Rewarding Learning

ADVANCED
General Certificate of Education
2025

Centre Number

Candidate Number

Physics

Assessment Unit A2 3A

assessing
Practical Techniques and
Data Analysis

APH31

[APH31]
FRIDAY 9 MAY, 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 not communicate with any other candidate during this examination.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete questions in black ink and use a dark HB pencil for drawings and graphs.
Do not write with a gel pen.
Answer **all** questions.
The supervisor will tell you the order in which you are to answer the questions. Not more than 28 minutes are to be spent in answering each question, and after 26 minutes you must stop using the apparatus in Questions 1 and 2 so that it can be rearranged for the next candidate. At the end of the 28 minute period you will be instructed to move to the station for the next question. At the end of the Test a 4 minute period will be provided for you to complete your answer to any question, but you will not have access to the apparatus during this time.

INFORMATION FOR CANDIDATES

The total mark for this paper is 40.
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.

14732

1 In this experiment you will investigate the distance moved by a ball bearing B after it is hit by a moving ball bearing A.

Aims

The aims of this experiment are to:

- measure the distance travelled by the ball bearing B after the collision;
- analyse the results and plot a linear graph;
- use the results to find the relationship between the diameter of ball bearing A and the distance ball bearing B moves.

Apparatus

You are provided with six ball bearings of varying diameter and a shallow 'v' shaped ramp constructed from half-metre rules, as shown in **Fig 1.1**.
A micrometer screw gauge has also been provided.

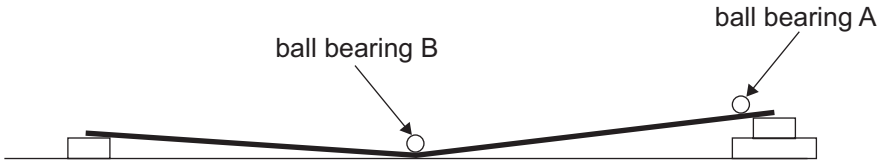

Fig. 1.1

Procedure

Ball bearing B is positioned in the centre of the ramp, as shown in **Fig. 1.1**. It has a black mark on it for identification.

(a) Use the micrometer screw gauge to measure the diameter of the remaining **five** ball bearings provided in the container labelled 'Ball bearings A'. Record all of your measurements in the first column of **Table 1.1**. [1]

Table 1.1

d / mm	R / cm				
	1	2	Average		

(b) Take the first ball bearing A recorded in **Table 1.1** and set it 5 cm away from the higher end of the ramp, as shown in **Fig. 1.1**, so that it will travel 45 cm before the collision happens. Release the ball bearing.

After the collision, measure the maximum distance R that ball bearing B travels up the ramp. Record the value of R in **Table 1.1**.
Replace ball bearing B in its initial position and repeat the procedure for the same ball bearing A.
Calculate the average value of R and record it in **Table 1.1**.

Repeat the whole procedure for the remaining **four** ball bearings A. [4]

Analysis
The relationship between d and R is given by **Equation 1.1**.

$$R = Pd^{Q} \qquad \textbf{Equation 1.1}$$

where P and Q are constants.

(c) **(i)** Show that a graph of log R against log d will result in a straight line graph from which the constants P and Q can be determined.

[3]

(ii) Calculate log R and log d and record the values in the final two columns of **Table 1.1**. Head the columns appropriately and give your values to 2 decimal places. [4]

(iii) Plot a graph of log R against log d on the grid of **Fig. 1.2** and draw the best fit straight line for the points plotted. [5]

