Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

# GATEWAY SCIENCE PHYSICS A

J249

For first teaching in 2016

## J249/01 Summer 2022 series

Version 1

ocr.org.uk/science

# Contents



# Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

**Advance Information for Summer 2022 assessments**

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

# Paper 1 series overview

This is the Foundation Tier paper examining content from topics P1 to P4 and P9 in the Gateway Physics specification. The paper incorporates multiple choice and short answer questions and features one extended six-mark Level of Response question.

There is some evidence that candidates were a bit short of time on this paper. However, the standard is similar to that in previous years.

| Candidates who did well on this paper generally did the following: | Candidates who did less well on this paper generally did the following: |
|---|---|
| • Read the entire question and did what the question asked them to do.<br>• Scanned the longer questions to see how the structure ((a)(i), (a)(ii), (a)(iii), (b)(i), (b)(ii), etc) implied a 'story' to each question.<br>• Knew and understood the difference between significant figures and decimal places.<br>• Tackled calculations systematically, laying out the stages in a consistent way. | • Scanned a question and jumped to a conclusion about what it was demanding (presumably what they had prepared on a topic) and answered the imagined question instead of the one actually set.<br>• Picked the wrong equation for a question based on the fact that it contained a variable which was similar to one needed.<br>• Omitted stages in calculations, often just writing down an answer without showing working. |

# Section A overview

Questions 5 ($s = vt$ calculation), 11 (Boyle's Law), 12 (Principle of moments) and 15 (kinetic energy calculation) were correctly answered by almost everyone while Questions 2 (identifying upthrust as a contact force), 4 (identifying the *R*-*T* graph for an NTC thermistor), 9 (identifying the physical state of mercury metal at two different temperatures) and 10 (knowing that static charge builds up only on insulators) proved much harder.

## Question 1

**1** 10 g of ice melts and then evaporates.

What is the mass of the **gas** produced?

**A** 0 g

**B** 1 g

**C** 10 g

**D** 11 g

Your answer ☐ **[1]**

## Question 2

**2** Which is a **contact** force?

**A** Electrostatic

**B** Gravity

**C** Magnetism

**D** Upthrust

Your answer ☐ **[1]**

## Question 3

**3** All objects have a gravitational field that causes attraction.

Which property affects the gravitational field strength of an object?

**A** Charge

**B** Mass

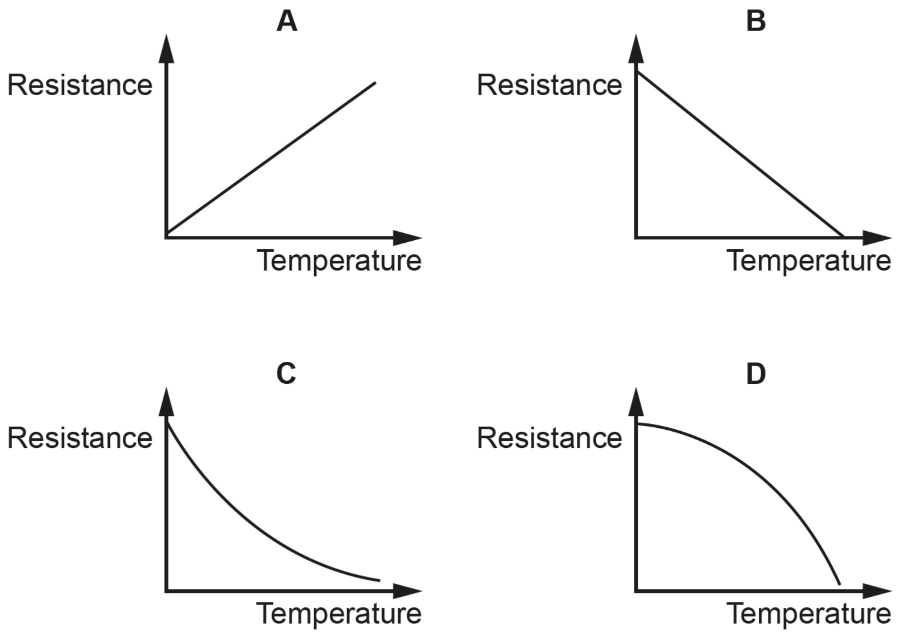
**C** Specific heat capacity

**D** Temperature

Your answer ☐ **[1]**

## Question 4

**4** Which graph shows the relationship between temperature and resistance for a NTC thermistor?




Your answer ☐ **[1]**

## Question 5

**5** A bird flies at an average speed of 5.0 m/s for 240 s.

What is the distance travelled by the bird?

Use the equation: distance travelled = speed × time

**A** 0.8 m

**B** 20 m

**C** 48 m

**D** 1200 m

Your answer [ ] **[1]**

## Question 6

**6** A student places a magnet next to a copper rod and then an iron rod.

| | Copper rod | Iron rod |
|---|---|---|
| **A** | attracts | attracts |
| **B** | attracts | repels |
| **C** | nothing happens | attracts |
| **D** | nothing happens | repels |

Which row in the table describes what happens?

Your answer [ ] **[1]**

## Question 7

**7** Why does atmospheric pressure decrease as the height above the Earth's surface increases?

**A** The distance from the equator decreases.

**B** The number of air molecules above you decreases.

**C** The temperature of the air increases.

**D** The weight of each air molecule increases.

Your answer ☐ **[1]**

## Question 8

**8** A student is studying examples of physical and chemical changes.

| | **Chemical change** | **Physical change** |
|---|---|---|
| **A** | boiling water | frying an egg |
| **B** | boiling water | melting ice |
| **C** | burning wood | frying an egg |
| **D** | burning wood | melting ice |

Which row in the table shows a correct example of a chemical change and a physical change?

Your answer ☐ **[1]**

## Question 9

**9** Mercury has a melting point of –40 °C and a boiling point of 357 °C.

| | **State at –20 °C** | **State at 300 °C** |
|---|---|---|
| **A** | solid | gas |
| **B** | solid | liquid |
| **C** | liquid | liquid |
| **D** | liquid | gas |

Which row in the table is correct?

