Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE PHYSICS B

J259
For first teaching in 2016

J259/01 Summer 2019 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 1 series overview

J259/01 is the Breadth in Physics Paper at Foundation Tier. It covers topics across the whole specification with short answer questions. This includes structured questions, calculations and questions based on practical skills. It counts for 50% of the marks for Foundation Tier GCSE qualification in Physics (21st Century Science). The other 50% is covered by J259/03 Depth in Physics.

Key point call out

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

- Recalled and rearranged equations correctly.
- Remembered to convert units to SI units before completing a calculation.
- Used scientific vocabulary appropriately.

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

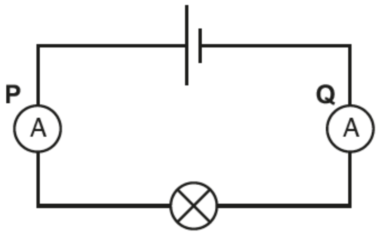
- Found it difficult to separate practical observations and conclusions.
- Struggle to interpret what was being asked in some questions.
- Used incorrect scientific terminology.

Some candidates seemed unsure of the command words used in questions. For example if a question asked candidates to describe a pattern in the data, some of them tried to explain a reason, which is much more difficult.

Most successful topic/question/set texts	***Least successful topic/question/set texts***
• Calculating efficiency (Question 8) • Structure of the atom (Question 3c) • Simple electrical circuits (Question 1)	• Electromagnetic spectrum and waves (Questions 2 and 6) • Magnetic fields (Question 4) • Forces (Question 12)

Question 1 (a)

1 Amaya and Li each build the circuit shown in the diagram.



(a) Which **two** parts of the circuit **must** be present for a current to flow?

Tick (✓) **two** boxes.

The ammeters, to measure the current ☐

The cell, to provide a potential difference ☐

The lamp, to provide resistance ☐

The wires, to make a complete circuit ☐

[1]

Many candidates correctly chose the cell and the wires. A common misconception was to tick only one box.

Question 1 (b)

(b) Amaya measured the current in the lamp as 1.5A.

The potential difference across the lamp is 3.3V.

Calculate the resistance of the lamp.

Use the equation: resistance = potential difference ÷ current

Resistance = ...Ω **[2]**

Most candidates were able to correctly substitute the values for potential difference and current in to the equation to calculate resistance.

Question 1 (c) (i)

(c) Amaya and Li compare their results.

The table shows the readings on the ammeters **P** and **Q**.

	Reading on ammeter P (A)	**Reading on ammeter Q (A)**
Amaya	1.5	1.5
Li	1.4	1.5

(i) Who got the expected results?

Amaya ☐

Li ☐

Explain your answer.

....

....

.... **[2]**

Most candidates realised that Amaya's results were the correct one, but some of them did not explain this correctly. Just saying that the two values were the same is not an explanation. Candidates needed to explain that both the ammeters should have read the same value because the current is the same all the way round the circuit.

Question 1 (c) (ii)

(ii) Amaya thinks her results are different to Li's because something is wrong with the ammeters.

Suggest how Amaya could check if there is something wrong with the ammeters.

....

....

.... **[1]**

Many candidates did suggest that the ammeters were swapped round, or different ammeters were used and the results compared. Candidates who suggested using these ammeters in another different circuit needed to state that the current in the new circuit was already known, so that some comparison could be made.

Question 2 (a) (i)

2 A solar flare is an explosion on the surface of the Sun.

(a) Solar flares release huge amounts of radiation, including visible light and X-rays.

(i) Which statement is true?

Tick (✓) **one** box.

- Visible light is ionising radiation. ☐
- Visible light has a higher frequency than X-rays. ☐
- X-rays have a shorter wavelength than visible light. ☐
- X-rays are longitudinal waves. ☐

[1]

Question 2 (a) (ii)

(ii) Why can humans see visible light but not X-rays?

Tick (✓) **one** box.

- Our eyes can detect only a small range of frequencies. ☐
- X-rays cannot travel through space towards the Earth. ☐
- Our eyes cannot detect electromagnetic waves. ☐
- X-rays are absorbed by the atmosphere of the Sun. ☐

[1]

Many candidates got both these questions correct. The most common incorrect response in part (ii) was that our eyes cannot detect electromagnetic waves. About the same proportion of candidates chose the correct response.

Question 2 (b) (i)

(b) The speed of visible light in empty space is 300 000 km/s.

The distance from the Sun to the Earth is 150 000 000 km.

Speed can be calculated using the equation: speed = distance ÷ time

(i) Which is the correct way to calculate the **time** for visible light from a solar flare to reach the Earth?

Put a (ring) around the correct calculation.

$\frac{150\,000\,000}{300\,000}$ $\qquad$ $\frac{300\,000}{150\,000\,000}$ $\qquad$ **300 000 × 150 000 000**

[1]

Question 2 (b) (ii)

(ii) When do the X-rays from the solar flare reach the Earth?

Tick (✓) **one** box.