[Turn over

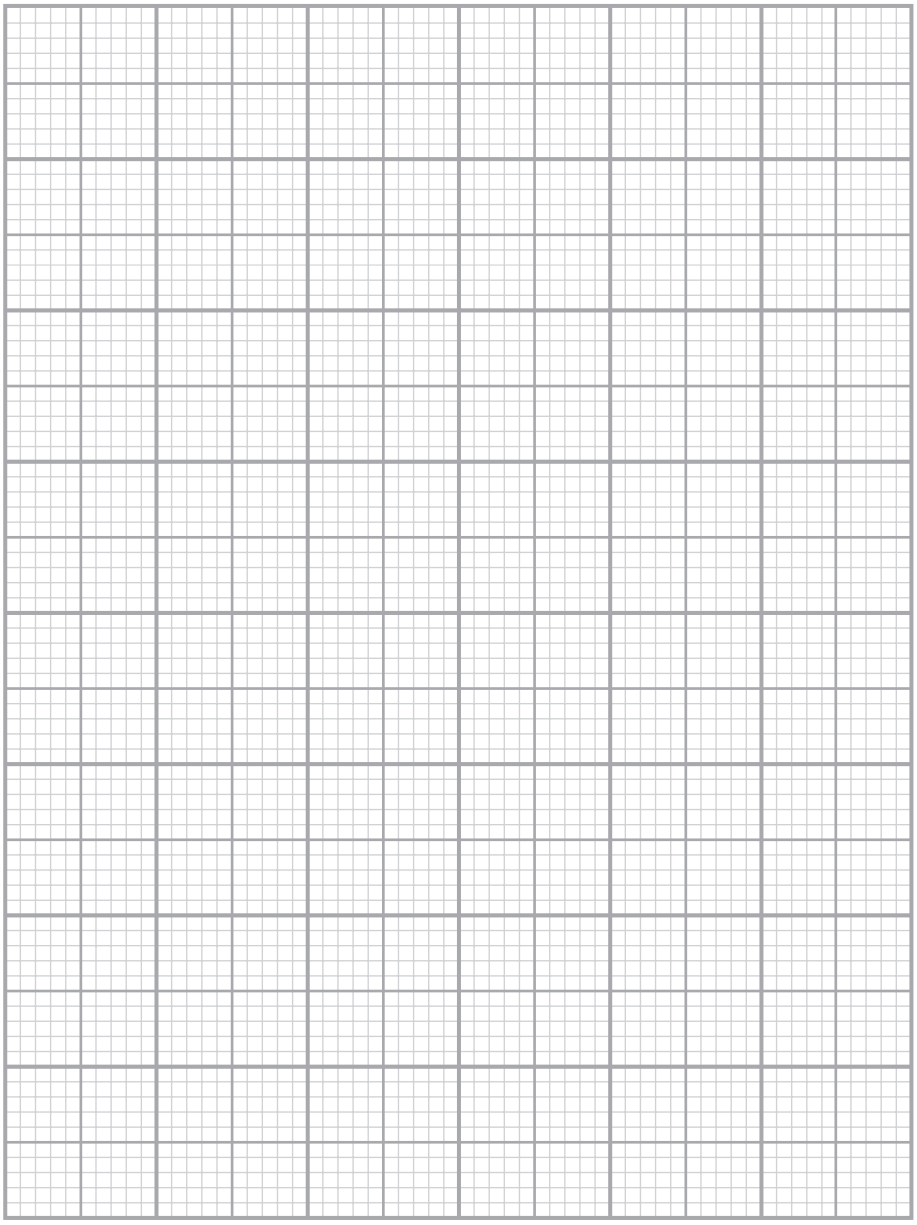

Fig. 1.2

(d) The constant Q is an integer. Use your graph to calculate a value for the integer Q.

Q = _____ [3]

[Turn over

2 In this experiment you will investigate the potential difference between two points in a circuit as the length of a resistance wire is changed.

Aims

The aims of this experiment are to:

- measure the potential difference between two points in a circuit;
- analyse the results and plot a linear graph;
- measure the resistance of a wire using an ohmmeter;
- use your results to compare the experimental value obtained with the theoretical value.

Apparatus

You are provided with a circuit consisting of three resistors, a length of wire, two cells, and a voltmeter. The circuit diagram is shown in **Fig. 2.1**.
The length L of the wire in the circuit can be adjusted by moving the crocodile clip along the wire.

