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OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250

For first teaching in 2016

J250/11 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 11 series overview

J250/11 is one of six papers for the GCSE (9-1) Gateway Science Combined Science A Higher Tier Qualification. It is the first of the two physics papers covering Topics P1 Matter, P2 Forces, P3 Electricity and magnetism and CS7 Practical skills.

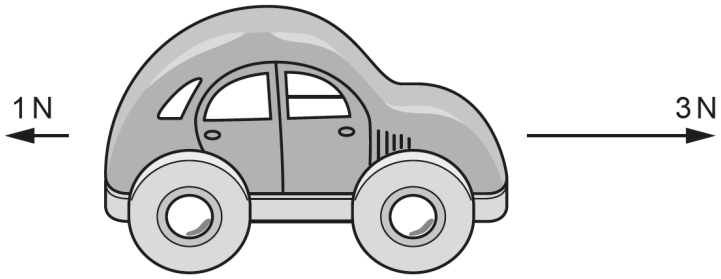
Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• read the questions carefully, considered the command words and gave full responses for questions asking about, e.g. a description, an explanation, a diagram, use of a graph, a definition and use of a free-body diagram. • considered the number of marks available for the question and provided a suitably detailed response as required for the number of marks. • worked through calculations in a methodical manner, showing clear steps in their calculations. • gave a well-developed line of reasoning which was clear, logically structured and relevant for the LOR question.	• tried to change an answer to the multiple choice questions by overwriting the letter rather than crossing out the original letter and rewriting the new letter clearly. • provided a very brief and simple explanation for questions that were worth more than 1 mark. • gave just the final numerical response for calculations, without showing the steps and working out. This means that if there is an incorrect step in the calculation making the final numerical response incorrect then 0 marks were given. • gave muddled responses and repeated information for the LOR question.

Section A overview

This section consists of 10 multiple choice questions testing AO1 and AO2.

Question 1

1 The diagram shows some forces acting on a toy car.



Which row of the table describes the motion of the toy car?

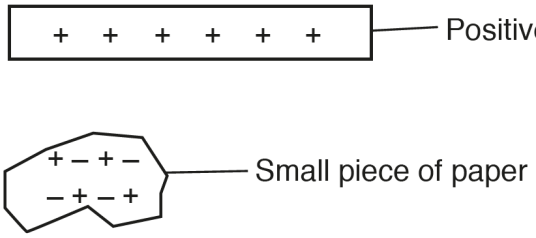
	Resultant force	Motion
A	2 N forwards	acceleration
B	2 N forwards	constant velocity
C	3 N forwards	acceleration
D	3 N forwards	constant velocity

Your answer ☐ **[1]**

Most candidates were able to identify the resultant force as being 2N but found it harder to identify the motion being acceleration rather than constant speed. Therefore, the most common error was to select response B rather than the correct response A.

Question 2

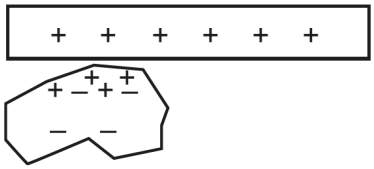
2 The diagram shows a positively charged rod near a small piece of paper.



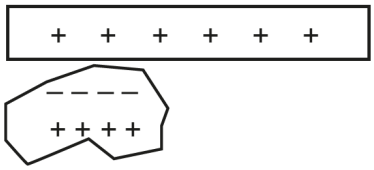
The paper is attracted to the rod.

Which diagram shows the **correct** distribution of positive and negative charges in the piece of paper as the rod is brought closer?

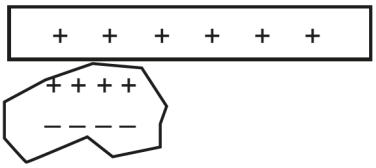
A



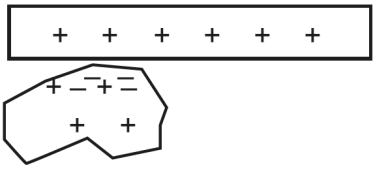
B



C



D



Your answer ☐ **[1]**

The majority of candidates selected response B or A, rather than the correct response D.

Question 3

3 A compass needle is made of a magnet containing a north pole and a south pole.
The N pole of the compass needle points north on Earth.

Which row in the table describes the magnetic field of the Earth?

	Type of magnetic pole near to the Earth's geographic north pole	Direction of magnetic field
A	N	N to S
B	N	S to N
C	S	N to S
D	S	S to N

Your answer ☐ **[1]**

Most candidates were able to identify the direction of the magnetic field as being N to S, however, a few were unable to identify the type of magnetic pole near the Earth's geographic north pole as S. Therefore, the most common error was to select response A rather than the correct response C.

Question 4

4 A ball is inflated with air.

In which environment will the air inside the ball have the **highest** pressure?

A In a refrigerator (3 °C)

B In a house (18 °C)

C Outside on a cold day (5 °C)

D Outside on a warm day (21 °C)

Your answer ☐ **[1]**

This question was well answered with the majority of candidates recognising that D, outside on a warm day, was the correct response. The most common incorrect response was A, in a refrigerator.

Question 5

5 A 1.5 V cell transfers 18 mC of charge in a circuit.

What is the amount of energy transferred by the cell?
Use the Data Sheet.

