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 2022 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. A selection of candidate answers is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

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

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

Advance Information for Summer 2022 assessments

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

Paper 1 series overview

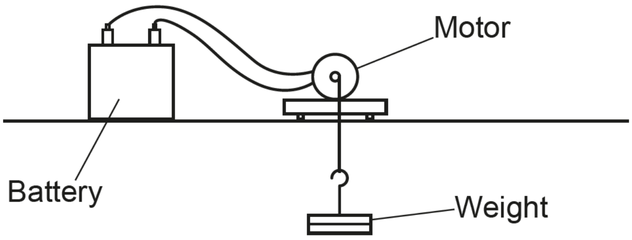
J259/01 is the Breadth in Physics paper at Foundation Tier. It covers topics across the whole specification with short answer questions. This includes structured questions, calculations and questions based on practical skills. It counts for 50% of the marks for Foundation Tier GCSE qualification in Physics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

On the whole candidates found the AO3 questions much more challenging than those testing AO1 and AO2. Some of the recall was good but applying knowledge in novel context was often difficult. Some candidates struggled with some part of the specification; this was more noticeable when it came to 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:
• explained and described scientific concepts and ideas using correct scientific terminology. • were able to rearrange equations and convert values into SI units for calculations. • correctly interpreted the context of the questions well.	• found it difficult to substitute the correct values into equations. • got distracted by the context and re-wrote the question stem rather than answered the question.

Question 1 (a) (i)

1 Layla uses a motor to lift a weight, as shown in the diagram. The motor is powered by a battery.



(a) (i) What is the energy store of the battery?

Tick (✓) **one** box.

Chemical ☐

Electrical ☐

Nuclear ☐

Thermal ☐

[1]

Question 1 (a) (ii)

(ii) How is energy transferred from the battery to the motor?

Tick (✓) **one** box.

By heating ☐

By radiation ☐

Electrically ☐

Mechanically ☐

[1]

More candidates answered part (ii) correctly but many candidates gave the response 'electrical' in part (i).

Question 1 (b) (i)

(b) (i) Layla measures the power of the motor as 13 W.

It takes 3.0 s to lift the weight.

Calculate the energy transferred by the motor.

Use the equation: energy transferred = power × time

Energy = ... J **[2]**

Question 1 (b) (ii)

(ii) Layla repeats the experiment.

She measures the power three times in total.

Her three measurements are: 13 W 17 W 12 W

Calculate the mean (average) power.

Mean power = ... W **[2]**

These two calculations were fairly straightforward and most candidates answered both correctly.

Question 1 (c)

(c) Layla's teacher says that the motor transfers too much energy to thermal energy.

How could Layla reduce this unwanted energy transfer?

Tick (✓) **one** box.

Use a higher voltage battery. ☐

Use foam to insulate the motor. ☐

Use longer wires. ☐

Use oil to lubricate the motor. ☐

[1]

This question was quite challenging to many candidates. A common incorrect response was to use foam to insulate the motor. Foam insulation would help to reduce thermal transfer from the motor, but this could result in the motor overheating. In this example we need to reduce the frictional losses.

Question 2 (a) (i)

2 Amir is studying the structure of atoms. **Fig. 2.1** shows a model of an atom.

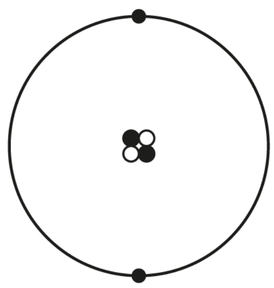


Fig. 2.1

(a) **(i)** Use a word from the list to complete the sentence.

electrons **neutrons** **protons**

The atom has a positive nucleus surrounded by negative .... **[1]**

Question 2 (a) (ii)

(ii) Use words from this list to complete the sentence.

charge **mass** **nucleus** **space** **volume**

Almost all of the .... of the atom is in the .... **[2]**

Most candidates were able to answer these questions quite well.

Question 2 (b)

(b) What is the typical size of an atom?

Tick (✓) **one** box.

10^{10} m ☐

10^{5} m ☐

10^{-5} m ☐

10^{-10} m ☐

[1]

Some candidates were confused about whether to use the negative or positive powers but many of them recalled the size of an atom correctly.

Question 2 (c) (i)

(c) Amir researches the hydrogen atom. He finds diagrams of three different hydrogen atoms. The diagrams are shown in **Fig. 2.2**.

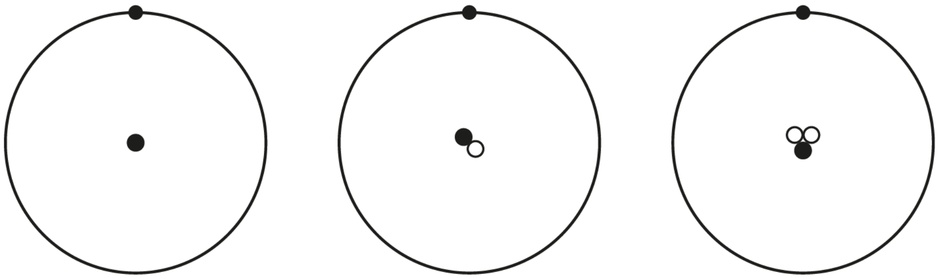
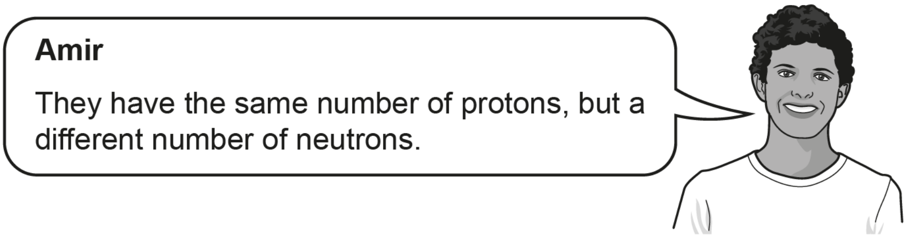


Fig. 2.2



(i) Which statement could be used to describe these atoms?

Tick (✓) **one** box.

They are identical ☐

They are isotopes ☐

They are negative ions ☐

They are positive ions ☐

[1]

Question 2 (c) (ii)

(ii) One of the atoms is unstable.

Which statement can be used to describe this atom?

Tick (✓) **one** box.