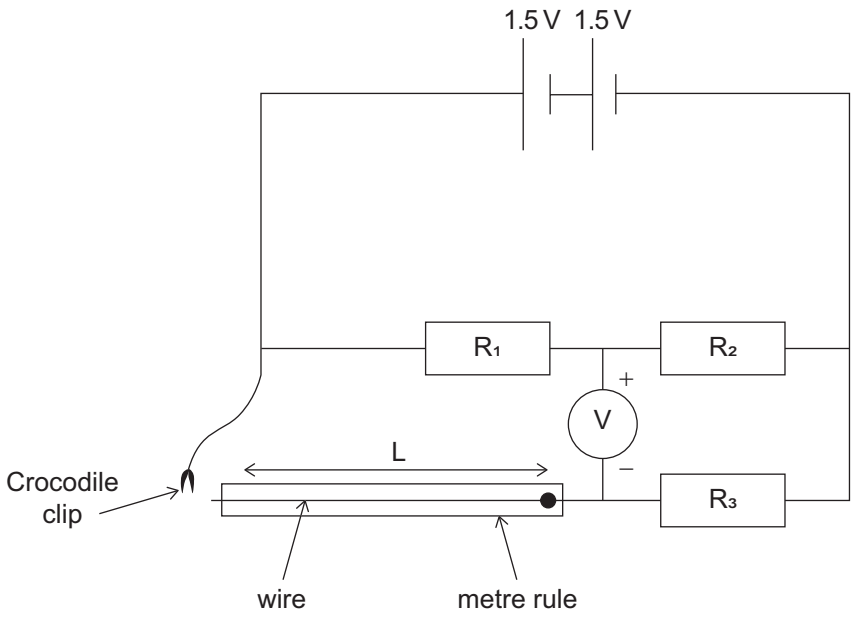

Fig. 2.1

You are also provided with an ohmmeter with two connecting leads.

Procedure

(a) Attach the crocodile clip to the wire so that the length L of the wire in the circuit is approximately 100 cm. Measure L and record the value in the first column of **Table 2.1**. Measure the potential difference V shown on the voltmeter. Record the value in the second column of **Table 2.1**.

Repeat the procedure for four more lengths of wire, down to a minimum length of approximately 20 cm. [4]

Table 2.1

L / cm	V / V

[Turn over

Analysis

(b) (i) Plot a graph of V against L on the grid of **Fig. 2.2** and draw the best fit straight line for the points plotted. [5]

