OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



EXAM QUESTION PACK

M2 HANDLING DATA

SCORE	PERCENTAGE
/119	%

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Gateway Physics A (9-1)

Maths 2: Handling data

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **119**.
- The total number of marks may take into account some 'either/or' question choices.

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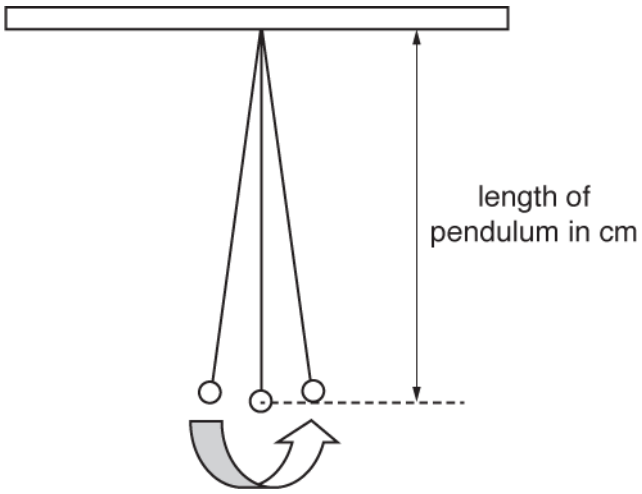
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1(a) Helen investigates children's swings.

She models the swings in the laboratory using weights attached to a string.

This type of swing is called a **pendulum**.

She sets up a pendulum and makes it swing.



Helen uses a pendulum that has a length of 60 cm.

She measures the time it takes the pendulum to complete 10 swings.

She repeats this three times, **A, B** and **C**.

Look at her results.

Length of pendulum in cm	Time for 10 swings in s			
	A	B	C	Mean (average)
60	16.35		15.65	16.00

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The results table is incomplete.

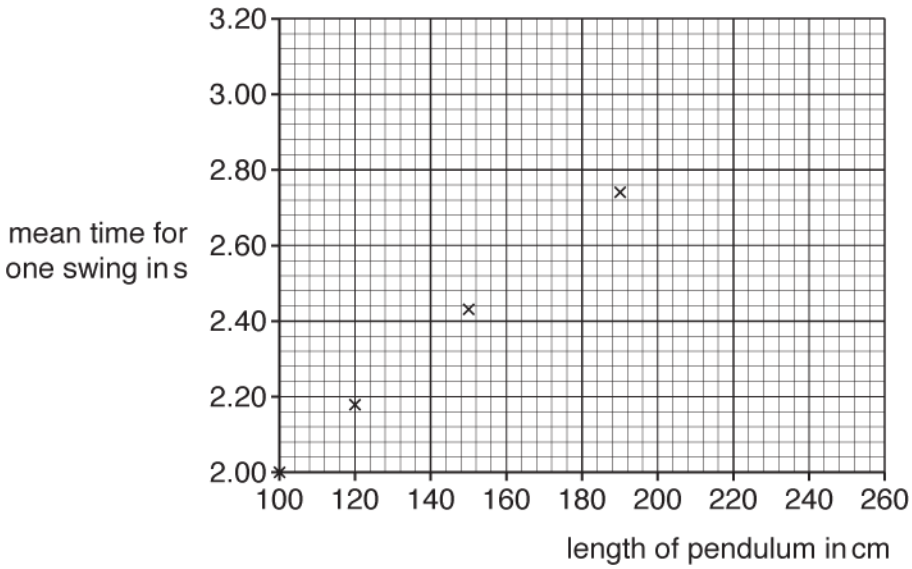
Use the data to calculate the missing value **B**.

answer _____ s **[2]**

(b) Helen wants to find out about real swings, like those used by children.

She uses longer pendulums and investigates the effect of changing the length.

Look at the graph of Helen's results.



Helen wants to make a pendulum that takes 3 s for one complete swing.

Predict the length of this pendulum.