After the visible light. ☐

At the same time as the solar flare happens. ☐

At the same time as the visible light. ☐

Before the visible light. ☐

[1]

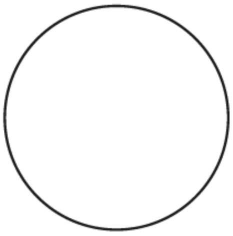
The first part of the Question 2(b) was there to encourage candidates to think about the speed of light. However, many candidates thought that the frequency of the electromagnetic radiation affects its speed and so chose either the first or fourth response in part 2(b)(ii).

i	**OCR support**	The fact that the speed of electromagnetic radiation is referred to as the 'speed of light' is confusing to some candidates who suggested that nothing can travel as fast as light, so the X-ray travelled slower. The Electromagnetic spectrum teaching activity https://stgprd-ocr.ucles.internal/Images/311753-electromagnetic-spectrum-activity-lesson-element.doc can be used to support learning of this topic.

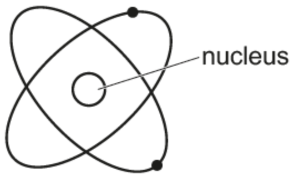
Question 3 (b)

(b) Mia finds out about the models of atoms suggested by Dalton and Rutherford.

She draws these diagrams.



Dalton model



Rutherford model

Describe some of the **evidence** that led scientists to believe the Rutherford model instead of the Dalton model.

....

....

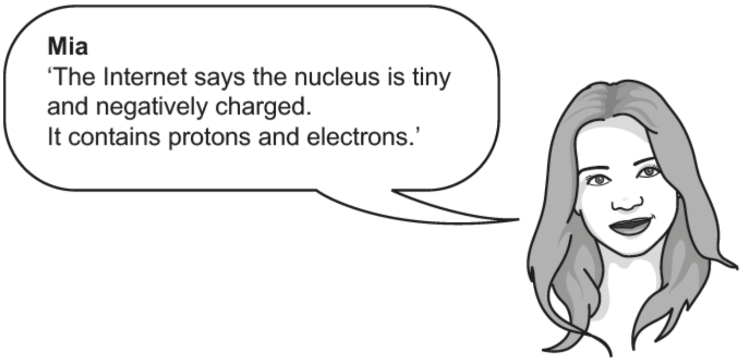
....

.... **[2]**

Some candidates were able to recall that Rutherford fired particles at gold foil and that some of them bounced back. Even where there were some errors in a candidate's explanation, they were given credit for this recall because they were able to describe 'some evidence'. A common error was to write a description of the two atomic models which did not answer the question.

Question 3 (c)

(c) Mia finds out more information about the nucleus of the atom on the Internet.



There are some mistakes in this information.

Write down **two incorrect** parts of the information.

1 ....

....

2 ....

....
[2]

Two thirds of candidates recalled that the nucleus was positively charged and that it contains protons and neutrons, rather than electrons.

Question 4 (a)

4 James investigates the magnetic field around a wire. He uses a vertical wire passing through a sheet of card, as shown in **Fig. 4.1**.

He maps the magnetic field using a compass.

The current in the wire is travelling upwards.

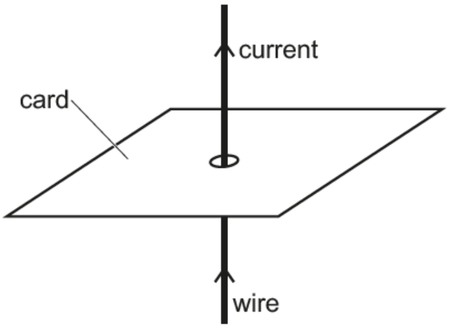


Fig. 4.1

(a) On the diagram in **Fig. 4.2**, draw the pattern of magnetic field lines that James should expect to find.

Draw at least **three** magnetic field lines and include **arrows** to show the direction of the magnetic field.

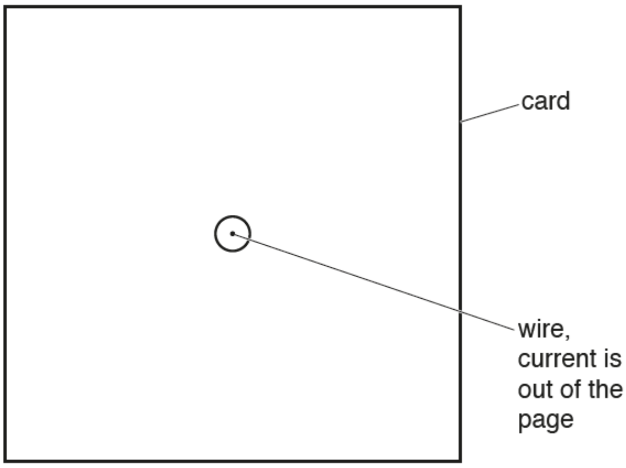


Fig. 4.2

[3]

This question assesses on-specification knowledge that is in covered in both the teaching narrative for P3.5 and learning outcome P3.5.6. Only a quarter of candidates were able to recall that the magnetic field around a wire carrying current is circular. There were many different shapes and lines drawn. Those who did show circular field lines were evenly split on the direction shown. Very few candidates showed the distance between the circles becoming larger further from the wire as the strength of the magnetic field weakened.

Question 4 (b) (i)

(b) At the edge of the card, James cannot detect a magnetic field caused by the wire. He thinks this is because the magnetic field is very weak at the edge of the card.