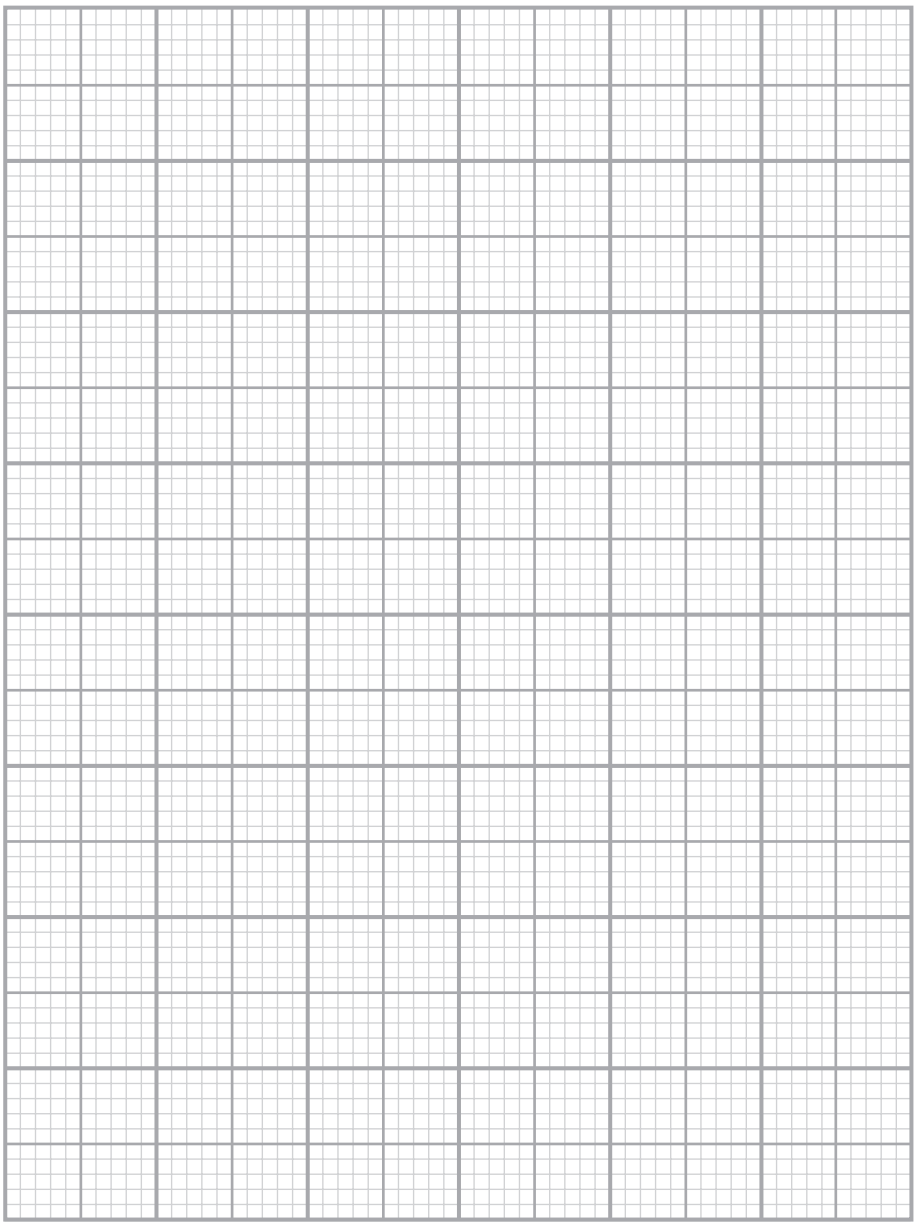

Fig. 2.2

(ii) The circuit is said to be 'balanced' when V = 0. Use your graph to determine the length of wire in the circuit when it is balanced.

Length = _____ m [2]

(iii) Use the plotted points to determine the uncertainty in the value of length determined in **(b)(ii)**.

Uncertainty in length = ± _____ m [3]

(c) Use the ohmmeter and connecting wires provided to determine a value for the resistance of one metre of the resistance wire.

Resistance of 1 m = _____ Ω [2]

(d) **(i)** Use your answers to **(b)(ii)** and **(c)** to determine the experimental value for the resistance of the wire when the circuit is balanced.

Resistance = _____ Ω [2]

(ii) When the circuit is balanced, the theoretical value for the resistance of the wire is 5.5 Ω. With reference to the uncertainty in length calculated in **(b)(iii)**, explain if your value in **(d)(i)** agrees with the theoretical value.

_____

_____

_____ [2]

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

Examiner Number

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2025

Physics

Assessment Unit A2 3A

Practical Techniques and Data Analysis

[APH31]
FRIDAY 9 MAY, MORNING

APPARATUS AND MATERIALS LIST

To be accessed by Head of Department only

PHYSICS UNIT 3 (A2 3A)
APPARATUS AND MATERIALS REQUIRED FOR PRACTICAL ASSESSMENT

CONFIDENTIAL

This document gives preliminary information on the apparatus and materials required for the A2 Practical Assessment.

Information about the apparatus and materials required for this assessment must NOT be communicated to students. If apparatus/materials have their serial code and/or manufacturer specified then it is essential that centres use this exact apparatus/material.

On receipt of this APPARATUS AND MATERIALS LIST, centres must contact the Subject Officer, Dr Alan McMurray (amcmurray@ccea.org.uk), immediately if they have difficulty in sourcing the specified apparatus or materials.

Teachers will be given detailed instructions for setting up the experiment in the *Confidential Instructions for Physics Practical Test*, to which they will have confidential access from April 2025.

Teachers will have confidential access to a copy of the experimental test two working days (48 hours) before the start of the assessment.

The A2 3 Practical Techniques Assessment is a test of practical skills consisting of **two** experimental tests (40 marks). The duration of the assessment is 1 hour.

The apparatus in the following list will allow for **one experiment** to be set up for the practical test which makes up questions 1–2. In other words, each set of apparatus (as listed on **page 3**) will accommodate two candidates when doing the circus of experiments.