The neutrons are positively charged.	☐
The nucleus may emit a radioactive particle.	☐
The proton orbits the nucleus.	☐
There are electrons in the nucleus.	☐

[1]

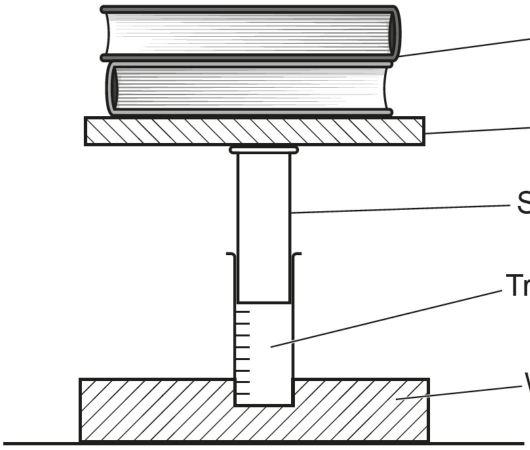
Many candidates correctly recalled that isotopes have the same number of protons but different numbers of neutrons. More candidates got the second part to this question correct and realised that unstable atoms are often radioactive.

Question 3 (a)

3 Beth investigates the pressure and volume of gases.

She uses the equipment shown in the diagram.

The pressure of the gas is increased by using a greater weight of books.



(a) The pressure of the gas causes forces against the inside surface of the syringe.

Which statement correctly describes the direction of these forces?

Tick (✓) **one** box.

They act at right angles to the surface of the syringe. ☐

They all act downwards. ☐

They act in random directions. ☐

They act parallel to the surface of the syringe. ☐

[1]

Candidates struggled with this question, many of them thinking that the forces due to pressure of a gas act in random directions or downwards.

Question 3 (b) (i)

(b) Beth wants to increase the force from the books by 24 N.

(i) Calculate the mass of a book with a weight of 24 N.

Gravitational field strength = 10 N / kg

Use the equation: mass = weight ÷ gravitational field strength

Mass = ... kg **[2]**

Question 3 (b) (ii)

(ii) The surface area of the top of the syringe is 0.0012 m^2.

Beth adds a book with a weight of 24 N.

Calculate the increase in pressure.

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

Pressure = ... Pa **[2]**

Most candidates correctly calculated the mass of the book in part (i) but found the calculation of pressure in part (ii) more challenging. Many candidates multiplied the force by the area, and some decided to square the area of the surface before using the given equation.

Misconception

The unit for area is usually m^2 or cm^2. This doesn't mean that the numerical value given for area should be squared. In this question the area is 0.0012 m^2.

If the length of the sides of a square was given at 0.0012 m then the area of that square is $0.0012^2 = 0.00000144$ m^2. This is very different from being given the value for area.

Question 3 (c)

(c) The temperature of the gas remains constant.

Beth observes that as the pressure increases, volume decreases.

Which statements correctly explain why this happens?

Tick (✓) **two** boxes.

The particles are closer together. ☐

The particles become smaller. ☐

The particles collide more often. ☐

The particles move faster. ☐

The particles push with a larger force when they collide. ☐

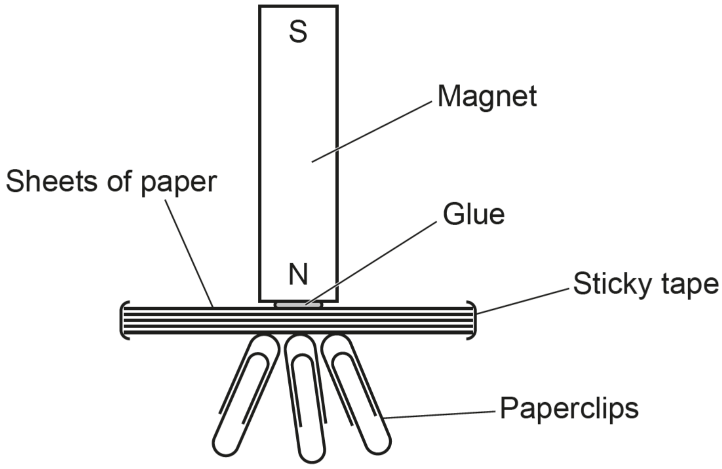
[2]

This was quite a challenging concept for many candidates. It is often easier to think about gases heating up and the particles move faster and collide with larger forces. In this case candidates had been told that the temperature remains constant so this is not the case. If the gas is compressed into a smaller volume, then the particles must become closer together and because of this they will collide more often.

Question 4 (a) (i)

4 Kai investigates how the strength of a magnet depends on distance from the magnet.

He uses the equipment shown in the diagram. The distance between the magnet and the paperclips is varied by using different numbers of sheets of paper.



(a) **(i)** Complete the following sentences about the paperclips.

Use words from the list.

copper **hard** **induced** **iron** **permanent** **zinc**

When the magnet is close to the paperclips they become .... magnets.

They must be made of a magnetic material, such as ....

[2]

Question 4 (a) (ii)

(ii) Describe the difference between a permanent and an induced magnet.

....

.... **[1]**

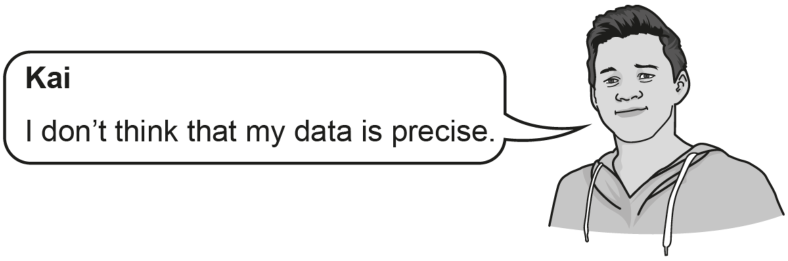
Most candidates recognised that the paper clips become induced magnets but there were many who selected either zinc or copper as magnetic materials. Many candidates were able to describe the difference between permanent and induced magnets although a few said that permanent magnets always attracted rather than were always a magnet. Magnetic forces can be either attractive or repulsive

Question 4 (b) (i)

(b) Kai's results are shown in the table.

Number of sheets of paper	Number of paperclips attracted to magnet			
	1	**2**	**3**	**Mean**
1	9	6	10	8.3
2	5	7	11	7.7
3	5	5	8	6.0
4	3	4	7	4.7
5	3	6	2	3.7
6	2	5	3	3.3

(i) Kai evaluates the quality of his data in the table.



Explain why Kai is correct.

....

....

.... **[1]**

This question was not well answered. There were many candidates who suggested that the calculation of the mean was incorrect or simply stating that there was no pattern in any of the results.

Assessment for learning

IaS2 refers to drawing conclusions from data. The quality of data generated from experimental work will depend on both accuracy and precision. Accuracy relates to how close the measured values are from the true value, while precision is about how close together repeated measurements are.

Question 4 (b) (ii)

(ii) Describe the pattern in Kai's data.

....

....