A 0.027 mJ

B 0.27 J

C 27 mJ

D 27 J

Your answer ☐ **[1]**

Half the candidates gave the correct response C, 27 mJ. The most common incorrect response was response A, 0.027 mJ.

Question 6

6 A student does 20 "step ups" onto a wall.

- The total work done by the student is 3000 J.
- The time taken is 24 s.

Calculate the power of the student.

Use the equation: power = $\frac{\text{work done}}{\text{time}}$

A 6.25 W

B 125 W

C 2500 W

D 3600 W

Your answer ☐ **[1]**

The majority of candidates selected option B, 125 W, having carefully read in the question that 3000 J was the total work done by the student.

Exemplar 1

Calculate the power of the student.

Use the equation: power = $\frac{\text{work done}}{\text{time}}$

3000 / 24

A 6.25 W

B 125 W

C 2500 W

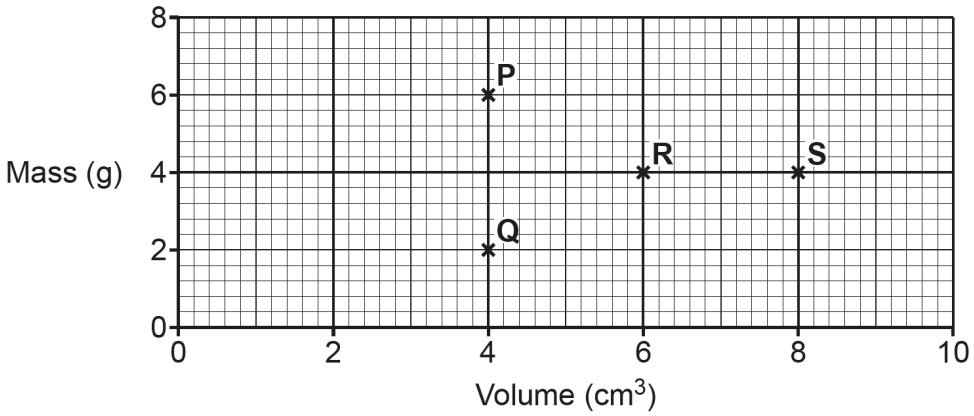
D 3600 W

Your answer B **[1]**

This response shows a candidate who highlighted the important information in a question by underlining it, and, where appropriate, clearly showed the individual steps in a calculation performed well. The candidate has used the equation given, $\text{power} = \frac{\text{work done}}{\text{time}}$.

Question 7

7 A student measures the mass and volume of four blocks.
The graph shows their results.



Which two blocks have the **same** density?

Use the equation: density = $\frac{\text{mass}}{\text{volume}}$

A **P** and **Q**

B **P** and **R**

C **Q** and **S**

D **R** and **S**

Your answer ☐ **[1]**

The majority of candidates selected option C, points Q and S on the graph. These candidates often gave all the calculations, P = 6/4, Q = 2/4, R = 4/6 and S = 4/8 before coming to the response that the density for Q and S are both 0.5 g/cm^3.

Question 8

8 Planets **X** and **Z** are the same size.

- The gravitational field strength on planet **X** is 12 N/kg.
- Planet **X** has a mass of 1×10^{25} kg.
- Planet **Z** has a mass of 4×10^{25} kg.

What is the gravitational field strength on planet **Z**?
Use the Data Sheet.

A 0.75 N/kg

B 3 N/kg

C 12 N/kg

D 48 N/kg

Your answer ☐ **[1]**

Erratum Notice

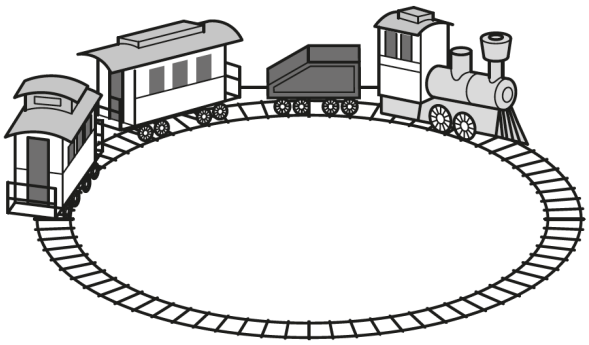
Turn to **page 6** of the **question paper** and look at **question 8.**

In **line 6** cross out 'Use the Data Sheet'.

The majority of candidates selected the response D, 48 N/kg, with many of these candidates showing their workings in the space beside the question. The most common incorrect response was B, 3 N/kg.

Question 9

9 A toy train moves around a circle of track.
The speed of the toy train is 2 cm / s.



Why is the velocity of the toy train changing?

A Air resistance is acting on the toy train.

B Force of track on toy train = force of toy train on track.

C Friction is acting between the track and the toy train.

D The toy train is changing direction.

Your answer ☐ **[1]**

Half the candidates gave the correct response D, the toy train is changing direction. The most common incorrect response was response C, friction is acting between the track and the toy train.