(i) Explain why the magnetic field is weak at the edge of the card.

....

....

.... **[1]**

Question 4 (b) (ii)

(ii) Describe **one** change that James could make to increase the strength of the magnetic field at the edge of the card.

....

....

.... **[1]**

Many candidates were able to explain that the strength of the magnetic field decreases the further from the wire. Also, many suggested that the magnetic field strength could be increased by increasing the current through the wire. Suggestions to make the card smaller were ignored as this changes the basic context of the practical activity.

Question 4 (c)

(c) When the current in the wire is switched off, the compass points north.

Explain why the compass points north.

....

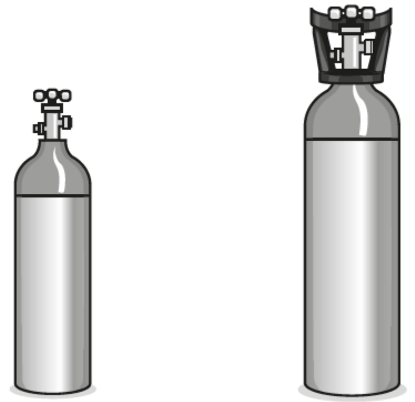
.... **[1]**

Most students just repeated the stem of the question stating that the compass points north but gave no explanation for this phenomenon. Around a fifth of candidates mentioned the Earth's magnetic field to correctly answer the question.

Question 5 (a)

5 Hospitals store oxygen at high pressure in metal cylinders.

The pictures show two cylinders, **A** and **B**. Both cylinders contain the same mass of gas and have the same temperature.



Cylinder **A** Cylinder **B**

(a) Cylinder **A** contains oxygen at a pressure of 23 000 kPa.

The area of the base of cylinder **A** is 0.030 m^2.

Calculate the force exerted by the gas on the base of cylinder **A**.

Use the equation: force normal to a surface = pressure × area of that surface

Force = ...N **[3]**

Very few candidates converted the pressure given in kPa to 23,000,000 Pa before doing the calculation. Some candidates incorrectly squared 0.030 m^2 to use as the area in the calculation.

	AfL	Candidates should learn the SI units prefixes such as kilo, milli, etc. They should be able to convert from one form to the other. This is part of IaS2.

Question 5 (b) (i)

(b) Cylinder **B** has a larger volume than cylinder **A**.

The pressure in cylinder **B** is smaller than the pressure in cylinder **A**.

(i) Explain, using ideas about **particles**, why storing the same mass of gas in a larger volume produces a smaller pressure.

....

....

....

.... **[2]**

Few candidates mentioned collisions in their response to this question. The explanation for pressure is all about particles colliding with the walls of a container, so the expected response here was to mention collisions. Most candidates suggested that the particles had more space in the larger container.

?	**Misconception**	Research indicates that most GCSE students have some misconceptions about the particle model (e.g. gas particles expand to fill the empty space, repulsive forces between particles cause pressure), and that even at A Level and undergraduate level a minority still have misconceptions about 'space.' Using a big ideas in science approach in teaching can help overcome these misconceptions www.ase.org.uk/bigideas.

Exemplar 1

As the volumes is larger in B the particles have more space to move around which leads to less collisions with the cylinder leading to a lower pressure. Because there's more space to move into. **[2]**

This is an example of a good candidate's response. It clearly states that because the particles have more space they will have 'less collisions' with the walls of the cylinder.

Question 5 (b) (ii)

(ii) Both cylinders contain the same mass of gas and are at the same temperature.

	Pressure (kPa)	**Volume (dm^3)**
Cylinder A	23 000	15
Cylinder B	10 000	

Calculate the volume of gas in cylinder **B**.

Use the equation: pressure × volume = constant

Volume of gas = ... dm^3 **[2]**

Half the candidates got this calculation correct. They first calculated the constant, and then were able to rearrange the equation to find the new volume of the gas.

Question 6 (a)

6 Alex plays the violin. The violin has four strings. The strings are 32.5 cm in length, as shown in **Fig. 6.1**.

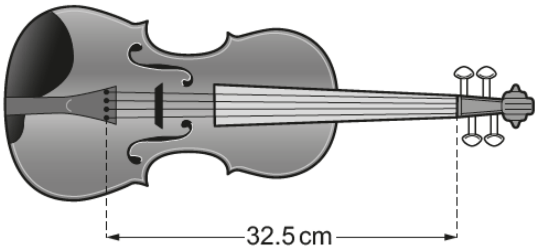


Fig. 6.1

When Alex plays the violin, waves pass along the strings. **Fig. 6.2** shows a wave on one of the strings.

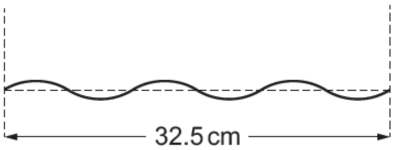


Fig. 6.2

(a) Calculate the wavelength of the wave shown in **Fig 6.2**.

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

Wavelength = ...cm **[2]**

Candidates should be able to identify that there are 3 complete waves shown in the diagram, so the length 32.5 needs to be divided by 3 to find the wavelength. Most candidates found this question difficult and there were a variety of incorrect responses. Around one in six candidates answered the question including rounded their final value to 2 significant figures correctly.

