OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



EXAM QUESTION PACK

WS1.2 EXPERIMENTAL SKILLS AND STRATEGIES

SCORE	PERCENTAGE
/141	%

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Gateway Physics A (9-1)

Experimental skills and strategies

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 **141**.
- The total number of marks may take into account some 'either/or' question choices.

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1 Some scientists are concerned about the effects of using mobile phones.

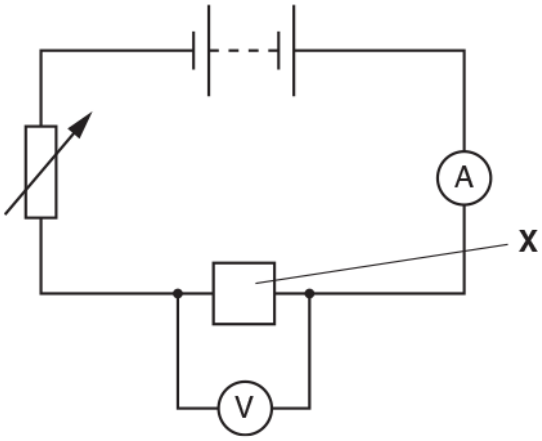
The scientists publish the results of their investigations.

Explain why publishing results is a good idea.

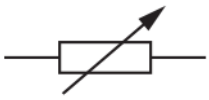
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[2]

2 A student builds a circuit to investigate the resistance of component **X**.



(i) What is the name of this component?



---

[1]

(ii) Why is this component needed in this circuit?

---

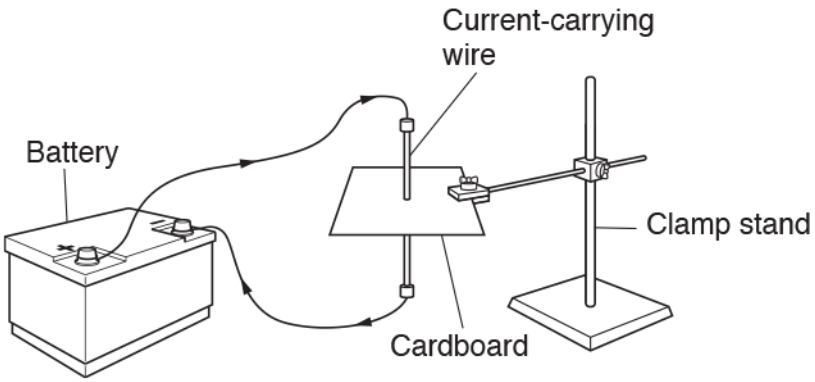
[1]

3 A student sets up an experiment to investigate the magnetic field around a current-carrying wire.

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(i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire.

[3]

(ii) Draw the shape of the field which would be found around this wire.

[2]

4 Which does **not** increase the magnetic effect of a solenoid?

A Increasing the cross-sectional area of the solenoid

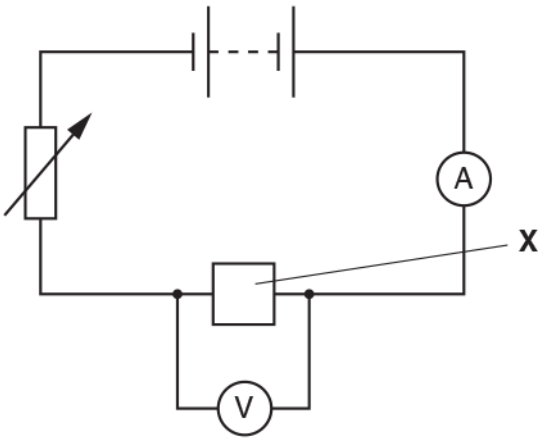
B Increasing the current in the solenoid

C Increasing the number of turns on the solenoid

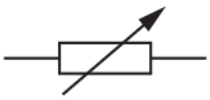
D Putting a soft iron core in the solenoid

Your answer ☐ [1]

5 A student builds a circuit to investigate the resistance of component **X**.



(i) What is the name of this component?