.... **[1]**

When candidates describe patterns in data they need to refer to both the dependent and the independent variable, preferably in the correct order. Simply stating that there is negative correlation is insufficient. Candidates should clearly state that as the amount of paper increased the number or paper clips attracted to the magnet decreased.

Question 4 (c)

(c) Kai decides to investigate the strength of electromagnets.

He builds an electromagnet by wrapping a coil of wire around an iron core.

How could Kai increase the strength of his electromagnet?

Tick (✓) **one** box.

Swap the iron core for a plastic core. ☐

Increase the current in the wires. ☐

Increase the resistance of the wires. ☐

Increase the spacing between the coils. ☐

[1]

Many candidates correctly selected 'increase the current'. The most common incorrect response was to increase the spacing of the coils.

Question 5 (a)

5 Eve investigates how white light reflects from a mirror.

Fig. 5.1 shows her equipment.

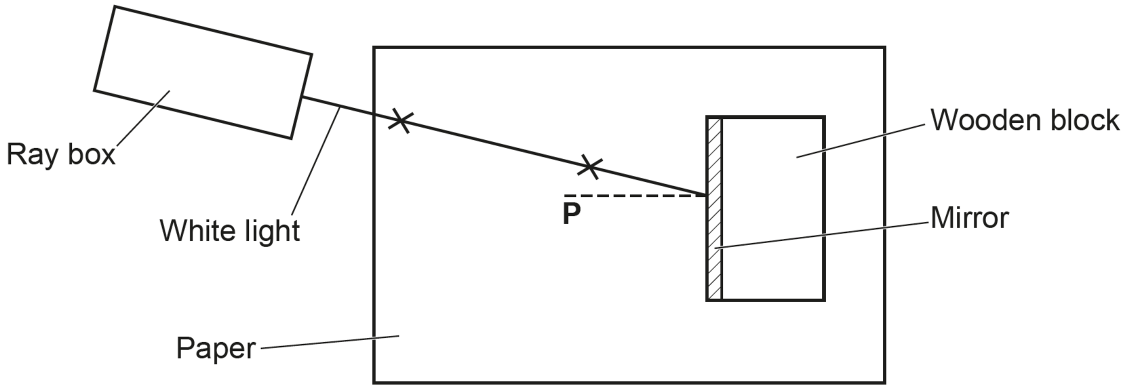


Fig. 5.1

(a) What is the name of the dotted line **P** in **Fig. 5.1**?

Tick (✓) **one** box.

Boundary line ☐

Incident ray ☐

Normal line ☐

Reflected ray ☐

[1]

Many candidates were able to select the correct response to this question.

Question 5 (b)

(b) Eve records the position of the ray by marking crosses on the paper and then joining them together.

Describe two things that Eve should do to record the position as accurately as possible.

1 ....

....

2 ....

....
[2]

This question was not well answered. Some candidates gained 1 mark for suggesting a ruler was used to draw the rays of light, but there were few other suggestions worthy of marks. Very few candidates gained both marks here, and there were several mundane comments about not moving the equipment while carrying out the experiment. This question was really about techniques to improve the accuracy of measurements specific to this particular practical.

Question 5 (c)

(c) **Fig. 5.2** shows the expected result from Eve's investigation.

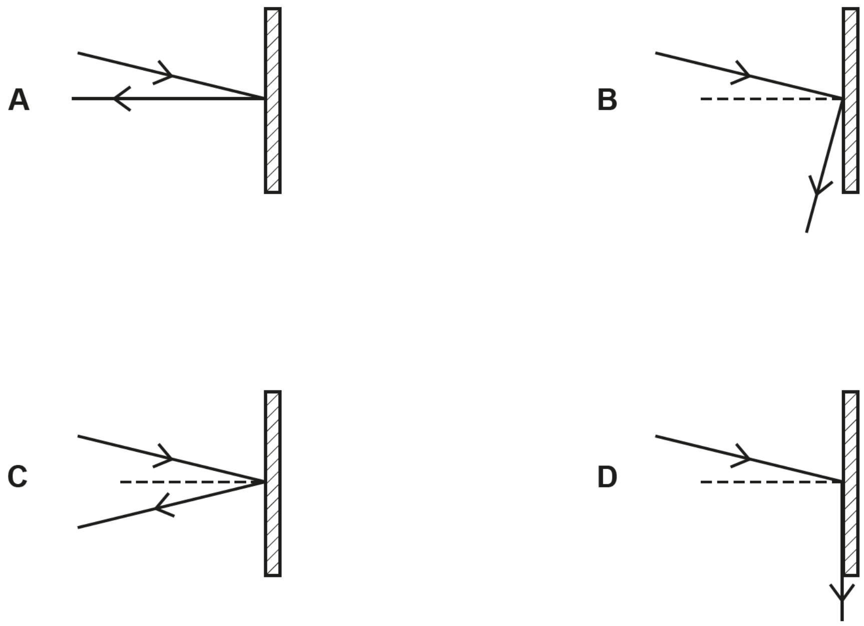


Fig. 5.2

Write the letter (**A**, **B**, **C** or **D**) of the correct diagram. .... **[1]**

Many candidates gained the mark here for identifying C as the correct response.

Question 5 (d)

(d) Eve wants to extend her experiment.

Eve

White light is a mixture of different wavelengths.

I want to investigate the reflection of just one wavelength of light.

Suggest how Eve could extend her experiment to investigate just one wavelength of light.

....

....

....

.... **[2]**

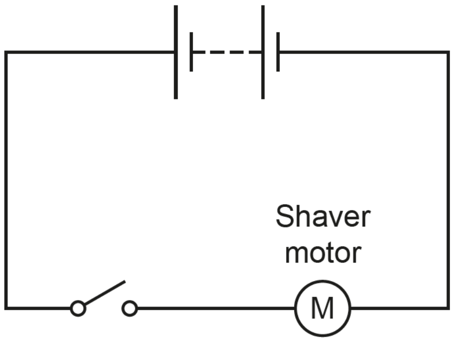
This question was not well answered. Many candidates did suggest that the white light should be split into the spectrum using a prism, but in order to carry out this investigation a slit would need to be used in order to isolate one particular band of colour.

Question 6 (a)

6 Ben uses a battery-powered shaver.

The shaver uses an electric motor to move the blades.

A circuit diagram for the shaver is shown below.



(a) When the shaver is switched on, energy is transferred.

Which **two** statements correctly describe changes in the energy stores when the shaver is switched on?

Tick (✓) **two** boxes.

Chemical energy store in battery decreases. ☐

Elastic energy store in room increases. ☐

Gravitational energy store in battery decreases. ☐

Kinetic energy store in battery decreases. ☐

Nuclear energy store in room increases. ☐

Thermal energy store in room increases. ☐

[2]

Candidates performed more successfully at this question than in previous years when this topic has not been tested using MCQ style questions. Given the choice of responses, many candidates managed to gain at least 1 mark.

