Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE PHYSICS B

J259
For first teaching in 2016

J259/03 Summer 2018 series

Version 1

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. 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 can be downloaded from OCR.

Paper J259/03 series overview

J259/03 Breadth in Physics is one of the two examination components aimed at Higher Tier candidates studying the new revised GCSE (9-1) 21st Century Science Suite.

The 13 questions of this 90 mark paper assess knowledge and understanding from all six chapters of the syllabus plus Practical Skills and Ideas about Science. Questions 1 to 3 are overlap questions which appear in identical form on the Foundation paper. In common with previous qualifications, approximately 40% of the marks were awarded for demonstrating knowledge and understanding of scientific ideas, techniques and procedures, 40% for applying that knowledge to solve problems and 20% for analysing information, drawing conclusions and improving experimental procedures. In contrast with previous qualifications, the new examination has a greater mathematical content with approximately 30% of the marks for simple and developed calculations. A very small number of questions worth approximately 5 marks on this paper were synoptic. This means that candidates were required to piece together ideas from the different chapters of the syllabus in order to answer them.

Candidates who did well on this paper generally did the following:

- Recalled, rearranged and substituted numbers into equations with their working shown clearly.
- Recognised when units such as minutes needed to be converted to seconds for example.
- Made more than one point when following command words to describe and explain and when the number of marks indicate that a more developed answer is required.
- Described and evaluated information presented in charts and diagrams.

Candidates who did less well on this paper generally did the following:

- Made use of the answer space to explore a variety of unstructured attempts at calculations. Candidates should be reminded that they can use the three pages of additional answer sheets to develop their ideas and cross it out when they transfer their response to the answer space.
- Made fewer attempts to explain or evaluate data.
- Did not draw upon the breadth of their learning in Physics to apply knowledge and understanding in a synoptic way.

There was no evidence that any candidates were disadvantaged by time constraints. Only a very small number of candidates achieved marks that indicated that the Foundation Tier examination would have been a more appropriate paper for them. By contrast, 12% of the candidates scored over 60 marks.

Question 1 (a)

1 Nina is writing a report about the Solar System.

She has written an introduction.

> The planets in our Solar System all move around the Sun.
> They orbit in perfect circles and in the same direction.
> Each planet has at least one moon orbiting it.
> The planets and their moons are all made of rock.

(a) Identify **two** mistakes in Nina's introduction.

1 ....

....

2 ....

.... **[2]**

A common misconception is that the planets do not all orbit in the same direction. A few candidates were able to provide specific examples such as Jupiter is made of gas or Venus does not have a moon but most responses gained credit for contradicting assertions from the text box.

Question 1 (b)

(b) Nina wants to include a section about how the Solar System was formed.

Describe how the Solar System was formed.

....

....

....

.... **[2]**

Most candidates were able to identify one or more of dust/gas/matter but a common misconception is that the cloud is pulled together by the Sun's gravity rather than the gravity it exerts on itself. Many responses also revealed misconceptions about the big bang which, fortunately for these candidates, was not being assessed and could be ignored.

Question 1 (c)

(c) Nina researches how the Sun releases energy. She finds this information in a textbook.

The Sun releases energy by nuclear fusion. The Sun emits about 4×10^{26} J of energy every second. As a result, its mass falls by about 4 billion kilograms every second.

Explain why nuclear fusion causes the mass of the Sun to decrease.

....

.... **[1]**

Only the most able candidates were able to explain that the Sun's mass is converted to energy or state the relationship: $E = mc^2$. Many candidates repeated information from the text box or gave descriptions of the process of nuclear fusion.

Question 2 (a)

2 A toothbrush uses a rechargeable battery.

(a) The energy that is stored in the battery comes from a power station.

State how the energy is transferred from the power station to the chemical store in the battery.

....

.... **[1]**

A common error in the responses to this question was to only describe the infrastructure (transformers, national grid) that carries the energy and omit to describe the form (electrical) in which the energy is transferred.

Question 2 (b) (i)

(b) The potential difference across the battery is 1.2 V.

During a typical use, 360 C of charge moves through the toothbrush motor over a time of 2 minutes.

(i) Calculate the total energy transferred by the toothbrush in one day if it is used **two** times a day.

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

The higher ability candidates recalled the equation: E = QV, converted minutes to seconds and then doubled their answer in recognition of the toothbrush being used twice. Lower ability candidates missed one or more of these steps.

Question 2 (b) (ii)

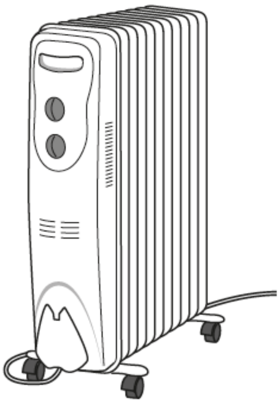
(ii) Calculate the current in the toothbrush when used for 2 minutes each time.

