Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2023

Physics

Unit 3: Practical Skills

Booklet A

MV18

Higher Tier

[GPY33]

Time

2 hours, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all** questions.

Information for Candidates

The total mark for this paper is **30**.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
Follow all health and safety instructions.
You may use a ruler and calculator if required.
The apparatus and materials required to complete the task(s) are provided.

For Teacher Use Only

In Experiment 2, it is assumed that the candidate was given help to complete the circuit. If this is **not** the case please tick the box below.

No help was given ☐

Experiment 1 Motion down a ramp

Introduction

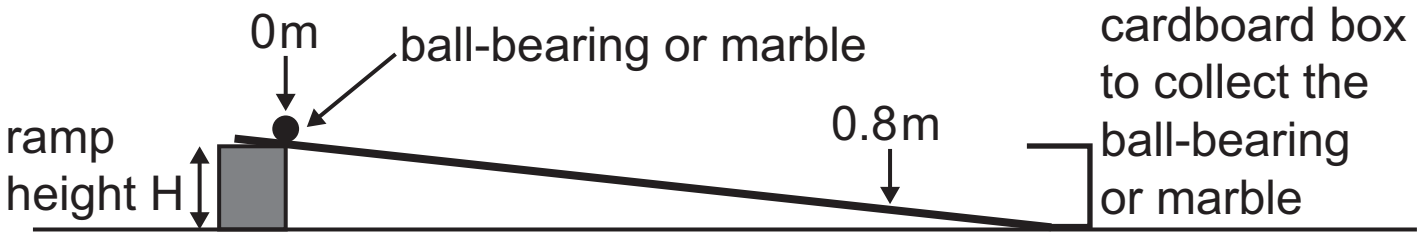
In this experiment you will investigate how the motion of a ball-bearing or marble down a ramp is affected by the ramp height.

Aims

The aim of the experiment is to measure the time it takes a ball-bearing or marble to travel from rest, a measured distance down the ramp. You will repeat this process for a number of different ramp heights from 1 cm to 5 cm.

You will calculate the **average velocity** and use this to calculate the **final velocity** of the ball-bearing or marble after it has moved a distance of 0.8 m down the ramp.

Apparatus



The apparatus shown in the diagram above has been set up for you.
The ramp has two lines marked on it which are **0.8 m apart**.
A wooden block has been placed under the ramp.

Procedure

During (a)(i) to (iii) you may work on your own or as part of a group of two or three.

(a) (i) A wooden block marked 1 cm has been placed under the ramp as shown in the diagram on page 3.
Release the ball-bearing or marble from rest at the position on the ramp marked 0 m, and record the time it takes the ball-bearing or marble to reach the 0.8 m mark.
Record this time to **one decimal place** in Table 1.
Repeat this process twice more so that you have three values of the time.
Record all these values to **one decimal place** in Table 1.
Add appropriate headings with units to columns 1, 2 and 3 of Table 1. [2 marks]

(ii) Remove the block marked 1 cm and replace it with the one marked 2 cm.
Release the ball-bearing or marble from rest at the position on the ramp marked 0 m, and record the time it takes the ball-bearing or marble to reach the 0.8 m mark.
Record this time to **one decimal place** in Table 1.
Repeat this process twice more so that you have three values of the time.
Record all these values to **one decimal place** in Table 1.
[1 mark]

(iii) Repeat the process for ramp heights of 3 cm, 4 cm and 5 cm.
Record your values in Table 1 to **one decimal place**.
[2 marks]

Table 1

	Column 1	Column 2	Column 3
Ramp height/cm			
1			
2			
3			
4			
5			

Insert heading

When you have taken all your measurements or when your teacher tells you that 30 minutes are up you must stop using the apparatus.

To complete the remainder of this assessment you must work alone.
Your teacher will direct you to a place in the room to do this.

For the remainder of Experiment 1 you must work alone.

Analysis of your data

The analysis of your data will involve calculating the **average time** it takes the ball-bearing or marble to travel 0.8 m down the ramp.

You will then use this average time to calculate the **average velocity** of the ball-bearing or marble as it travels 0.8 m down the ramp.

You will use the average velocity to calculate the **final velocity** when the ball-bearing or marble reaches the 0.8 m mark.

(b) (i) Using your values in Table 1, calculate the **average time** for the ball-bearing or marble to travel down the ramp for each ramp height.
You may use the space below for calculations.
Record your values to **one decimal place** in column 4 of Table 2. [2 marks]

Space for calculation of average times.