---------- [1]

(ii) Why is this component needed in this circuit?

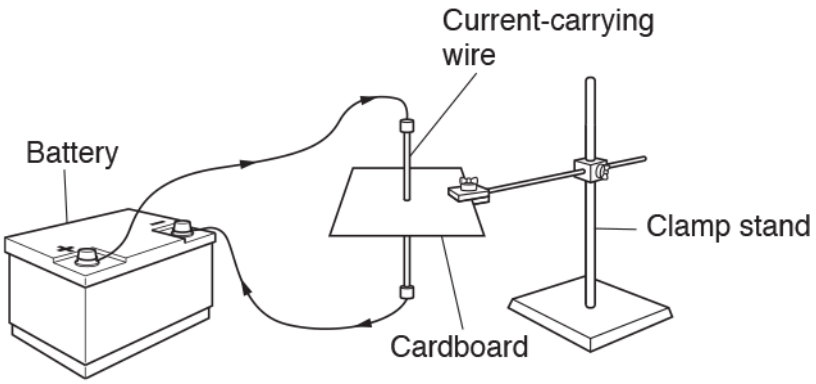
---------- [1]

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6 A student sets up an experiment to investigate the magnetic field around a current-carrying wire.



(i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire.

---

[3]

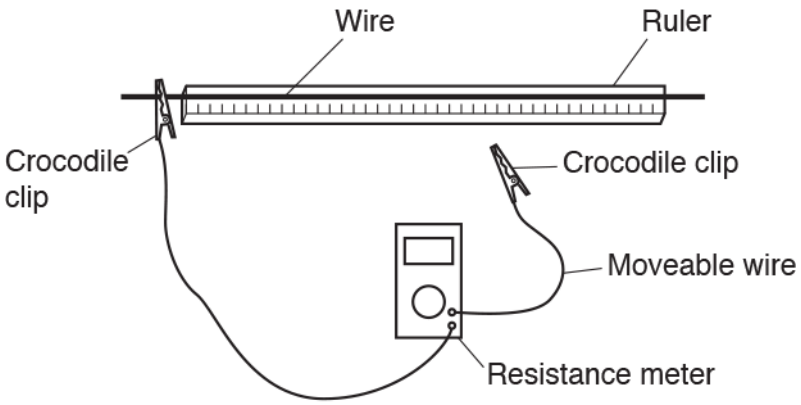
(ii) Draw the shape of the field which would be found around **this** wire.

[2]

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7 Two students investigate the resistance of a wire.

They tape a length of wire to a metre ruler and connect it to a resistance meter using crocodile clips.



Look at their results.

Length of wire (cm)	Resistance (Ω)			
	Attempt 1	Attempt 2	Attempt 3	Mean
25	8.8	8.3	8.5	8.533
50	16.2	16.1	16.4	16.4
75	23.5	23.8	18.7	23.7
100	30.8	31.1	31.0	31.0

(i) The actual mean resistance values are more than expected.

Suggest **two** possible errors with the experiment.

---

[2]

(ii) For **one** of the errors, suggest how the experimental procedure could be improved.

---

[1]

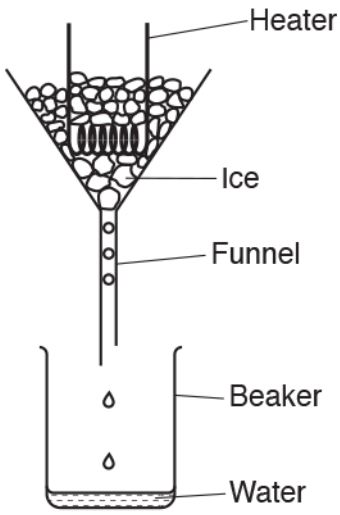
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8 Two students design an experiment to find the specific latent heat of water.

They set up their equipment as shown in the diagram.



The students also have access to a power supply, a voltmeter, an ammeter, a stop-clock and a top-pan balance.

