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GCSE (9–1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE PHYSICS B

J259

For first teaching in 2016

J259/02 Summer 2024 series

Version 1

ocr.org.uk/science

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers 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.

Paper 2 series overview

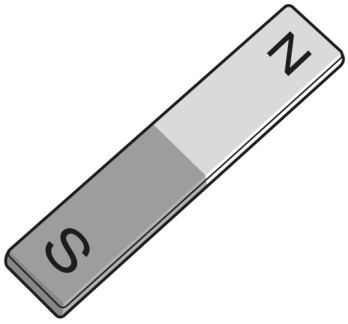
J259/02 is the Foundation tier of one of the two examination components for the GCSE (9-1) Physics B specification (Twenty First Century Science). This is the examination component 'Depth in Physics' and follows the examination component 'Breadth in Physics'. The last two questions, 11 and 12, are also on the Higher tier paper and are marked with the same mark scheme as the Higher tier.

This component assesses content from across the whole specification. It allows candidates to demonstrate their depth of understanding of specific aspects of the content. To do well on this component, candidates need to understand the questions in the context of the knowledge and understanding they have developed during the course. They need to be able to analyse the information and ideas presented by the questions and they need to be able to communicate their answers clearly and unambiguously. In calculations they should write down the equation they are going to use and show their working.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• attempted to answer almost all the questions • could select the equations required, and sometimes rearrange them correctly • were able to substitute correct values into equations • performed calculations accurately • knew the definitions of words such as amplitude • knew the names of equipment such as ammeter and transformer • remembered information about many of the topics, for example, isotopes, the Big Bang, energy resources and climate change • were able to interpret the graphs and charts, for example, of mass against volume, and pie charts showing energy resources.	• did well on multiple choice questions, but sometimes omitted answers where they were required to ring the correct answer • did not attempt many of the other questions • did not understand some of the questions • did well on calculations where the equation was given and did not need rearranging • did not show their working for calculations • had difficulty rearranging equations, and to decide whether to multiply or divide • interpreted the speed-time graph as a distance-time graph.

Question 1 (a)

1 A bar magnet is a permanent magnet. It has a north-pole N and a south-pole S.



(a) Which metal can be used to make a permanent magnet?

Tick (✓) **one** box.

Aluminium ☐

Copper ☐

Steel ☐

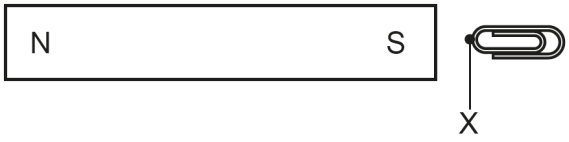
[1]

The majority of candidates did not know the metal was steel. Many thought it was aluminium.

Question 1 (b) (i) and (ii)

(b) A paperclip is an induced magnet.

(i) The diagram shows a paperclip being brought close to the S-pole of a magnet.



What happens?

Tick (✓) **one** box.

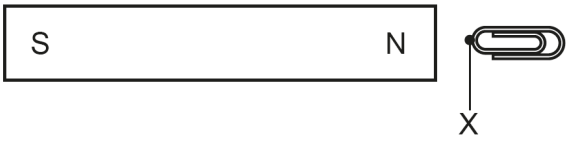
Point X is attracted to the S-pole. ☐

Point X is repelled by the S-pole. ☐

Nothing. ☐

[1]

(ii) The magnet is turned so the paperclip is now brought close to the N-pole of the magnet.



What happens?

Tick (✓) **one** box.

Point X is attracted to the N-pole. ☐

Point X is repelled by the N-pole. ☐

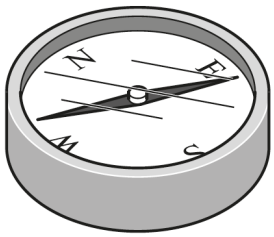
Nothing. ☐

[1]

The attraction between an induced magnet and both poles of permanent magnet was not well known. The majority of candidates answered (b) (i) correctly, but a smaller majority of candidates answered (b) (ii) correctly. A number of candidates had changed their answer to (b) (i) – this may have been when they started to think about (b) (ii). It was common to see one correct and one incorrect answer, as candidates appeared to reason that the answers should be different.

Question 1 (c)

(c) A magnetic compass consists of a magnetic pointer that can rotate freely.



Describe how a compass can be used to show that the core of the Earth is magnetic.

.....

.....

.....

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

Most candidates said that the compass would point to the core. The specification narrative says that the magnetic field around the Earth, with poles near the geographic north and south, provides evidence that the core of the Earth is magnetic. No candidates showed knowledge of this link between the Earth's magnetic field and the core, so only a very small minority said that the compass would point north.