Question 6 (b) (i)

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

(i) Each time Ben uses the shaver, 180 C of charge flows.

Calculate the energy transferred each time he uses the shaver.

Use the equation: energy transferred = charge flow × potential difference

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

Question 6 (b) (ii)

(ii) The power of the shaver is 1.1 W.

Calculate the current flowing through the shaver.

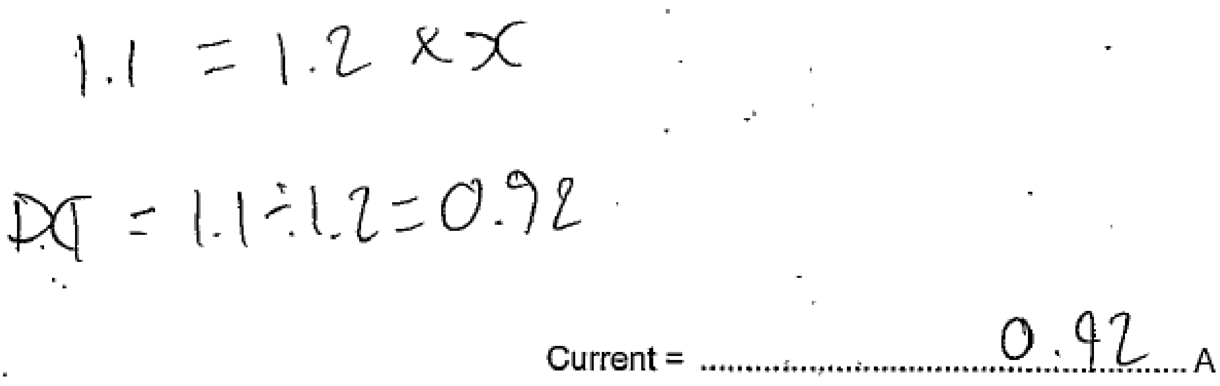
Use the equation: power = potential difference × current

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

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

Most candidates correctly used the given equation to calculate the energy transferred in part (i). However, in part (ii) many candidates were unable to correctly rearrange the equation to calculate current. Commonly candidates tended to multiply the two given values together. There were also some candidates who confused the terms 'potential difference' and 'power' even if they correctly rearranged the equation. Some candidates who did the incorrect calculation were able to round their value correctly to 2 significant figures and gained 1 mark.

Exemplar 1



This is a well laid out calculation response. The candidate has correctly rearranged the equation to calculate power and written it down clearly. Then the values for power (1.1) and potential difference (1.2) have been substituted into the equation correctly to give the answer 0.916.

Assessment for learning

Candidates need to be able to use correct scientific terms. Unfortunately, everyday language confuses some technical terms, for example, people might use the word power to describe the voltage of a battery.

Matching the term to the unit might help candidates choose the correct value to substitute into equations.

- Potential difference is measured in volt (V).
- Current is measured in amp (A).
- Power is measured in watts (W).

Question 7 (a)

7 **Fig. 7.1** shows a hole puncher.

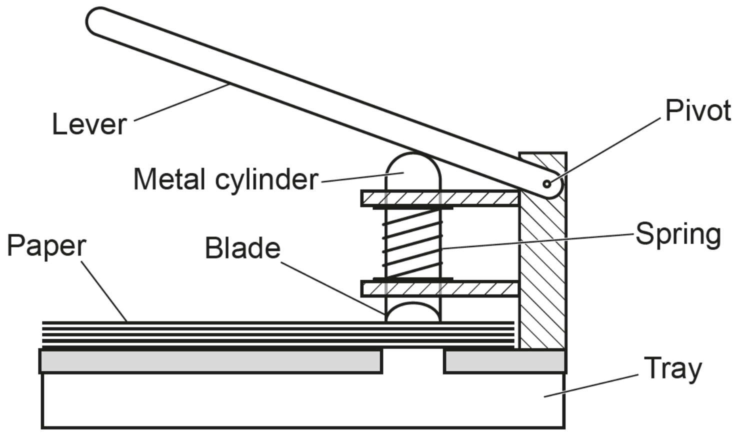


Fig. 7.1

The lever is pushed down to punch a hole in some paper.

Fig. 7.2 shows two of the forces on the lever when it has been pushed down. The force arrows **P** and **Q** have not been drawn to scale.

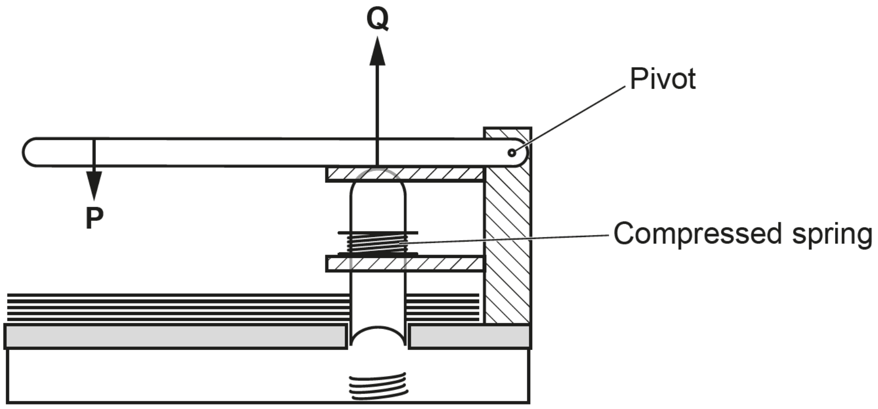


Fig. 7.2

(a) The size of force **P** is 30 N.

The distance from the pivot to force **P** is 6.0 cm.

Calculate the moment of the force.

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

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

Many candidates were able to substitute the given values into the equation correctly. The unit given on the answer line is Nm so the distance used in the calculation needs to be in metres. The distance is given in cm. Some candidates spotted this and remembered to convert 6.0 cm to 0.060 m before they did the calculation.

Question 7 (b) (i)

(b) **(i)** The force **Q** is caused by the metal cylinder pushing against the lever.

Which statement describes how to increase **Q** without increasing **P**?

Tick (✓) **one** box.

Push closer to the pivot. ☐

Push further from the pivot. ☐

Push sideways instead of down. ☐

Push up instead of down. ☐

[1]

This question was not well answered. Increasing the distance of the force P from the pivot will increase the moment of the pushing force P. If the contact force Q was closer to the pivot it would increase but that is a fixed point on this particular hole punch, so it cannot be moved.

Question 7 (b) (ii)

(ii) The lever exerts a force **R** on the metal cylinder. The force **R** and force **Q** are an interaction pair.