* Explain how the students could use this equipment to determine an accurate value for the specific latent heat of water.

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[6]

9 Beta radiation is used to check the thickness of thin aluminium foil at a factory.

Why is beta radiation used?

A All electromagnetic radiation is reflected by aluminium foil.

B Beta radiation will **not** pass through aluminium foil.

C Beta radiation will partially pass through aluminium foil.

D Beta radiation is reflected by aluminium foil.

Your answer [1]

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10 A student watches a ball game on the school field.

The student sees the ball being hit with a bat but he hears the sound a short time after. This is because the speed of light is much greater than the speed of sound.

Describe an experiment which measures the speed of **sound** in air. In your answer describe the measurements, calculations and procedures needed to gather **accurate** and **reliable** results.

You may draw a diagram as part of your answer.

[5]

11 Which equation shows a correct alpha decay?

A $^{241}_{95}Am \rightarrow {}^{239}_{91}Np + {}^{2}_{4}He$

B $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{0}_{2}He$

C $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$

D $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{0}_{1}He$

Your answer ☐ [1]

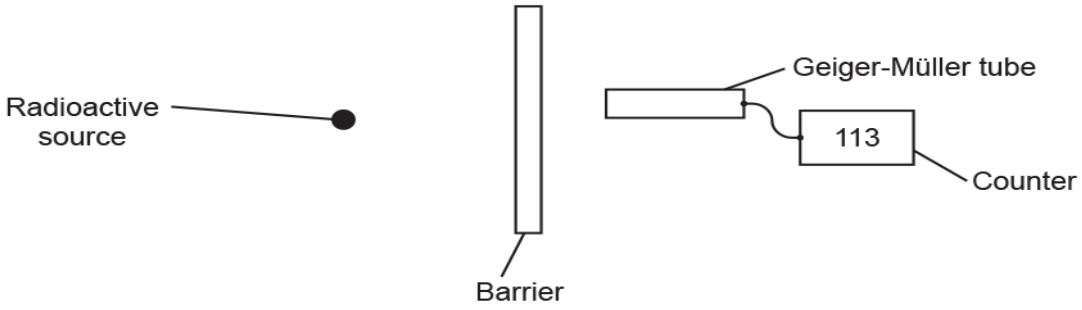
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12(a) A teacher demonstrates an experiment about radioactivity. He demonstrates how different types of radiation can be absorbed.

He puts different barriers between the source and the Geiger-Müller tube. He uses four different radioactive sources **A**, **B**, **C** and **D**.



Suggest two safety **precautions** that the teacher should use when demonstrating this experiment.

1. ---

---

2. ---

---

[2]

(b) The teacher chooses source **A** and uses the Geiger-Müller tube to measure the count rate (counts per minute) for different barriers. He repeats the experiment with source **B**, source **C** and then source **D**.

Look at his results.

Source	Count rate using different barriers			
	Paper	Aluminium	Lead	No barrier
A	113	112	22	112
B	20	21	20	182
C	162	23	21	164
D	282	78	24	280

He also finds that the **average count rate** with no sources and no barriers is 20.

(i) Which source **A**, **B**, **C** or **D** emits **gamma** radiation only?

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Explain your answer.

Source ---------- because ----------

---[2]

(ii) Which source **A**, **B**, **C** or **D** emits **alpha** radiation only?

Explain your answer.

Source ---------- because ----------

---[2]

(iii) Which source **A**, **B**, **C** or **D** could emit both **beta and gamma** radiation?

Explain your answer.

Source ---------- because ----------

---[2]

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(c) The teacher notices that the count rate behind the lead barrier ranges from 20 to 24.

Give **two** reasons why there are a wide range of results around 22 counts per minute.

1. ---

---

2. ---

---

[2]

(d) The teacher decides to repeat the experiment.

This time he records the number of counts for a much longer time interval for each source.

Explain why this is an improvement to the experiment.

---[2]

13(a) A student watches a ball game on the school field.