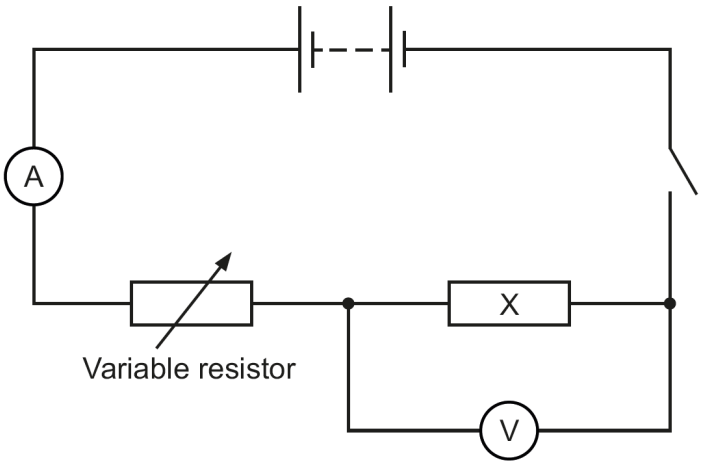
Misconception

Some candidates believe that the core of the Earth is like the core of an apple stretching from the North to the South pole. Foundation candidates are only required to know about the Earth's core in the context of the Earth's magnetic field, but an understanding that the core is a spherical shape that is concentric with the Earth's centre might help to stop some of them saying that a compass points to the core of the Earth, or to the top of the core, when they probably meant towards North.

Question 2 (a) (i)

2 A student investigates the I-V characteristics of an unknown component X.

The diagram shows the circuit they build.



(a)
(i) The student needs to measure the current and the potential difference in the circuit.

Name the **two** pieces of measuring equipment shown in the circuit.

…….... and …….... **[2]**

The majority of candidates answered this correctly. Phonetic spellings were allowed, but 'ampmeter' and 'voltameter' were common incorrect answers. A number of candidates suggested items that were not measuring equipment, such as 'battery' and 'variable resistor'.

Question 2 (a) (ii)

(ii) Why is there a variable resistor in the circuit?

Tick (✓) **one** box.

To change the power of the battery. ☐

To change the potential difference across X. ☐

To measure the charge flowing in the circuit. ☐

[1]

The majority of candidates answered this correctly.

Question 2 (a) (iii)

(iii) The student states that component X is getting hot whilst they are doing the experiment.

Describe **one** precaution the student can take to prevent the component from over heating.

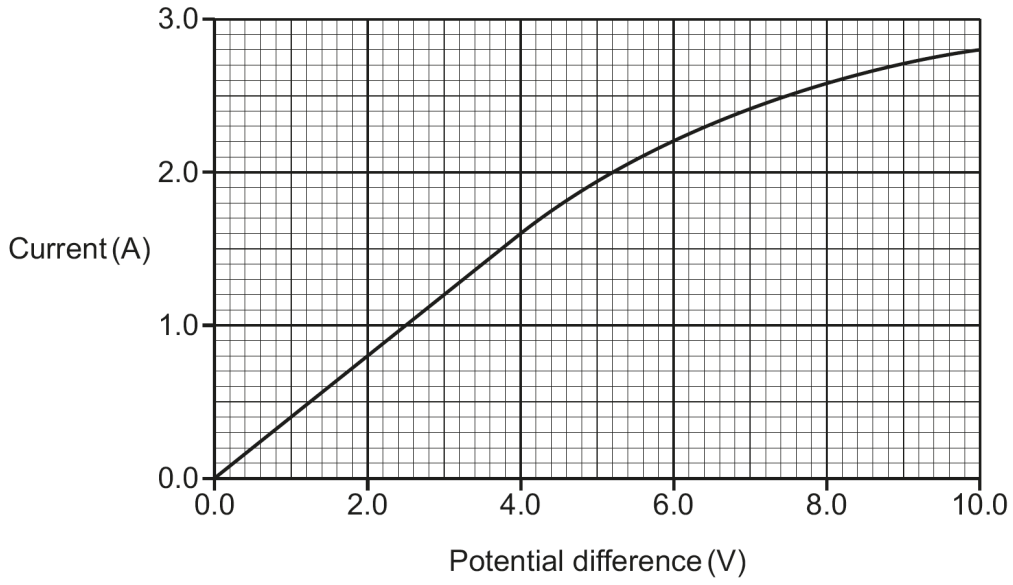
.....

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

The majority of candidates gained a mark here. A common answer was to switch off and let the circuit cool. This was expressed in many ways, frequently as 'taking a break'. Fans were popular, and also reducing the current or power.

Question 2 (b) (i)

(b) The student plots a graph of her results.



(i) Calculate the resistance of X when the potential difference is 4.0 V.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[3]**

The majority of candidates scored full marks here. Unfortunately, some lower achieving candidates did not show their working. As a result, very few candidates gained 1 or 2 marks.

Question 2 (b) (ii)

(ii) The student concludes that the resistance of component X changes as the potential difference increases.

Describe how the graph shows that the student is correct.

.....

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

Only a few of the most successful candidates said that the line was not straight or that it curved. Almost all answers said because the current increased, the potential difference (p.d.) increased or because the current increased as the p.d. increased.

Question 2 (b) (iii)

(iii) Suggest what component X is.