Show your working on the graph.

answer _____ cm **[2]**

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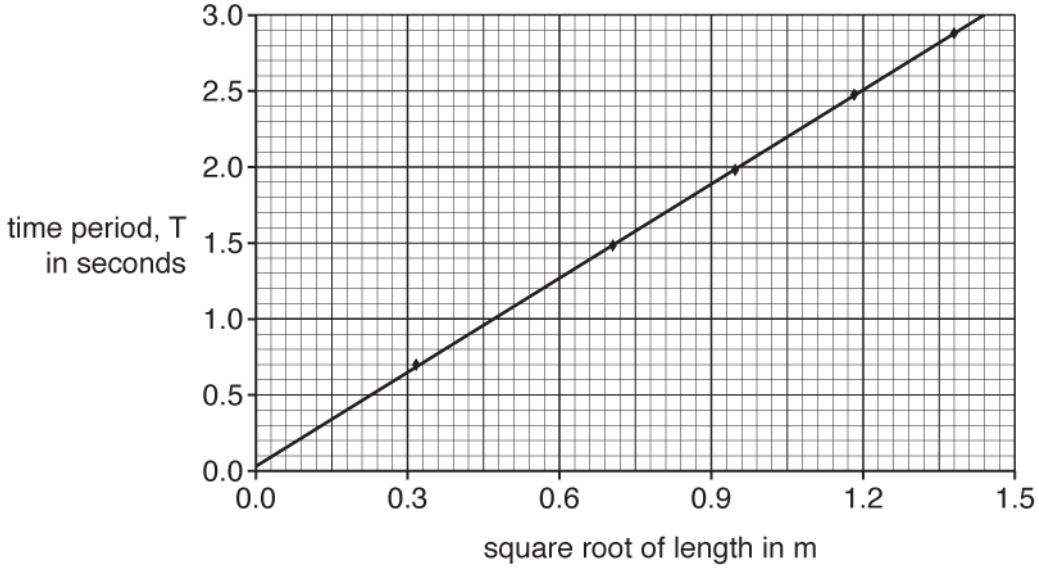
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(c) Helen collects more results using a pendulum.

She processes her results.

Look at her graph.



(i) Describe the relationship shown in the graph.

--- [1]

(ii) Helen does some research.

She finds out this information:

- the time it takes for one complete swing is called the time period, T.
- **g** = 10 m/s^2 (the acceleration due to gravity)
- **L** = the length of the pendulum
- π = 3.142

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Helen finds an equation which describes the behaviour of pendulums.

$$T = 2\pi \sqrt{\frac{L}{g}}$$

She wants to find the time period, T for a longer swing.

Calculate the time period for a swing that is **3 m** long.

Give your answer to one decimal place.

answer _____ s. **[3]**

(iii) Helen needs to make a swing with a time period, T, of 1 second.

Calculate the length of a pendulum with a time period of 1 second.

answer _____ m. **[2]**

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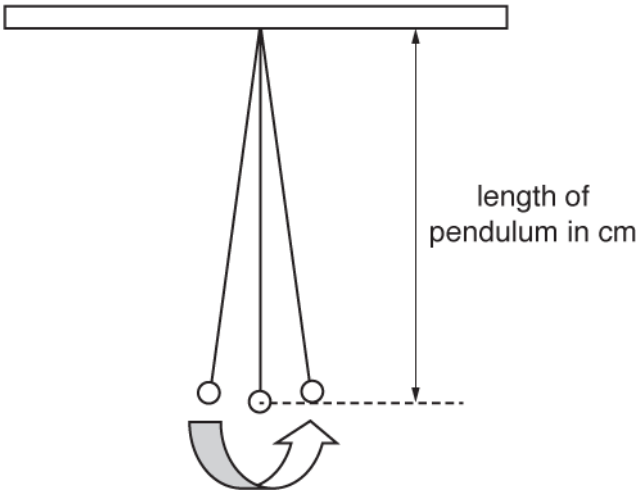
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2(a) Helen investigates children's swings.

She models the swings in the laboratory using weights attached to string.

This type of swing is called a **pendulum**.

She sets up a pendulum and makes it swing.



Helen uses a pendulum that has a length of 50 cm.

She measures the time it takes the pendulum to complete 10 swings.

She repeats this three times, **A, B** and **C**.

Look at her results.

Length of pendulum in cm	Time for 10 swings in s			
	A	B	C	Mean (average)
50	14.62	14.78	14.40	

Calculate the mean (average) time for 10 swings.

answer _____ s **[1]**

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(b) Helen changes the length of the pendulum to 60 cm.

She takes three more measurements and calculates the mean.

Look at her results.

Length of pendulum in cm	Time for 10 swings in s			
	A	B	C	Mean (average)
60	16.35		15.65	16.00

The results table is incomplete.

Use the data to calculate the missing value **B**.

answer ---------- s **[2]**

(c) Helen changes the length of the pendulum to 70 cm.

