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Examiners' report

GCSE

COMBINED SCIENCE A (GATEWAY SCIENCE)

OCR Level 1/Level 2 GCSE (9-1) in Combined Science A (Gateway Science)

J250

For first teaching in 2016

J250/05 Summer 2025 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 responses is 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 Teach Cambridge.

Paper 5 series overview

J250/05 is the first of the two Foundation physics papers for GCSE (9–1) Gateway Science Combined Science A. Question 16 is the overlap question with the Higher Tier paper J250/11.

J250/05 covers the topics:

- P1 Matter
- P2 Forces
- P3 Electricity and Matter
- CS7 Practical Skills

The vast majority of candidates completed all questions in the examination within the allotted time. To do well on this paper, candidates needed to able to use the Equation Sheet to identify the correct equations, manipulate these equations and be comfortable applying their knowledge and understanding to both familiar and unfamiliar contexts and practical science activities.

Many candidates showed their calculations in numerical questions both in Section A and Section B.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• identified and/or substituted into equations correctly • demonstrated knowledge of scientific procedures (for example, explained how to determine the extension of a spring) • analysed graphs and interpreted trends.	• found it challenging to rearrange equations correctly • found it challenging to complete electrical circuit diagrams • did not demonstrate the necessary knowledge about pressure and changes in pressure to respond in depth to the Level of Response question • did not demonstrate knowledge about different models of the atom.

Section A overview

Section A consists of ten multiple choice questions, concentrating on Assessment Objectives 1 and 2 (AO1 and AO2).

Nearly all candidates attempted all of the questions.

Candidates need to be aware that when they write their response in the answer box, if they do not clearly write the letter, especially when writing 'B' or 'D', no credit will be given. If a candidate changes their mind about a response, they need to cross out their initial answer and write their final response next to the answer box.

A positive was that some candidates also wrote down their calculations for the numerical multiple choice questions, especially when the calculation required an intermediate step, for example when determining the change in velocity and substituting this into the equation to calculate acceleration.

Assessment for learning

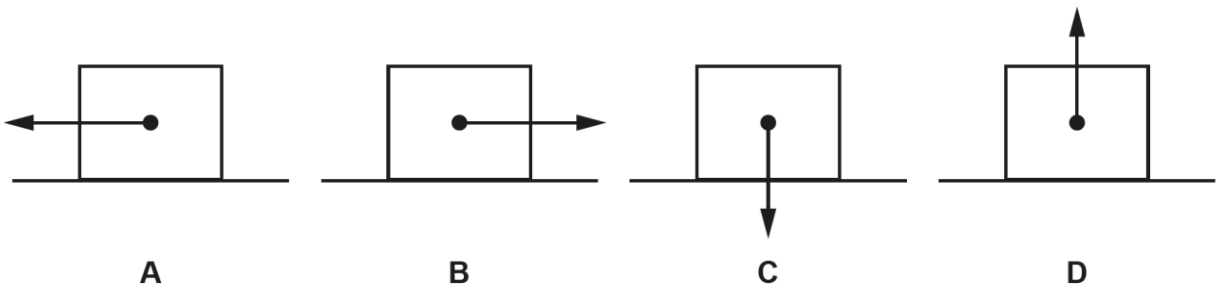
Candidates who were higher scoring on this section did the following:

- substituted correctly into the provided equations
- wrote calculations next to numerical questions
- interpreted free body diagrams.

Question 2

2 A box is at rest on flat ground.

Which diagram shows the correct direction of the **normal contact force** acting on the box?



Your answer ☐ **[1]**

This question assessed candidates' knowledge of forces as they had to identify the direction of the normal contact force. The majority of candidates found this question very challenging. The most common incorrect answer was response C.

Assessment for learning

Candidates could benefit from short activities, such as a matching activity, based on identifying the forces acting on different objects.

Question 3

3 A runner increases their velocity from 0 m/s to 8 m/s in 2 s.

What is their acceleration?

Use the equation: $\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$

A $0.25\,m/s^2$

B $0.33\,m/s^2$

C $3.0\,m/s^2$

D $4.0\,m/s^2$

Your answer ☐ **[1]**

Nearly all candidates were able to determine the change in velocity and substitute the correct values into the equation to calculate acceleration.

Question 4

4 What is an ammeter used to measure?

A Charge

B Current

C Potential difference

D Resistance

Your answer ☐ **[1]**

Although the majority of candidates recognised that an ammeter is used to measure current, a significant number of candidates were unable to choose the correct quantity. Answers were distributed over all of the three incorrect options, indicating some guesswork.

Question 8

8 Quantities such as distance, speed and velocity can be a scalar quantity or a vector quantity.

Which row of this table is correct?

	Distance	Speed	Velocity
A	scalar	vector	scalar
B	vector	scalar	vector
C	scalar	scalar	vector
D	vector	vector	scalar

Your answer ☐ **[1]**

The majority of candidates appeared to find this question challenging and could not to apply their knowledge of scalar quantities and vector quantities to the examples in the table. Higher scoring candidates sometimes wrote down the definition of scalar quantities and vector quantities next to the question and were more likely to choose the correct option.