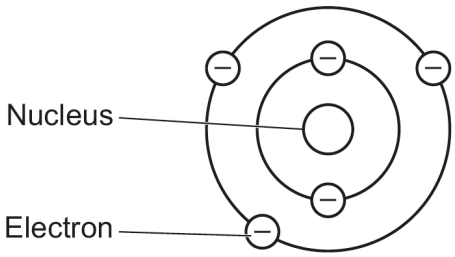
..... **[1]**

Few candidates knew this was a lamp or bulb. Resistors and types of resistors were common suggestions.

Question 3 (a)

3 **Fig. 3.1** shows the Bohr model of an atom.

Fig. 3.1



(a) Complete the sentences about the Bohr model of an atom.

Put a (ring) around each correct option.

The nucleus has an overall **negative / neutral / positive** charge.

Most of the mass of the atom is found in the **electrons / nucleus / shells**.

The diameter of the nucleus is **much smaller / the same / much larger** compared to the diameter of the atom.

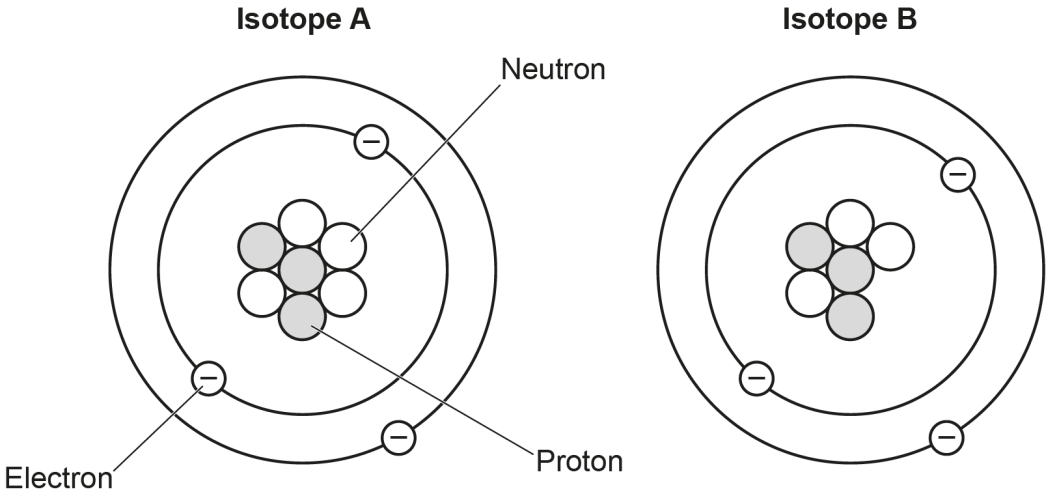
[3]

The majority of candidates gained some marks here. A large number gained 1 mark, but the majority gained 2 or 3 marks.

Question 3 (b)

(b) **Fig. 3.2** shows the Bohr model of two isotopes of the same element.

Fig. 3.2



Describe the similarities and differences between the two isotopes shown in **Fig. 3.2**.

.....

.....

.....

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

This was very well answered. Candidates generally focused on the number of protons, neutrons, and electrons, and many gained both marks. Some candidates chose an awkward way to phrase their answer. 'A has more nucleons' or 'more particles in the nucleus' gains 1 mark. However, 'A has more protons and neutrons' is true for the neutrons, but not for the protons. This answer also gains 1 mark, but candidates have also given an incorrect answer, and cannot go on to score a second mark. A few candidates gave answers about the pattern, or position, of the electrons, and some said they were both negative.

Question 3 (c)

(c) Which **two** statements describe why the model of the atom has changed over time?

Tick (✓) **two** boxes.