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

The higher ability candidates were able to arrange the equation into the form I = Q/t, convert the 2 minutes to 120 seconds and use charge = 360 C to calculate their answer. Many of the responses of lower ability candidates seemed to indicate that they did not understand the question structure ((i), (ii) etc.), which meant that they did not attempt to use the information provided in the stem of 2b.

Question 3 (a)

3 The diagram shows a common type of electric heater. It contains oil which is heated by an electrical element.



The table shows some information about the heater.

Electrical power	1500 W
Voltage rating	230 V
Specific heat capacity of oil	1600 J / kg °C
Mass of oil	4.5 kg

(a) Show that more than 700 000 J of energy is needed to heat the oil from 20 °C to 120 °C.

Use the equation:
change in internal energy = mass × specific heat capacity × change in temperature

[2]

The vast majority of candidates calculated 720,000 correctly.

Question 3 (b) (i)

(b) (i) Use your answer to **(a)** to calculate the minimum time for the oil to reach a temperature of 120 °C, starting at 20 °C.

Minimum time = ... s **[3]**

This is the first of the synoptic questions and it assesses syllabus statements 6.1.6 and 2.1.3. Candidates have been steered towards thinking about specific heat capacity. They now needed to use the relationship E = P x t in a rearranged form and extract the information about power from the table. A common error was to divide the 720,000 calculated in (a) by the specific heat capacity.

Question 3 (b) (ii)

(ii) In practice, it will take longer than this for the heater to reach 120 °C.

State the reason for this.

....

.... **[1]**

To access this question candidates must first realise that the extra time means more energy will be supplied than is used to heat the oil. Many candidates made this conceptual leap but then gave simplistic answers such as 'some of it will be wasted'. Only the higher ability candidates identified that the metal of the radiator and the air in the surroundings would also be heated.

Question 4 (a)

4 **(a)** The maximum speed of a racing car is 320 km / hour.

Calculate this speed in metres per second.

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

The common errors in responses to this question were failing to convert hours to seconds and giving the final answer incorrectly rounded.

Question 4 (b) (i)

(b) **(i)** A different racing car is moving with a speed of 80 m / s.

Before turning a corner, it slows down to a speed of 20 m / s.

While slowing down, it has a constant acceleration of –40 m / s^2.

Calculate the distance that it travels as it slows down.

Distance travelled = ... m **[3]**

Candidates needed to select the equation $v^2 – u^2 = 2as$. Most candidates who were able to substitute the numbers into this equation did the rearrangement at the end and gained full marks. Many of the lower ability candidates attempted to use speed = distance ÷ time which was insufficient to gain any marks. Some candidates determined, using the relationship acceleration = speed change ÷ time, that it would take 1.5 seconds. However, only the candidates who were able to multiply this time by a velocity gained credit for this alternative approach. By applying the average velocity (50 m/s) were able to get 3 marks. Two marks were gained for applying the initial or final velocities.

Question 4 (b) (ii)

(ii) The car moves at a constant speed around the corner.

Explain why its velocity is changing as it moves around the corner.

....

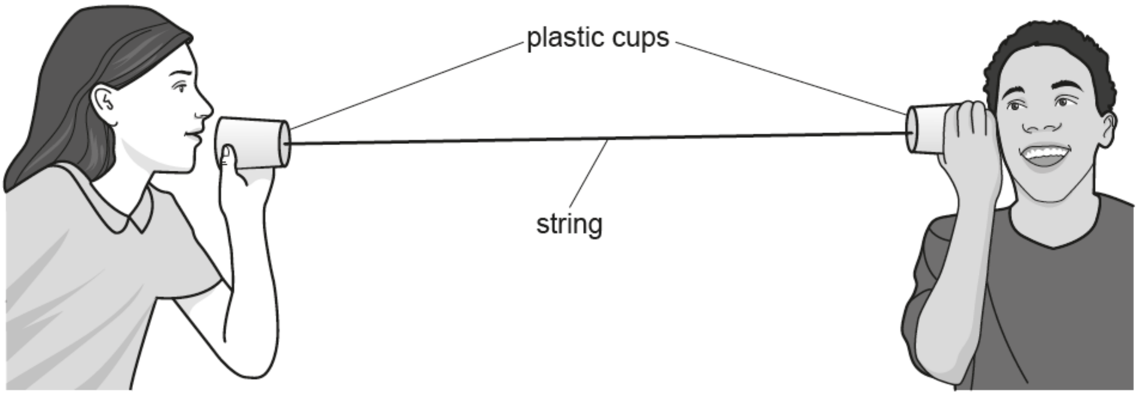
....