She takes more measurements and calculates the mean.

Look at her results.

Length of pendulum in cm	Time for 10 swings in s				Mean (average) time for one swing in s
	A	B	C	Mean (average)	
70	17.55	17.65	17.32	17.50666	

Use the data to calculate the mean time for one swing.

Give your answer to 2 decimal places.

answer _____ s **[2]**

(d) Helen wants to find out about real swings, like those used by children.

She uses longer pendulums and investigates the effect of changing the length.

Look at the summary of her results.

Length of pendulum in cm	Mean (average) time for one swing in s
100	2.00
120	2.18
150	2.43
190	2.74

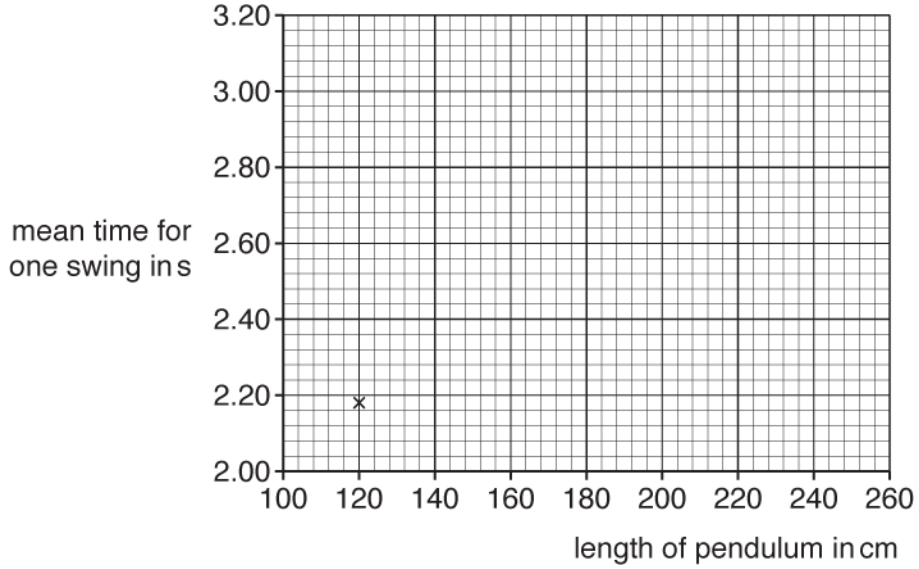
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(i) Plot Helen's results onto the graph. One has been plotted for you.

Draw a line of best fit.



[2]

(ii) Describe the pattern shown by the graph.

---

[1]

(iii) Helen wants to make a pendulum that takes 3 s for one complete swing.

Predict the length of this pendulum.

Show your working on the graph.

answer ---------- cm [2]

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3 A charge of 44 000 C flows through a light bulb. The potential difference is 230 V.

Calculate the energy transferred.

Use the equation: Charge = Energy ÷ Potential difference

Record your answer to **2** significant figures.

Answer = ... J **[4]**

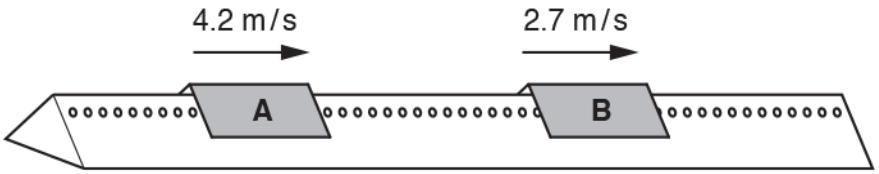
4(a) A student investigates collisions of trolleys on a horizontal airtrack.

Write down the **two** quantities involved with motion which are conserved during an elastic collision.

---

[2]

(b) Trolley **A** has a mass of 2 kg. Trolley **B** has a mass of 2.5 kg.



(i) Calculate the **momentum** of each trolley.

Trolley **A** = ... kg m/s
Trolley **B** = ... kg m/s
[3]

(ii) The two trolleys collide and stick together after the collision. Use your answers to **(i)** to calculate the **speed** of the combined trolleys after the collision.

Record your answer to **2** significant figures.

Answer = ... m/s **[3]**

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5 A student measures the time it takes for a bicycle to stop in an emergency.

She repeats the measurement to get three results.

The average time for her results is 2.72 s.

The first two results are 2.66 s and 2.60 s.

What is the value of her third result?