Atoms have changed. ☐

Experiments have provided new evidence. ☐

New particles have been discovered. ☐

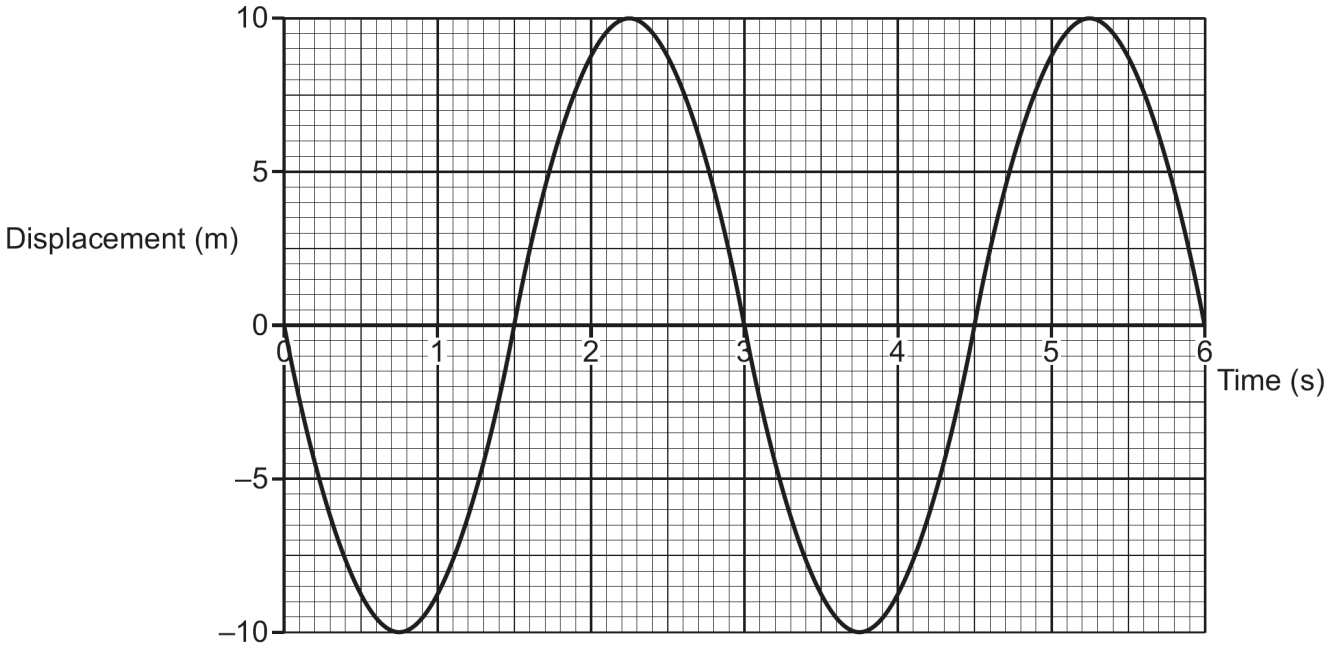
People have become more intelligent. ☐

[2]

The majority of candidates scored 2 marks. Some candidates only ticked one box. A common incorrect answer was that people have become more intelligent.

Question 4 (a) (i)

4 A graph of displacement against time for a particle on a wave is shown.



(a)

(i) State the amplitude of the wave. ..... m **[1]**

Many candidates read the amplitude correctly as 10 m. The common incorrect answer was 20 m.

Question 4 (a) (ii)

(ii) State the number of wavelengths shown. ..... **[1]**

Slightly less than half of the candidates correctly determined the number of wavelengths. The most common incorrect answer was 4. Among less successful candidates 3 (the time period of the oscillation) and 10 (the amplitude) were also quite common.

Question 4 (a) (iii)

(iii) State the period for the wave. ..... s **[1]**

Very few candidates correctly stated the period. The most common answers were 6 s and 1.5 s.

Question 4 (a) (iv)

(iv) Calculate the frequency of the wave.

Use the equation: frequency = $\frac{1}{\text{period}}$

Frequency of the wave = ... Hz **[1]**

The majority of candidates, especially higher and middle achieving candidates, scored this mark for a correct calculation using their incorrect answer for the period.

Question 4 (b)

(b) A wave travels at a constant speed.

Complete the sentence to describe the relationship between the frequency and wavelength of the wave.

Put a (ring) around the correct option.

When the frequency is doubled the wavelength **doubles / halves / stays the same**. **[1]**

Almost half of candidates correctly ringed that the wavelength halved.

Question 4 (c)

(c) Another wave has a wavelength of 2 cm and a frequency of 7.5 Hz.

Calculate the speed of this wave, in **cm / s**.

Use the Equation Sheet.

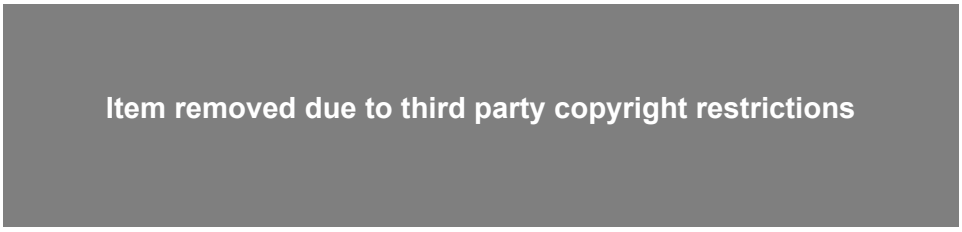
Wave speed = ... cm / s **[3]**

Almost all candidates, with the exception of the lowest achieving candidates, gained full marks for this calculation.

Question 5 (a) (i) and (ii)

5 A teacher demonstrates static electricity.

(a) The teacher rubs an uncharged plastic rod with an uncharged cloth. The rod becomes positively charged.



(i) Which particle has been removed from the rod and transferred to the cloth?

Tick (✓) **one** box.

Electron ☐

Proton ☐

Neutron ☐

[1]

(ii) What charge is now on the **cloth**?

Tick (✓) **one** box.

Positive ☐

Negative ☐

Neutral ☐

[1]

For Question 5 (a) (i) slightly over half of candidates selected electron. For Question 5 (a) (ii) half of the candidates knew the charge on the cloth was negative.

Question 5 (b)

(b) The teacher hangs the positively charged rod from a string.