.... **[2]**

This was generally well answered as most candidates understand that velocity is speed with a direction and that the direction of the car changes.

Question 5 (a)

5 Eve and Amir make a toy telephone out of plastic cups and string.



Sound waves in the air change when they become sound waves in the string.

(a) How do the **speed**, **frequency** and **wavelength** of the sound waves change when they leave the air and enter the string?

Put one tick (✓) in each row. One has been done for you.

	Increase	Decrease	Stay the same
Speed	✓		
Frequency			
Wavelength			

[2]

Most candidates appreciate that the frequency of the sound does not change, however a very common error was to indicate that wavelength would decrease.

Question 5 (b)

(b) The speed of sound in the string is 600 m/s.

Calculate the frequency of a sound with wavelength 1.2 m in the string.

Frequency = ... Hz **[3]**

By contrast with part (a), most candidates made correct use of the wave equation to calculate the frequency of 500 Hz.

Question 6 (a)

6 James and Mia investigate their hearing.

James uses an app on his phone to make sounds with different frequencies.

For each frequency, he starts with the volume on his phone set at zero.

Then he turns the volume up step by step until Mia can just hear the sound.

The results show the volume setting needed before Mia can hear the noise for each frequency.

Frequency (Hz)	Volume setting
55	13
110	11
220	7
440	1
880	1
1760	1

(a) Explain why Mia finds it easier to hear some of these frequencies.

....

....

.... **[2]**

This question is aimed at assessing specification statement 1.4.7. Candidates should be able to explain that the transmission of sound through the bones of the ear works over a limited frequency range. Although many candidates made reference to the ear drum, very few candidates referred to the bones. Candidates who were able to identify that humans have a hearing range often found it difficult to use the data to conclude that we are less sensitive to frequencies at the lower limit of that range.

Question 6 (b) (i)

(b) They repeat the experiment.

This time there is a wall between the phone and Mia. They want to see what effect the wall has on the results.

(i) Suggest **one** variable that should be controlled to make this new experiment a fair comparison with the first experiment.

....

.... **[1]**

Most candidates gained credit for identifying a continuous variable such as the distance between the phone and Mia or using the same frequency values from the first experiment. Discrete variables such as 'use the same wall' did not gain credit.

Question 6 (b) (ii)

(ii) The volume setting needed for each frequency is higher in the new experiment.

Describe how the sound waves reach Mia and why they sound more faint.

....

....

....

.... **[2]**

Most candidates were able to express the idea that waves are transmitted through the wall but only a few of the most able candidates were able to explain the faintness of the sound in terms of absorption or reflection of the sound waves. A common response was simply to state that the waves had lost energy with no attempt to explain the cause of the energy loss.

Question 6 (c)

(c) Mia reads on the internet that the human ear is most sensitive at a frequency about 2000 Hz.

Describe how James and Mia could improve their experiment to test this hypothesis.

....

....

....

....

....

.... **[3]**

In this AO3 (develop and improve experimental procedures) question, candidates gained credit for the idea of testing frequencies above and below 2000 Hz. Many weak responses only suggested testing up to 2000 Hz. A very few of the more able candidates gained a second mark either for the idea of using regular, smaller increases in frequency or for adapting their apparatus to permit smaller volume increments. Only a handful of candidates were able to make all three points.

Question 7 (a)

7 Ali investigates electromagnetic induction.

He pushes a magnet quickly into a coil of wire. He uses an ammeter to record the biggest current produced in the coil.

He repeats the experiment for coils with different numbers of turns.

Table 7.1 shows his results.

Number of turns	Current (mA)
200	1.1
400	3.0
600	5.4
800	6.7
1000	9.1
1200	11.0

Table 7.1

(a) Explain why a current is produced in the coil.

....

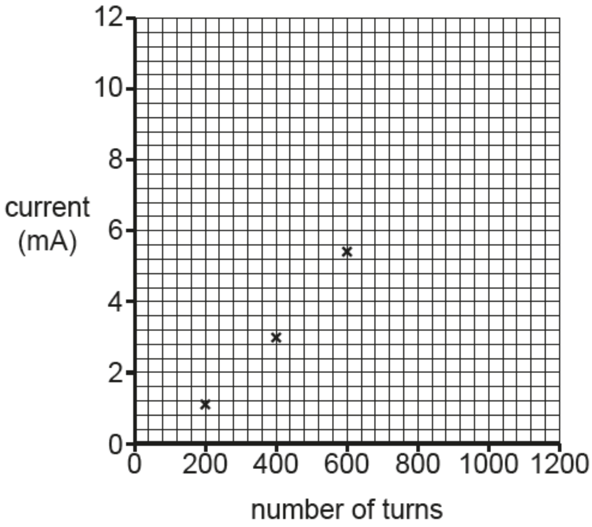
....