A 2.63 s

B 2.66 s

C 2.72 s

D 2.90 s

Your answer [ ] **[1]**

6 A scientist uses different drivers to test the stopping distances of the same car.

Look at the results.

Driver	Speed (m/s)	Thinking distance (m)	Braking distance (m)
A	8	6	6
B	16	13	24
C	32	24	96
D	16	12	22
E	8	5	6
F	32	30	120

Driver **C** travels at 32 m/s on the road and then stops. The car has a mass of 1200 kg.

(i) Show that the **kinetic energy** stored by the car at 32 m/s is 614 000 J.

[3]

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(ii) Describe what happens to the kinetic energy of the car as it brakes and stops.

---

[2]

(iii) The braking distance of the car is 96 m.

Calculate the **braking force** on the car.

Give your answer to **4** significant figures.

Answer = ---------- N [3]

7 A student experiments with a model parachute and collects some results.

She drops the parachute from a height of 4 m three times and takes three results of the time taken.

The three results are:

3.25 s
3.00 s
3.08 s

What is the mean of the three results?

A 3.00 s

B 3.08 s

C 3.11 s

D 3.25 s

Your answer [ ] **[1]**

8 A student wants to find out which heater produces the largest temperature rise.

Look at the results she collects and the calculations she makes.

Heater	Starting temperature (°C)	Finishing temperature (°C)	Change in temperature (°C)
A	18	28	20
B	18	36	16
C	18	44	26
D	18	51	23

Which heater has results that are correctly calculated?

Your answer [ ] **[1]**

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9 **Fig. 20.1** shows thinking, braking and stopping distances for the same car travelling at different speeds.

Speed (m/s)	Thinking distance (m)	Braking distance (m)	Stopping distance (m)
8	6	6	12
16	12	24	36
32	24	96	120

Fig. 20.1

Calculate the reaction time of the person driving the car.

Answer = _____ s **[3]**

10

A car has a total weight of 12 000 N. It has four tyres which each have an area of 25 cm^2 in contact with the road.

Calculate the pressure of the car on the road.

Answer = _____ N/cm^2

[3]

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11(a) This question is about force, mass and acceleration.

A car starts from rest and accelerates at 3 m/s^2.

Use the equation: Acceleration = Change in velocity ÷ Time taken

Calculate the **velocity** of the car after 4 s.

Answer = _____ m/s **[2]**

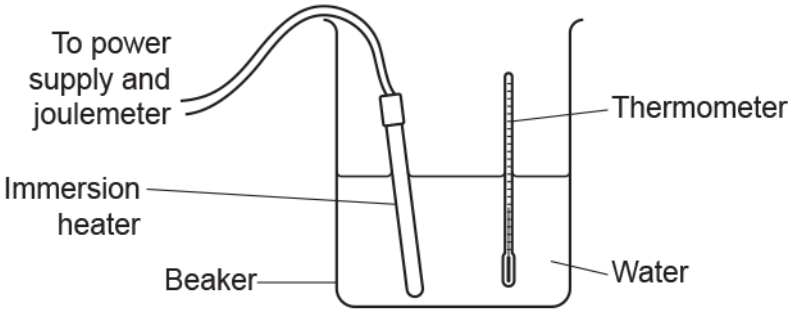
(b) A roller coaster car moves down a slope with an acceleration of 5 m/s^2.

The force on the roller coaster car is 4000 N.

Calculate the **mass** of the roller coaster car.

Answer = _____ kg **[2]**

12(a) A student completes an experiment to find the specific heat capacity of water.



He heats up 1 kg of water, using an immersion heater. He measures the temperature rise and calculates the specific heat capacity of the water.

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Attempt	Energy supplied (J)	Temperature rise (°C)	Specific heat capacity (J/kg °C)
1	10 000	2	5000
2	21 000	4	5250
3	44 000	8	5500

(i) Calculate the **mean** specific heat capacity.

Answer = ... J/kg °C **[1]**

(ii) Describe the conclusions that can be drawn from the data.

---**[3]**

(b) The actual value for the specific heat capacity of water is 4200 J/kg °C.

(i) Explain why the mean specific heat capacity calculated in **(a)(i)** is higher than the actual value.

---

[2]

(ii) Write down **two** problems with this experiment **and** suggest how they could be solved.

Use the diagram and results table to help you.

Problem 1 ---

Solution ---

Problem 2 ---

Solution ---

---

[4]

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13(a) A TV has the label below on it.