Your answer [ ] **[1]**

## Question 10

**10** A student rubs two objects together. The two objects become **charged**.

| | **Type of objects** | **Charges which move** |
|---|---|---|
| **A** | two insulators | positive |
| **B** | two insulators | negative |
| **C** | two metals | positive |
| **D** | two metals | negative |

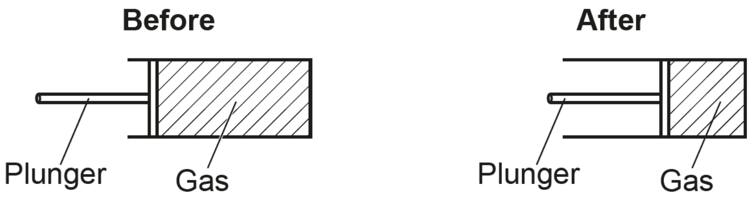
Which row in the table is correct?

Your answer [ ] **[1]**

## Question 11

**11** The diagram shows a gas in a sealed syringe.

The plunger is pushed half-way into the syringe. The gas temperature stays constant.



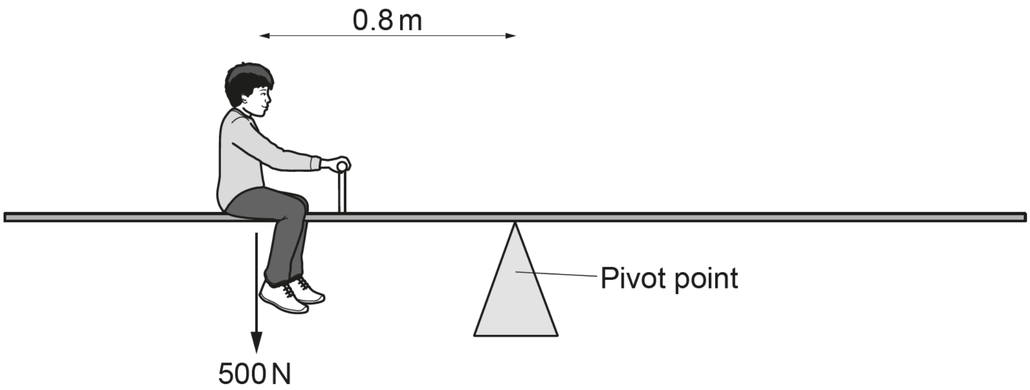

| | **Volume** | **Pressure** |
|---|---|---|
| **A** | doubles | halves |
| **B** | doubles | doubles |
| **C** | halves | doubles |
| **D** | halves | halves |

Which row in the table describes what happens to the volume and pressure of the gas?

Your answer ☐ **[1]**

## Question 12

**12** A student with a weight of 500 N sits on the left-hand side of a see-saw, 0.8 m from the pivot point. Another student then sits on the right-hand side of the pivot point.




Which student will balance the see-saw when they sit on the right-hand side of the pivot point?

Use the equation: moment of a force = force × distance (normal to direction of the force)

| | **Moment of the student's weight (N)** |
|---|---|
| **A** | 40 |
| **B** | 62.5 |
| **C** | 400 |
| **D** | 625 |

Your answer ☐ **[1]**

### Erratum notice

Turn to **page 7** of the **question paper** and look at **question 12.**

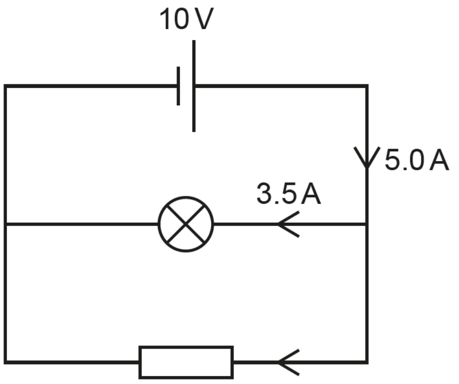
In the **table** cross out (N) and replace it with (N m).

The table heading should now read:

| | Moment of the student's weight (N m) |
|---|---|

## Question 13

**13** A student sets up an electrical circuit as shown in the diagram.




What is the value of the current flowing through the fixed resistor?

**A** 1.5A

**B** 3.5A

**C** 5.0A

**D** 8.5A

Your answer ☐ **[1]**

## Question 14

**14** What is an induced magnet?

**A** A permanent magnet which is always magnetic.

**B** A permanent magnet with two identical poles.

**C** A temporary magnet which is only magnetic when it is within a magnetic field.

**D** A temporary magnet with two identical poles.

Your answer ☐ **[1]**

## Question 15

**15** A dog has a mass of 10 kg and runs at a speed of 14 m/s.

What is the kinetic energy of the dog?

Use the equation: kinetic energy = 0.5 × mass × $(\text{speed})^2$

**A** 70 J

**B** 196 J

**C** 980 J

**D** 1960 J

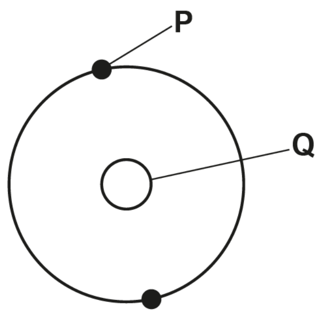
Your answer ☐ **[1]**

# Section B overview

The questions in section B get progressively harder, although some earlier ones may be on topics about which some candidates are less secure.

## Question 16 (a) (i)

**16 (a)** The diagram shows a simple model of an atom.




Answer the questions using words from the list.

| | | | | | |
|---|---|---|---|---|---|
| **electron** | **negative** | **neutral** | **neutron** | **nucleus** | **proton** |

**(i)** What is the name of the part of the atom labelled **Q**?

............................................................................................................................ **[1]**

## Question 16 (a) (ii)

**(ii)** Which **two** particles are found within part **Q**?

............................................................... and ............................................................... **[2]**

## Question 16 (a) (iii)

**(iii)** What is the name of the particle labelled **P**?

............................................................................................................................ **[1]**

## Question 16 (a) (iv)

**(iv)** What is the overall charge on an atom?

.................................................................................................................................... **[1]**

All parts of this question were answered very well. There were numerous mis-spellings in part (a) although all the words were given in the list above; the mis-spellings were not penalised if the meaning was clear.