.... **[2]**

This question assesses specification statement 3.7.1. Many candidates used the term 'induction' given in the stem of the question and referred only to current being induced. More able candidates recalled that potential difference must be produced in order to drive the current. Only the higher ability candidates were able to link the movement of the magnet into the coil to the idea that the magnetic field changes around the coil, or that the magnetic field cuts the coil.

Question 7 (b) (i)

(b) **(i)** Complete the graph by plotting the missing results in **Table 7.1** and draw a line of best fit.



[2]

This question was generally answered very well with most candidates gaining both marks. Common errors were to start the best fit line at the origin or not use a ruler.

Question 7 (b) (ii)

(ii) Use your line of best fit to determine the maximum current that Ali could produce if he used a coil with **700 turns**.

Maximum current = ... mA **[1]**

Almost all candidates were able to read their graph correctly to gain this mark.

Question 7 (b) (iii)

(iii) Amaya says that this experiment is not valid because the speed of the magnet may be different each time.

Suggest how Ali could control the speed of the magnet.

....

.... **[1]**

Most candidates found it quite difficult to suggest that either a motor or a machine could be used to control the speed of the motor. A common response was to explain what is meant by speed. These responses described the idea of moving the magnet a certain distance in a certain time without explaining how that could be done.

Question 7 (c)

(c) As Ali pushes the magnet towards the coil, he feels a small repulsive force.

Explain why.

....

....

....

.... **[2]**

Only the higher ability candidates scored one or more marks on this second synoptic question which assesses specification statements 3.7.3 and 4.1.1. Many candidates have the misconception that magnetic fields can be described, like static electricity, in terms of positive and negative charges. A common error therefore was to state that like charges repel. Where candidates gained one mark, this was generally for identifying that like poles were repelling. Only a very small number of candidates were also able to explain that the magnetic field of the coil was due to the current in it.

Question 8 (a)

8 **Table 8.1** shows data for four radioactive isotopes.

Isotope	Half life	Type of decay
molybdenum-98	stable	
molybdenum-99	66 hours	beta
technetium-99m	6 hours	gamma
thallium-201	73 hours	gamma

Table 8.1

Technetium-99m is used in hospitals.

Technetium-99m is produced when molybdenum-99 emits beta radiation.

One method of producing molybdenum-99 is by firing neutrons at molybdenum-98.

(a) Complete these nuclear equations to show the production of technetium-99m.

$$^{98}_{42}\text{Mo} + ^{\cdots\cdots}_{\cdots\cdots}\text{n} \rightarrow ^{99}_{42}\text{Mo}$$

$$^{99}_{42}\text{Mo} \rightarrow ^{99}_{43}\text{Tc} + ^{\cdots\cdots}_{\cdots\cdots}\text{e}$$

[2]

Most candidates score both marks on this question. A common error was to omit the negative sign for the (0, -1) electron.

Question 8 (b)

(b) Molybdenum-99 is produced in nuclear reactors and then transported to hospitals. It may take several days for the molybdenum-99 to be transported.

In the hospital molybdenum-99 decays and the technetium-99m is produced as shown in part **(a)**.

Using information from **Table 8.1**, explain why technetium-99m is not transported directly to hospitals.

....

....

....

.... **[2]**

Most candidates scored at least one mark for this AO3 (making judgements and drawing conclusions) question. However many more candidates could have gained more marks if they had been just a little more precise in their answer. In general candidates recognised that the Tc-99m has a short half-life in comparison to Mo-99. Commonly, candidates go on to explain that the Tc-99m would decay. While this is correct it is insufficient for the idea that so much would decay there would be little left after transportation.

Question 8 (c) (i)

(c) Production of technetium-99m is becoming more expensive. An alternative for many medical procedures is thallium-201.

A patient is injected with a compound containing thallium-201. After 24 hours, 80% of the thallium-201 has not decayed.

A second patient is injected with a compound containing technetium-99m.

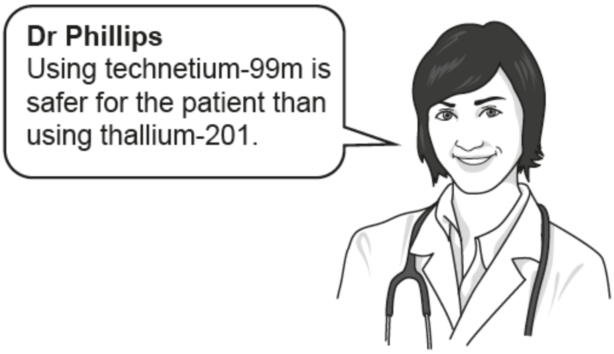
(i) Calculate the percentage of technetium-99m remaining after 24 hours.