Some candidates were confused and wrote down the equation wave speed = frequency x wavelength, which is not needed for this question.

Question 6 (b) (i)

(b) (i) Explain how **Fig. 6.2** shows that the wave is a transverse wave.

....

....

....

.... **[2]**

Candidates found it difficult to explain why the waves are transverse in words. A simple response would be just to say that there were crests and troughs, but few candidates wrote this. Some candidates did write that the oscillations were perpendicular, but then did not specify what they were perpendicular to.

Question 6 (b) (ii)

(ii) Explain how the sound waves produced by the violin are different to the waves on the string.

....

....

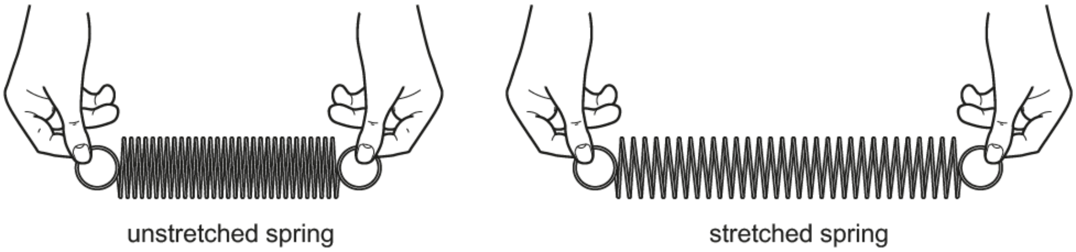
....

.... **[2]**

Many candidates were able to recall that sound waves are longitudinal, and a few stated that sound waves travelled through the air.

Question 7 (a)

7 Sundip wants to use a spring to make a device to measure forces. She picks up a spring and stretches it.



(a) Explain why Sundip is wrong.

....

....

.... **[2]**

Candidates just needed to state two pulling forces in opposite directions at each end of the spring are needed to stretch the spring. The most common misconception was that the force of gravity was involved here, but as the spring is being stretched horizontally gravity is irrelevant.

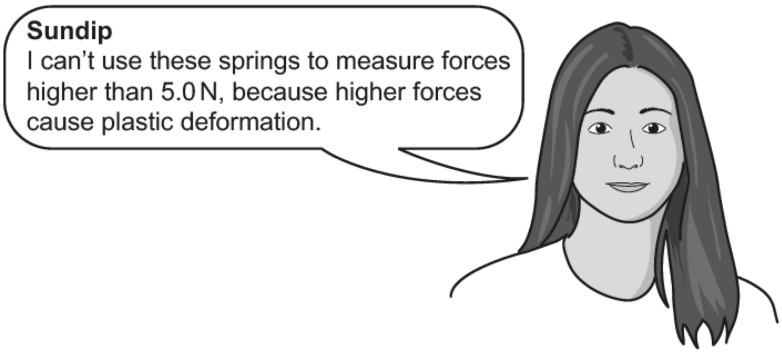
Question 7 (b) (i)

(b) Sundip investigates the extension of identical springs when different forces are applied.

The table shows her results.

Force (N)	Extension (cm)	Type of deformation
1.0	2.5	elastic
2.0	5.0	elastic
3.0	7.5	elastic
4.0	10.5	elastic
5.0	14.0	elastic
6.0	18.0	plastic
7.0	25.0	plastic

Sundip comments on her data in the table.



(i) Describe what is meant by plastic deformation.

....

.... **[1]**

Many candidates correctly stated that plastic deformation meant that the spring did not return to its original shape. Some candidates implied that the spring was made of plastic, so were confused about the scientific definition of the word plastic.

Question 7 (b) (ii)

(ii) Explain why Sundip is correct.

....

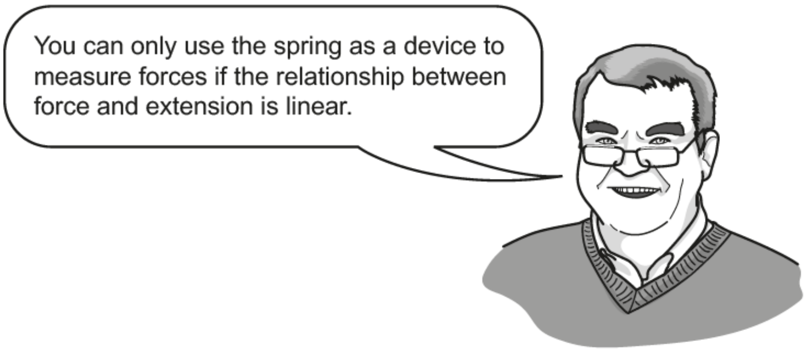
....

.... **[1]**

Here candidates needed to apply their knowledge about plastic deformation to say that the spring would no longer provide accurate results when used as a device to measure forces, which is the context of the question. A common error by candidates was to just repeat their answer to the previous part of the question 7(b)(i).

Question 7 (c) (i)

(c) Sundip's teacher looks at her data in the table.



(i) Describe what is meant by a **linear relationship**.

....

.... **[1]**

The majority of candidates struggled to answer this question correctly.