They hold a negatively charged rod close to it.

Describe what happens to the positively charged rod.

.....

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

About half of the candidates stated that the rod would be attracted, or words to that effect. The common incorrect answer was to assume the rods were touching (or that the charges could jump the gap) and just to say that it would become neutral. Variations on this included that the charges transferred. There were a few who thought the rod would repel.

Question 5 (c)

(c) The teacher touches the positively charged plastic rod with a piece of metal foil.

The rod becomes uncharged.

Explain how the rod becomes uncharged.

.....

.....

.....

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

Almost all candidates gave an incorrect explanation here. Usually something to do with the positive charges (or the protons, or neutrons, or 'positive electrons') moving from the rod to the foil.

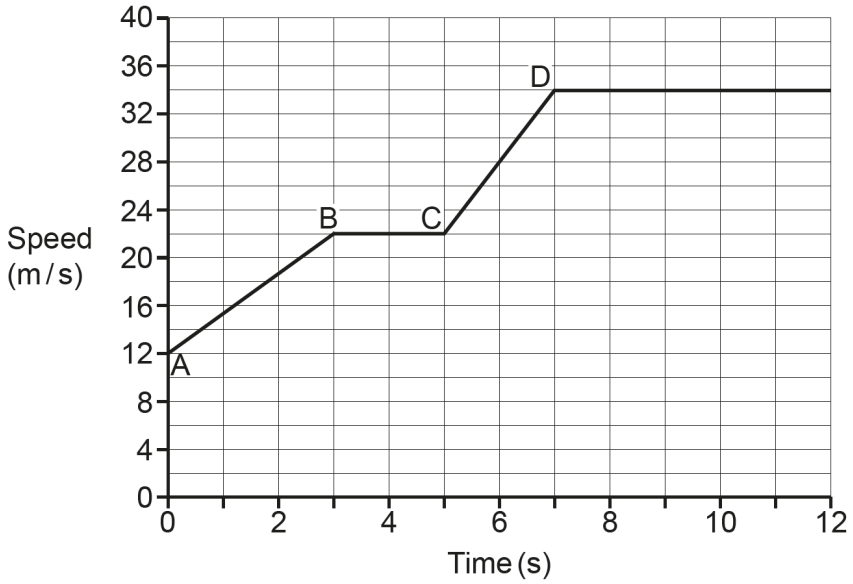
Misconception

Many candidates seemed to believe that positive charges transfer between objects (such as insulating rods and between metal foil and insulating rods). It may be helpful to link understanding here to the structure of atoms. The electrons, being far from the nucleus, can easily move, but the protons are very firmly fixed in the nucleus and cannot move between objects.

Question 6 (a) (i)

6

(a) The speed–time graph shows part of the journey of a car.



(i) Describe the motion of the car between B and C.

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

Candidates generally recognised that something was the same or constant. Less than half answered correctly that this was speed. It was common to see answers stating the car was stationary, or just that the motion was 'constant' or 'the same' without saying what it was about the motion that was 'constant' or 'the same'. Another incorrect answer was constant acceleration.

Question 6 (a) (ii)

(ii) Calculate the acceleration of the car between C and D.

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

Acceleration between C and D = ... m/s^2 **[3]**

Many candidates gained full marks here, and some who showed their working gained a mark for using the correct time of 2 s or correct change in speed of 12 m/s.

Question 6 (a) (iii)

(iii) The car also accelerates between A and B.

Compare the acceleration of the car between A and B with the acceleration of the car between C and D.

Use the graph.

.....

.....

.....

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

There was quite a variation of marks for this part. More successful candidates generally gained full marks, with many choosing to calculate the acceleration for AB as they had for CD. Others compared the steepness of the graphs. The less successful candidates who attempted this part generally compared the change in speed **or** the time taken, and not the acceleration.

Question 6 (b)

(b) Zayn owns an electric car.

He completes a journey of 410 km. It takes 4 hours 30 minutes.

Calculate the average speed of the journey.

Use the Equation Sheet.

Average speed = ... km/h **[3]**

Almost half of candidates scored full marks for this calculation. However, the question contains data in km, hours and minutes, and many candidates concluded that they needed to convert the time to minutes or to seconds, rather than to hours. There were also a few who thought the time was 4.3 hours. Those who showed their working often gained 1 or 2 marks for a time conversion and/or a correct use of the equation, but some candidates gave a bald answer and scored zero.

Question 6 (c) (i)

(c)

(i) It takes 8 hours to fully charge the battery in the electric car using a 7 kW power source.

Calculate the energy transferred to the battery.

Use the equation: energy transferred = power × time

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

Most of the candidates completed this calculation correctly.

Question 6 (c) (ii)

(ii) The cost of the energy supplied by electricity is 34p per kWh.

Calculate the cost to fully charge the battery.

Give your answer in pounds.