## Question 16 (b)

**(b)** Suggest why the model of the atom has changed over time.

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

.................................................................................................................................... **[2]**

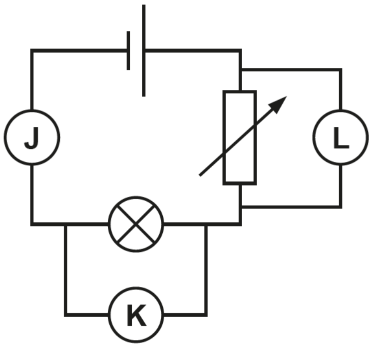
Answers were not always expressed particularly well but were often actually very good; clear reference to new experimentation or to revised models of the atom each scored a mark and were frequently seen.

## Question 17 (a)

**17** A teacher investigates the resistance of a filament lamp.

**Fig. 17.1** shows the circuit the teacher uses.

**Fig. 17.1**




**(a)** The teacher takes measurements of the current through the filament lamp and the potential difference across it.

In which position, **J**, **K** or **L**, should the teacher place the ammeter and voltmeter?

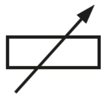
Ammeter position: .................... Voltmeter position: .................... **[2]**

This very basic question on the position of an ammeter and a voltmeter in a circuit showed that most knew an ammeter should be placed in series, but often candidates did not place the Voltmeter in parallel with the lamp. Some candidates perhaps recognised the circuit (vaguely) and knew that J and K were the correct positions but did not remember the correct usage of the meters.

### Assessment for learning

The correct connection of ammeters and voltmeters in a simple series circuit needs frequent practice, both practically and in drawing and labelling circuit diagrams.

## Question 17 (b)

**(b)** Four students discuss the purpose of the component  in this circuit.

Student **A** says: "It is used to change the current flowing in the circuit."

Student **B** says: "It is used to change the resistance of the cell."

Student **C** says: "It is used to change the potential difference of the cell."

Student **D** says: "It is used to change the total resistance of the circuit."

Which **two** students have made a correct statement about the component?

Tick (✓) **two** boxes.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **[2]**

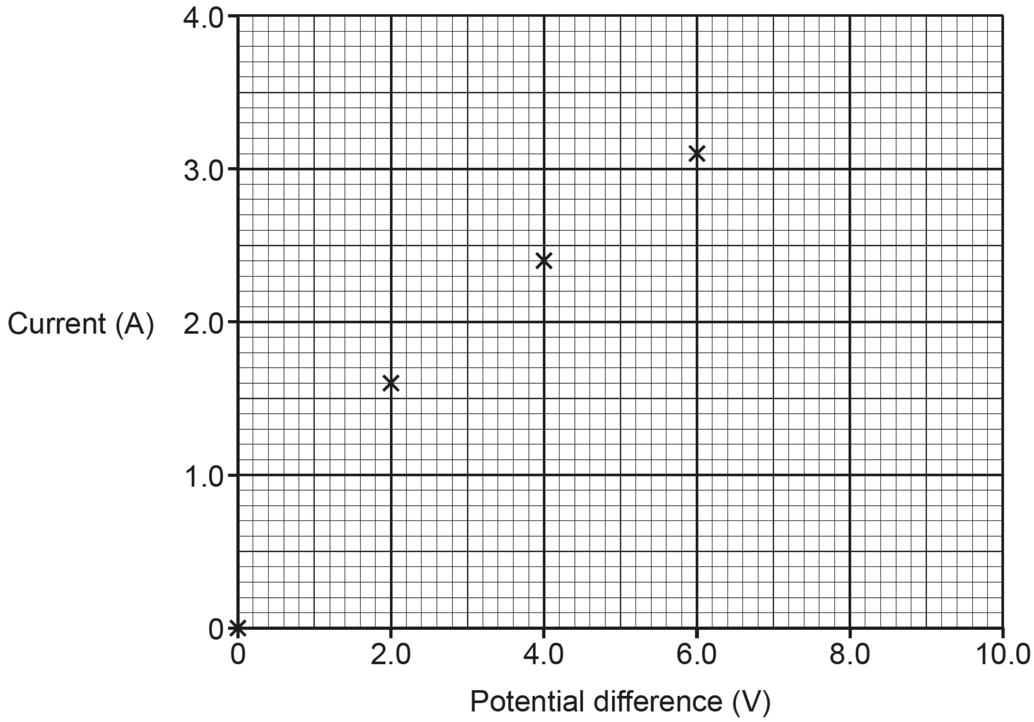
Answers to this part were no better than would be expected from a random choice of two boxes.

## Question 17 (c) (i)

**(c)** The teacher records their results in the table and plots the graph shown in **Fig. 17.2**.

| **Potential difference (V)** | **Current (A)** |
|---|---|
| 0.0 | 0.0 |
| 2.0 | 1.6 |
| 4.0 | 2.4 |
| 6.0 | 3.1 |
| 8.0 | 3.6 |
| 10.0 | 4.0 |

**Fig. 17.2**




**(i)** Plot the **two** missing points on **Fig. 17.2** and draw a line of best fit. **[2]**

Most candidates plotted both points on the graph correctly but only about half drew an appropriate line of best fit. Many of the remainder thought it should be a linear relationship and drew a straight line, either from (0,0) to (10.0, 4.0) or else a best fit to the data. Others drew no line at all, possibly because 'line' meant 'straight line' to them, and the points clearly cannot fit to a straight line.

### Assessment for learning

This graph, or a similar one, is an excellent exercise in plotting points, drawing best fit curves, reading from the graph and also using $I$-$V$ values along the curve to calculate resistance and power.

## Misconception

In the Sciences, a line of best fit does not have to be a straight line. In this case it's a curve.

It is worth highlighting that the term line of best fit may be used in mathematics GCSE to be a straight line to indicate a correlation in a scatter graph.

The Language of Mathematics in Science is a useful reference for science departments. It can help teachers of science to understand how terms can be used differently in maths lessons.

## Question 17 (c) (ii)

**(ii)** Calculate the power dissipated by the filament lamp when the potential difference is 5.0 V.

Use **Fig. 17.2** and the equation: power = potential difference × current

Power = ...................................................... W **[2]**

Where candidates drew the line incorrectly, or where they did not but the interpolation was reasonable, 'error-carried-forward' was applied and many got full marks here.