The student sees the ball being hit with a bat but he hears the sound a short time after. This is because the speed of light is greater than the speed of sound.

He decides to do an experiment to measure the speed of sound waves in air.

Describe which measurements he needs to measure this speed.

---[2]

(b) Which equation is used to calculate speed?

---

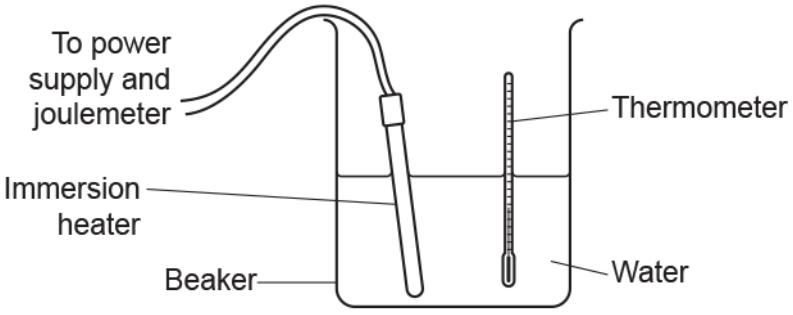
[1]

(c) Describe one way he could get valid results for this experiment.

---

[1]

14(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.

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.

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Answer = ... J/kg °C **[1]**

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

---

[3]

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(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 ---

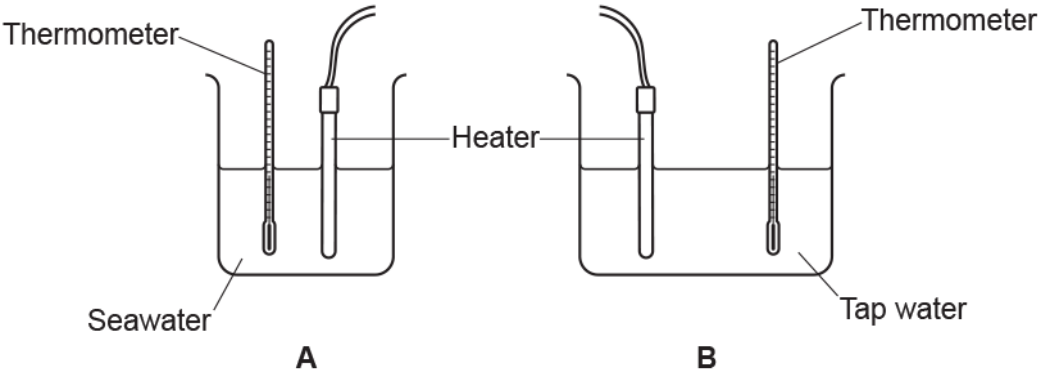
Solution ---

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[4]

15 A student does an experiment to find the difference between the specific heat capacities of seawater and tap water.

The student places a heater and a thermometer into two beakers, **A** and **B**. Look at the diagram.



(i) There are 5 steps to the method for this experiment.

Complete the missing steps for this method.

Step 1 – Put seawater into beaker and tap water into beaker .

Step 2 – .....

Step 3 – .....

Step 4 – .....

Step 5 – Calculate the temperature change of beaker and beaker .

[3]

(ii) Suggest **one** mistake the student made when choosing their equipment.

.....

[1]

(iii) Suggest **two** improvements to the method followed.

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1 _____

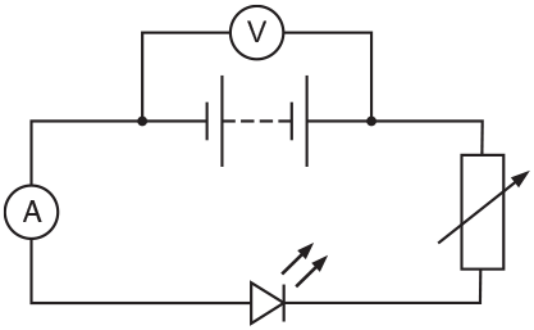
2 _____

[2]

16(a) A student investigates the electrical characteristics of a light emitting diode (LED).