The apparatus can be used for alternative sessions according to the following schedule:

Friday 9th May Physics A2 3A (APH31)

(Main Session) **9.15 am–10.15 am**
(First Alternative) **10.30 am–11.30 am**
(Second Alternative) **11.45 am–12.45 pm**
(Third Alternative) **1.15 pm–2.15 pm**
(Fourth Alternative) **2.30 pm–3.30 pm**

One set of apparatus for A2 3A (APH31) will therefore be sufficient for ten candidates on **Friday 9th May** if the Main Session and all four alternatives are used. A laboratory may contain one, two, three or more sets of apparatus. This means that two, four, six, eight or more candidates can be accommodated in the same session. **To maintain the confidentiality of details of the practical tests, candidates entered for any of the alternative sessions must be segregated within the centre so that there can be no contact with candidates who have taken an earlier test in any centre.**

IMPORTANT NOTICE
Centres are urged to order items needed for the Physics Practical Test from the suppliers as soon as possible.

Question 1

Requirements

- Half-metre rule × 4
- 6 ball bearings. 5 different diameters in range 0.8 cm – 2.0 cm. The 6th ball bearing should have the same diameter as the middle diameter of the five
- 100 g mass × 5
- 50 g mass × 2
- Small container/bowl to hold ball bearings
- Labels
- Blu tack
- Micrometer screw gauge
- Black permanent marker

Question 2

Requirements

- 34 swg constantan wire 105 cm length
- 1.5 V D cells in holders × 2
- Connecting wires × 11 (depending on set-up)
- Crocodile clips × 4 (depending on set-up)
- Voltmeter to 0.01 V × 1
- 10 Ω resistor in holder
- 18 Ω resistor in holder
- 33 Ω resistor in holder
- Metre rule × 1
- Multimeter set as ohmmeter measuring 0–20 Ω to 0.1 Ω

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Assessment Unit A2 3A

Practical Techniques and Data Analysis

[APH31]
FRIDAY 9 MAY, MORNING

CONFIDENTIAL INSTRUCTIONS

1 Confidential Instructions

These instructions will give detailed guidance on setting up and testing the apparatus and materials to be used. **Again, information contained within the Confidential Instructions must not be relayed to candidates under any circumstances**. If at this point, centres find that the testing process produces results different to those specified in the Confidential Instructions, they must contact the CCEA Subject Officer, Dr Alan McMurray (amcmurray@ccea.org.uk) immediately.

2 Final Apparatus Testing

The practical assessment question paper will be made available to the Head of Physics **two** working days before the timetabled starting time so that teachers and technicians can carry out a final test on the experiments. If on checking the apparatus gives unexpected results, the CCEA Physics Subject Officer should be contacted immediately, if the problem cannot be resolved. Then the centre must e-mail the CCEA Physics Subject Officer stating the centre name and number, the specific nature of the problem and the range of anomalous results produced. CCEA will respond by acknowledging receipt of the e-mail. If you do not receive a response within 24 hours, please contact the CCEA Physics Subject Officer by telephone (028 95906548) to confirm that CCEA has received your e-mail.

3 Practical Assessment A2 3A

The A2 3A Practical Techniques Assessment is a test of practical skills comprised of 2 experimental tests. The duration of the assessment is 1 hour. Some of this time will be set aside for supervisors to re-set the apparatus ready for the next candidates. The assessment should be run as a circus of experiments with candidates moving to the next experiment at the designated time. Candidates should work individually and there should be no communication between candidates at any point during the assessment. In APH31, candidates who have difficulty obtaining their own results will not be provided with a sample set of readings. The assessment should be timed as follows:

Questions	**Time**
Q1 (practical test)	26 minutes
Changeover and practical write-up	2 minutes
Q2 (practical test)	26 minutes
Changeover and practical write-up	2 minutes
End of test write-up	4 minutes

At the end of the 26 minute period, candidates must stop using the apparatus. During each 2 minute changeover period candidates may continue with their write up, however they will not have access to the apparatus. At the end of the test a 4 minute period is provided to complete their answer to any question, but will not have access to the apparatus.

