$\mathbf{V^2 = kH}$$

Using values from the graph for V = 0.4V, calculate the value of the constant k.
Give your answer to **1 decimal place**.
State the unit of k.
Show your working out.

k = _____

Unit of k = _____ [3]

(iii) In this investigation name and explain the following:

The dependent variable _____

Explanation _____

_____

The independent variable _____

Explanation _____

_____

The control variable _____

Explanation _____

_____ [6]

THIS IS THE END OF THE QUESTION PAPER

DO NOT WRITE ON THIS PAGE

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

Examiner Number