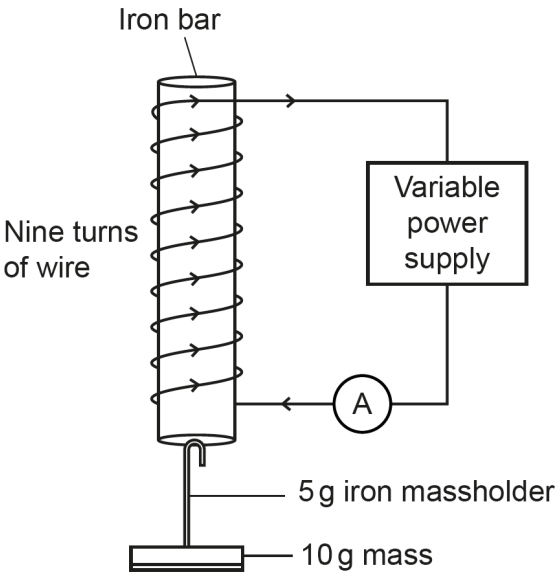
Use your answer from **(c)(i)**.

Cost = £ ..... **[2]**

Many candidates correctly calculated the cost and some successfully used their incorrect answer to Question 6 (c) (i), but a few forgot to convert their answer to pounds.

Question 7*

7* A student builds an electromagnet by wrapping a wire around an iron bar.



The student uses the variable power supply to increase the current in the wire in steps of 1 A.

They measure the maximum number of 10 g masses that the bar can hold at each value of current.

They predict that as the current increases, the electromagnet will hold more mass.

The table shows their results.

Current (A)	Number of 10 g masses
0	0
1	0
2	0
3	1
4	1

Explain improvements that the student can make to their experiment to show that their prediction is correct.

Use ideas about:
- the validity of the measurements
- improvements to the apparatus.

.....

.....

.....

.....

.....

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

Candidates' answers showed that they did not understand the difference between improving the validity of the measurements and improving the apparatus. As a result, there was an element of luck in whether the changes they suggested addressed one, or both, of the bullet points. In addition, many candidates listed changes they would make without giving any reason. More successful candidates generally did give a reason for at least one of the changes, and, since they listed several key improvements, some did achieve a Level 3. Many candidates understood that a larger range of current and smaller masses would both be sensible improvements. Candidates recognised that more turns would be a good idea, and a few correctly explained the effect of more turns. However, many candidates were confused, ranging from thinking that more masses should be added in order to increase the current, to thinking that the experiment involved changing the number of turns to see the effect. Some less successful candidates thought the coil was a spring and the purpose of the experiment was to add mass to stretch it.

Exemplar 1

The student can improve the experiment by, repeating the experiment and having a larger range of currents. The student can increase or decrease the weight of the mass to better show that their prediction is correct. The student can increase the turns of the wire allowing a larger current to flow through. Do the experiment multiple times to get a better range of data, then collect the mean data to show a result of all experiments combined. Have a larger difference inbetween the strengths of the current to better show that the prediction is correct. **[6]**

This candidate has suggested several ways to improve the validity of the measurements. They have suggested repeating the experiment to get a better range of data, and to use a larger range of currents (with a larger difference between the strengths of the current) to better show their prediction is correct. The comment about increasing or decreasing the mass is confused, but they have said to increase the turns of the wire, although their reason of allowing a larger current to flow through is not valid. On balance this was judged a best fit to Level 3. Their answer is well structured, with improvements followed by reasons, and is easy to follow. The communication statement was judged to be met, and the candidate was given 6 marks.

Question 8 (a) (i)

8 The brakes of three different cars **A**, **B** and **C** are being tested on a test track.

The cars travel at 14 m / s along the track and the brakes are applied to bring them to a stop.

The braking distance and the time taken for each car to stop are measured.

(a) After the brakes are applied car **A** decelerates at 4.7 m / s^2.

(i) Calculate the braking force.

The mass of car **A** = 1500 kg

Use the equation: force = mass × acceleration

Braking force = ... N **[2]**

Many candidates selected the correct data and successfully calculated the force, but many tried to include the speed of 14 m / s in their calculation, usually by finding the difference between 14 and 4.7 and using this number as their value for the acceleration.

Question 8 (a) (ii)

(ii) A very large mass is added to car **A** and the test is repeated.

The braking force is unchanged.

Complete the sentences about the deceleration and the time taken for the car to stop.

Put a (ring) around the correct options.

The deceleration **decreases / increases / stays the same**.

The time taken for the car to stop **decreases / increases / stays the same**.

[2]

Some candidates scored both marks here, but there were more who scored 1 mark. These were fairly evenly split between answering that both deceleration and time decreased, or that both increased, which suggests many candidates were guessing and did not know what effect the mass would have.

Question 8 (b) (i)

(b) Cars **B** and **C** have the same mass.

The table shows the braking force and the time taken to stop for cars **B** and **C**.

Car	Braking force (N)	Time taken to stop (s)
B	5 000	5
C	10 000	

(i) Calculate the deceleration of car **B** as its speed reduces from 14 m/s to 0 m/s.

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

Deceleration = ... m/s^2 **[2]**

Many candidates were able to calculate the acceleration correctly. Some less successful candidates wrote just '10'.