	AfL	Most candidates will be familiar with the term 'directly proportional' as they will have used it Mathematics and other science subjects. Putting this can be difficult to explain clearly in words, even if candidates can visualise linear relationships and direct proportionality. Get students to practice describing relationships between using simple terms like 'extension goes up in equal steps for each equal increase in force.'

Question 7 (c) (ii)

(ii) Identify the maximum force for which the spring shows a linear force-extension relationship.

Use the data in the table to explain your answer.

Maximum force = ... N

Explanation ....

....

.... **[2]**

Some candidates were able to identify that the spring was not behaving in a linear manner beyond 3 or 4N. They also stated that until that point the extension went up by 2.5 cm each time. Many candidates suggested that the whole of the elastic region was linear, even though the data in Sundip's table did not show a linear relationship beyond 3 or 4N.

Question 8 (a) (i)

8 Layla charges the battery in her phone every evening.

The energy used to charge the battery is transferred from an energy resource at a power station.

(a) Two examples of energy resources are **fossil fuels** and **wind power**.

(i) Give one **similarity** and one **difference** in the ways these energy resources are used to generate electricity.

Similarity ....

....

Difference ....

.... **[2]**

Many candidates stated that fossil fuels and wind power were both natural resources or that fossil fuels are non-renewable. However, these reasons are not to do with the way the resources are used to generate electricity. The question asks for a similarity and a difference in the way that the energy resources are used to generate electricity, not differences in their impact on the environment.

Exemplar 2

(i) Give one **similarity** and one **difference** in the ways these energy resources are used to generate electricity.

Similarity ... Both energy resources are connected to electricity using a motor ....

Difference ... Fossil fuels are extracted from the ground whereas wind power derives from air .... **[2]**

This candidate has attempted to answer the question in terms of how the resources are used to generate electricity but unfortunately has referred to a motor, rather than a generator for the similarity. They have correctly stated that wind power converts energy from the air to electricity. Another acceptable response would have been to state that fossil fuels are burnt to generate electricity.

Question 8 (a) (ii)

(ii) Another energy resource is the Sun.

Energy is transferred from the energy store in the Sun as radiation.

Explain how the energy is stored in the Sun and how it is converted to radiation.

....

....

....

.... **[2]**

Only a small number of candidates answered this question correctly. The question asks for an explanation about how energy is stored in the Sun, not how or where it is transferred. There were several answers about how energy is radiated from the Sun to solar panels, but not about how it is stored in the Sun. Another common misconception is that energy is stored as heat in the Sun, rather than in a nuclear energy store.

Question 8 (b) (i)

(b) Layla notices that her phone charger gets very hot. She thinks this might be dangerous. Her phone also takes a very long time to fully charge.

She decides to buy a new charger.

The table shows information about two phone chargers, **A** and **B**.

Charger	Total energy transferred in 1 second (mJ)	Energy stored usefully in battery in 1 second (mJ)	Efficiency (%)	Cost to buy (£)
A	195	112	57	12.00
B	240	150		12.00

(i) Calculate the efficiency of charger **B**.

Give your answer as a percentage.

Efficiency = ... % **[3]**

This calculation was done well by the majority of candidates. Most candidates remembered the equation to use and correctly found the efficiency.

Question 8 (b) (ii)

(ii) Suggest which charger Layla should buy.

Justify your answer using the data from the table.

....

....

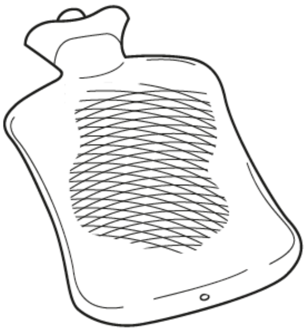
....

.... **[2]**

This question is really asking candidates to use the data in the table to make judgements about the chargers. It is not just a case of quoting the data given in the table, but explaining what the data tells us in practice about the chargers. For example many candidates told us that the total energy transferred was greater in charger B, but in fact this column of the table is actually about the amount of energy transferred in one second, so it is really about the rate that energy is supplied to the charger. Similarly the next column refers to the amount of energy usefully stored in the charger in one second, so this relates to the speed at which the phone will be charged.

Question 9 (a)

9 Ali uses a hot water bottle to keep warm.



(a) He uses a kettle to heat 1.1 kg of water from 20 °C to 90 °C. Ali then pours the hot water into the hot water bottle.

The specific heat capacity of water is 4200 J/kg/°C.

Calculate the change in internal energy in heating the water.

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

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

Change in internal energy = ...J **[3]**

Most candidates were able to use the equation given and correctly calculated the change in temperature to give the change in internal energy of 323400 J. Some candidates were able to correctly round this value to 2 significant figures. Some candidates just wrote down the first two figures of the answer omitting the trailing zeros, and some did not try to round the answer at all.

Question 9 (b)

(b) The kettle transfers energy electrically.

The resistance of the kettle is 20 Ω.

The electric current in the kettle is 11 A.

Calculate the power of the kettle.

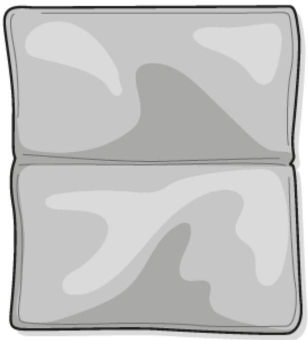
Power = ... W **[3]**

Most candidates were unable to recall the correct equation to use in this calculation. Most just multiplied the two numbers together to give an answer of 220, but this would have been the potential difference, not the power.