4 After the Practical Assessments

When the individual exam sessions have finished, please return the A2 3A practical scripts together with the corresponding advice notes to the examinations officer (EO). We will collect these by the day after the examination. If we don't, please contact us immediately to arrange another time for collection.

Where the centre finds that a candidate may have been disadvantaged because the apparatus did not function as intended, the supervising teachers should make a report to the EO. The EO will forward the confidential report on the issue and the candidates affected to the centre support section at CCEA for special consideration. Candidates should be identified by their examination number.

IMPORTANT NOTICE
Centres are urged to order items needed for the Physics Practical Tests from the suppliers as soon as possible.

Confidential Instructions

Question 1

Requirements

- Half-metre rule × 4
- 6 ball bearings. 5 different diameters in range 0.8 cm – 2.0 cm. The 6th ball bearing should have the same diameter as the middle diameter of the five
- 100 g mass × 5
- 50 g mass × 2
- Small container/bowl to hold ball bearings
- Labels
- Blu tack
- Micrometer screw gauge
- Black permanent marker

Preparation

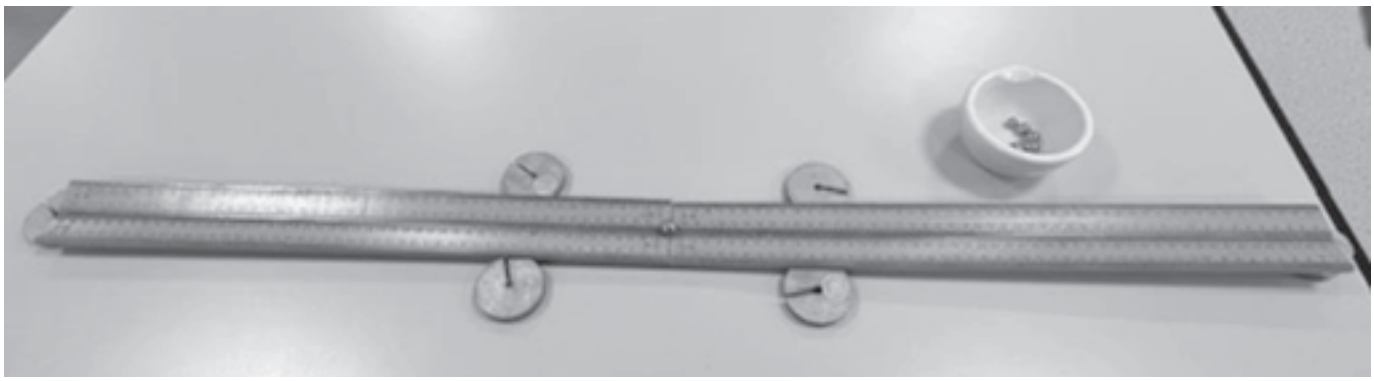

Fig. 1.1

Set up the 4 half-metre rules to form a shallow v-shaped ramp by placing them as shown in **Fig 1.1** with the end to the right raised using a 100 and 50 g mass and the opposite end raised using a 50 g mass.

The remaining four 100 g masses should be used to raise the outside edge of the rules to produce a v-shape.

Use small pieces of blu-tack to secure the ends of the rules on the desk and on the masses.

Write ‘Ball bearings **A**’ on a label and stick it on the container containing the 5 different diameter ball bearings. Use the permanent marker to mark a black spot on the 6th ball bearing. NB, this has the same diameter as the middle diameter of the five.

Before the examination

Place the ball bearing marked with the black spot on the centre of the ramp as shown in **Fig 1.1**. Place the remaining ball bearings into the container labelled ‘Ball bearings **A**’ and set them close to the ramp.

Place the micrometer screw gauge close to the ramp.

Action at changeover

Return the apparatus to the original arrangement on the bench.