## Question 17 (c) (iii)

**(iii)** Calculate the energy transferred if the filament lamp is used for 2 minutes.

Use your answer from **(b)(ii)** and the equation: energy transferred = power × time

Energy = ...................................................... J **[3]**

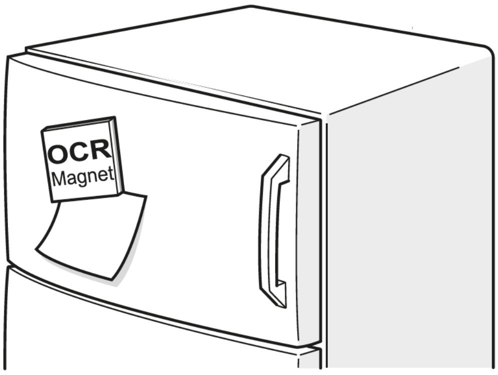
Many candidates lost the conversion mark (for minutes to seconds) and scored 2/3 here.

## Assessment for learning

Questions 17 (c) (ii) and 17 (c) (iii) each require the use of equations. Students should learn to be systematic in laying these out showing all steps. This will help them to avoid mistakes, and it can also allow them to gain marks for the correct method if there is a calculation error.

## Question 18 (a)

**18** A fridge magnet is used to hold pieces of paper onto a metal fridge.




A student tests the strength of **three** square fridge magnets using this method:

- Place pieces of paper between each magnet and the fridge
- Increase the amount of pieces of paper until the magnets no longer stick to the fridge.

**(a)** Suggest **two** variables that the student should keep the same for this experiment.

1 ....................................................................................................................................

2 ....................................................................................................................................
**[2]**

Despite the question stating that three different magnets were used, many candidates suggested 'the magnet' as a controlled variable.

## Question 18 (b)

**(b)** The student tests three different magnets **A**, **B** and **C** and puts their results into a table.

| Magnet | Maximum number of pieces of paper held by the magnet |
|---|---|
| **A** | 24 |
| **B** | 20 |
| **C** | 26 |

Which magnet is the strongest? Give a reason for your answer.

Magnet: ..........................................................................................................................

Reason: ..........................................................................................................................

..........................................................................................................................................

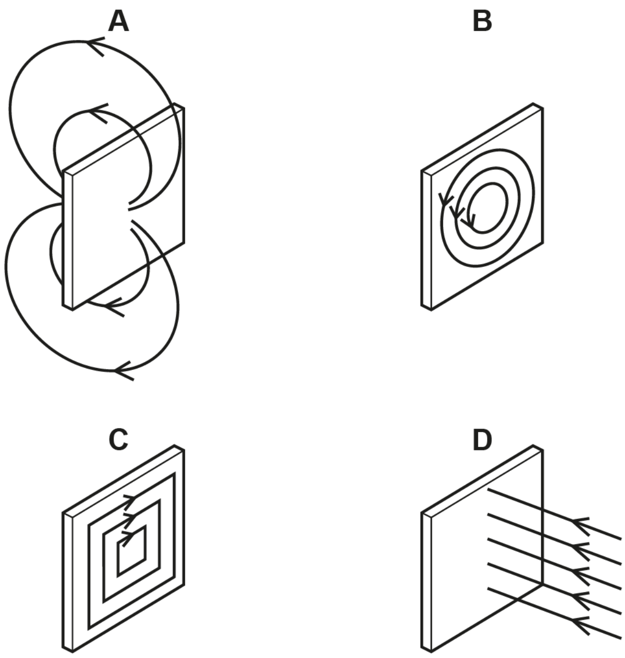
**[1]**

This was mostly correctly answered although some candidates did not refer to the data in the table, stating, e.g. 'C is strongest.'

## Question 18 (c) (i)

**(c)** The front and back faces of the fridge magnets are the poles.

The student draws four magnetic field line diagrams for a fridge magnet.




**(i)** Which diagram, **A**, **B**, **C** or **D**, shows the correct magnetic field around a fridge magnet?

.......................................................................................................................... **[1]**

Many candidates chose diagram D here, possibly attracted by the parallel straight field lines.

## Question 18 (c) (ii)

**(ii)** How does this diagram show the direction of the magnetic field?

.......................................................................................................................... **[1]**

Only some candidates referred to the arrows indicating the direction of the magnetic field.

## Question 18 (d)

**(d)** The student writes a method to plot the magnetic field around a bar magnet using a plotting compass.

1 Join the dots together on the paper to show the field line.

2 Move the compass so that the opposite end of its arrow points to the dot you have just drawn.

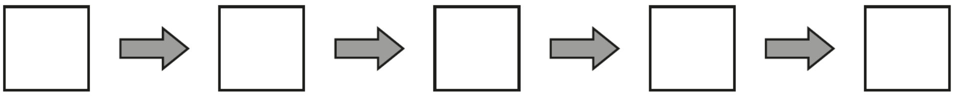
3 Place the magnet on a piece of paper and draw around the magnet.

4 Place the compass near to one end of the bar magnet and mark where the compass arrow points to with a dot.

5 Draw another dot on the paper for the new compass position and repeat.

The student has written their method steps in the wrong order.

Write down the correct order for their method.



**[2]**

This question discriminated well with successful candidates realising that statement 3 had to be the beginning and statement 1 had to be the end - this limited the options available.

## Question 19*

**19*** A group of students investigate the resistance of an LDR.
The students change the distance between the LDR and the lamp and measure the resistance of the LDR.

The results are plotted on a graph.