Question 9 (c) (i)

(c) Ali decides to use a heat pack instead of a hot water bottle.

A heat pack is a bag containing seeds, such as rice or wheat. It is heated in a microwave oven.



heat pack

Ali has two heat packs, one containing rice, and one containing wheat. He wants to investigate which heat pack will stay warm for longer.

(i) Suggest **two** pieces of measuring apparatus he will need to use in his investigation.

1 ....

2 ....
[2]

Many candidates correctly suggested that Ali needed to use a thermometer and a stopwatch or timer. However some candidates gave other apparatus which is not a type of measuring apparatus, for example the microwave oven.

Question 9 (c) (ii)

(ii) Suggest **one** control variable for Ali's investigation.

....

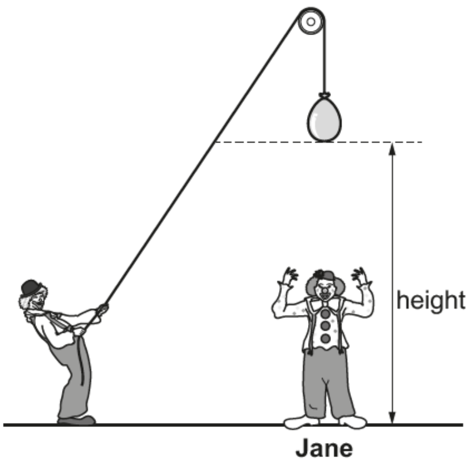
.... **[1]**

Many candidates were able to suggest a suitable control variable, such as keeping the starting temperature of both heat packs the same.

Question 10 (a) (i)

10 Jane is a clown in a circus. She is preparing a new show.

(a) In the show, water balloons will be dropped on her head from different heights.



(i) She needs the first water balloon to hit her at a speed of 10 m/s.

The first water balloon has a mass of 1.6 kg.

Calculate the kinetic energy of this water balloon moving at 10 m/s.

Kinetic energy = ...J **[3]**

Candidates found it difficult to recall the equation to calculate kinetic energy and multiplied the two numbers together. If candidates were able to recall the equation they got the correct answer.

Question 10 (a) (ii)

(ii) The second water balloon has a mass of 2.4 kg. When it is released, it has gravitational potential energy of 120 J.

Calculate the height from which it is released.

Use the equation:
gravitational potential energy = mass × gravitational field strength × height

Gravitational field strength = 10 N/kg

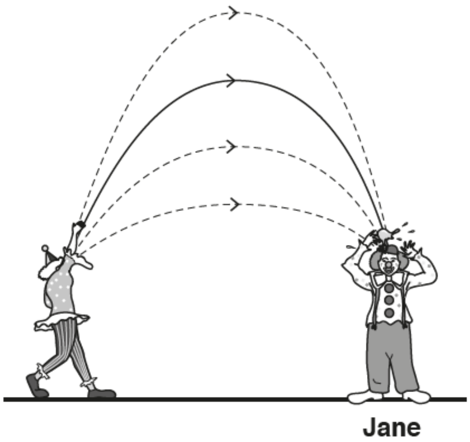
Height = ... m **[3]**

Although candidates were given the equation here, many found it difficult to rearrange it correctly as there are 3 terms multiplied together. Some candidates were able to correctly calculate the height.

Question 10 (b) (i)

(b) In the next part of the show, a second clown throws water balloons at Jane.

The clown throws each water balloon at Jane to a different height.



(i) What is the name of the energy store before the water balloon is thrown?

Tick (✓) **one** box.

Chemical store ☐

Elastic store ☐

Kinetic store ☐

Nuclear store ☐

Question 10 (b) (ii)

(ii) Name the energy store while the water balloon is in the air.

Tick (✓) **one** box.

Chemical store ☐

Elastic store ☐

Kinetic store ☐

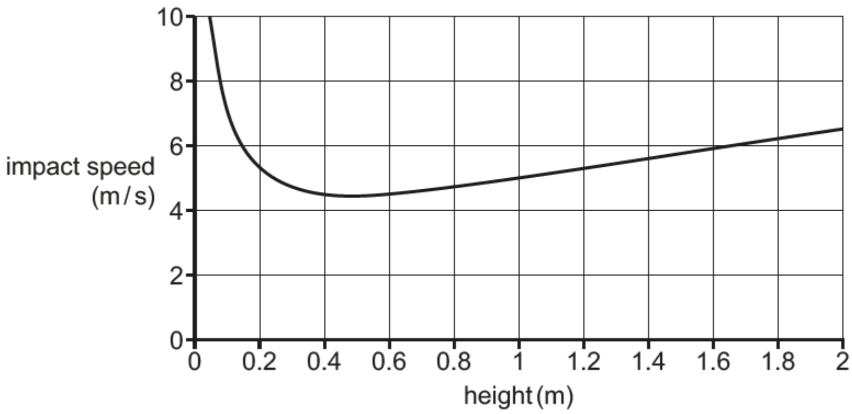
Nuclear store ☐

[1]

More candidates chose the correct response (kinetic store) in part (ii) than the correct response (chemical store in the first clown's muscles) in part (ii).