Question 9

9 A lamp is turned on for 100 s.

The charge flowing is 12 C.

The current is then **doubled**. The time the lamp is turned on is **doubled**.

What is the charge flowing now?

Use the equation: charge flow = current × time

A 6 C

B 12 C

C 24 C

D 48 C

Your answer ☐ **[1]**

This question assessed candidates' understanding of what happens to charge flow when both current and time are doubled. The equation relating the three quantities was provided but the question still proved very challenging to most candidates. The most common error was to double the charge flow instead of multiplying it by four.

Question 10

10 A builder carries bricks to the top of the same ladder on four mornings.

All the bricks have the same mass.

On which morning does the builder use the most power?

Morning	Number of bricks carried	Time taken (s)
A	5	10
B	10	10
C	5	5
D	10	5

Your answer ☐ **[1]**

The majority of candidates were able to determine on which morning the builder used the most power.

Nearly all candidates identified that the correct response involved the greatest number of bricks, and therefore chose either option B or option D.

Misconception

A misconception was that some candidates thought that the longer the builder took to carry the bricks to the top of the ladder, the greater the power he used.

Section B overview

Section B consisted of short, 1-mark questions as well as questions requiring longer responses and a Level of Response question. It covered all of the assessment objectives, and many questions needed candidates to use mathematical skills.

The majority of candidates attempted most questions which is good examination technique. It is also good technique to show calculations in numerical questions, not just the final response, as this can help compensatory marks to be given if the final response is incorrect.

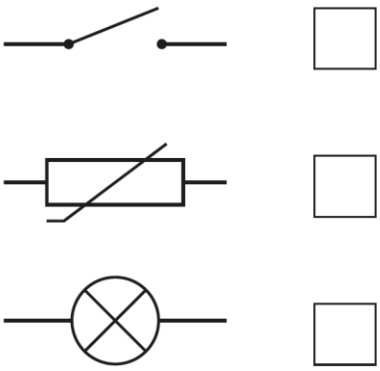
Key areas for improvement in future series include rearranging equations, reading values from a graph, describing methods for practical activities and working scientifically skills.

Question 11 (a) and (b)

11 A **thermistor** has a resistance which changes with temperature.

(a) Which symbol is a thermistor?

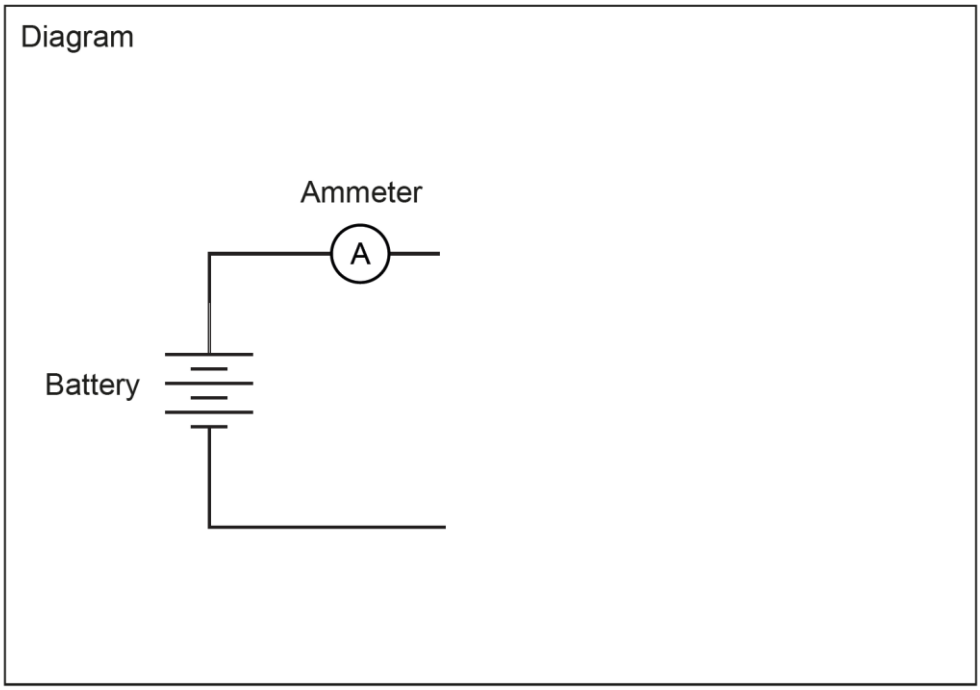
Tick (✓) **one** box.



[1]

(b) A student determines the resistance of a thermistor using an ammeter and a voltmeter.

Complete the diagram to show a circuit they can use.



[3]

Most candidates had a good understanding of electrical circuits symbols in Questions 11 (a) and (b). Many candidates, however, did not recall how to connect the voltmeter correctly into the circuit. Only the higher scoring candidates connected it in parallel with the thermistor. Some candidates scored zero in Question 11 (b) as, even though they correctly identified the symbol for the thermistor in Question 11 (a), they chose to use the symbol for a different component in Question 11 (b).