The student builds a circuit to investigate how the current through an LED and the potential difference across it vary when the LED lights up.

Look at the circuit diagram.



(i) The student has made **two** errors connecting the circuit.

Identify the errors.

1 _____

2 _____

[2]

(ii) What is the purpose of the component  in the circuit?

_____

[1]

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(b) The student then connects the circuit correctly. He measures the current through the LED as 0.03 A when the potential difference across it is 3.0 V.

(i) Calculate the resistance of the LED.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[3]**

(ii) Calculate the charge which flows when this LED operates for 2.5 minutes.

Charge = ... C **[4]**

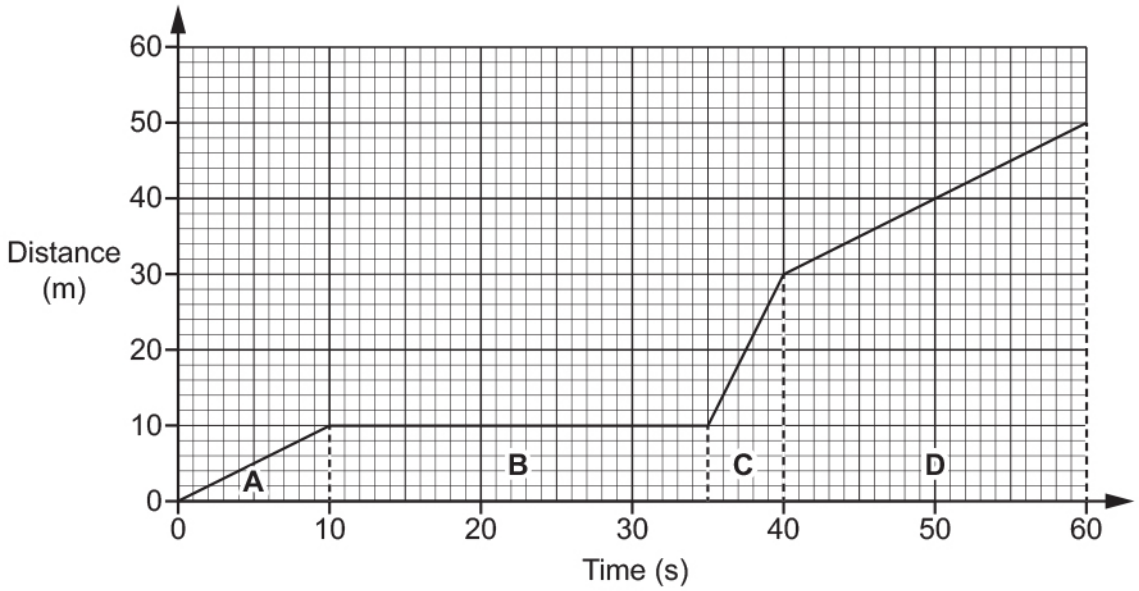
(iii) Calculate the energy transferred when this LED operates for 2.5 minutes.

Use the equation: energy transferred = charge × potential difference

Energy transferred = ... J **[2]**

17(a) A student investigates motion graphs.

Look at a distance-time graph for the movement of a dog in a park.



(i) How far did the dog move in the park?

Distance = ... m **[1]**

(ii) How long was the dog in the park?

Time = ... s **[1]**

(iii) Name a piece of apparatus the student could use to accurately measure the distance the dog moved.

[1]

(b) The distance-time graph has four sections: **A**, **B**, **C** and **D**.

(i) Which section of the graph shows the **greatest** speed?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

Explain your answer.

---

[2]

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(ii) Which section of the graph shows **zero** speed?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

Explain your answer.

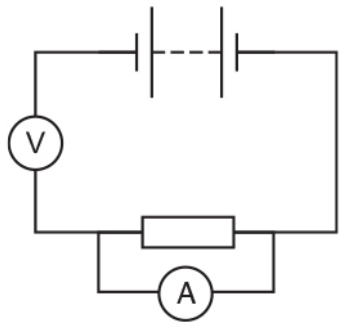
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[2]

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18 A student sets up a circuit to find out the resistance of an unknown resistor. The student makes **three** mistakes in their circuit.