Percentage remaining = ... % **[2]**

To answer this question, candidates first needed to refer back to the data table to find that Tc-99m has a half-life of 6 hours. Most candidates were able to show some understanding that the number of 6-hour half-lives in 24 hours is 4. A common error is to divide 100% by 4.

Question 8 (c) (ii)

(ii) A doctor is deciding which radioactive isotope is best to use.



Evaluate this statement.

Use the data in **Table 8.1** and the information above in your answer.

....

....

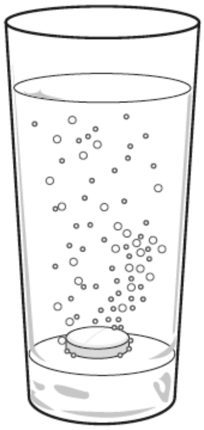
....

.... **[2]**

Most candidates were able to express the idea that Tc-99m spends less time in the body compared with Ti-201. Very few candidates were able to address the 'safer' aspect of this comment however. These candidates recognised that with less time in the body, there would be less exposure to radiation or express this in some other comparative way such as 'less damage to cells'.

Question 9 (a)

9 The picture shows a glass of water with a vitamin tablet at the bottom.



The tablet reacts with the water to produce bubbles of carbon dioxide.

The tablet stays at the bottom of the glass. The bubbles rise to the top of the glass.

(a) Which **two** of the statements below, taken together, explain why the bubbles rise but the tablet sinks?

Tick (✓) **two** boxes.

The bubbles are made of gas, but the tablet is solid.	☐
The material in the tablet is denser than water.	☐
The tablet is heavier than the bubbles.	☐
The water pressure at the bottom of the glass is greater than the water pressure at the top.	☐
Water is denser than the gas in the bubbles.	☐

[1]

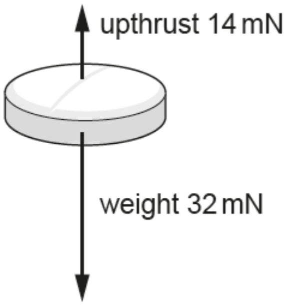
Most candidates identified both correct statements.

Question 9 (b)

(b) The diagram below is a free-body diagram for the tablet resting on the bottom of the glass.

Two of the forces acting on the tablet have already been drawn.

Draw **one** further force for the tablet and label it with its name and magnitude.



[2]

Only the higher ability candidates were able to score one or both marks on this third of the three synoptic questions. Specification statements 4.3.2 (use free body diagrams where several forces lead to a resultant force) and 6.4.10 (factors which influence floating or sinking) are assessed. Many candidates recognised that the further force was in the upwards direction but were unable to recall the name of this force (reaction). A common error was to add a down arrow labelled gravity. Only the candidates who were able to deduce that 'resting on the bottom' implied zero resultant force were able to calculate that 18 mN is needed to balance the forces.

Question 9 (c) (i)

(c) **(i)** Explain what causes the force of upthrust that acts on the tablet.

....

....

....

.... **[2]**

This question assesses specification statement 6.4.9 (the increase in pressure with depth leads to an upward force). Only the most able candidates were able to recall this explanation. There were many confused attempts at an explanation but a common error was to ascribe the cause of upthrust to the bubbles produced by the dissolving tablet.

Question 9 (c) (ii)

(ii) The upthrust on the tablet is bigger than the upthrust on any one bubble.

Give a reason for this.

....

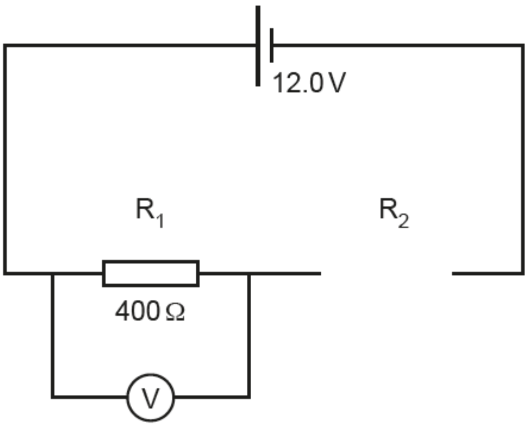
.... **[1]**

A very common misconception is that the table has more upthrust due to its greater mass or weight or density.

Question 10 (a)

10 Alex wants to use a thermistor as a temperature sensor.

He sets up the circuit shown below.