OCR TV
Voltage: 230 V Power: 65 W Frequency: 50 Hz

Calculate the **current** in the TV when it is turned on.

Use the equation: power = potential difference × current

Give your answer to **2** significant figures.

Current = ... A **[4]**

(b) The TV is turned on for 30 minutes.

Calculate the energy transferred by the TV.

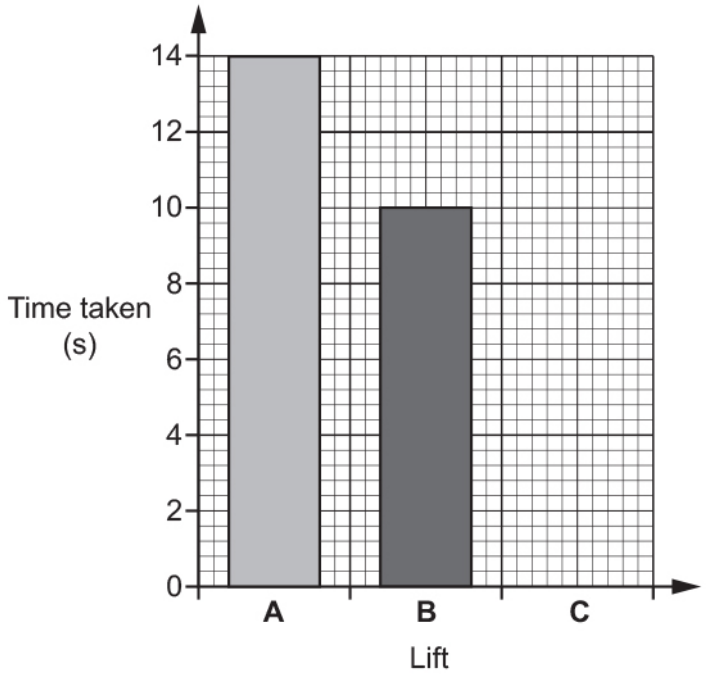
Energy used = ... J **[4]**

14(a) A tall building needs a lift to move people from one floor to another.

The builder has a choice of three different lifts.

Each lift takes a different amount of time to move between the two floors.

Look at a bar chart of the time taken for each lift.



(i) Lift **C** takes 12 s to move between the two floors.

Draw a bar for lift **C** on the bar chart. **[1]**

(ii) Calculate the **mean** time of the three lift journeys.

Mean = ... s **[2]**

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(iii) Explain which lift uses the most power.

---

[2]

(b)

(i) One lift uses 50 000 J for a 12 s journey.

Calculate the power of the lift.

Give your answer to **1** decimal place.

Power = ... W **[4]**

(ii) When the lift is broken the stairs are used.

Calculate the work done when a 750 N person climbs a distance of 4 m.

Work done = ... J **[3]**

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15(a) A TV has the label below on it.

OCR TV
Voltage: 230 V Power: 65 W Frequency: 50 Hz

Calculate the **current** in the TV when it is turned on.

Use the equation: power = potential difference × current

Give your answer to **2** significant figures.

Current = ... A **[4]**

(b) The TV is turned on for 30 minutes.

Calculate the energy transferred by the TV.

Energy used = ... J **[4]**

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16 Ripples are made on the surface of the water. The ripples can be used to model waves.

Student **A** and student **B** drop stones into a pond.

(i) Student **A** measures the frequency and wavelength of the water ripples. **Table 17.1** shows his results:

Frequency (Hz) of ripples	0.6
Wavelength (m) of ripples	0.1

Table 17.1

Calculate the wave speed of the ripples.

Use the equation: wave speed = frequency × wavelength

Wave speed = ...m / s **[2]**

(ii) Student **B** measures the same ripples as student **A**.

She measures:

- The distance one ripple travels.
- The time it takes the ripple to travel this distance.

Table 17.2 shows student **B**'s results:

Distance ripple travels (m)	2.40
Time taken (s)	30.0

Table 17.2

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Name the equipment student **B** uses to measure the distance and time.

Distance ----------

Time ----------

[2]

(iii) Use results in **Table 17.2** to calculate the wave speed of the ripples.

Wave speed = ...m / s **[1]**

(iv) Student **A** and student **B** obtained different answers for the wave speed of the ripples.

Suggest why.