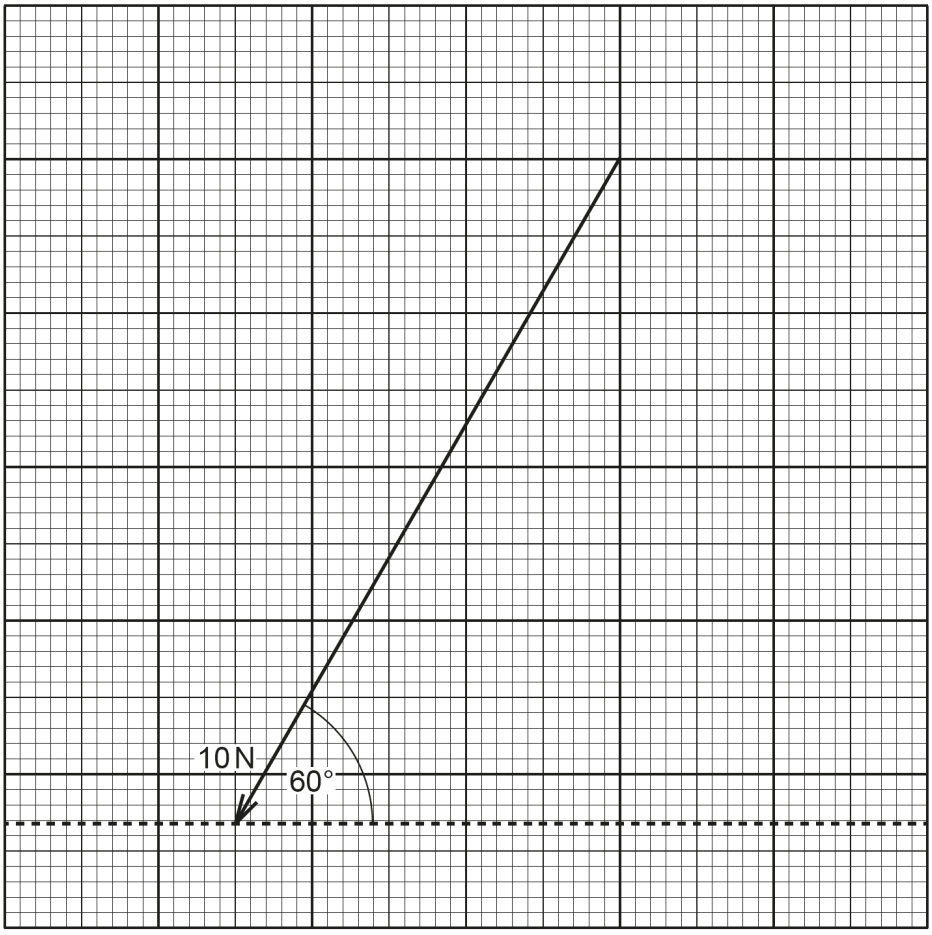
Misconception

? Many candidates find it difficult to distinguish between speed and velocity. In this question the candidates are told that the speed of the toy train is 2 cm/s and are asked why the velocity is changing as it moves around the circular track in the diagram. Many candidates think that velocity can only change if the toy train slows down due the friction acting between the track and the toy train.

Question 10

10 A child uses a force of 10 N at an angle of 60° to push a toy car.
This is a **scale diagram** of the force:

Scale:
1 cm = 1 N



What is the **horizontal** component of the force pushing the toy car?
Use the scale diagram.

A 3.2 N

B 5 N

C 8.7 N

D 10 N

Your answer [ ] **[1]**

The majority of candidates selected the response B, 5 N, with many of these candidates drawing both the vertical and horizontal components on the grid.

Question 11 (a)

11 (a) Describe the difference between specific heat capacity and specific latent heat.

.....

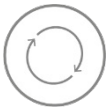
.....

.....

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

A third of candidates gained some marks for this question, although most of these only gained 1 mark. The descriptions of specific latent heat were generally less successful, with many candidates either not attempting to describe it or giving vague responses such as the energy to change without a change in temperature or the amount of heat needed to make 1kg of solid change. Many candidates gave responses that described specific heat capacity as the 'temperature' required to increase the temperature of 1 kg of a substance rather than the 'energy' required.