Assessment for learning

Candidates may continue to benefit from activities involving electrical circuits, for example identifying errors in circuit diagrams where components are not correctly connected.

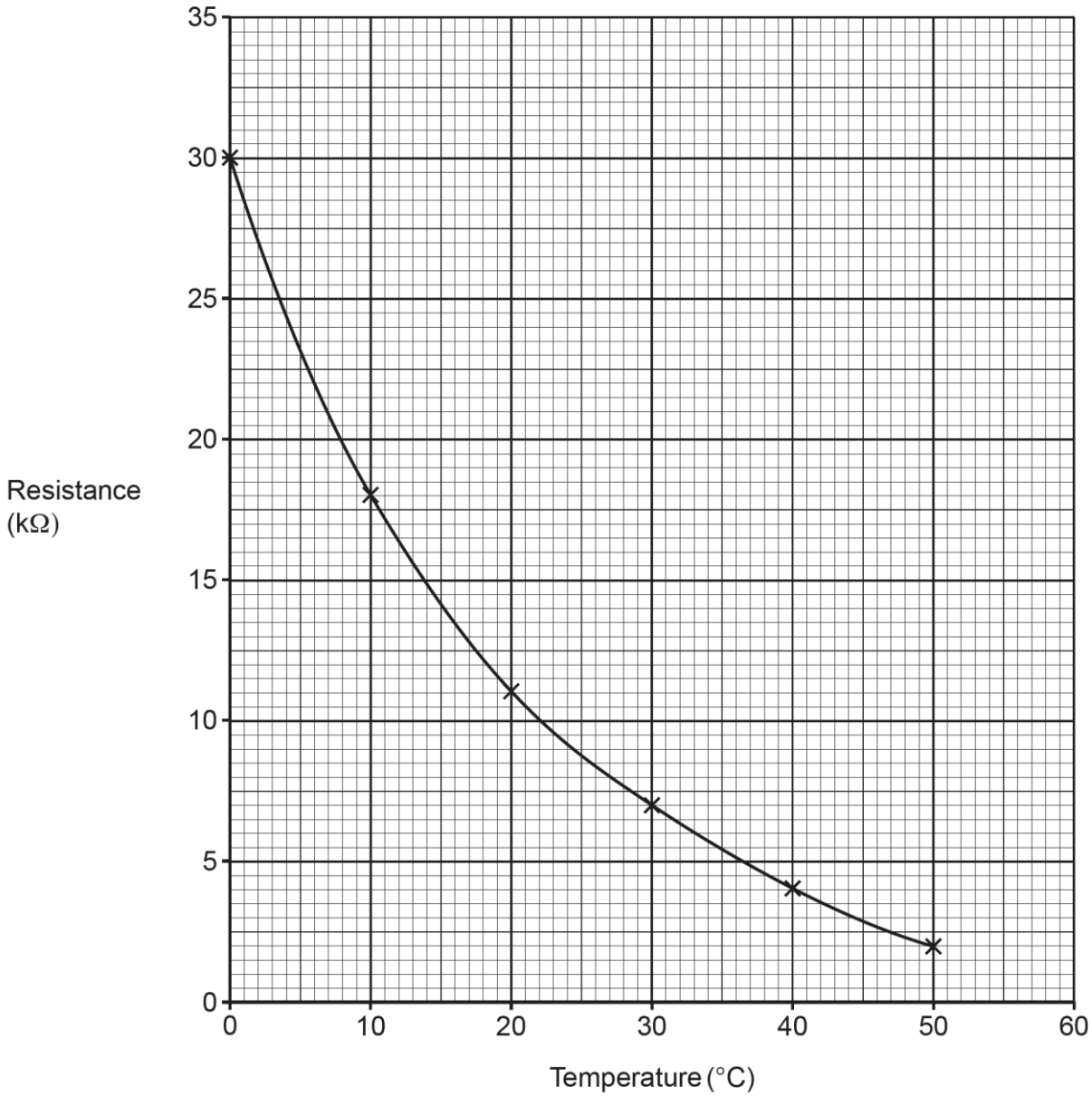
Misconception

A common misconception was that candidates thought voltmeters are connected in series in a circuit.

Question 11 (c) (i) and (ii)

(c) The student finds the resistance of the thermistor at several different temperatures.

The graph shows their results.



(i) Describe the trend between temperature and resistance.
Include data from the graph to support your answer.

.....

.....

.....

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

(ii) A thermistor is to be used in the range 20 °C to 40 °C.

Its resistance must change by at least 10 kΩ over this range.

Explain why this thermistor is **not** suitable?
Include data from the graph.

.....

.....

.....

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

Candidates struggled to use data from the two graphs to support their answers in Question 11 (c).

Part (c) (i) discriminated well with only higher achieving candidates scoring both marks.