---

[1]

---

17 A student sets up the circuit in **Fig. 17.1** to investigate the resistance of a lamp.

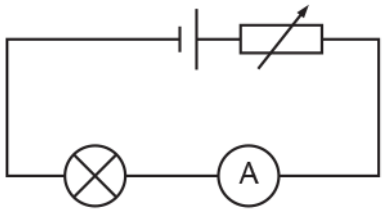


Fig. 17.1

The student plots the results from **Table 17.1** on the graph in **Fig. 17.2**.

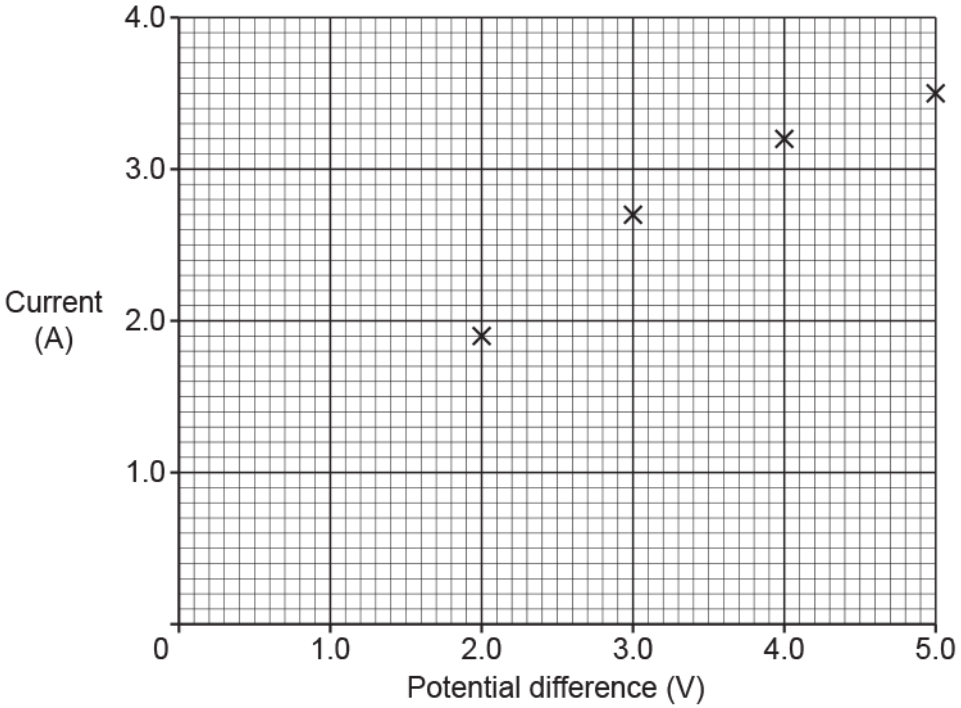


Fig. 17.2

(i) Plot the missing point at 1.0 V on the graph **and** draw a line of best fit.

[2]

(ii) Describe the relationship between potential difference and current.

Use data from the graph to support your answer.

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[2]

(iii) Explain how you could use the circuit in **Fig. 17.1** to investigate the resistance of a fixed resistor instead of a lamp.

[2]

(iv) Explain how and why the graph in **Fig. 17.2** would look different for a fixed resistor at a constant temperature.

[2]

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18 A student investigates how a spring stretches.

She measures the original length of the spring, adds a 2.0 N weight, and then measures the extended length of the spring.

Look at her data in the table.

Force used	2.0 N
Original length	3.0 cm
Extended length	7.0 cm
Extension	4.0 cm

(i) Calculate the spring constant for the spring.

Use the equation: force = spring constant × extension

Spring constant = ... N / cm **[3]**

(ii) Suggest **two** ways that the student could improve and develop their method to find the spring constant.

---

[2]

19(a) A student drops a paper ball from a balcony 4.00 m high. Her friend measures the time taken for the paper ball to reach the ground.

Suggest the equipment used to measure the height of the balcony and the time taken for the paper ball to reach the ground.

Height _____

Time taken _____

[1]

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(b) They record their results in a table.

Attempt	1	2	3	4	5
Time taken (s)	1.84	2.08	2.02	2.08	1.98

(i) Use the data in the table to calculate the mean, median and mode of their results.

Mean = ...

Median = ...

Mode = ...

[3]

(ii) The results are not very precise. Explain how you can tell from the data in the table.

.....

.....

[1]

(iii) Suggest a possible source of error in the experimental method and how it could be improved.

Source of error .....

Improvement .....

.....

[1]

END OF QUESTION PAPER

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