Question 8 (b) (ii)

(ii) Find the time taken to stop for car **C**.

Time taken to stop = ... s **[1]**

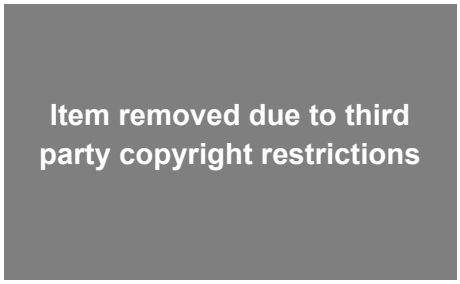
This question was a challenge. A small proportion of candidates were able to deduce the answer. Many candidates wrote '10'.

Question 9 (a)

9 Sasha has a battery operated electric hand warmer.

The hand warmer has these components:

- an aluminium case
- a heating element
- a battery
- a switch.



(a) Sasha closes the switch and holds the hand warmer.

Describe the transfer between energy stores when the switch is closed.

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.....

.....

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

Despite the question asking about transfers between energy stores, only the most successful candidates mentioned energy stores, and many candidates did not write about energy or transfers. Common answers described the current in the circuit, and the fact that the heater would get hot. When energy was mentioned, candidates talked about the kinetic energy of the switch, about electrical energy, and about the process being exothermic.

Misconception

Many candidates wrote that when the switch was closed the electricity or current could no longer pass through the circuit and the heater would cool down. Just as closing a door prevents people passing, they were very clear that closing a switch prevents current passing. In one case a candidate also answered the earlier Question 2 (a) (iii) by saying that you could prevent the circuit overheating by closing the switch.

Candidates are expected to know that a closed switch (or a closed circuit) is one in which current can flow and that the current is stopped if the switch is opened.

Question 9 (b)

(b) The table shows some specifications of the aluminium case.

Description	Detail
Mass of the aluminium case	0.2 kg
Specific heat capacity of aluminium	920 J / kg °C

The temperature of the aluminium case increases from 20 °C to 50 °C.

Calculate the change in internal energy of the aluminium case.

Use the Equation Sheet.

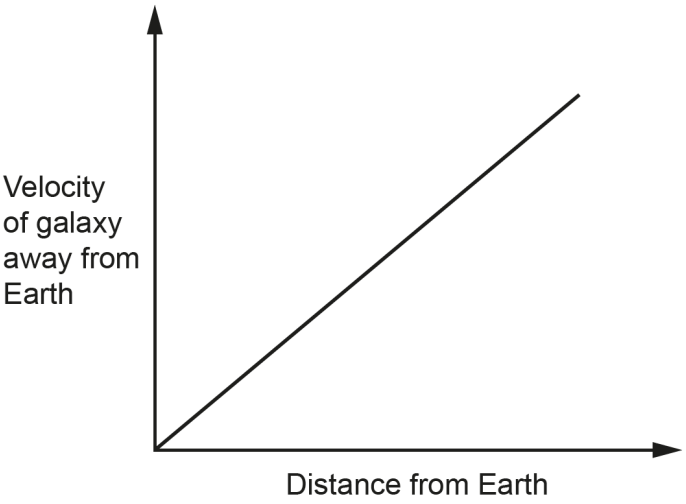
Change in internal energy = ... J **[4]**

The majority of candidates scored the full 4 marks for this calculation. It was rare to see candidates scoring 1, 2 or 3 marks. One mark was occasionally scored for correctly calculating the temperature change to be 30 °C, or for a correct substitution in the equation, but using a temperature instead of a temperature change.

Question 10 (a)

10 The astronomer Edwin Hubble observed how the velocity of a galaxy away from Earth depends on the distance of the galaxy from Earth.

A graph of his results is shown.



(a) Describe the relationship shown by the graph.

.....

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

Candidates described the relationship as showing that the velocity of the galaxy away from the Earth increased as the distance from the Earth increased, but very rarely said that it was directly proportional.

Question 10 (b)

(b) Explain how this relationship provides evidence for the Big Bang model of the universe.

.....

.....

.....

.....

.....

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

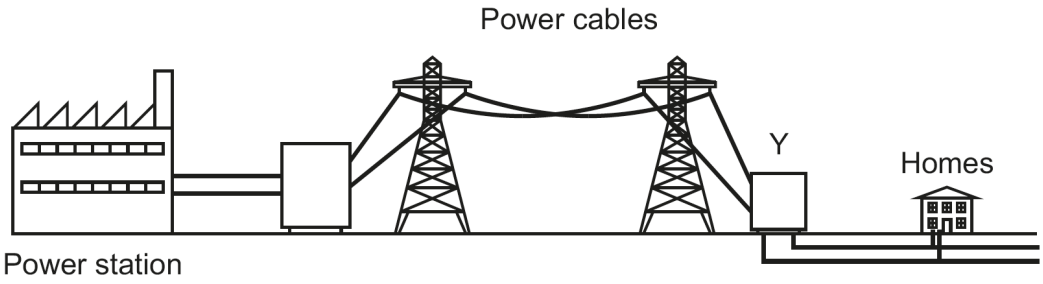
The more successful candidates often wrote that the universe, or space, was expanding. Some wrote that everything started from a small point. A few said that galaxies were moving away, and above average achieving candidates sometimes used the graph to say that the velocity of a galaxy increased with its distance from Earth. However, there was a lot of confusion especially among less successful candidates who muddled almost everything about the solar system, fusion and fission into their answers. A lot of candidates did not attempt this question.