Compare and contrast force **P** to the force **Q**.

....

.... **[2]**

Many candidates were able to gain a mark for stating that force P and force Q were in opposite directions, and that Q was larger than P.

Question 7 (c)

(c) Explain how the lever returns to its original position when **P** is removed.

....

....

.... **[1]**

Many candidates gained a mark here for suggesting that the spring returned to its normal size and pushed the lever back to position.

Question 8 (a) (i)

8 Jack is a sprinter. He uses a parachute when he trains, as shown in **Fig. 8.1**.

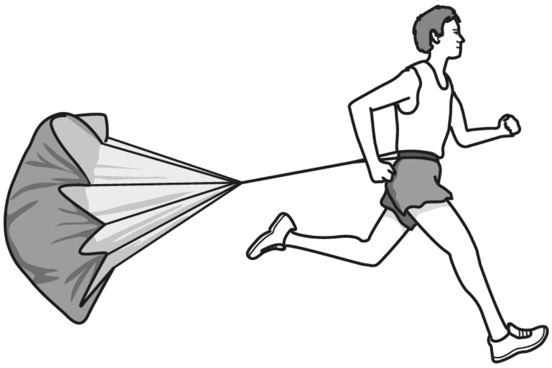


Fig. 8.1

(a) **Fig. 8.2** shows the forces acting on Jack when he is training.

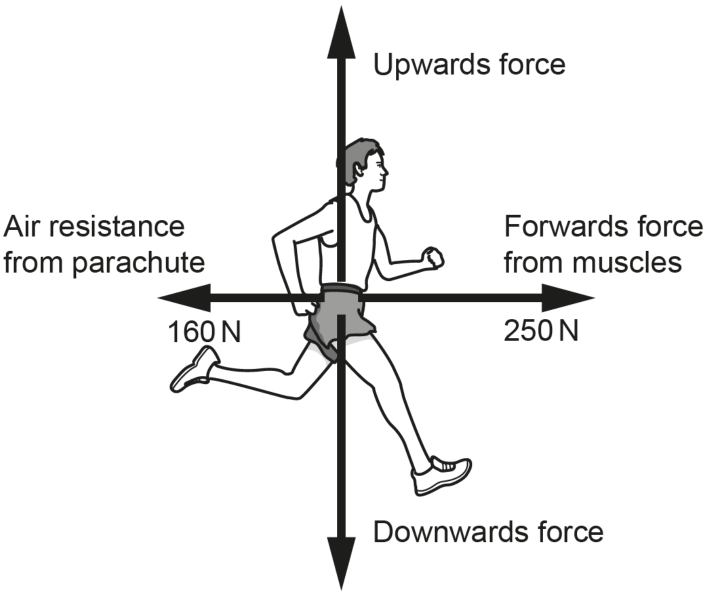


Fig. 8.2

(i) Name the upwards and downwards forces acting on Jack.

Upwards force ....

Downwards force ....

[2]

Most candidates were able to name the downwards force as weight or gravitational force. Naming the upwards force was much more difficult.

Question 8 (a) (ii)

(ii) Jack's mass is 60 kg.

Calculate Jack's acceleration.

Use information from **Fig. 8.2**.

Use the equation: acceleration = force ÷ mass

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

Many candidates were able to use the given equation and substitute in a force value and a mass value. Only some candidates calculated the resultant force as 250 – 160 = 90 N, before carrying out the calculation.

Question 8 (b)

(b) **Fig. 8.3** shows the horizontal forces acting on Jack a few moments later. Jack is still running.

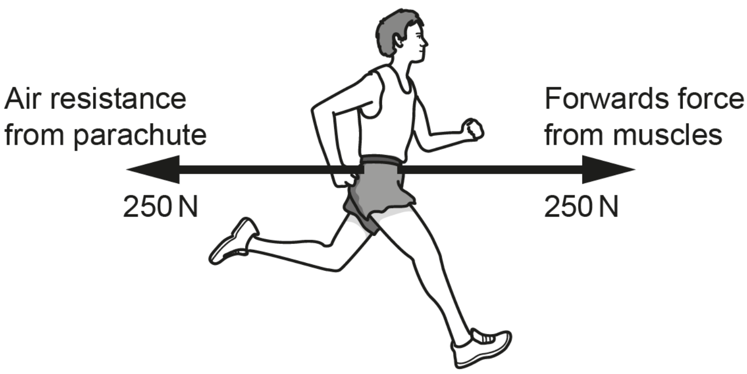


Fig. 8.3

Describe Jack's velocity, and explain your answer using information from **Fig. 8.3**.

....

....

....

.... **[2]**

Many candidates correctly identified that the two forces were equal and opposite, but some of them then thought that this meant that Jack must be stationary or that he had slowed down from the previous image.

Exemplar 2

Jack is running at a constant velocity with no accelaration as he has the same force on each side unlike before when the forwards force was higher **[2]**

This is a good response to this question. It clearly says that Jack is moving at constant velocity with no acceleration. Then it says that there is the same force on each side, which is sufficient for the second mark. Both forces are equal in size and act in opposite directions.

Misconception

When the net force acting on an object is zero, the object is at equilibrium. This means one of two things:

- The object is moving at constant velocity (or constant speed in a straight line).

OR

- The object is stationary.

Question 8 (c)

(c) Jack wants to buy a new training parachute. He wants a parachute that will give the biggest possible air resistance.

The table shows information about three parachutes.

Parachute	Diameter (cm)	Mass (kg)	Cost
A	42	0.32	£9
B	48	0.29	£15
C	56	0.30	£12

Suggest which parachute Jack should buy.

....

....

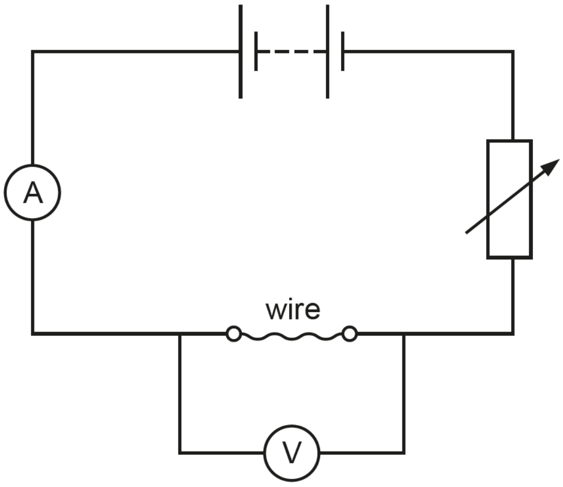
.... **[2]**

Most candidates correctly identified that parachute C was most suitable, but in order to gain the second mark they needed to state that it would have the largest surface area. Just writing out parts of the question stem such as it will provide the largest air resistance is not enough to gain a mark.