Nearly half of candidates did not gain credit in part (c) (ii). The most common errors included:

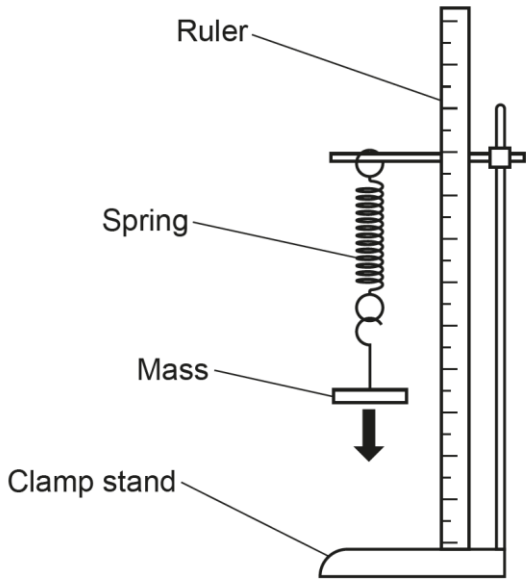
- vague answers that did not involve the use of data but only referred to the resistance not changing by 10 Ω
- misreading the values form the graph at 20 °C and 40 °C.

Assessment for learning

Candidates often found it challenging to clearly describe the trend between two variables, especially when asked to use data to support their answer. Short starter/plenary activities may be very beneficial where students are provided with different graphs to describe, involving both familiar and unfamiliar data.

Question 12 (a)

12 A student investigates a spring. They set up this apparatus.



(a) Explain how the student finds the **extension** of the spring.

.....

.....

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

Candidates found it challenging to score any marks on this question, usually because their answers were too vague and often just repeated the question.

Common incorrect answers included:

- measure the extension
- measure the spring when extended
- measure how much longer the spring gets.

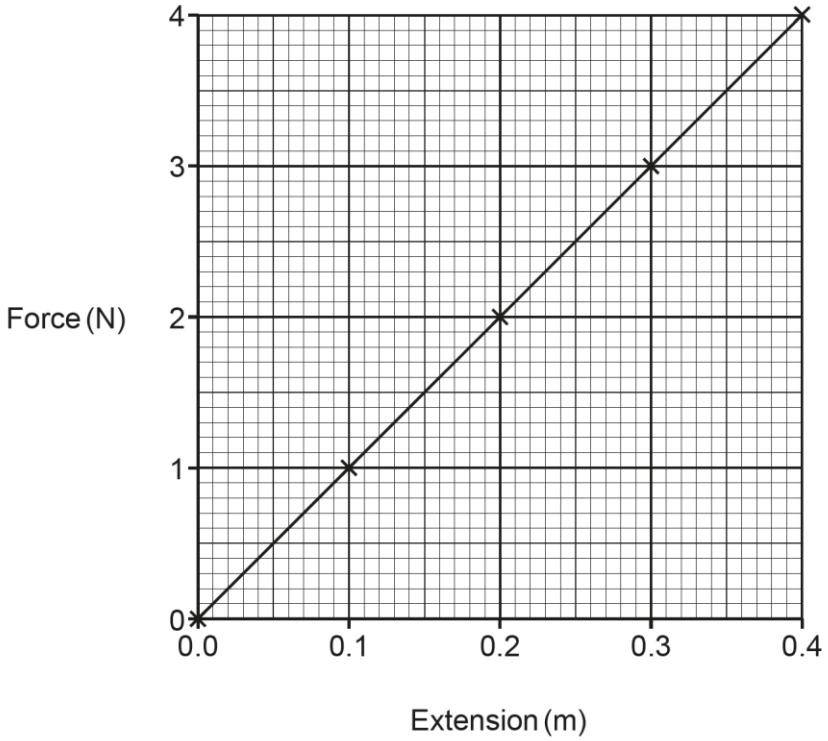
Assessment for learning

When asked how to find or measure a quantity, candidates should make sure that they are very clear in their description of which quantities they are measuring, i.e. the length of the spring before the mass is added and the length of the spring after the mass is added (and then subtract to find the extension).

Question 12 (c)

(c) The student measures the extension of the spring for four different forces.

They plot a graph of force against extension.



Use any point on the graph to calculate the spring constant for this spring.

Use the equation: force exerted by a spring = spring constant × extension

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

Most candidates did not gain credit as they did not rearrange the equation correctly.

A small number of candidates did not gain marks due to misreading values from the graph.

Question 13 (a)

13 Cool packs are used to treat injuries by cooling the injured area.

Cool packs are stored in a freezer. The chemical they contain is solid in the freezer, but it melts on contact with warm skin.

(a) When the cool pack melts, the density of the chemical inside **decreases**.

Explain why the density **decreases**.

Use ideas about particles.

.....

.....

.....

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

This question demonstrated that candidates could improve understanding about density changes in terms of particles. Nearly all candidates attempted the question but most responses referred to the motion of particles rather than the separation when explaining why the density decreases.

Question 13 (b)

(b) The cool pack contains 0.125 kg of a chemical with a specific latent heat of 425 000 J/kg.

Calculate the energy needed to **completely** melt the chemical in the cool pack.

Give your answer to **3** significant figures.

Use the Equation Sheet.

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

Most candidates made a good attempt at this question. The majority of candidates gained at least 3 marks and it discriminated well between the lower achieving and higher achieving candidates. The most common error was that candidates were unable to give their answers to 3 significant figures correctly.