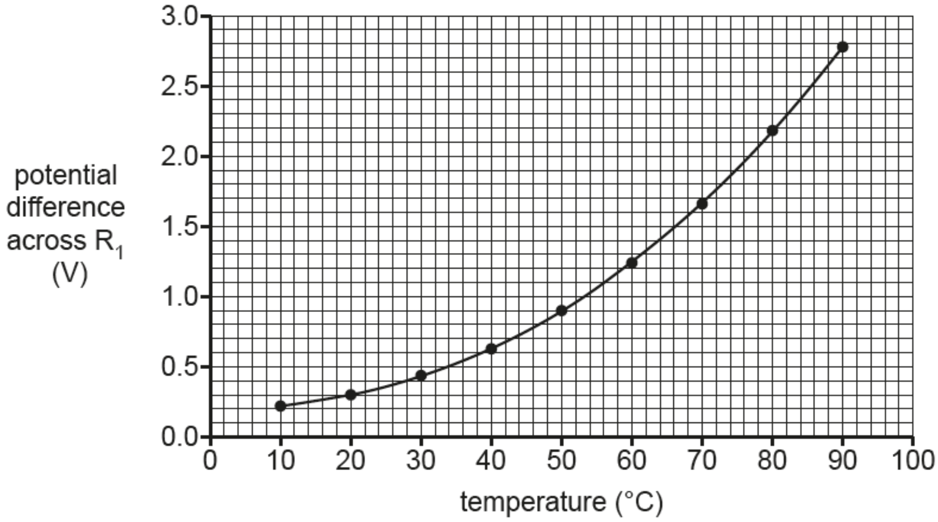
(a) Draw the symbol for a thermistor in the space labelled R_2. **[1]**

Examiners allowed any recognisable mirror image of a thermistor symbol. However, a little more than half of the candidates were able to recall the circuit symbol. A common error was to draw the symbol of a variable resistor.

Question 10 (b) (i)

(b) To investigate the sensitivity of the thermistor, Alex places it in a water bath with a temperature control.

He records the potential difference across R_1 for different temperatures set by the water bath. His results are shown in the graph.



(i) Describe and explain the relationship shown in the graph.

....

....

....

....

....

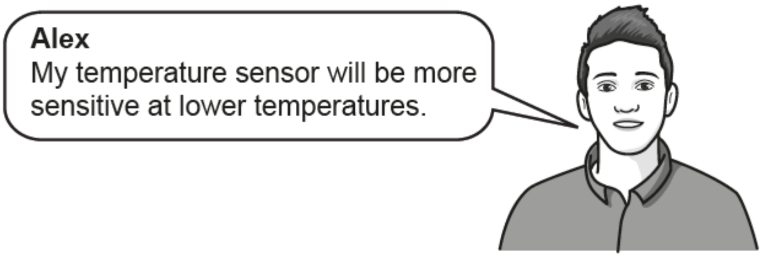
.... **[3]**

Most candidates were able to describe the relationship (temperature increases so potential difference increases) but only the most able candidates were able to explain this in terms of the decreasing resistance of the thermistor. Only a small percentage of the candidates also managed to explain that since the supply voltage remained constant, then if the p.d. across R_1 was rising, then the p.d. across the thermistor must be falling.

Question 10 (b) (ii)

(ii) Alex plans to use the sensor to monitor temperature in a greenhouse. To find the temperature, Alex will measure the potential difference across R_1.

He will then read the temperature off the graph.



Evaluate Alex's statement using evidence from the graph.

....

....

....

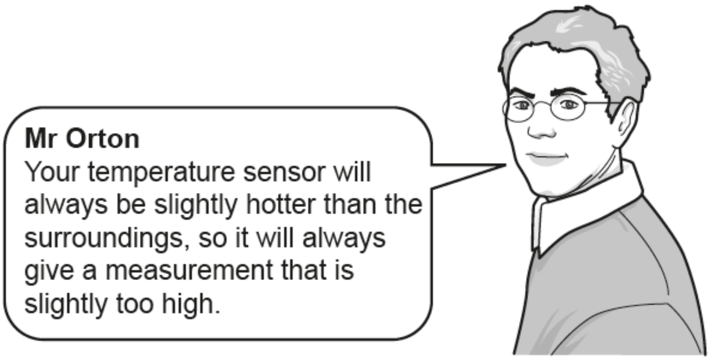
....

.... **[2]**

Candidates are unclear about what is meant by the term sensitivity. However responses such as 'Alex is right / Alex is wrong' are 50/50 and therefore always likely to be regarded by the examiner as insufficient without further explanation. Comments about sensitivity were therefore ignored and marks were awarded for the recognition that small changes in temperature when the temperature is high produce larger changes in p.d. (or the opposite at low temperatures). Candidates who supported this conclusion with readings from the graph gained both marks.

Question 10 (c) (i)

(c) Mr Orton, Alex's teacher, says that his temperature sensor will not work properly.