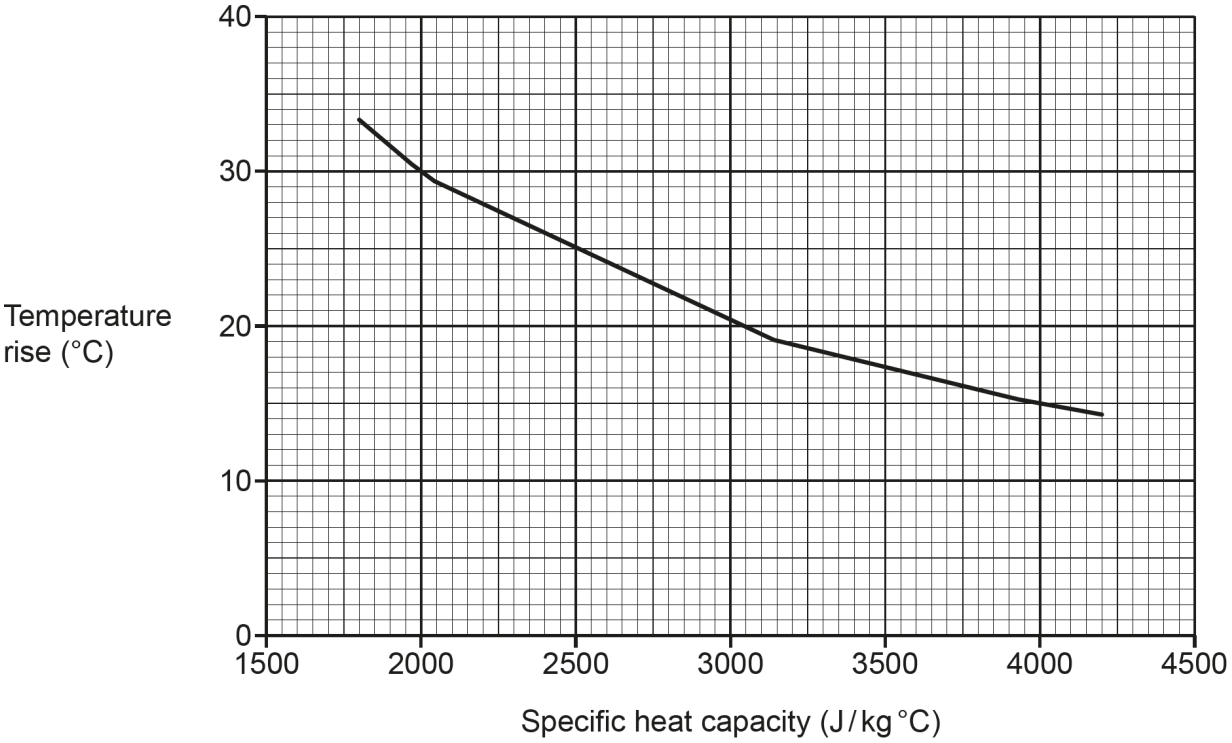
Assessment for learning



Candidates need to read the question carefully and respond to the whole question. This question asks candidates to describe the difference between specific heat capacity and specific latent heat. The majority of candidates only gave a definition of specific heat capacity and did not describe how this is different from specific latent heat.

Question 11 (b) (i)

(b) A small heater is used to increase the temperature of different liquids.
The graph shows how the temperature rise changes due to the varying specific heat capacities of these liquids.



(i) Using the graph, describe the relationship between temperature rise and specific heat capacity.

.....

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

Most candidates described the relationship between temperature rise and specific heat capacity as 'when the temperature increases the specific heat capacity decreases.' A few candidates tried to describe the relationship in terms of a negative correlation or with vague incorrect descriptions such as 'as one goes up so does the other one'.

Question 11 (b) (ii)

(ii) A liquid has a specific heat capacity of 1600 J / kg °C.

Use the graph to estimate the temperature rise of the liquid.

Temperature rise = ... °C **[2]**

The majority of candidates were able to use the graph to estimate the temperature rise of the liquid, with the most common correct response being 37°C. These candidates also tended to extrapolate the graph to show how they had reached this temperature rise. Candidates who gave responses in the range of 33°C to 34°C drew a horizontal line from the line to the y axis on the grid and had therefore not considered that the trend would continue.

Question 11 (b) (iii)

(iii) State **one** assumption you made when answering **(b)(ii)**.

.....

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

Many candidates gave incorrect responses to this question such as 'the specific heat capacity will stay the same', 'no further heat will be lost', 'the temperature is constant' and 'the temperature can only rise to 40°C'.

Question 11 (c)

(c) A student calculates the specific heat capacity of water.
The student does **one** experiment and gets this result:

- Student's value = 4250 J / kg °C.
- Textbook value = 4200 J / kg °C.

Complete the sentence below.
Use one of the words.

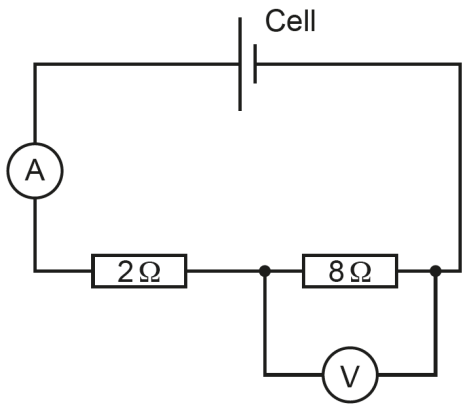
Accurate	**Precise**	**Reliable**	**Repeatable**	**Systematic**

The student's value is …….. . **[1]**

Most candidates completed the sentence with 'The student's value is accurate'. These candidates worked their way through the possible words in the box and crossed out the incorrect options.

Question 12 (a)

12 A teacher builds the circuit shown in the diagram.



(a) Give the **total** resistance of the circuit.

Total resistance = ... Ω **[1]**

The majority of candidates gave the response of 10 Ω. As the addition was quite simple, 2 + 8 = 10 Ω, working out was rarely seen.

Question 12 (b)

(b) The voltmeter reads 4 V.

Calculate the ammeter reading.
Use the Data Sheet.

Ammeter reading = ... A **[3]**

This question was not answered well with very few candidates gaining any marks apart from writing the equation, current = p.d. ÷ resistance or 4 ÷ 10. Many candidates did not look carefully at the circuit diagram and assumed that the voltmeter reading of 4 V was for the whole circuit rather than just across the 8 Ω resistor.

Assessment for learning

Candidates need to read the question carefully and look carefully at any diagrams, especially circuit diagrams. This question asks candidates to calculate the ammeter reading so they need to look at the position of the ammeter and the position of the voltmeter in the circuit diagram.

Question 12 (c)

(c) Calculate the potential difference across the cell.

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

The majority of candidates were able to calculate the potential difference across the cell. However, some candidates just multiplied their response to resistance in part (a) by the voltmeter reading, 4 V.