Misconception

Many candidates had the misconception that giving their answer to 3 significant figures meant that they just needed to quote the first 3 numbers in their answer.

Exemplar 1

Use the Equation Sheet. Thermal energy for change in state
= ~~0.125kg~~ mass x specific latent heat
= 0.125 x 425000
= 53125
= 531

Energy = ~~531~~ 531 J **[4]**

In this exemplar, the candidate clearly showed all of their working, including:

- selecting and quoting the correct equation
- substituting the values into the equation
- evaluating their answer.

The answer of 53125 gained the candidate 3 out of the 4 possible marks. The candidate was not given the 4th mark as they did not correctly state their answer to 3 significant figures.

Exemplar 2

Energy = 531 J **[4]**

This candidate was not given any marks even though they quoted the same final answer as the candidate in Exemplar 1. If the final answer is incorrect, candidates can only be awarded compensatory marks based on their working. In this exemplar, the candidate has not shown any working so could not be given any marks.

Exemplar 1 and Exemplar 2 highlight the importance of showing all working in a numerical question to gain compensatory marks.

Question 14*

14* Some air is in a closed container.

The table shows its pressure at two temperatures.

Temperature (°C)	2	100
Pressure (kN/m^2)	110	140

Explain how the pressure of the air changes.

Use ideas about the movement of particles.

.....

.....

.....

.....

.....

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

The Level of Response question was assessed AO1 and AO2. It required candidates to explain what creates air pressure on the container and how the pressure varied with temperature.

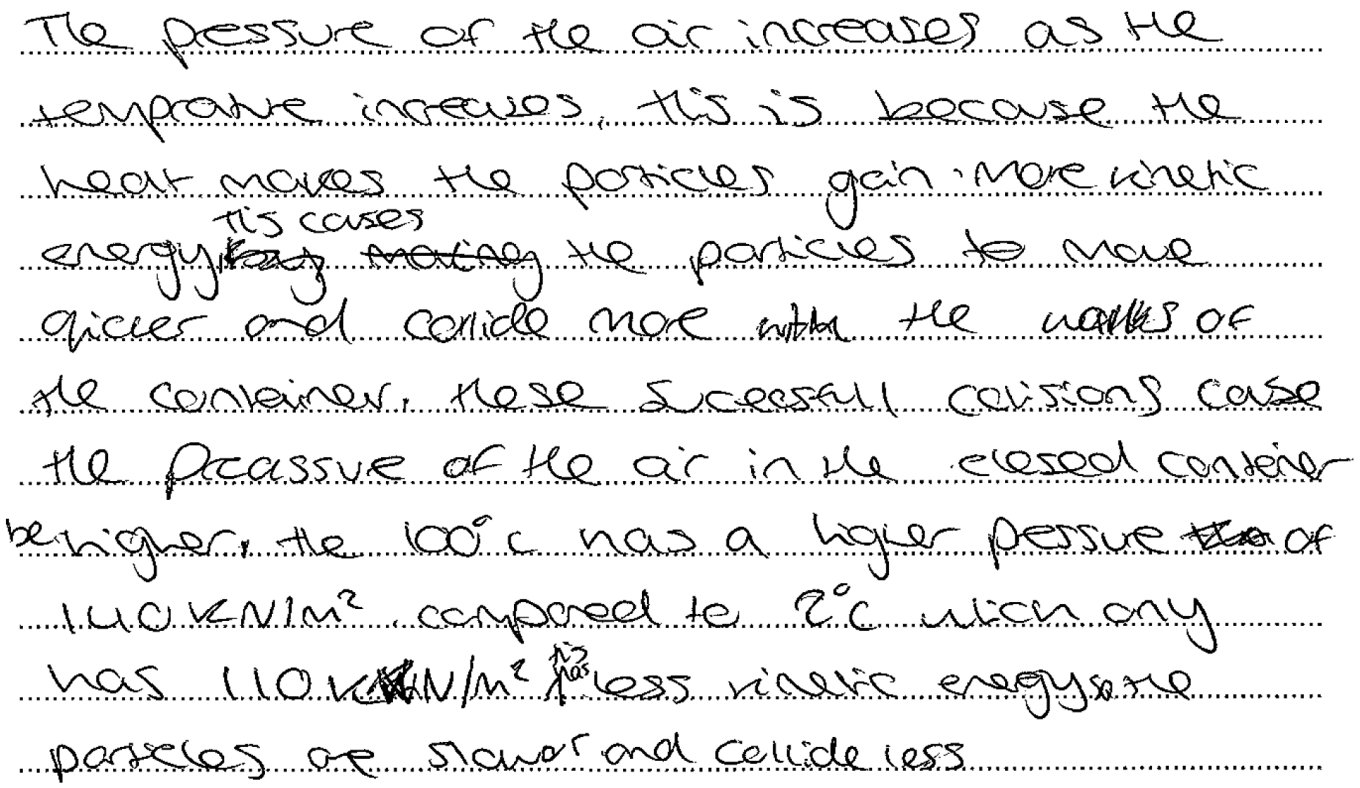
The question was attempted well with the majority of candidates awarded Level 1 or Level 2. However, the question proved challenging to some candidates as a significant number did not gain any credit. Common errors included referring to successful collisions and different states of matter, even though the question clearly stated it was about a gas.