Question 2

Requirements

- 34 swg constantan wire 105 cm length
- 1.5 V D cells in holders × 2
- Connecting wires × 11 (depending on set-up)
- Crocodile clips × 4 (depending on set-up)
- Voltmeter to 0.01 V × 1
- 10 Ω resistor in holder
- 18 Ω resistor in holder
- 33 Ω resistor in holder
- Metre rule × 1
- Multimeter set as ohmmeter measuring 0–20 Ω to 0.1 Ω

Preparation

Tape the 34 swg constantan wire to the metre rule at the 95 cm and 5 cm mark leaving a few cm overhang at each side of the metre rule.

Set up the circuit as shown in **Fig 2.1**.

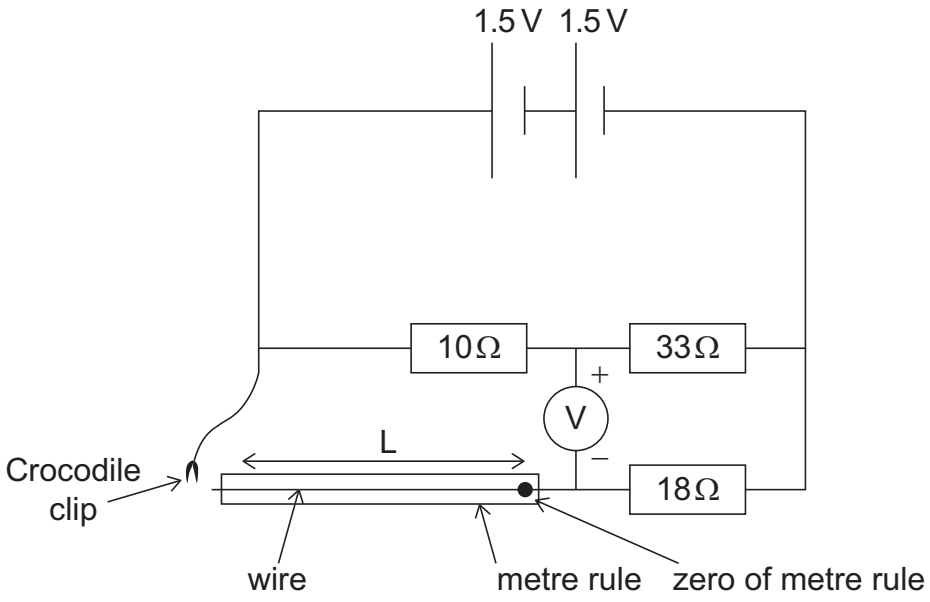

Fig 2.1

Ensure that connecting leads are secure, some connections can be soldered if preferred.

The wire at the 0 end of the metre rule should be connected to the 18 Ω resistor. The connection here will be fixed so a crocodile clip or solder can be used.

The lead shown in fig. 2.1 with the crocodile clip labelled is required so that its position on the wire can be moved by the candidate.

Check that the voltmeter reads zero when the crocodile clip is on the wire within the range 44–52 cm from the zero mark of the metre rule.

Set the multimeter to measure resistance of 0–20 Ω and insert two connecting leads with one crocodile clip on the other end of each lead. The leads must be long enough to reach either end of the 1 m long wire.

Before the examination

Ensure the crocodile clip is disconnected from the wire. Check that the multimeter is at the correct setting.

Action at changeover

Return the apparatus to the original arrangement on the bench. Ensure that the crocodile clip is disconnected from the wire. Check that the multimeter is disconnected and at the correct setting. Check that the voltmeter reads zero when the crocodile clip is on the wire within the range 44–52 cm from the zero mark of the metre rule.

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Physics

Assessment Unit A2 3A
assessing
Practical Techniques and
Data Analysis

[APH31]
FRIDAY 9 MAY, MORNING

TEACHER'S COPY

Not to be used by candidates

Please Note: This Teacher's Copy only shows the minimum information required to test the practical work in advance of the exam sitting. As information has been removed, the question numbering may not be consistent.

1 In this experiment you will investigate the distance moved by a ball bearing B after it is hit by a moving ball bearing A.

Apparatus
You are provided with six ball bearings of varying diameter and a shallow 'v' shaped ramp constructed from half-metre rules, as shown in **Fig 1.1**.
A micrometer screw gauge has also been provided.