Question 13 (a)

13 Children often make models with clay.
Clay and springs behave differently.

(a) Draw **three** lines to match the **materials** to the **properties**.

Materials	Properties
	Elastic
Clay	
	Obeys Hooke's law
Spring	
	Plastic

[3]

The majority of candidates correctly drew one line from clay to plastic and two lines from spring, one to elastic and one to obeys Hooke's law. However, some candidates confused the properties of elastic with plastic and so thought the spring had plastic properties.

Question 13 (b)

(b) Two children are squashing clay on a desk.

Child **A** says, 'Only one force is needed to squash clay.'
Child **B** says, 'There are three forces acting on the clay when I squash the clay.'

Using ideas about forces, explain why child **B** is correct.

Use a free-body force diagram to help explain your answer.

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.....

.....

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

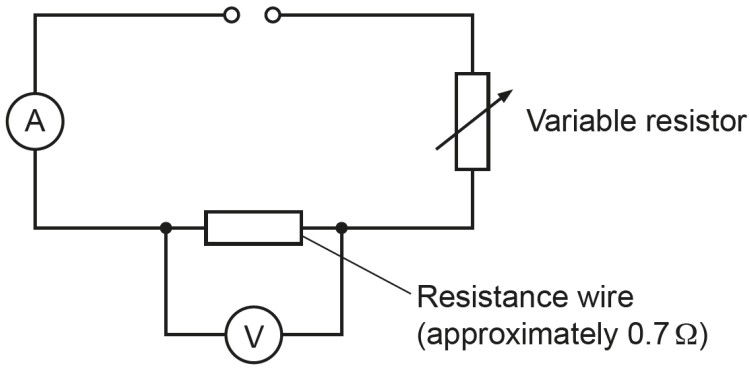
This was a challenging question with very few candidates gaining more than two marks. The expected response was for candidates to show the normal reaction from table (upward force arrow on clay), the weight of the clay (downward force arrow on clay) and the push of the hand (downward force arrow on clay) as a free-body force diagram. Many candidates only drew two force arrows, weight as the downwards force and air resistance or drag as the upward force. Other candidates did not attempt to draw a free-body diagram and instead just tried to describe the three forces, often without considering the directions of these forces.

Question 14*

14* A student investigates if a length of resistance wire has linear or non-linear behaviour.

They use the circuit shown in **Fig. 14.1**.

Fig. 14.1

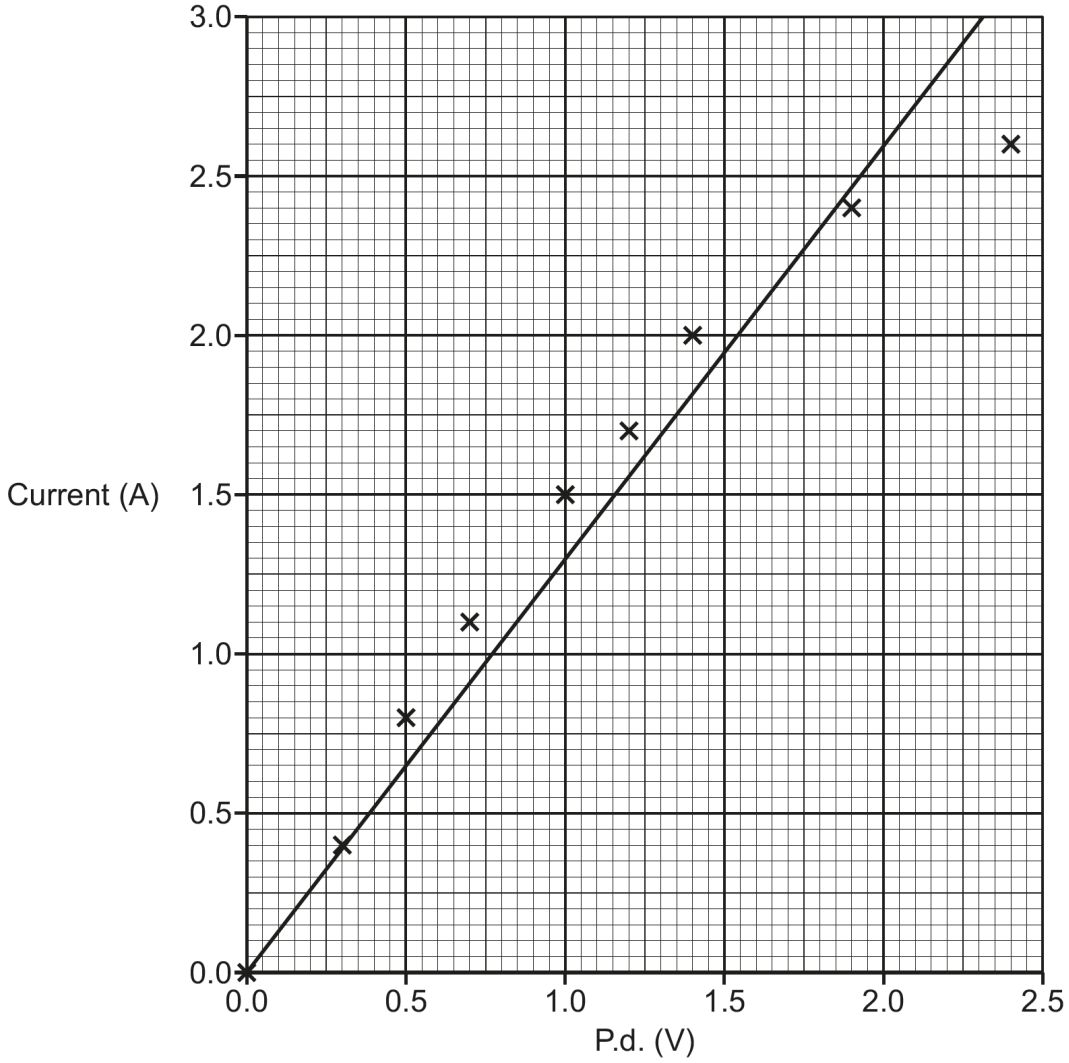


This is their method:

- Turn on the power supply.
- Measure the p.d. and current.
- Move slider on variable resistor.
- Take repeat measurements of p.d. and current.

Fig. 14.2 shows the student's results.

Fig. 14.2



The student says, 'I think my results are linear.'

Evaluate the student's graph (**Fig. 14.2**) and conclusion.

Suggest how their method could be improved.

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This is the level of response question. This question was attempted by the majority of candidates and the full range of the marks available were given. Many candidates gained marks for AO3.3d by suggesting improvements to the experimental procedure. Fewer candidates gained marks for AO3.1b and AO3.2a for analysing, evaluating and making a judgement about the graph by comparing the position of the plotting crosses with the position of the straight line.

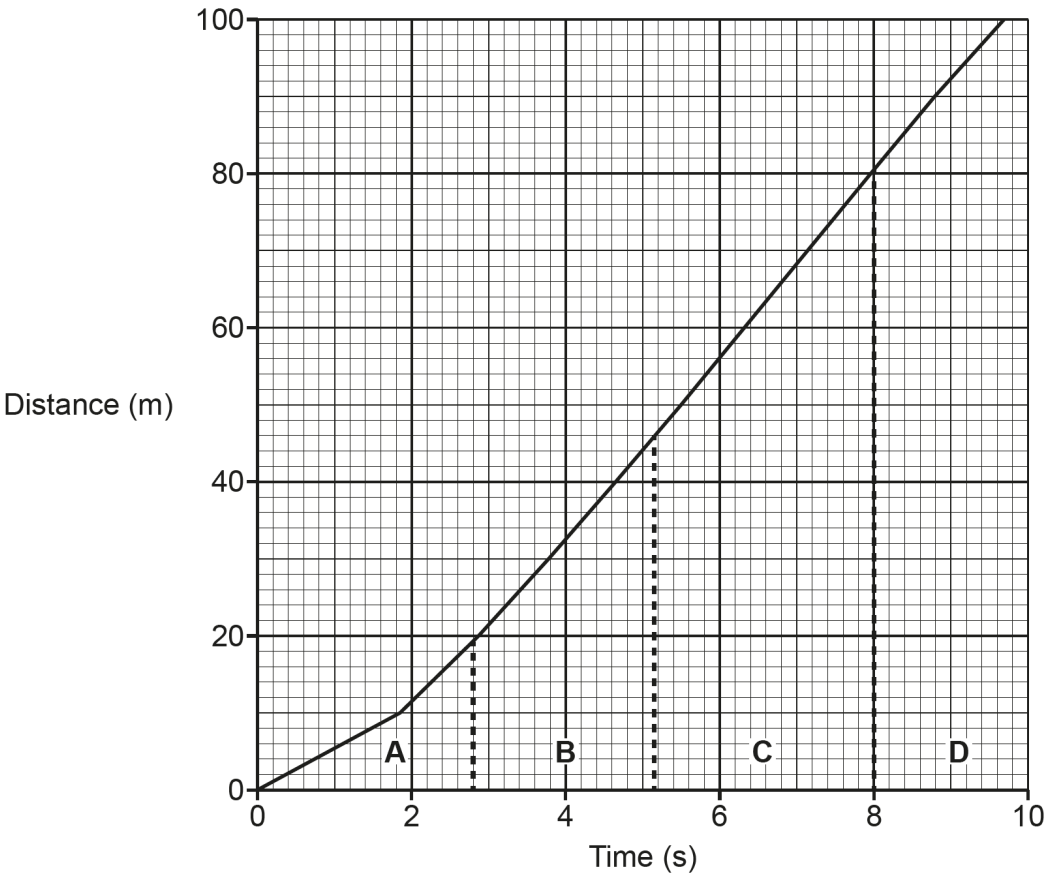
Exemplar 2

The students line of best fit is linear however the majority of the points are above the line of best fit with the exception of 2 underneath therefore their results are not linear. The method could of been improved by repeating the same length of wire a few times to see if their first results where accurate. The first six points are linear because as current increases ~~sodes~~ so does pd however the last 2 don't continue it. **[6]**

In this response, the candidate has broken their response down into a series of clear statements that cover all the requirements for AO3.3d, AO3.1b and AO3.2a. This is a good example of a response that meets all the criteria for Level 3 and was given 6 marks.

Question 15 (a)

15 An athlete ran a 100 m sprint.
This is a distance-time graph of the sprint:



(a) Describe the athlete's motion in part **A** and part **C**.

A .....

C .....

[2]

The majority of candidates were able to describe the athlete's motion in part A as accelerating. Fewer candidates were able to describe the athlete's motion in part C as constant velocity, with many of these candidates thinking the motion was still accelerating or moving at a different speed.