**Fig. 19.1** shows the experiment set-up and **Fig. 19.2** shows the graph of the students' results.

**Fig. 19.1**

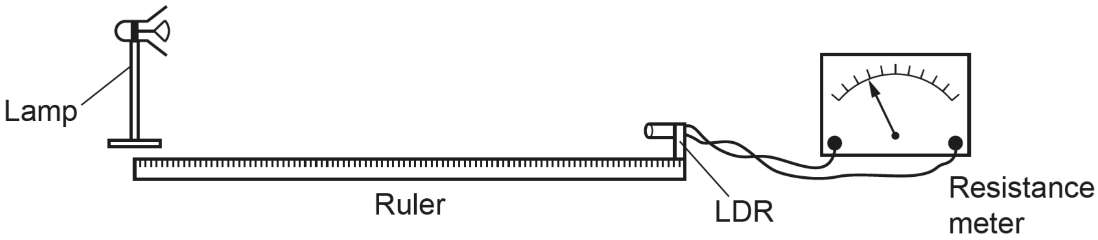
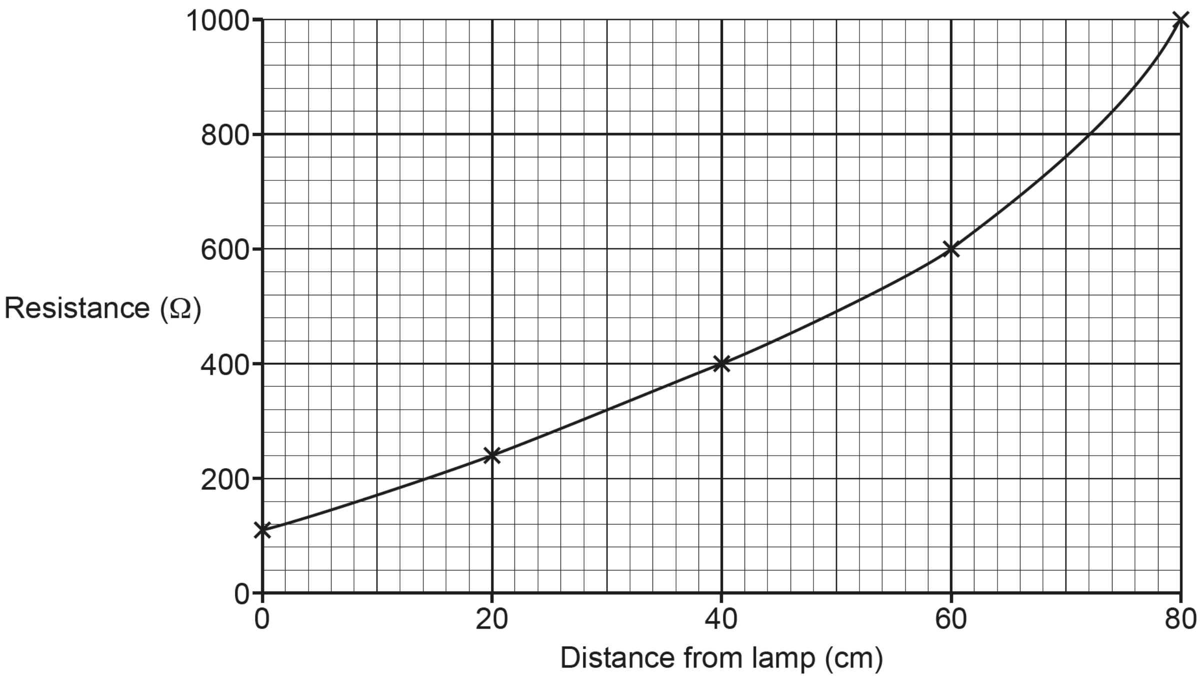



**Fig. 19.2**



Describe the trend shown by the graph in **Fig. 19.2**. Use data from the graph in your answer.
Suggest how the students could improve the accuracy and precision of their results.

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.............................................................................................................................................. **[6]**

This level of response was answered well with very good, well-structured responses. Very few candidates were given fewer than 2 marks, and most achieved 4 or more. Less successful responses would have gained more marks if they recognised that to improve accuracy and precision for any experiment they should repeat the results , calculate a mean and investigate / discard anomalies: Many only said, 'repeat results.'

Three student exemplars, one at each level, are given on the following pages.

## Exemplar 1

• The ~~[illegible]~~ trend increase each ~~time~~ centimeter by time 2 .

• The student should have double ~~cheack~~ check the before plotting on the graph

• The ~~[illegible]~~ student should check the ~~k~~ ~~re~~ resistance ~~and~~ and does it work correctly ~~[illegible]~~

• Student should check the wires and they are in good ~~work and the~~ condtion.

• student should check the lamp work and the ~~[illegible]~~ blub also work too.

> The italicised part of the mark scheme for Level 1 states 'The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.' This response fits that description. The mark scheme requires either a basic description of the trend or a basic suggestion to improve accuracy or precision: the first two lines (bullet point 1) cover the trend; lines 3 and 4 (bullet point 2) are not enough for a precision/accuracy comment. The remaining three bullet points do not address the question at all and get no credit.

## Exemplar 2

The graph has a Positive Corolation and Shows that ~~as~~ the further the lamp the more resistance. a way to improve the acuracy and Precision of this test would be to repeat the test and obtain an ~~avg~~ avercge and use more precice equipment insted of a ruler.

> The positive correlation between distance and resistance is noted ('Basic description of the trend shown') and 'repeat the test and obtain an average' is enough for a suggestion to improve the accuracy and precision of the results. This fits the Level 2 criteria and so gets 4 marks.

## Exemplar 3

The closer the distance is, the lower the resistance is. When the distance is 0cm from the lamp, the resistance is about 95Ω. When the distance is at 40cm the resistance is 400Ω, so as distance increases, the resistance gradually increases. When the distance is further away, at 80cm, the resistance is much higher, it is then at 1000Ω. The student can't improve the accuracy of their results by doing the experiment in a darker room, so the resistance starts from 0. By doing it in a darker room, the LDR won't be recording light that comes from around the room, instead it will only record light coming from the lamp. **[6]**

The communication aspect part of the mark scheme for Level 3 states 'There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.' This is true here. As regards the physics content, the trend is well described with the non-linearity made clear (...at 80 cm, the resistance is much higher) and the data is quoted sensibly. The sentence 'The student can't improve…starts from 0.' Contributes nothing to the response, but the final sentence describes a good practical improvement of avoiding extraneous light and so eliminating a confounding variable. Although this improvement is to accuracy, not precision, the quality of the response is such that this merits a full 6 marks.

## Question 20 (a)

**20** A student investigates density using cubes made of different types of material.

Each cube has dimensions of 5 cm × 5 cm × 5 cm.