Look at the circuit diagram of their experiment.



(i) Write down the **three** mistakes the student makes.

1 _____

_____

2 _____

_____

3 _____

_____ **[3]**

(i) For **one** of the mistakes identified in **(i)** describe how the student can fix the error.

_____

_____ **[1]**

19 A student has a spring, a ruler and a 2.0 N weight.

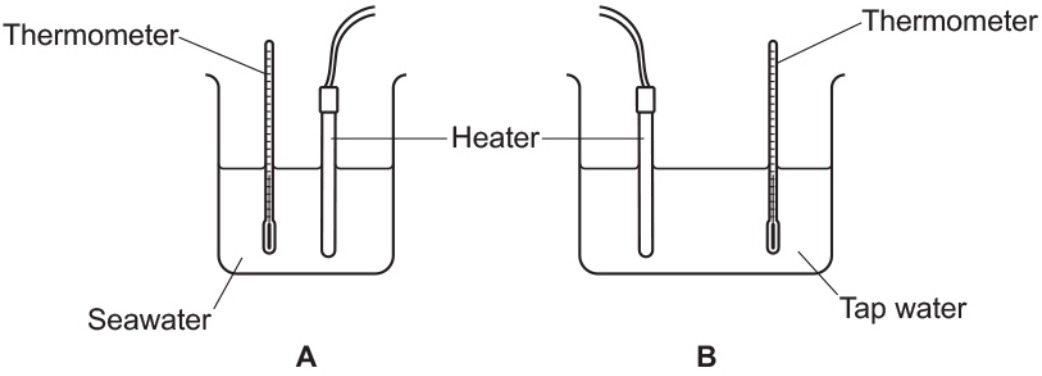
Describe how the student can use this equipment to determine the **spring constant** of the spring.

---

[3]

20 A student does an experiment to find the difference between the specific heat capacities of seawater and tap water.

The student places a heater and a thermometer into two beakers, **A** and **B**. Look at the diagram.



(i) There are 5 steps to the method for this experiment.

Complete the missing steps for this method.

Step 1 – Put seawater into beaker **A** and tap water into beaker **B**.

Step 2 – ---

Step 3 – _____

Step 4 – _____

Step 5 – Calculate the temperature change of beaker **A** and beaker **B**.

[3]

(ii) Suggest one mistake the student made when choosing their equipment.

_____

[1]

(iii) Suggest **two** improvements to the method followed.

1 _____

2 _____

[2]

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21 A student investigates the rate of cooling using a cardboard box to model the walls of a building.

She puts a beaker of hot water into the cardboard box. She measures the temperature of the water every two minutes.

She investigates how the rate of cooling changes with the thickness of the walls.

Describe a method she can use to do this investigation.

[3]

22 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]

23 A student investigates the resistance of a filament lamp.

(i) Explain why the resistance of a filament lamp increases when current increases.

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[2]

(ii) Design a circuit diagram which could be used to investigate how the resistance of a filament lamp changes with current.

Use the circuit symbols below. Each symbol can be used once, more than once, or not at all.



[2]

(iii) Describe how the student would use the circuit you have drawn in **(ii)** to investigate how the resistance of a filament lamp changes with current.

[3]

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24 A student investigates the rate of cooling using a cardboard box to model the walls of a building.

She puts a beaker of hot water into the cardboard box. She measures the temperature of the water every two minutes.

She investigates how the rate of cooling changes with the thickness of the walls.

Describe a method she can use to do this investigation.

---

[7]

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

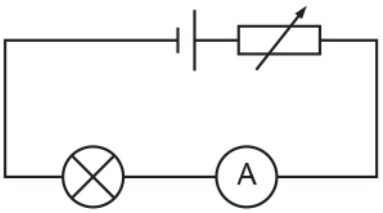


Fig. 17.1

(i) The student also needs to add a voltmeter to the circuit.