Question 15 (b)

(b) After the first 4 seconds, the athlete's speed is 11.5 m/s.
They travelled a distance of 32 m.

Calculate their acceleration during the first 4 seconds.

Use the Data Sheet.

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

Acceleration = ... m/s^2 **[4]**

Candidates usually either gained the full 4 marks or just 2 marks for this question. Some candidates were able to quote the equation to calculate acceleration and then show clear working to obtain the correct response to 2 significant figures. However, some candidates were unable to use the equation to calculate acceleration correctly and often did not give their response to 2 significant figures. These candidates did not see this part of the instruction in the question or gave their response to 2 decimal places.

Misconception

Many candidates believe that a response given to 2 decimals places is the same as a response with 2 significant figures.

OCR support

The Mathematical Skills Handbook provides guidance on the use of significant figures and the difference between significant figures and decimal places (Chapter 2: Handling Data).
www.ocr.org.uk/Images/310651-mathematical-skills-handbook.pdf

Question 16 (a)

16 A teacher teaches their class about momentum.

(a) Define the term **momentum**.

.....

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

Only the highest performing candidates were able to respond to this question correctly. Many candidates incorrectly thought that momentum is the speed or force required for an object to start moving or the acceleration of an object.

Question 16 (b)

(b) Define the **principle of conservation of momentum**.

.....

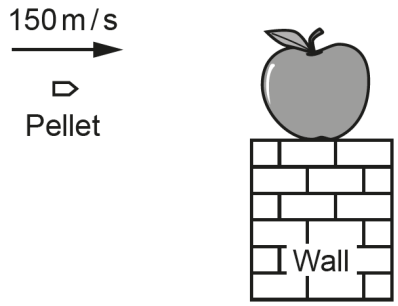
..... **[1]**

This was a challenging question with few candidates gaining the mark. Many candidates described the principle of conservation of energy rather than the principle of conservation of momentum.

Question 16 (c)

(c) In an experiment, shown in **Fig. 16.1**, the teacher uses a pellet gun to shoot an apple.

Fig. 16.1



The mass of the pellet is 7 grams.

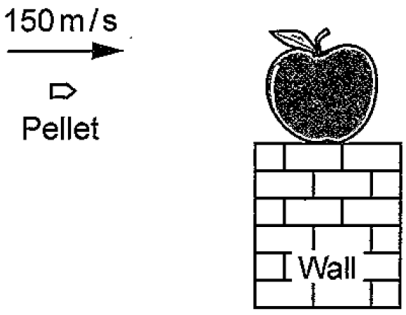
Calculate the momentum of the pellet before it hits the apple.
Use the Data Sheet.

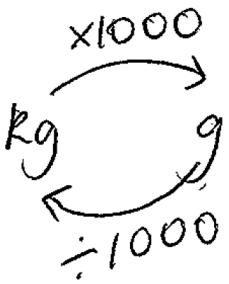
Momentum of pellet = ... kg m / s **[3]**

The majority of candidates correctly calculated the moment of the pellet. These candidates showed the steps in the calculation. Those responses that did not follow logical steps in a calculation often did not gain full marks. The most common error in this question was to use the mass in grams rather than the mass in kilograms in the calculation.

Exemplar 3

Fig. 16.1





The mass of the pellet is 7 grams.

Calculate the momentum of the pellet before it hits the apple.
Use the Data Sheet.

M = mass x velocity

7g = 0.007 kg

= 0.007 x 150

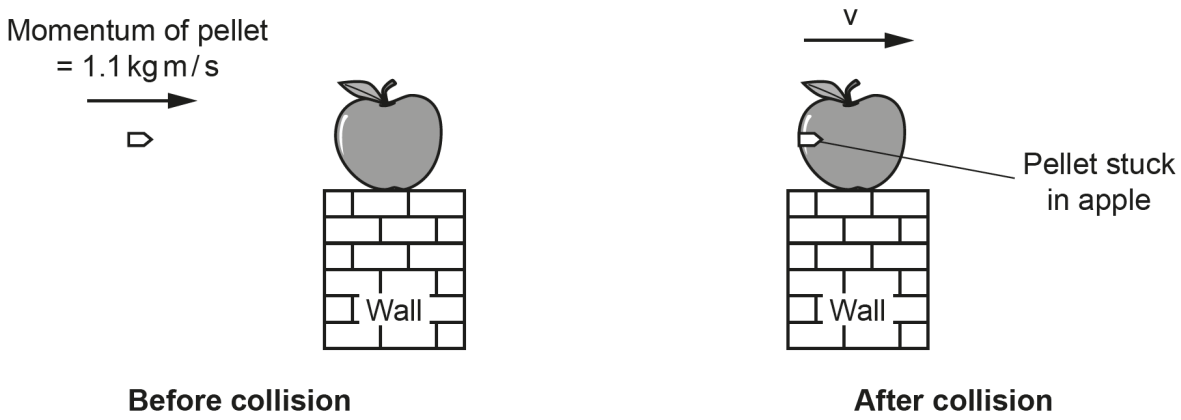
Momentum of pellet = 1.05 kg m/s **[3]**

In this response, the candidate has written the equation required to calculate momentum, the conversion of the mass in grams into the mass in kilograms and then substituted these numbers into the calculation. This response was given all 3 marks.