Question 9 (a) (i)

9 Jane investigates how the resistance of a wire depends on its diameter.

She uses the circuit shown in the diagram to measure the resistance of wires of different diameters.



(a) One control variable in this experiment is the temperature of the wire.

(i) Suggest how to keep the temperature of the wire constant.

....

.... **[1]**

Question 9 (a) (ii)

(ii) State **two** other control variables for this experiment.

1 ....

....

2 ....

....

[2]

These questions were not well answered. In part (i) a few candidates suggested the use of a controlled environment such as a water bath, but most did not appreciate that a resistance wire gets hot as current passes through it. Very few candidates suggested keeping a low current in the wire and there were many candidates who incorrectly suggested that the wire should be insulated.

There was quite a wide selection of incorrect responses in part (ii), but a few candidates did suggest that the length of wire and/or the current should remain constant. Candidates putting 'voltage' or 'power' down were not credited, because in order to maintain a constant current in the wire the 'voltage' will need to be varied as the resistance of the wire changes. Candidates should learn to use the correct scientific terminology.

Question 9 (b)

(b) Jane makes the following measurements for one wire.

reading on voltmeter = 0.55 V
reading on ammeter = 2.5 A

Use the Data Sheet.
Calculate the resistance of the wire.

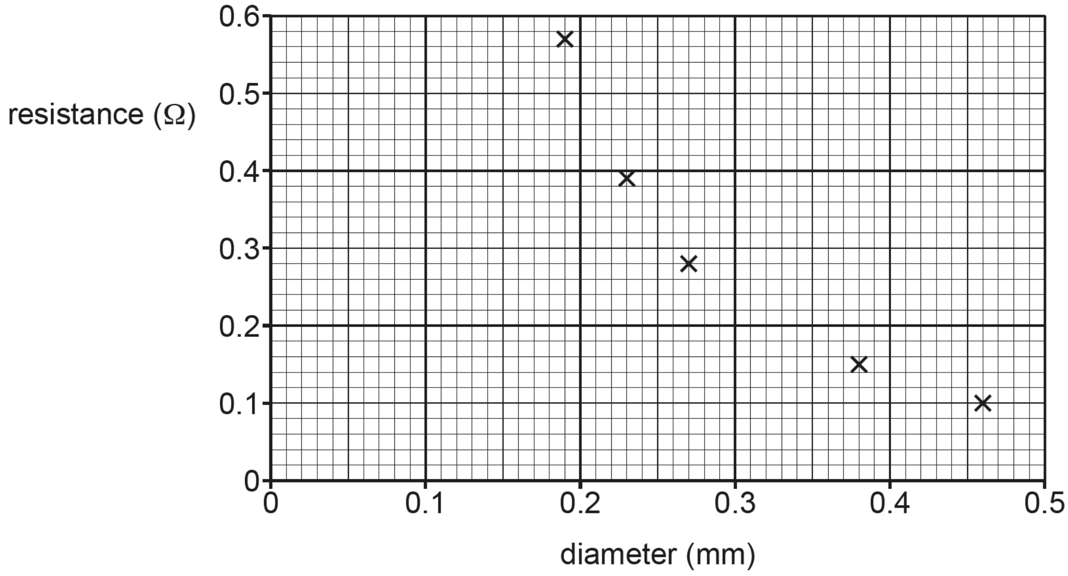
Resistance = ... Ω **[3]**

Some candidates were unable to select the correct equation to use from the Data Sheet, and only a few of those who did select correctly were able to rearrange to calculate resistance. Some candidates attempted to use the equation 'Power = potential difference × current' instead, many candidates tend to just multiply the given numbers together.

Question 9 (c) (i)

(c) The table and graph show Jane's results.

diameter (mm)	resistance (Ω)
0.19	0.57
0.23	0.39
0.27	0.28
0.32	0.22
0.38	0.15
0.46	0.10



(i) Complete the graph by plotting the missing result from the table and draw a line of best fit. **[2]**

Question 9 (c) (ii)

(ii) Write a conclusion for Jane's investigation.

....

....

....

.... **[2]**

Some candidates did not notice that the scale on the y-axis was different from the scale on the x-axis. Most candidates correctly plotted the point at x = 0.32, but often at y = 0.24 instead of y = 0.22. Most candidates attempted to draw a straight line through the curved trend and this was difficult to achieve the best straight line so a curved line is more appropriate for a curved trend.

Most candidates were able to state the conclusion that as the diameter increases the resistance decreases, but few candidates gained a second mark for more a more detailed description of the trend such as it is not a linear trend, or that for larger diameters the change of resistance is less than for small diameters.

Question 10 (a)

10 Different types of wave can be used for communications.

Fifty years ago, microwaves were used for long distance communications. Microwaves travel through the air between microwave aerials.

Now, light waves travelling along optical fibres are normally used instead.

(a) State **one** similarity and **one** difference between microwaves and light waves.

Similarity ....

....

Difference ....

....

[2]

Some candidates did recall that both light and microwaves are electromagnetic waves, or that they are transverse waves, and some did state that the wavelength or frequency was different. Many candidates re-wrote parts of the question stem for their answer here. The text at the beginning of the question is to put the science into context, but this question is trying to assess candidates' knowledge of the electromagnetic spectrum, rather than their ability to read the question.

Question 10 (b) (i)

(b) The table compares the speed of the two methods of communication.

	Method of communication	Speed of wave (m/s)
1	Microwaves in air	3.0×10^8
2	Light waves in an optical fibre	2.0×10^8

(i) The distance between two locations is 90 km.

Use the Data Sheet.

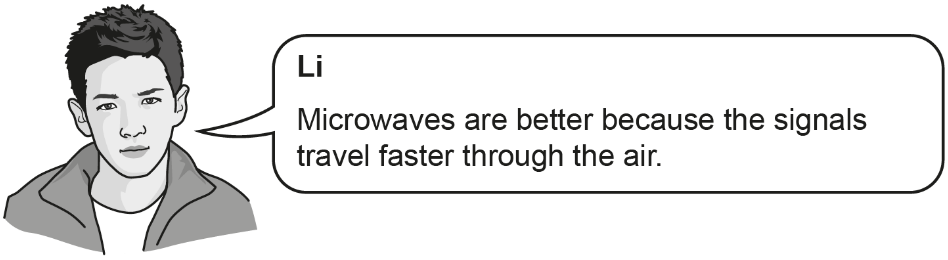
Calculate the time taken for a light wave to travel this distance through an optical fibre.

Time = ... s **[4]**

Some candidates were able to select the correct equation and manage to rearrange it to calculate time, but most candidates did not convert 90km to 90000m before doing the calculation.