**(a)** Calculate the volume of **one** cube.

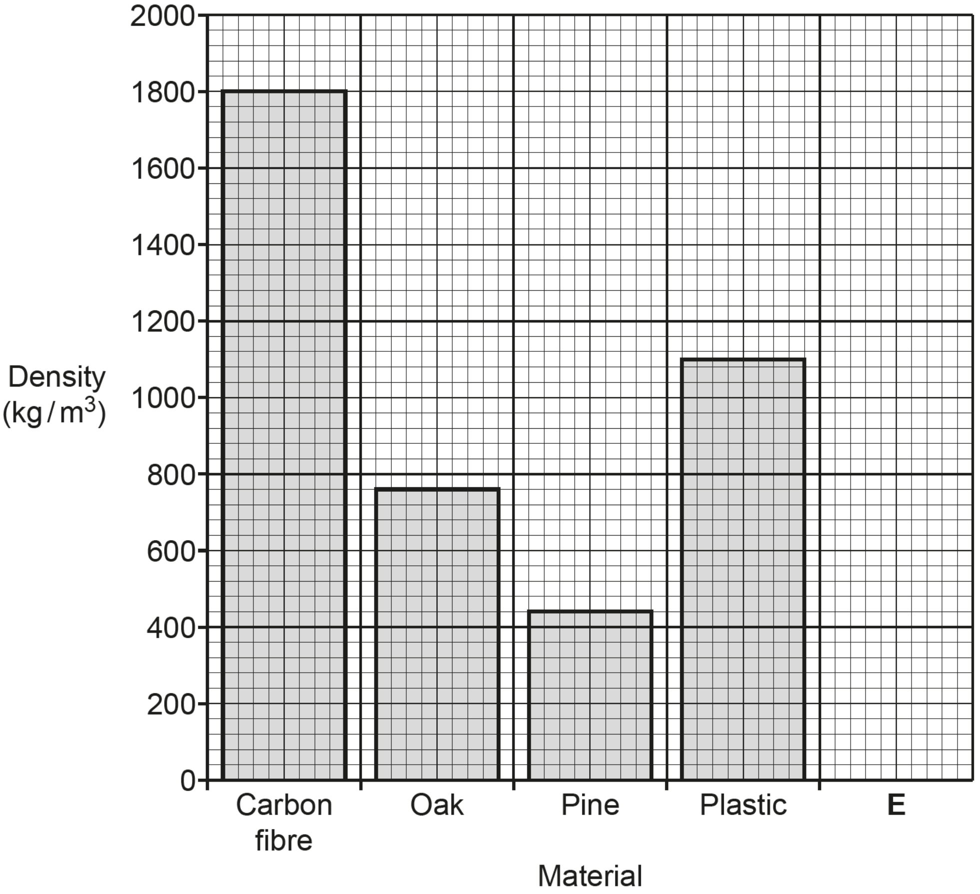
Volume = .................................................. $cm^3$ **[1]**

Most candidates gained this mark.

## Question 20 (b) (i)

**(b)** The table and the bar chart show the student's results.

| Material | Density (kg / $m^3$) |
|---|---|
| carbon fibre | 1800 |
| oak | 760 |
| pine | 520 |
| plastic | 1100 |




**(i)** The student makes a mistake when drawing one of the bars.
Identify the mistake that the student has made.

..............................................................................................................................

.............................................................................................................................. **[1]**

## Question 20 (b) (ii)

**(ii)** Water has a density of 1000 kg / $m^3$. Draw a bar for water in space **E** on the bar chart. **[1]**

## Question 20 (b) (iii)

**(iii)** The student wants to make a simple solid toy boat which can carry a heavy load.

Suggest which material the student should use. Explain your answer.

Material: ..........................................................................................................

Explanation: ......................................................................................................

...........................................................................................................................
**[2]**

Most recognised that the 'pine' bar was incorrectly drawn in part (b) (i). A large number did not draw a bar for water as response to (b) (ii) – virtually all who did so gained the mark. Most candidates did not get a mark for (b) (iii), not recognising that the three sub-sections of part (b) were linked. Virtually all of these opted for a dense material, such as plastic, fibreglass or metal: strength, not buoyancy, was the factor which featured in their explanations.

## Question 20 (c)

**(c)** Which **two** properties affect the density of an object?

Put a (ring) around the **two** correct answers.

| | | | |
|---|---|---|---|
| **mass of particles** | **particle arrangement** | **position on Earth** | **specific heat capacity** |

**[2]**

'Specific heat capacity' was a common incorrect answer here.

## Question 21 (a) (i)

**21** The diagram shows a swimmer in a pool.


**(a)** Their forward force is 50 N and the resistive force is 50 N.

**(i)** Describe the motion of the swimmer.

........................................................................................................................ **[1]**

**Assessment for learning**

Newton's First Law and equilibrium constitute a difficult area and should feature in discussions in as many situations as possible.

## Question 21 (a) (ii)

**(ii)** Explain what happens to the swimmer if their forward force increases but the resistive force remains constant.

........................................................................................................................

........................................................................................................................

........................................................................................................................ **[2]**

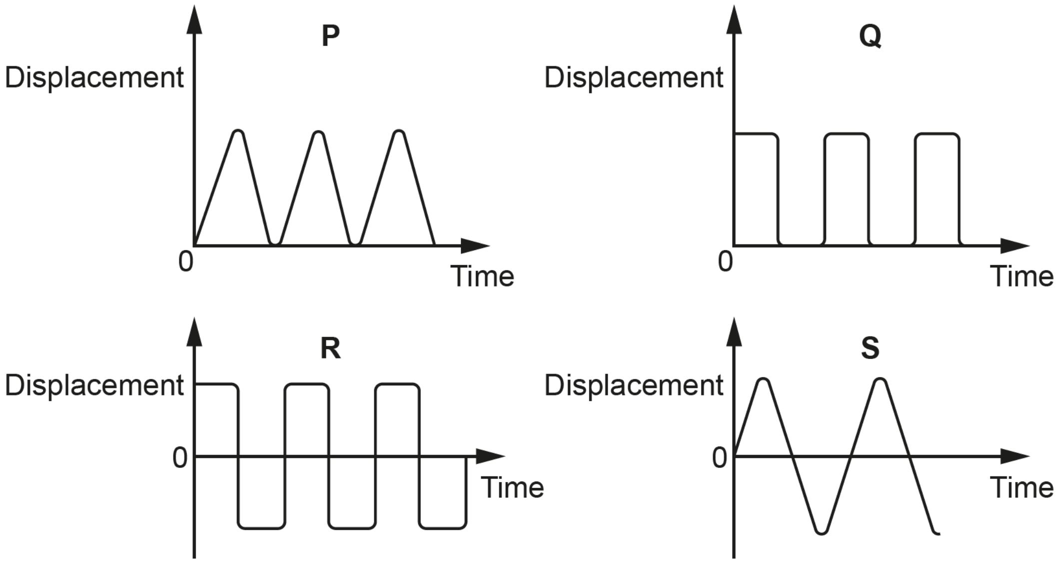
Virtually all candidates clearly believed that, if the forces balance out in part (i), the swimmer can't go anywhere, so must be stationary.