Question 10 (b) (iii)

(iii) The graph shows how the impact speed of the balloon depends on the height of the throw.



Describe the relationship between impact speed and height.

Use data from the graph in your answer.

....

....

....

.... **[2]**

Candidates found it difficult to describe the shape on the graph in words. They should describe what happens to the impact speed when the height is varied (the independent variable, height of throw, is plotted on the x-axis, rather than the other way around). Some candidates attempted to explain rather than describe why the graph was that shape, which requires knowledge outside of the specification for this paper.

	AfL	Make sure candidates understand the command words so that they are able to answer the questions correctly. **Describe** is to set out facts shown in the graph. **Explain** is to set out reasons for the shape of the graph. This is much more difficult.

Exemplar 3

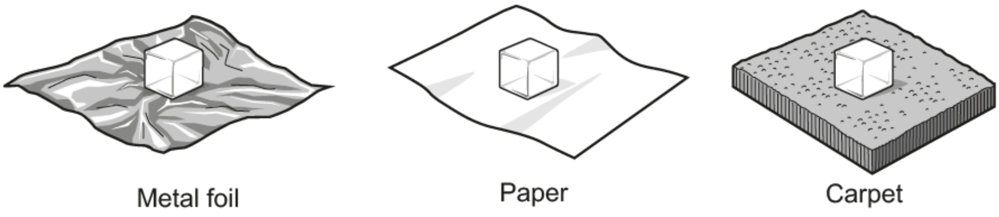
The lawer the hight, the higher the impact. Then a medium hight has low impact. Then high hight also has a high impact. **[2]**

This candidate has tried to explain that the impact speed is high for both low heights and high heights and that there is a low impact speed for heights in the middle. The word 'speed' is omitted so the benefit of doubt was given that this meant impact speed and this gained one mark. In order to get the second mark, this candidate could have identified that the minimum occurred at a height of about 0.5 m or gave a speed of about 4.5 m/s or described that there was a steeper curve at low heights than at high heights.

Question 11 (a)

11 Amir investigates melting ice.

He puts ice cubes on different materials. He then measures the time taken for each ice cube to completely melt.



Amir's results are shown in the table.

Material	**Time (min)**
Metal foil	86
Paper	105
Carpet	162

(a) Calculate the thermal energy needed to melt 20 g of ice.

The specific latent heat of melting for ice is 334 000 J / kg.

Thermal energy = ...J **[3]**

Many candidates used the correct equation to find the thermal energy, but most of them did not convert the mass in gram to a mass in kg before carrying out the calculation. Some candidates attempted to do this, but incorrectly said that 20 g equalled 0.2 kg.

Question 11 (b)

(b) Explain why the ice cubes take different times to melt on different materials.

....

....

....

....

.... **[2]**

This question was not particularly well answered. Many candidates use inappropriate scientific terminology regarding thermal transfer processes. Common errors were to suggest that the materials were not at the same temperature, that some of them 'absorbed heat energy better' than others. Very few candidates mentioned that energy from the heat store would need to be transferred to the ice cube for it to melt.

Exemplar 4

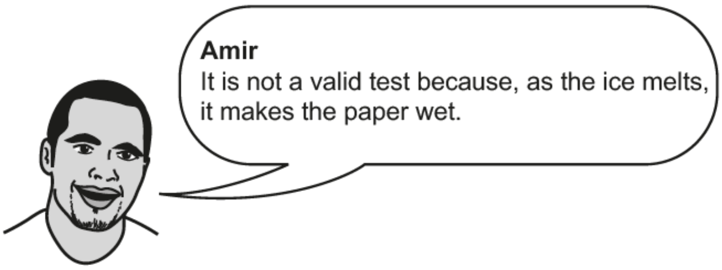
Explain why the ice cubes take different times to melt on different materials.

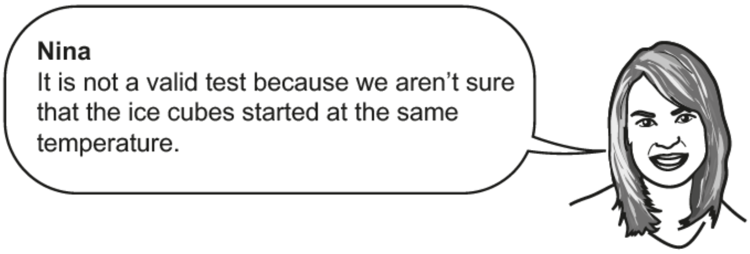
Because some of the materials conduct heat better than the others so they transfer more ~~heat to~~ thermal energy to the ice cube **[2]**

This is a good response to this question. The candidate refers to the rate at which thermal energy is transferred through each material..

Question 11 (c) (i)

(c) Amir discusses the experiment with Nina, another student.





(i) Suggest improvements to the experiment to solve each of these problems.

Amir's problem ....

....

....

Nina's problem ....

....

.... **[2]**

Most candidates suggest that Nina should record the temperature of the ice before the experiment or to take all the ice cubes out of the same freezer at the same time. Very few candidates attempted to suggest a suitable improvement for Amir's problem although the mark scheme was opened up to allow a wide range of possible improvements.