Question 10 (b) (ii)

(ii) Li thinks about which method is better.



Evaluate Li's statement.

....

.... **[1]**

This question was tricky for most candidates, who tended to either agree or disagree with the given statement, without any justification. The concept that both waves travel very fast and that the time delay could be considered to be negligible was not appreciated.

Question 11 (a)

11 Nina investigates how the resistance of a thermistor depends on its temperature.

She controls the temperature of the thermistor by placing it in a beaker of water at different temperatures.

Fig. 11.1 shows part of her circuit diagram.

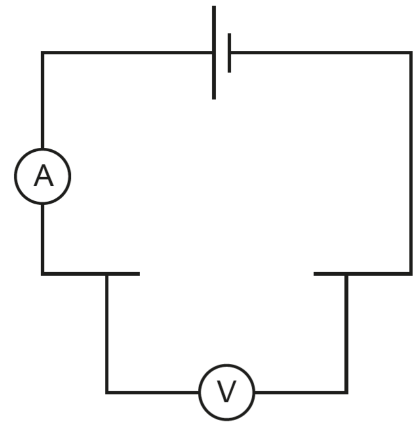


Fig. 11.1

(a) Complete **Fig. 11.1** to include a thermistor correctly connected to the circuit. **[1]**

Some candidates recalled the correct symbol for a thermistor but did not put the symbol in the gap in the circuit, instead trying to draw it over the vertical line on the right-hand side. Some candidates just made up their own symbol, such as a circle with a T in it, and some were confusing it with a rheostat or a resistor.

Question 11 (b) (i)

(b) **Table 11.1** shows her data.

Temperature (°C)	Resistance (Ω)
0	1300
80	1800

Table 11.1

Nina

My hypothesis is that as temperature increases, resistance increases.

To test this, I need a measurement at a temperature of about 50 °C.

(i) Suggest how she could make water with a temperature of about 50 °C.

....

.... **[1]**

Question 11 (b) (ii)

(ii) **Table 11.2** shows her data including the measurement at 50 °C.

Temperature (°C)	Resistance (Ω)
0	1300
50	350
80	1800

Table 11.2

How will the new data affect Nina's confidence in her hypothesis?

Explain your answer.

Tick (✓) **one** box.

Less confident ☐

More confident ☐

No effect ☐

Explanation: ....

....

.... **[2]**

In part (i), some candidates did suggest using water bath, and other suggested heating it up slowly until it got to the required temperature. In part (ii) most candidates were able to spot that the new result did not fit with the hypothesis and that this would make Nina less confident.

Question 11 (c)

(c) Nina made 7 more measurements at different temperatures.

All her data is plotted in **Fig. 11.2**.

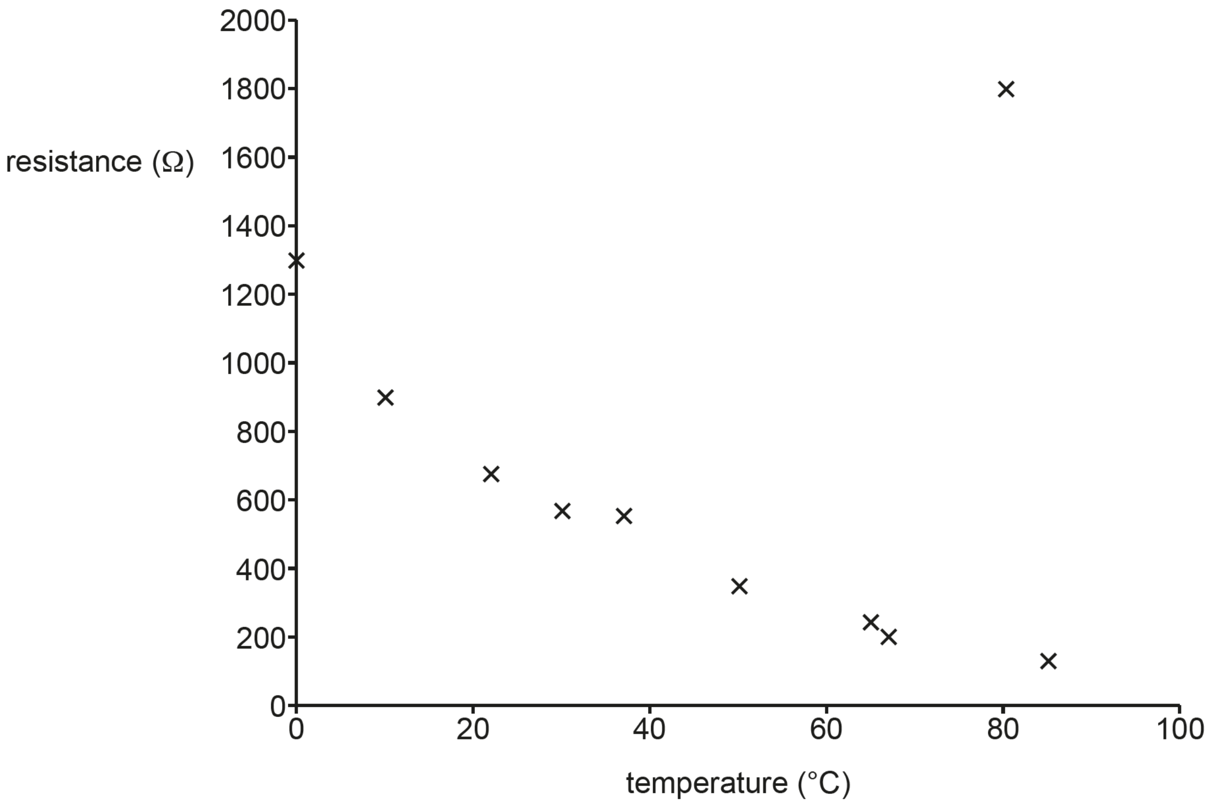


Fig. 11.2

Describe the trend shown in **Fig. 11.2**.

....

....

....

.... **[2]**

Most candidates stated correctly that the resistance decreases as the temperature increases and some of them did identify that there was an outlier at 80°C.

Question 12 (a)

12 Jamal, Sara and Jack are playing rounders.

Rounders is a game played with a bat and ball. **Fig. 12.1** shows the layout of the pitch. The bowler stands at X and throws the ball towards the batter at Y.

The batter hits the ball and then tries to run to third base, from Y to Z.