Many candidates who did not achieve a mark in part (a)(i) did get credit in part (a)(ii) by stating that the forward force overwhelms the resistive force, so the swimmer moves forward. Many candidates who had answered 'stationary' in (i), gained a mark for 'moves forwards' without the word 'accelerates' in (ii) as there is an implicit acceleration in the situation described.

## Question 21 (b) (i)

**(b)** The swimmer swims from one end of the pool to the other end at a constant speed. They then turn round and swim back at the same constant speed.

**(i)** Here are 4 displacement–time graphs, **P**, **Q**, **R** and **S**.



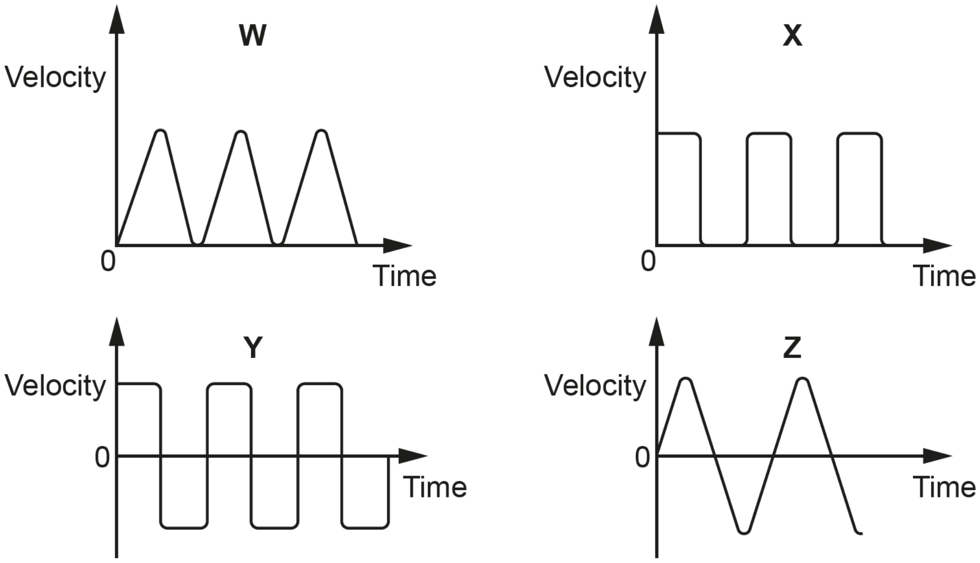

Which displacement–time graph shows the swimmer swimming to the end of the pool and back several times?

........................................................................................................................ **[1]**

Candidates here needed to realise that constant speed meant uniform gradient (+ or -) while the displacement from the starting point could not be negative.

## Question 21 (b) (ii)

**(ii)** Here are 4 velocity–time graphs, **W**, **X**, **Y** and **Z**.




Which velocity–time graph shows them swimming to the end of the pool and back several times?

........................................................................................................................ **[1]**

More successful responses here recognised that the velocity alternated between positive and negative values as the swimmer changed direction and also recalled that the question stem referred to 'constant speed'.

## Question 21 (c)

**(c)** The swimmer has a mass of 75 kg. Calculate their weight.

Use the equation: gravitational force = mass × gravitational field strength

Weight = ........................................................ N **[3]**

**Assessment for learning**

The specification requires that candidates should know that g = 10 N / kg.

## Question 22 (a)

**22** A climber investigates how a rope stretches with different forces. The climber's results are shown in the table.

| **Force (N)** | **Extension (m)** |
|---|---|
| 0 | 0.00 |
| 10 | 0.15 |
| 20 | 0.3 |
| 30 | 0.45 |
| 40 | 0.60 |

**(a)** The climber has made a mistake when recording their results.

Identify the mistake and suggest how it could be corrected.

Mistake: ..........................................................................................................................

Correction: ......................................................................................................................
**[2]**

This part was well answered.

## Question 22 (b) (i)

**(b)** **(i)** Calculate the spring constant for the rope.

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

Use the equation: force = extension × spring constant

Spring constant = ................................................ N / m **[4]**

This calculation was well done, but many candidates lost a mark as they did not express the spring constant to two significant figures (often expressing it to two decimal places).

**Assessment for learning**

This calculation question requires the change of the subject of a formula. Some candidates find this difficult to do algebraically and might find it easier to write the equation in the form given, then substitute in the values, and then simplify that form to get the required variable by itself.

## Question 22 (b) (ii)

**(ii)** Calculate the energy transferred when the rope is stretched with a force of 40 N.

Use the Data Sheet.

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

More successful responses handled this calculation well. Less successful ones had a number of hurdles to leap: not converting the extension from m (as quoted) to cm, using their own value of spring constant and squaring the extension value. As a consequence many ended up with no marks here.

## Question 22 (b) (iii)

**(iii)** A 200 N force is attached to the rope.

Suggest what extension the rope would have if it does not exceed its elastic limit.

............................................................................................................................. **[1]**

More successful responses went back to the data table and scaled up the 20 N extension

## Question 22 (c)

**(c)** When a force of 500 N is applied, the rope exceeds its elastic limit.

Explain what this means.

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

....................................................................................................................................... **[2]**

Very few candidates were given marks for this part. Most said the rope would snap, but more successful response realised that the rope would not return to its original shape and size.