(i) What is the name of this type of error?

.... **[1]**

The term 'systematic' error is clearly unfamiliar to most candidates so the mark scheme was eased to allow any idea that the error was in some way built-in to the apparatus. So we allowed apparatus error, equipment error and zero error as acceptable alternatives.

Question 10 (c) (ii)

(ii) Explain why Mr Orton is correct, and suggest how this problem could be reduced.

....

....

....

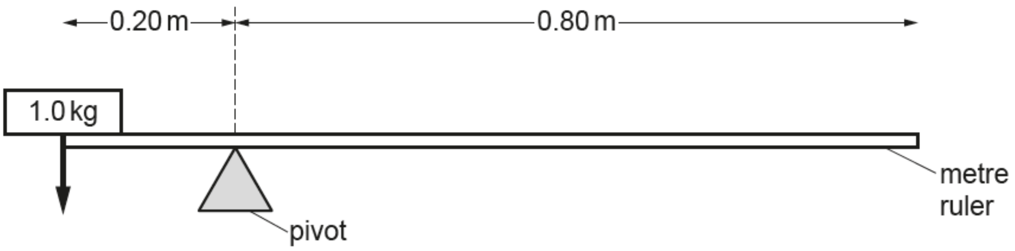
.... **[2]**

Only the most able candidates scored one or both marks on this question. Candidates were often able to explain that the resistors would get hot but very few candidates were able to explain that this was due to the current. Of those that did, a common error was to suggest increasing the voltage in order to reduce the current. Candidates most often gained one mark for suggesting that the effect should be measured and taken into account. A common misconception was that the thermistor needed to be insulated.

Question 11 (a)

11 Jack investigates using weights to balance a seesaw. He makes the seesaw out of a metre ruler with a pivot placed at the 20 cm mark, as shown in the diagram.

He places a 1.0 kg mass with its centre exactly at one end of the metre ruler.



(a) Calculate the moment of the 1.0 kg mass about the pivot, in units of Nm.

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

gravitational field strength = 10 N/kg

Moment = ... Nm **[3]**

Most candidates gained three marks for this calculation. Where this was not the case, candidates were unable to recognise that the force could be calculated using mass x gravitational field strength. It was clear from many responses that candidates simply recalled that 1 kg is 10 N and did not show this step of the calculation in their working.

Question 11 (b) (i)

(b) Jack predicts where he should put masses on the right-hand side of the seesaw to make it balance.

He then carefully places those masses at points which make the seesaw balance and measures the actual distances to the pivot.

The table shows his results.

Mass (g)	Predicted distance to pivot (m)	Measured distance to pivot (m)
400	0.50	0.46
600	0.33	0.31
800	0.25	0.23
1000	0.20	0.19

(i) The measured distances to the pivot are all slightly smaller than the predicted distances to the pivot.

Explain why.

....

.... **[1]**

Question 11 (b) (ii)

(ii) Suggest **one** way to improve his experiment to remove this difference.

....

.... **[1]**

Only a handful of candidates scored any marks for these two questions. Commonly, candidates held the misconception that the difference in predicted and actual measurements was due to the overhang of the 1.0 kg mass at the end of the ruler thereby increasing the moment on the left hand side. Candidates are not required to know that the mass of an object acts through its centre on this syllabus, but the increased left hand side moment line of reasoning does not explain why the measured right hand distance is less than predicted. Candidates who recognised that with the pivot in the position shown, there would be a moment due to the ruler itself were able to suggest moving the pivot to the middle to remove this moment.

Question 12 (a)

12 Trolley **A** of mass 5.0 kg moves at a constant speed of 1.6 m / s.

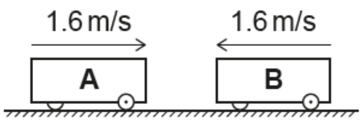
(a) Calculate the momentum of trolley **A**.

Momentum = ... kg m / s **[2]**

Almost all candidates were able to multiply 5 by 1.6 to get 8 here.

Question 12 (b) (i)

(b) Trolley **B** of mass 2.5 kg heads straight towards the first trolley in the opposite direction at the same speed of 1.6 m / s.



Trolley **A** of mass 5 kg

Trolley **B** of mass 2.5 kg

The two trolleys collide and stick together.

(i) Show that the velocity of the joined-up trolleys after the collision is about 0.5 m / s.

[4]

Most candidates gained at least one mark for calculating the momentum of trolley **B** (2.5 x 1.6 =) 4. A common error was then to divide the momentum of **B** by the momentum of trolley **A** (1.6 x 5 =) 8. Conveniently, this produces the number 0.5 but many candidates clearly did not realise that this number is not a speed and so felt that they had answered the question. Candidates who set out their calculation to show the conservation of momentum were able to deduct the momentum of A from B and equate that to the combined mass multiplied by the unknown velocity.