(ii) Using your **average time** values, calculate the **average velocity** of the ball-bearing or marble for each ramp height. Give your values in m/s.
Write the equation you plan to use in the box below.
[1 mark]

Record your calculated **average velocity** in column 5 of Table 2.
Record your calculated **average velocity** to **two decimal places**.
Remember the distance the ball-bearing or marble travels down the ramp is 0.8 m. [1 mark]

Table 2

	Column 4	Column 5	Column 6
Ramp height/ cm	Average time/s	Average velocity/m/s	Final velocity/ m/s
1			
2			
3			
4			
5			

(iii) Using the relationship below, calculate the **final velocity v** for the ball-bearing as it reaches the 0.8 m mark for each ramp height.

Final velocity v = 2 × average velocity

Record your final velocity values to **two decimal places** in column 6 of Table 2. [1 mark]

You may use the space below for final velocity calculations.

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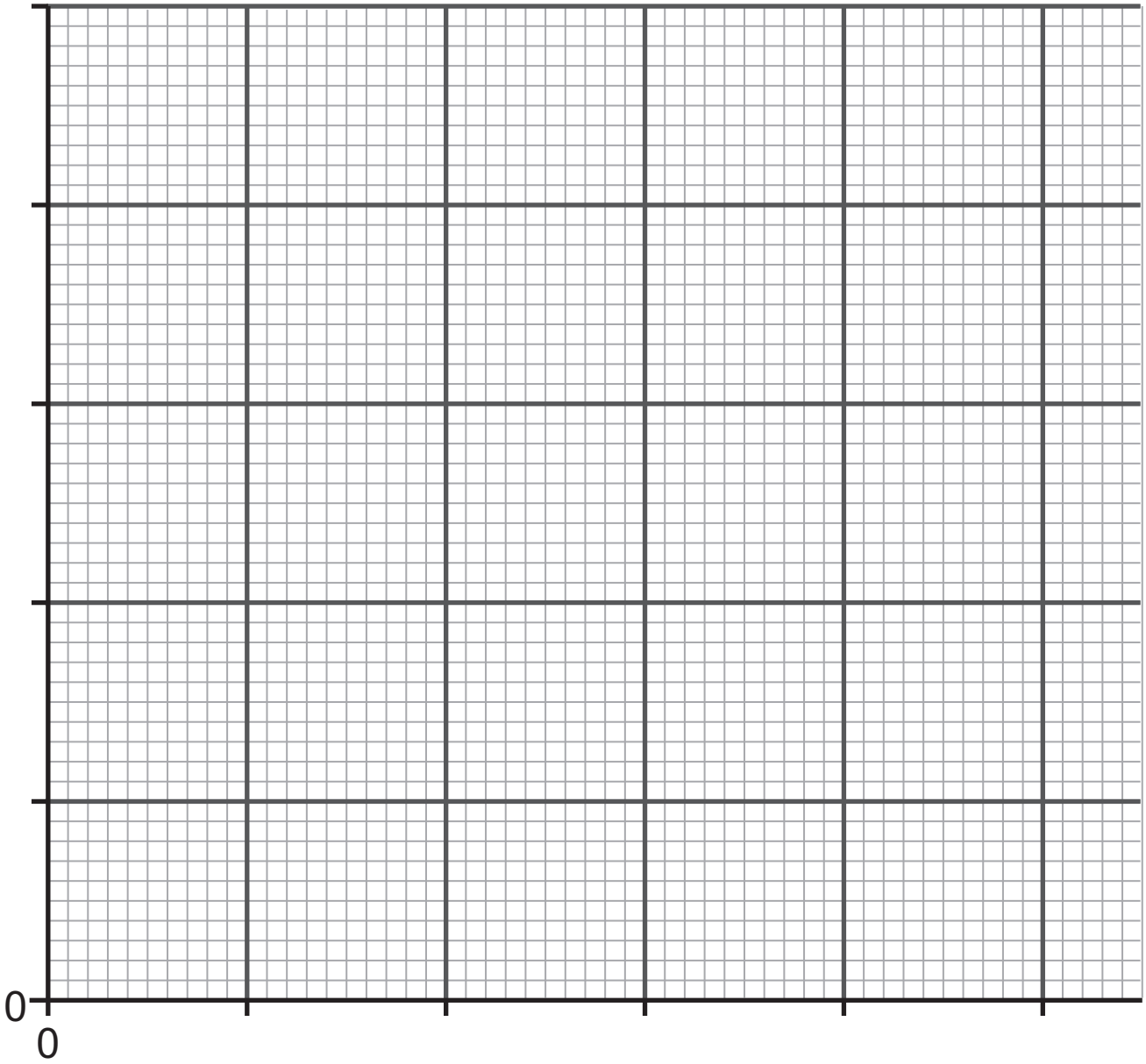
(Questions continue overleaf)

Interpretation of your data

(c) (i) Use the grid opposite to plot a graph of the **final velocity v** of the ball-bearing or marble against the **height H** of the ramp for the results given in Table 2 on page 8.