Most candidates gave at least a basic explanation of either the trend shown by the data or how pressure is created by particles colliding or moving quickly.

Candidates who gave a clear explanation, identifying that the particle collisions were with the walls and linking the effects of temperature, pressure and speed progressed to Level 2.

Higher achieving candidates progressed to Level 3 by linking increased pressure with more frequent or more forceful collisions.

Exemplar 3



Level 2, 4 marks awarded for a clear explanation of pressure and changes in pressure.

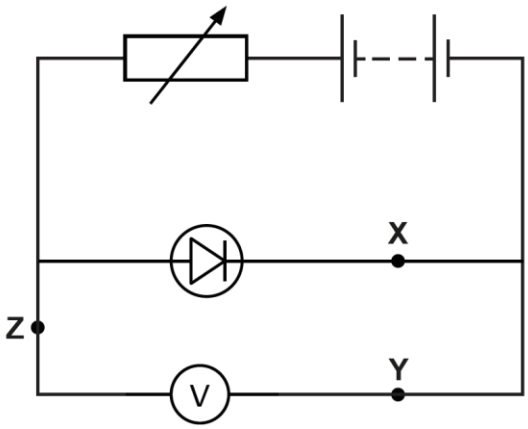
The candidate links temperature increase to increase in kinetic energy and there is a clear description about how pressure increases with temperature. There is also a clear description about collisions with walls creating pressure. The candidate mentions that the particles collide 'more' but this is insufficient as they need to say collide more 'frequently' or with more 'force' in order to progress to Level 3.

Question 15 (a)

15 Student **A** is investigating the question:

'How does the potential difference across a diode affect the current through it?'

They set up this circuit.



(a) **One** component is missing from the circuit.

State the name of this component.

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

The majority of candidates were able to identify the correct component.

Question 15 (b)

(b) Which position should this component be added?

Tick (✓) **one** box.

X ☐

Y ☐

Z ☐

[1]

The majority of candidates were able to identify the correct component in part (a) but far fewer knew the correct position for the component in part (b).

Question 15 (c)

(c) A variable resistor is placed next to the battery.

Why is it used in this investigation?

.....

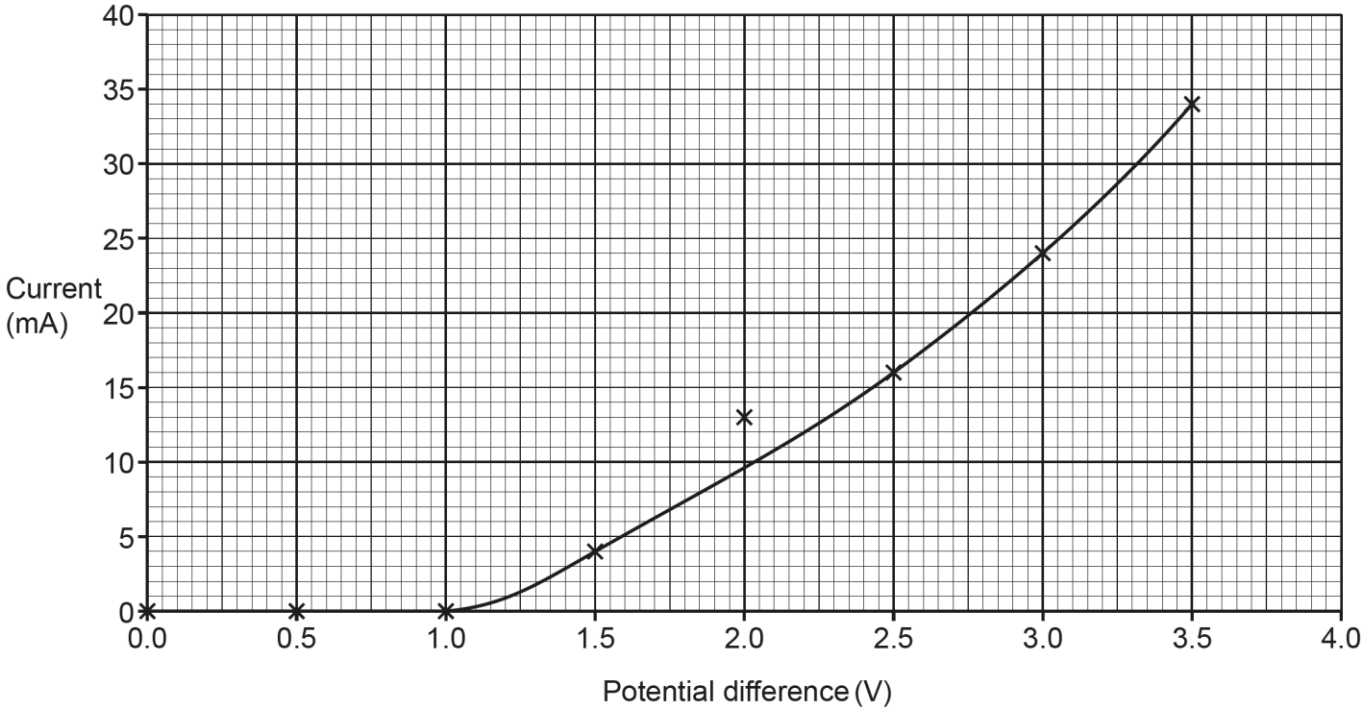
..... **[1]**

The purpose of a variable resistor was not well answered and few candidates gained credit. Incorrect answers varied, with many referring to varying or measuring the resistance/energy/power.