Question 12 (b) (ii)

(ii) The collision takes a total time of 0.20 s.

Calculate the average force acting on trolley **A** during the collision.

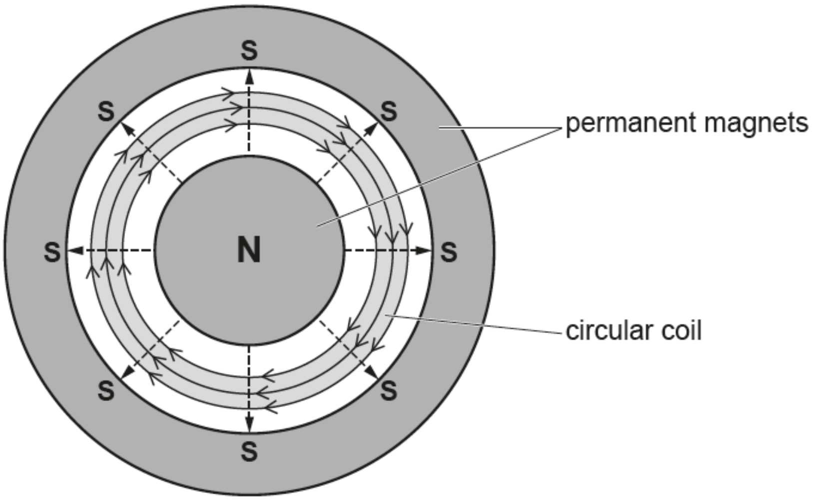
Average force = ... N **[4]**

Candidates often gained one mark for selecting and rearranging the impact equation in the form Force = change in momentum ÷ time. Many then struggled to determine the change in momentum of trolley A but were able to gain a compensatory mark for dividing the number that they had calculated as $\Delta\rho$ by 0.2. Candidates who were able to use the mass of A (5kg) multiplied by its change in speed (1.6 – 0.53) generally gained all four marks after dividing their answer by 0.2.

Question 13 (a)

13 The diagram shows part of a loudspeaker. It contains specially-shaped permanent magnets with south poles, **S**, in a ring around the outside and a circular north pole, **N**, in the centre.

In the gap between the shaped magnets there is a circular coil carrying electrical current.



The direction of the magnetic field between the poles is shown as -------►.

The magnetic field through the coil has strength 0.40 T.

The coil has circumference 25 mm and has 200 turns. The diagram shows only 3 turns of this coil.

A clockwise current of 0.60 A in the coil produces a force on the coil.

(a) What is the direction of the force on the coil?

Tick (✓) **one** box.

Anti-clockwise	☐
Clockwise	☐
Into the page	☐
Out of the page	☐

[1]

Candidates needed to be able to recall and apply Fleming's left hand rule. At every position, the direction of the current is perpendicular to the magnetic field and so the force or thrust or motion indicated by the thumb is out of the page.

Question 13 (b)

(b) Calculate the magnitude of the force acting on the coil.

Force = ... N **[4]**

Most candidates were able to select the correct formula but then failed to calculate the length of the conductor with a correct unit conversion.

Supporting you

For further details of this qualification please visit the subject webpage.

Review of results

If any of your students' results are not as expected, you may wish to consider one of our review of results services. For full information about the options available visit the OCR website. If university places are at stake you may wish to consider priority service 2 reviews of marking which have an earlier deadline to ensure your reviews are processed in time for university applications.

activeresults

Active Results offers a unique perspective on results data and greater opportunities to understand students' performance.

It allows you to:

- Review reports on the **performance of individual candidates**, cohorts of students and whole centres
- **Analyse results** at question and/or topic level
- **Compare your centre** with OCR national averages or similar OCR centres.
- Identify areas of the curriculum where students excel or struggle and help **pinpoint strengths and weaknesses** of students and teaching departments.

http://www.ocr.org.uk/administration/support-and-tools/active-results/

CPD Hub
Your route to OCR's teacher training

Attend one of our popular CPD courses to hear exam feedback directly from a senior assessor or drop in to an online Q&A session.

https://www.cpdhub.ocr.org.uk

The small print

We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest

OCR acknowledges the use of the following content:
Square down and Square up: alexwhite/Shutterstock.com

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk

Looking for a resource?

There is now a quick and easy search tool to help find **free** resources for your qualification:

www.ocr.org.uk/i-want-to/find-resources/

www.ocr.org.uk

OCR Customer Contact Centre

General qualifications

Telephone 01223 553998
Facsimile 01223 552627
Email general.qualifications@ocr.org.uk