Use the horizontal axis (x-axis) for the height of the ramp and the vertical axis (y-axis) for the **final velocity** of the ball-bearing or marble.
Choose a suitable scale for both axes that allows you to use most of the grid.
Label both axes with the quantity and its unit.
Use ⊙ or × to indicate your plotted values. [3 marks]

(ii) Draw the best fit **curve** through your points. [1 mark]


0
0

(iii) Which one of the equations below best describes the relationship between the **final velocity v** and the **ramp height H**? In the equations k is a constant.

$v = kH$

$v = k\sqrt{H}$

$v = \frac{k}{H}$

Circle the correct equation and explain your choice.
[1 mark]

Experiment 2 Electrical Resistance

Introduction

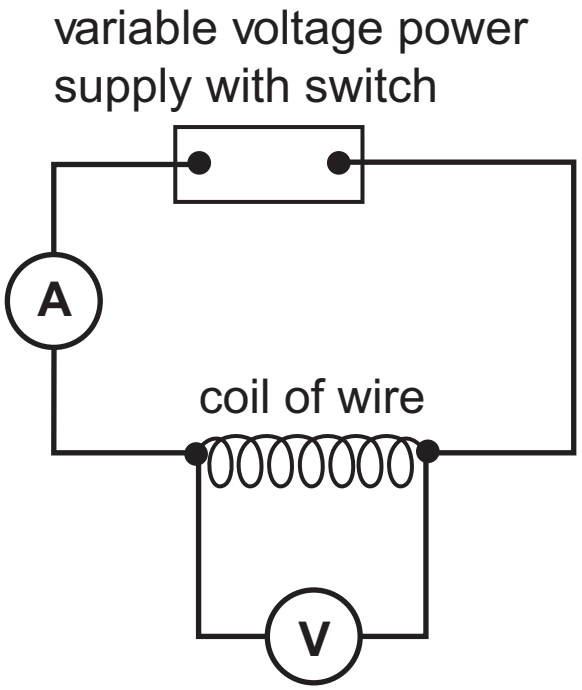
The current passing through a length of wire depends on the voltage applied across the wire.

Aims

The aim of the experiment is to obtain voltage and current measurements for a coil of wire at **constant temperature**.
You will calculate the resistance of the coil of wire using your measurements of voltage and current.
Using the measurements, you will plot a graph of resistance and current and decide if the resistance of the coil of wire has remained constant during the experiment.

Procedure

(a) (i) Complete the circuit according to the circuit diagram below, by adding the ammeter and voltmeter.
Before proceeding have your teacher check your circuit. [2 marks]



Caution: Do not touch the coil of wire, it could be very hot

You will use this experiment to obtain **voltage** and **current** measurements for the coil of wire at constant temperature.

(ii) Add column headings with units to column 1 and column 2 of the table opposite.
Column 3 is not required until later. [2 marks]

(iii) Close the switch.

Adjust the output of the power supply to a voltage of approximately 1.00 V.

Measure the voltage and current and record your measurements in the table below.

Record your values of voltage and current to **2 decimal places**.

Open the switch after you record each measurement of voltage and current, to allow the coil of wire to cool.

Increase the voltage in steps of approximately 1.00 V until you have a total of 5 sets of voltage and current measurements.

Do not exceed 6.0 V.

Switch off the power supply when you have recorded all your measurements. [2 marks]

Results

Column 1	Column 2	Column 3

Insert column headings with units

When you have taken all your measurements or when your teacher tells you that 30 minutes are up, you must stop using the apparatus.

To complete the remainder of this assessment you must work alone.
Your teacher will direct you to a place in the room to do this.

For the remainder of Experiment 2 you must work alone.

Analysis

(b) The resistance R of the wire is calculated using the equation below.