Question 15 (d) (i)

(d) Student **A** does the experiment and plots a graph of their results.

The graph shows the relationship between potential difference and current.



(i) Which potential difference shows an **anomalous** result?

Tick (✓) **one** box.

0.0 V ☐

2.0 V ☐

3.5 V ☐

[1]

Nearly all candidates understood the meaning of anomalous result and were able to identify it on the graph.

Question 15 (d) (ii) and (iii)

(ii) Use the graph to find the current when the potential difference is 2.75 V.

Current = ... mA **[1]**

(iii) State the **maximum** potential difference before the diode conducts.

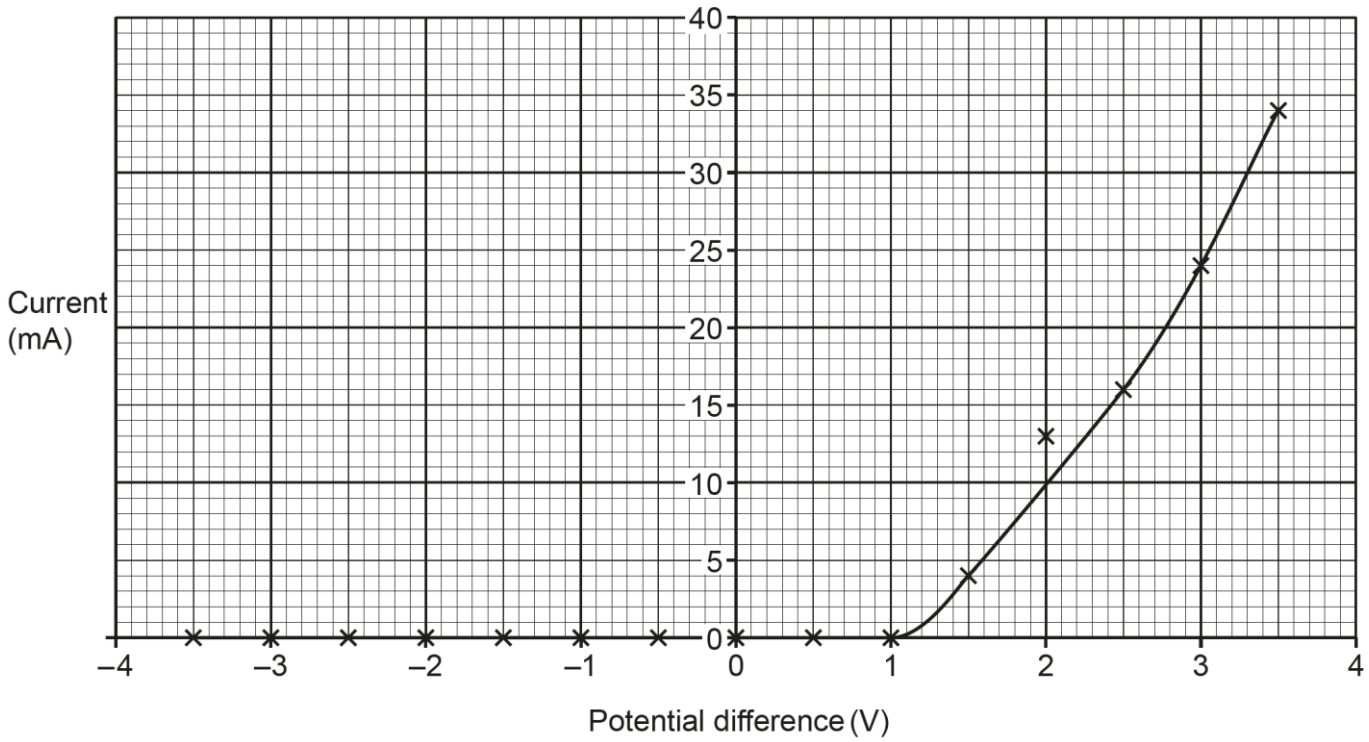
Use the graph.

Maximum potential difference = ... V **[1]**

This question asked candidates to read the maximum potential difference from the graph **before** the diode conducts. The most common incorrect response of 3.5 V. This implied that reading from the graph was not the issue. Candidates may not have read the question carefully enough, instead of stating the maximum potential difference before the diode conducts, candidates stated the highest potential difference reading from the graph.

Question 15 (e)

(e) Student **B** improves the investigation and obtains the results shown in this graph.



Describe what Student **B** did to get the additional results.

.....