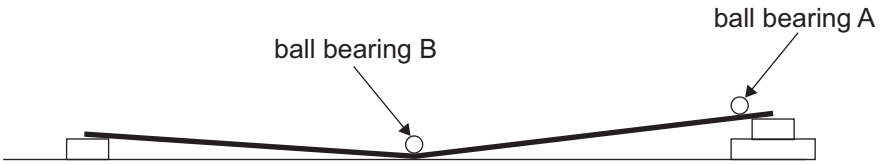

Fig. 1.1

Procedure
Ball bearing B is positioned in the centre of the ramp, as shown in **Fig. 1.1**. It has a black mark on it for identification.

Use the micrometer screw gauge to measure the diameter of the remaining **five** ball bearings provided in the container labelled 'Ball bearings A'. Record all of your measurements in the first column of **Table 1.1**.

Table 1.1

d / mm	R / cm		
	1	2	Average

Take the first ball bearing A recorded in **Table 1.1** and set it 5 cm away from the higher end of the ramp, as shown in **Fig. 1.1**, so that it will travel 45 cm before the collision happens. Release the ball bearing.

After the collision, measure the maximum distance R that ball bearing B travels up the ramp. Record the value of R in **Table 1.1**.
Replace ball bearing B in its initial position and repeat the procedure for the same ball bearing A.
Calculate the average value of R and record it in **Table 1.1**.

Repeat the whole procedure for the remaining **four** ball bearings A.

2 In this experiment you will investigate the potential difference between two points in a circuit as the length of a resistance wire is changed.

Apparatus

You are provided with a circuit consisting of three resistors, a length of wire, two cells, and a voltmeter. The circuit diagram is shown in **Fig. 2.1**.

The length L of the wire in the circuit can be adjusted by moving the crocodile clip along the wire.

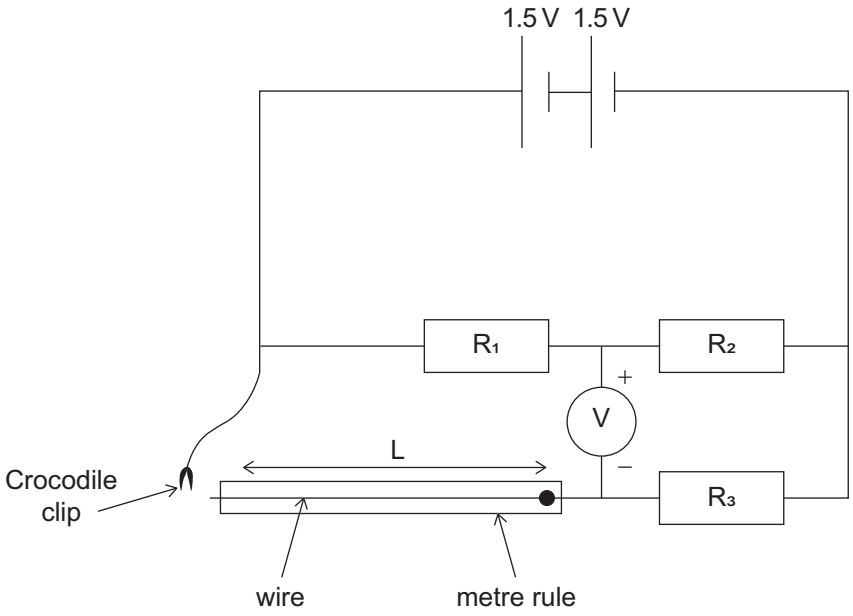

Fig. 2.1

You are also provided with an ohmmeter with two connecting leads.

Procedure
Attach the crocodile clip to the wire so that the length L of the wire in the circuit is approximately 100 cm. Measure L and record the value in the first column of **Table 2.1**. Measure the potential difference V shown on the voltmeter. Record the value in the second column of **Table 2.1**.

Repeat the procedure for four more lengths of wire, down to a minimum length of approximately 20 cm.

Table 2.1

L / cm	V / V

Use the ohmmeter and connecting wires provided to determine a value for the resistance of one metre of the resistance wire.

Resistance of 1 m = _____ Ω

THIS IS THE END OF THE QUESTION PAPER

14732.08 **R**