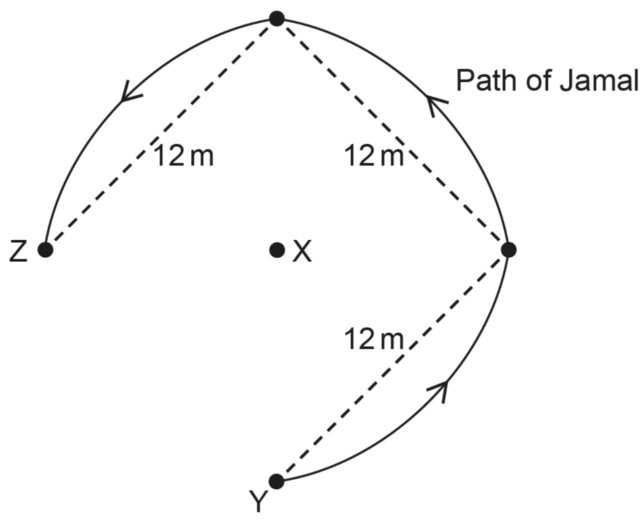
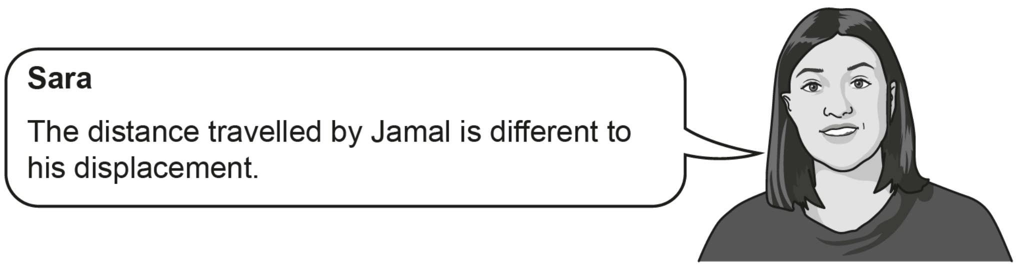


Fig. 12.1

(a) Jamal hits the ball and runs along the path from Y to Z shown in **Fig. 12.1**.



Explain why Sara is correct. Use information from **Fig. 12.1** in your answer.

....

....

....

.... **[2]**

This question was not well answered. Most candidates did not realise that this question was really asking them to explain the difference between distance and displacement, and instead commented that Jamal was running round a curved path rather than straight lines as it would be quicker than having to make sharp turns.

Question 12 (b) (i)

(b) Sara and Jack try to estimate how quickly Jamal speeded up.

Sara
He takes 10 seconds to reach a maximum speed of about 16 m / s.

Jack
He takes 2.5 seconds to reach a maximum speed of about 4 m / s.

(i) Which is the better estimate? Explain your answer.

Tick (✓) **one** box.

Sara ☐

Jack ☐

....

.... **[1]**

Some candidates did suggest that 16 m/s is an unrealistic running speed for people, but a common error was to suggest that the numbers Sara was using made it an easier calculation.

Question 12 (b) (ii)

(ii) Use **either** estimate to calculate Jamal's acceleration.

Use the Data Sheet.

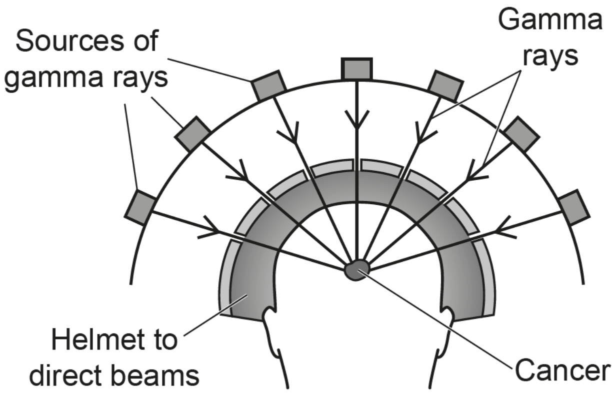
Acceleration = ... m/s^2 **[3]**

Many candidates were able to select the correct equation from the Data Sheet and manage to calculate the acceleration correctly.

Question 13 (a)

13 Cancer can be treated using radiation. This is called radiotherapy.

The diagram shows one way to use gamma rays to treat cancer.



(a) Describe why gamma rays can be used to treat cancer using the method shown in the diagram.

....

....

....

....

....

.... **[3]**

Many candidates gained marks here, usually for either saying that gamma rays were ionising and/or for saying that this destroyed the cancer cells. Some candidates were able to gain the final mark for some discussion of the penetration properties of gamma radiation or this particular process.

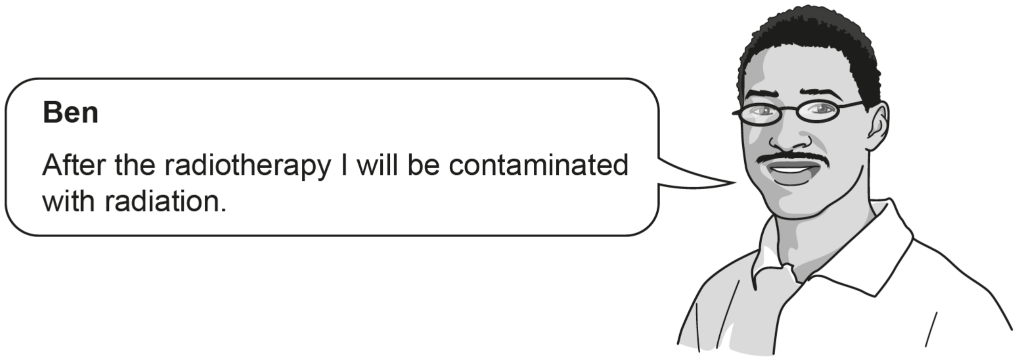
Exemplar 3

Gamma rays can ~~kill~~ ~~[illegible]~~ penetrate through skin. They attack the damaged cells that cause cancer and do not damage the living cells within the skin.

This candidate has correctly said that gamma rays are able to penetrate skin, but then they say that gamma rays attack cells, which is not quite enough for the mark. They need to say that the cells are killed or destroyed by the gamma rays for another mark. If they then say that this happens because the gamma rays are a type of ionising radiation, they would be able to get full marks on this question.

Question 13 (b)

(b) Ben's cancer is treated using gamma rays.



Explain why Ben is wrong.

....

....

.... **[2]**

This question was not well answered. Many candidates made comments about half-life or that it was a safe process. A few candidates did show understanding of the difference between contamination and irradiation.

Question 13 (c)

(c) X-rays can also be used for radiotherapy.

X-rays are produced electrically using a machine.

Suggest an advantage of treating cancer using X-rays instead of gamma rays.

....

....

.... **[1]**

This question was not answered well. Most candidates suggested that X-rays were safer as they were not ionising radiation.

Assessment for learning

Candidates should appreciate that the frequency range of X-rays and gamma rays overlap. There is very little difference in their ionising properties, the difference is really to do with the way that they are produced.

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