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

This question assessed candidates' knowledge of how a diode behaves and how to plot the current-potential difference graph for a diode. The majority of candidates did not demonstrate understanding that the battery or diode had to be reversed in order to get the additional results.

Misconception

Many candidates had the misconception that the additional results could be achieved by 'decreasing the potential difference into negative numbers'.

Question 16 (a), (b) and (c)

16 An iron bar can be magnetised by placing it inside a magnetic field.

(a) What **type** of magnet is the iron bar?

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

(b) Complete this sentence about magnetic fields.

Use words from the list.

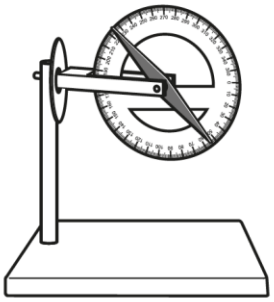
aluminium powder	**gold leaf**	**iron filings**	**plotting compasses**

The shape of the magnetic field around a bar magnet can be investigated using

..... or ..... .

[2]

(c) The diagram shows a **dipping compass**.



Describe how dipping compasses are used to find the shape of the Earth's magnetic field.

.....

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

Question 16 assessed candidates' knowledge of magnetism. Nearly all candidates were able to identify at least one of the items used to investigate the shape of a magnetic field in part (b) but fewer gained full credit. The most common incorrect answer was aluminium powder.

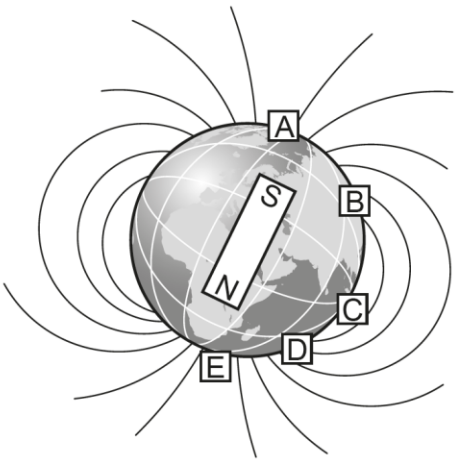
Dipping compasses have been assessed in previous years but candidates still demonstrated a lack knowledge in how they are used, with very few getting a mark in part (b).

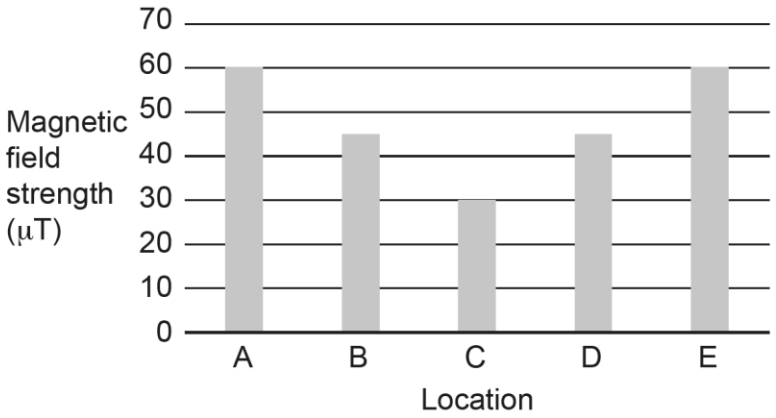
Question 16 (d)

(d) Scientists think that the Earth is surrounded by a magnetic field.

They measured the magnetic field strength at different locations around the Earth, **A**, **B**, **C**, **D** and **E**.

The graph shows the magnetic field strength at these different locations.





Describe the pattern in the results shown on the graph.

What does this pattern in results show about the magnetic field strength around the Earth?

.....

.....

.....

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

This question asked candidates to do two things: describe the pattern in the graph and to relate this to the magnetic field strength around the Earth. Most candidates scored at least 1 mark, although there were a large number who did not gain credit. This was mainly due to answers being too vague, for example saying that the magnetic field strength is different in different places or linking the magnetic field strength to how close the location was to the core of the Earth.

Question 17 (a) (i) and (ii)

17 In the early part of the twentieth century, several scientists developed new ideas about what atoms look like.

(a) Thomson proposed the plum pudding model in 1904.

(i) What are the two main ideas about **electric charge** in this model?

1 .....

.....

2 .....

.....

[2]

(ii) Give **one** reason this model was not developed until 1904.

.....

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

Question 17 was an overlap question with the Higher Tier paper and therefore of standard demand. It assessed candidates' understanding of models of the atom. The idea of the plum pudding model did not appear to be well understood. Many candidates mentioned positive charges and negative charges but not in a way which was consistent with the plum pudding model.

Misconception

The most common misconception was candidates thought that the plum pudding model was the same as the current model of the atom and described Bohr's model.

Question 17 (b) (i)

(b) Rutherford fired alpha particles at gold foil. He published his results in a scientific journal.

(i) Suggest **two** reasons why he published his results in a scientific journal.

1 .....

.....

2 .....

.....

[2]

This question assessed working scientifically skills and candidates made a good attempt, with most gaining at least 1 mark. The most common incorrect answer referred to an idea that Rutherford wanted to become famous.

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