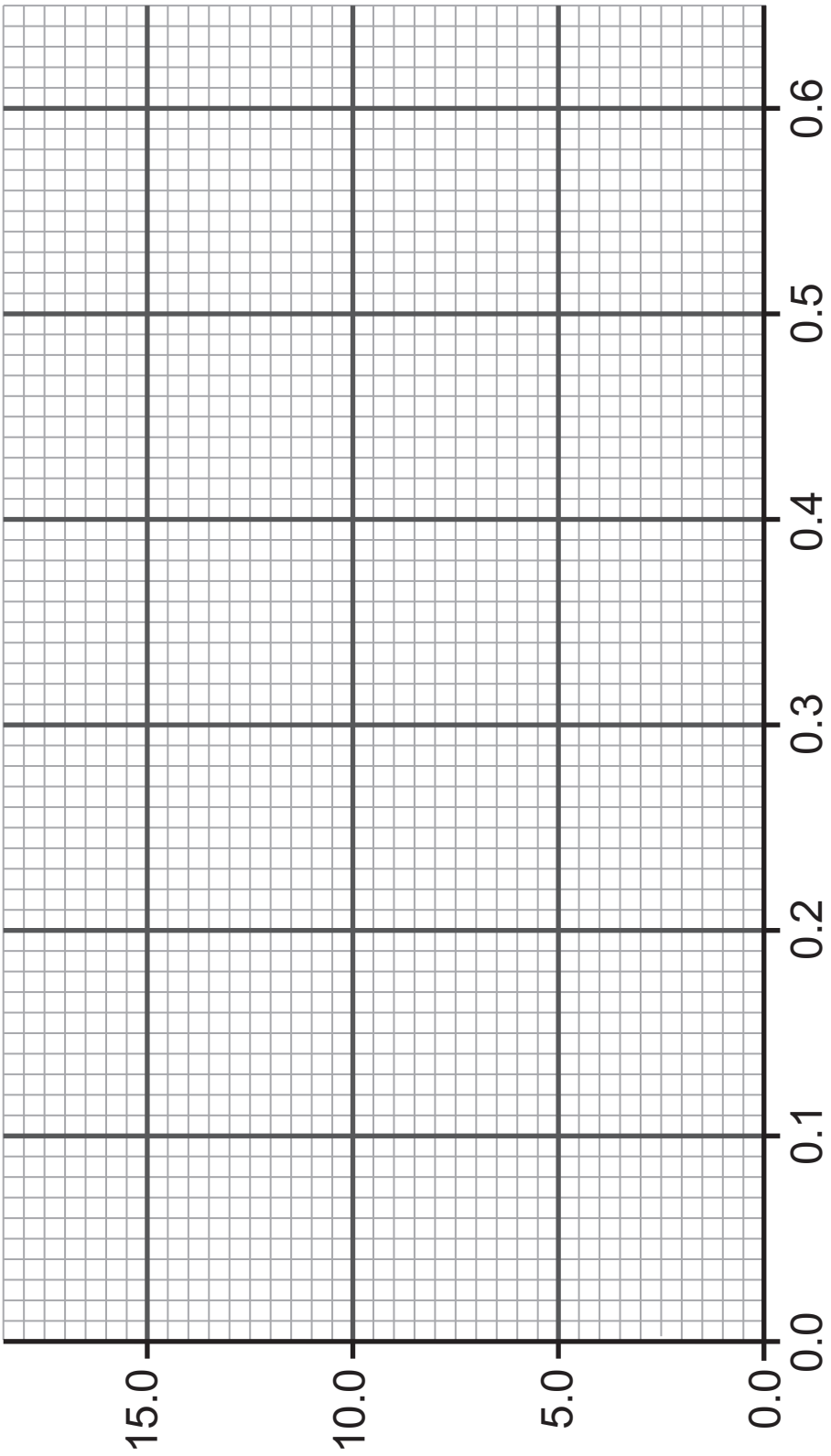
$$R = \frac{V}{I}$$

Calculate the resistance of the wire for each set of the voltage and current measurements.
Record your values of resistance to **one decimal place** in column 3 of the table on page 15. [3 marks]

Add a heading and unit to column 3. [1 mark]

Interpretation of your data

(c) (i) On the axes below, draw the graph of how the resistance (y-axis) and current (x-axis) are related.
Label each axis with the quantity and its unit.
Plot the points using ⊙ or ×. [4 marks]



(ii) The resistance of the coil of wire should remain the same throughout the experiment because the temperature of the coil of wire was kept constant. To show this, draw the **straight line of best fit** through the points you have plotted. [1 mark]

This is the end of the question paper

Examiner's use only	Marks
Experiment 1	
Experiment 2	
Total Marks	