?	**Misconception**	When a question asks candidates to 'suggest' or 'give reasons' many candidates think that there must be a single 'correct' and so will not give an answer. However with this type of question any reasonable suggestion that demonstrates a candidate's scientific understanding is allowed. It is always worth attempting these questions as marks will always be given for the use of correct science in the context of the question.

Question 11 (c) (ii)

(ii) Amir wants to speed up the experiment so it can be repeated more quickly.

Suggest **one** way he can change the experiment so that the ice melts more quickly, without making the experiment invalid.

....

.... **[1]**

This question was answered well, with slightly more candidates suggesting that the temperature of the environment should be increased, rather than using smaller ice cubes or broken up ice cubes.

Question 12 (a) (i)

12 Jamal is on a water slide.

(a) **Fig. 12.1** shows the force of gravity (weight) acting on Jamal.

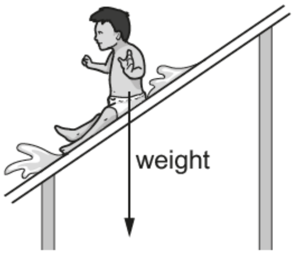


Fig. 12.1

(i) **Add an arrow** to **Fig. 12.1** to show the normal contact force between Jamal and the slide. Label this arrow **N**. **[1]**

Question 12 (a) (ii)

(ii) **Add an arrow** to **Fig. 12.1** to show the force of friction between Jamal and the slide. Label this arrow **F**. **[1]**

Candidates found this question very difficult, especially part (i). Many candidates drew a vertical arrow for the normal contact force. Slightly more candidates drew the correct arrow for friction in part (ii). Many candidates drew unlabelled arrows or arrows in opposite directions.

Exemplar 5

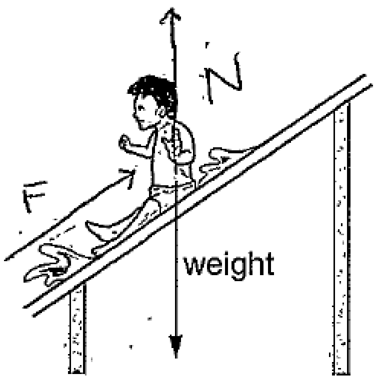


Fig. 12.1

This candidate has drawn a vertical upwards arrow for the normal force (N). The word 'normal' in physics means 'at right angle to'. The normal force should be an arrow at right angles to the surface. The friction arrow has been drawn correctly, pointing up the slope in the opposite direction to the direction that Jamal is moving.

Question 12 (b) (i)

(b) (i) State Newton's third law.

....

....

.... **[2]**

Question 12 (b) (ii)

(ii) Explain how Newton's third law applies to the force of gravity (weight) acting on Jamal.

....

.... **[1]**

Candidates did not show understanding of Newton's 3rd Law. A few did remember the phrase 'forces are equal and opposite' but did not explain the concept of force interaction pairs in part (i). Candidates tended to consider the normal contact force as being the other force in the interaction pair in part (ii). If candidates area able to recall the 3rd Law as 'if object A exerts a force of object B, then object B will exert an equal and opposite force on object A' then all that is needed to substitute the Earth for object A and Jamal for object B, and the question becomes quite logical.

Question 13 (a)

13 Beth works at a nuclear power station.

She is asked to investigate the risk caused by radioactive isotopes accidentally coming into contact with food.

(a) Would swallowing this food be a contamination effect or an irradiation effect?

Contamination effect ☐

Irradiation effect ☐

Explain your answer.

....

.... **[2]**

Many candidates correctly identified this as a contamination effect. A common misconception was to confuse radioactive contamination with bacterial infection or biological contamination of food with pathogens.

Question 13 (b)

(b) Explain why it is hazardous if radioactive isotopes enter the body.

....

....

.... **[1]**

Few candidates recalled that the reason that radioactive isotopes are dangerous is that they emit ionising radiation.

Question 13 (c)

(c) Information about three isotopes is shown in the table.

Isotope	Type of decay	Half-life	Biological effects
Plutonium-241	beta	14 years	absorbed by the bones
Radium-226	alpha	1600 years	absorbed by the bones
Technetium-99m	gamma	6 hours	excreted after a few days

Which isotope is most hazardous when inside the body?

Explain your answer.

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.... **[2]**

Many candidates did identify radium as the most hazardous, and quoted data from the table. However they need to be able to use the data in the table to form an explanation such as the link between half-life and the length of time the substance will remain radioactive. Just stating that a particular isotope has a long half-life is not an explanation.

Exemplar 6

Radium-226 is the most hazardess as Alpha rays are the most ionising and dangerous type of decays and have the longest half life meaning you can't get rid of it without treatment. Also it's absorbed by the bones which can effect body movement and the rate of production of white blood cells **[2]**

This is a good response to this question as it links data given in the table to their effect on the body. Radium has been suggested as it emits alpha radiation, and it then explains that alpha radiation is the most ionising type of radiation which is highly dangerous. Then for the second mark, another fact is quoted; that it has the longest half-life, which means that it would be difficult to get rid of.

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