On **Fig. 17.1 draw** where the voltmeter should be connected. **[2]**

(ii) The student takes readings of potential difference and current and records them in **Table 17.1**.

Potential difference (V)	Current

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1.0	1.000
2.0	1.9
3.0	2.7
4.0	3.2
5.0	3.5

Table 17.1

There are **two** mistakes in the results table.

Write down the **two** mistakes and suggest how they could be corrected.

Mistake 1: _____

Correction 1: _____

Mistake 2: _____

Correction 2: _____

[4]

(iii) Calculate the resistance of the lamp when the potential difference is 4.0 V in **Table 17.1**.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[3]**

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

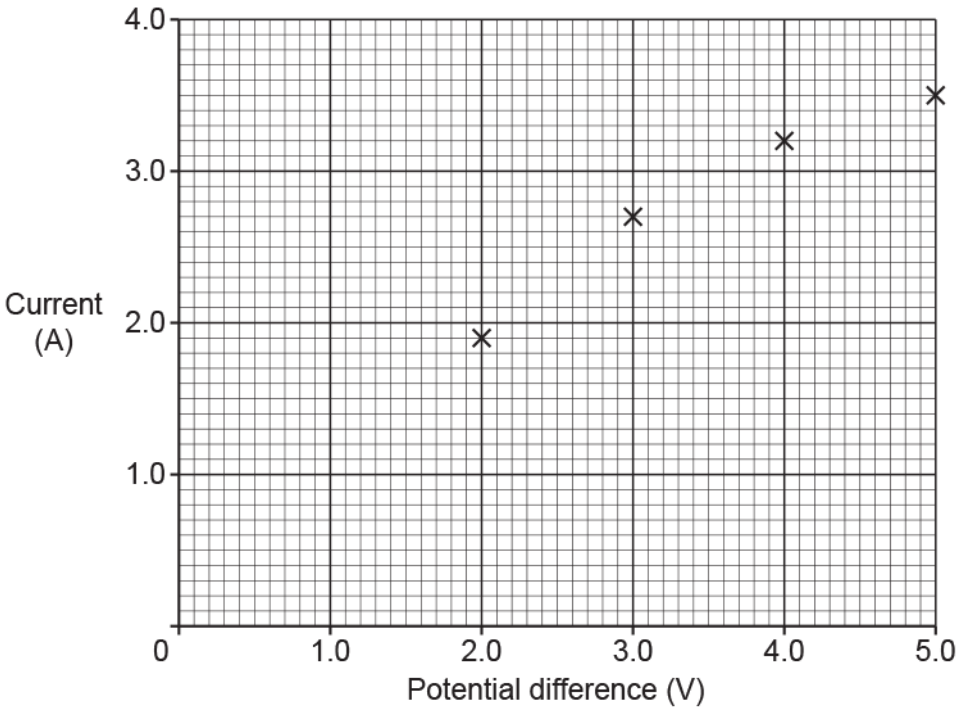


Fig. 17.2

(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.

---

[2]

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

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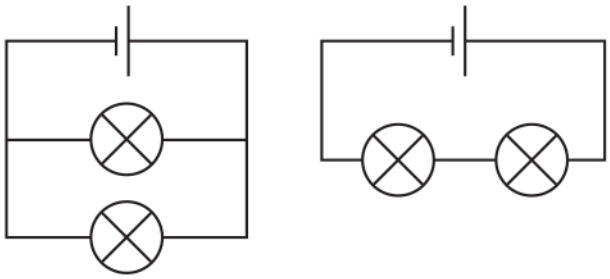
lamp.

[2]

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

[2]

26 A student investigates if lamps are brighter in a series circuit or a parallel circuit. He sets up two different circuits, **A** and **B**.



A **B**

State which circuit will have the brightest lamps and explain why.

In your answer, include the variables that the student will need to control in this experiment.

---

[6]

27(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