Question 16 (d)

(d) The teacher repeats the experiment with a different pellet as shown in **Fig. 16.2**.

Fig. 16.2



Before collision **After collision**

- The pellet becomes stuck in the apple and they move off the wall together.
- The mass of the pellet is 0.011 kg.
- The mass of the apple is 0.089 kg.

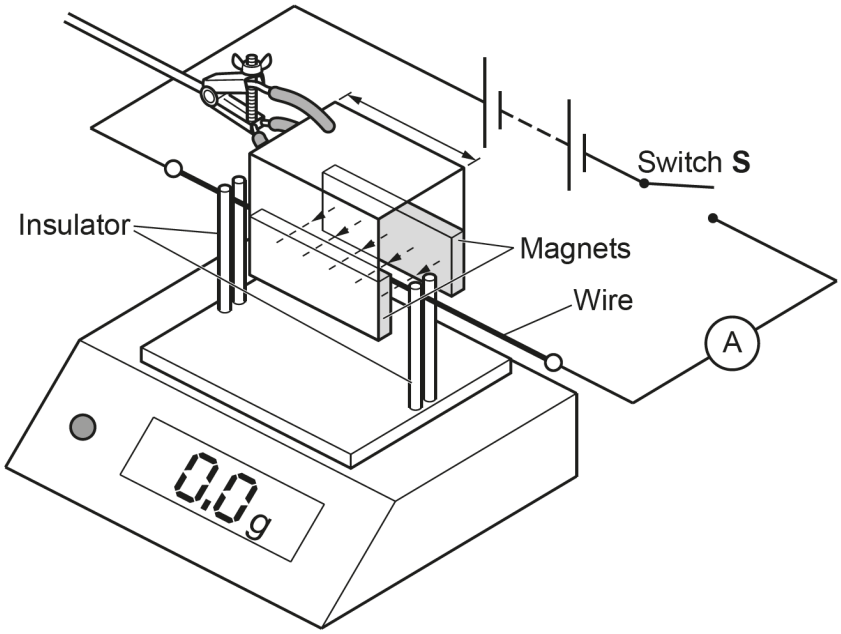
Calculate the velocity of the pellet and apple after the collision.
Use the Data Sheet.

Velocity of pellet and apple = ... m / s **[3]**

The majority of candidates correctly calculated the velocity of the pellet and apple. Those who did not gain full marks either calculated the momentum of just the apple or calculated the momentum of the pellet and the apple separately and then added these numbers together.

Question 17 (a)

17 The diagram shows a wire placed in a magnetic field.



The electronic balance is used to work out the force acting on the wire.

(a) When Switch **S** is open, the electronic balance reading is 0.0 g.
Explain why.

.....

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

The majority of candidates correctly explained that there was no current in the wire and therefore there was a reading of 0.0 g. Those who did not gain the mark either described there being no electricity flowing or just that the switch was not closed.

Question 17 (b) (i)

(b) When Switch **S** is closed, the electronic balance has a positive reading of 0.3 g.

(i) Explain why the balance shows a reading when Switch **S** is closed.

.....

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.....

.....

..... **[3]**

This was a very challenging question with very few candidates gaining any marks. The expected response was for candidate to describe that a current in a wire causes a magnetic field around the wire, this then interacts with the field around the magnet so causing a downward force on the wire. A few candidates gained 1 mark for mentioning that the force on the wire was downwards but very few wrote about the current in a wire causing a magnetic field around the wire.

Question 17 (b) (ii)

(ii) State the reading on the balance if the polarity of the battery is reversed.

Answer = ... g **[1]**

Less than a fifth of candidates gave the correct response of - 0.3 g. The most common responses being 0.3 g and 0.0 g.

Question 17 (b) (iii)

(iii) The polarity of the battery is unchanged from **(b)(i)**.
State the reading on the balance if the poles of the magnet are reversed.

Answer = ... g **[1]**

Less than a fifth of candidates gave the correct response of - 0.3 g. The most common responses being 0.3 g and 0.0 g.

Question 17 (c)

(c) The experiment is repeated.

- When Switch **S** is closed the force on the wire is 0.004 N.
- The ammeter reads 0.8 A.
- The length of the wire in the magnetic field is 0.05 m.

Calculate the magnetic flux density around the wire.
Use the Data Sheet.

Magnetic flux density = ... T **[3]**

The majority of candidates correctly calculated the magnetic flux density. These candidates usually gave the equation as flux density = force ÷ (current x length), then substituted the correct values into the equation before calculating the magnetic flux density as 0.1 (T).

Question 17 (d) (i)

(d) A student investigates if the current in the wire changes the force on the wire.

Answer the questions to describe how the student can do this investigation.

(i) What does the student **vary**?

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

The majority of candidates stated that current was varied by the student. A few candidates thought that the length of the wire was varied by the student.

Question 17 (d) (ii)

(ii) What does the student **control**?

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

Only about a quarter of candidates gave the correct response to this question with the most common response being the length of the wire. Some candidates thought the student controlled the size of the current, the resistance or the force on the wire.

Copyright information

Question 11 (b) (i) - graph produced using data from https://www.engineeringtoolbox.com/specific-heat-fluids-d_151.html

Question 15 (a) - graph has been produced adapting data from https://datagenetics.com/blog/july32013/index.html

Question 17 - adapted image of motor effect experiment

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