## Question 23 (a)

**23** Two students decide to determine the mean speed of cars passing outside their school.

**(a)** Describe how the students will take the measurements they need to be able to calculate the mean speed of a car.

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

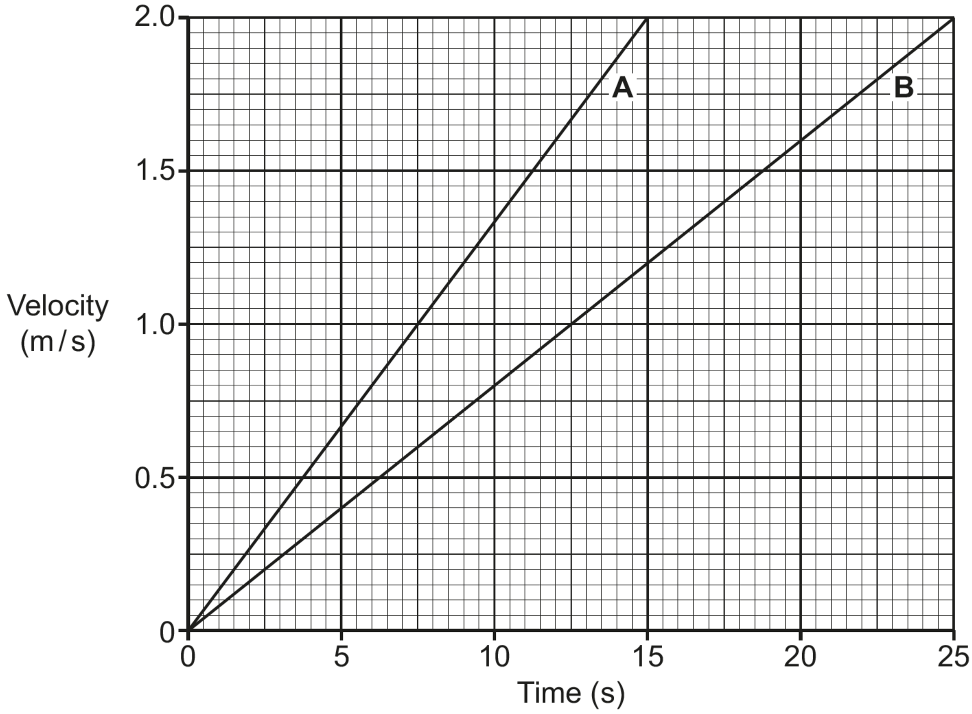
....................................................................................................................................... **[4]**

This was the first of the two overlap questions which featured also on J249/02. A large proportion of the candidature for J249/01 omitted this question, possibly disheartened by the demand in part (a).

The first line of the stem of Question 23, referring to 'speed of cars,' is setting the context for the question, but part (a) refers explicitly to 'the mean speed of a car.' Those trying to do a survey of cars (possibly with a speed gun) were in the majority but did not get any marks, unless they hit one of the marking points in the mark scheme.

## Question 23 (b) (i)

**(b)** The students also investigate the motion of two battery-powered toy cars, **A** and **B**.
The velocity–time graph shows their results.




**(i)** Which toy car, **A** or **B**, has the greater acceleration? Explain your answer.

Car ..............................................................................................................................

Reason .........................................................................................................................
**[1]**

## Question 23 (b) (ii)

**(ii)** Use the graph to calculate the acceleration of car **B**.

Acceleration = ................................................ $m/s^2$ **[3]**

Many candidates found it difficult to explain why the graphs in part (i) showed than car A had the greater acceleration, often referring to 'greater increase in speed' rather than the simpler 'steeper.' Those same candidates then often calculated the acceleration in part (ii) completely successfully, suggesting that they were competent in substituting values into an equation and working out the answer, but did not relate that to the appearance of the graph.

## Question 23 (b) (iii)

**(iii)** Both cars have the same mass.

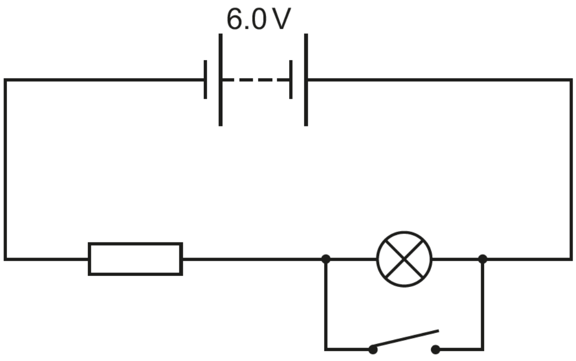
Suggest why it takes different amounts of time for them to reach their top speeds.

........................................................................................................................................ **[1]**

There were many vague answers here but lacking any reasonable physical factor such as tyre grip or aerodynamic drag. Specific suggestions about the battery or motors did gain credit if plausible, e.g. 'different battery' is not enough, but 'higher voltage battery' did gain credit. Weaker responses clearly confused the toy car experiment with the real car measurements in (a).

## Question 24 (a) (i)

**24** A scientist sets up an electrical circuit.




The lamp and the resistor each have a resistance of 5.0 Ω so that the total resistance in the circuit is 10.0 Ω.

**(a)** **(i)** Calculate the current in the circuit when the switch is open.
Use the Data Sheet.

Current = ...................................................... A **[3]**

## Question 24 (a) (ii)

**(ii)** State the potential difference across the resistor when the switch is open.

Potential difference = ...................................................... V **[1]**

## Question 24 (b) (i)

**(b)** The switch is now **closed**.

**(i)** Describe how the current through the resistor changes. Explain your answer.

.......................................................................................................................................

.......................................................................................................................................

....................................................................................................................................... **[2]**

## Question 24 (b) (ii)

**(ii)** Describe how the potential difference across the resistor changes. Explain your answer.

.......................................................................................................................................

.......................................................................................................................................

....................................................................................................................................... **[2]**

## Question 24 (b) (iii)

**(iii)** State the potential difference across the lamp when the switch is closed.

Potential difference = ...................................................... V **[1]**

This question was also an overlap question which featured also on J249/02. Although most candidates attempted this question, many achieved low marks. Part (a) was reasonably tackled, even though few could rearrange the equation to make current the subject (some tried to use $P = I^2R$), while part (b) was too difficult for nearly all the candidates.

The difficulties in part (b) included: the meaning of 'open' and 'closed' when applied to switches (as distinct from water taps, for example); the effect on the circuit of short-circuiting the lamp and what the resistance of the lamp/closed switch combination would be; how the potential difference across the resistor changes due to the action of the switch. In part (b) (i), some candidates obtained a mark for stating that the current increases, even without a sound physical explanation. Some candidates gained a mark in part (b) (ii) for having a p.d. change consistent with the current change they gave in (b)(i), even if that was wrong.

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