Misconception

Various things are believed to be expanding including the Earth, galaxies and the solar system. There is also a common misconception that because the galaxies are moving faster and faster there will eventually be an explosion or a collision, which is the Big Bang.

Question 11 (a) (i)

11 The diagram below shows part of the National Grid.



(a)
(i) What is the domestic mains supply voltage to homes in the UK?

Tick (✓) **one** box.

60 V a.c. ☐

60 V d.c. ☐

230 V a.c. ☐

230 V d.c. ☐

[1]

Many candidates knew the voltage was 230 V and most of those candidates knew it was a.c., but the most common incorrect answer was 230 V d.c.

Question 11 (a) (ii)

(ii) The electricity is transmitted along the power cables at around 230 000 V.

Explain how this high voltage makes the energy transfer along the power cables more efficient.

.....

.....

.....

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

Almost no candidates knew the answer to this question. Some of the most successful candidates said that less energy would be wasted/lost, but often said this was because it took less time to reach the consumer.

Misconception

Many candidates seem to believe that a higher voltage makes the current pass faster, which either reduces the energy losses, or ensures that it can reach more consumers.

Candidates should understand that energy dissipated in the cables depends on current. The use of step-up transformer, means a lower current passes through the high-voltage cables, and this means less energy is wasted.

Question 11 (a) (iii)

(iii) Name the device at Y.

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

The majority of candidates did not know this. 'Transmitter' was sometimes seen and possibly candidates were trying to remember transformer. 'Power box' and 'generator' were also seen quite often.

Question 11 (b) (i)

(b) Many different energy resources are used to generate electricity.

(i) State **two** types of **renewable** energy resources used to generate electricity.

1 .....

2 .....

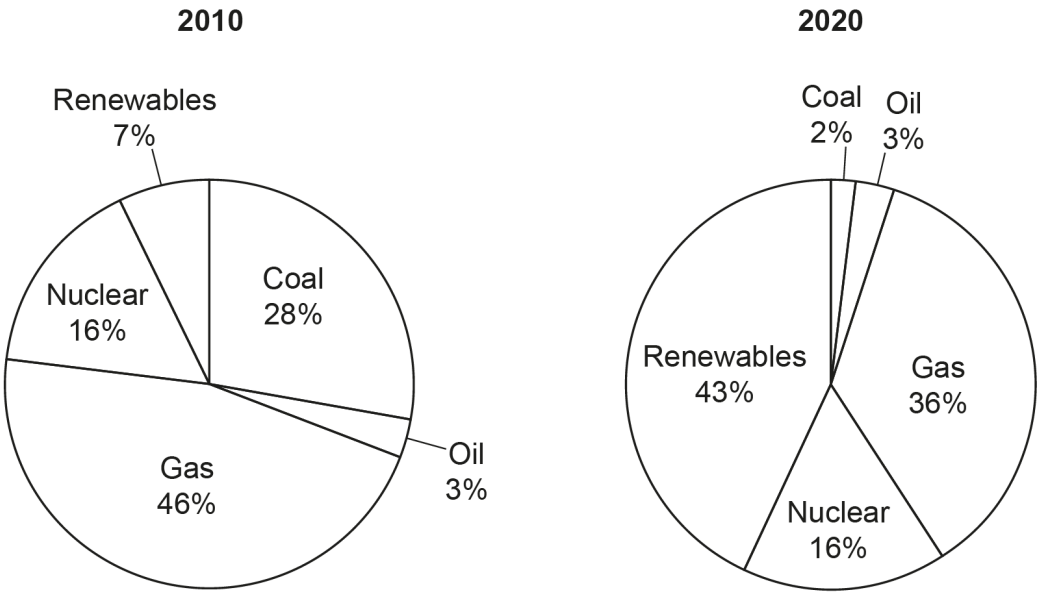
[2]

This question was generally well answered. Some candidates gave answers such as 'water' and 'the Sun' which were too vague. Some less successful candidates gave non-renewable resources, and a few did not understand the question and wrote names of components or meters.

Question 11 (b) (ii)*

(ii)* **Fig. 11.1** shows the percentage of electricity generated by different energy resources in the UK in 2010 and 2020.

Fig. 11.1



Describe how the trends in the use of energy resources in the UK changed between 2010 and 2020.

Suggest reasons for these changes.

Use the data in **Fig. 11.1** in your answer.

.....

.....

.....

.....

.....

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

This was very well answered. Most candidates were able to compare the trends and some wrote very good, detailed answers. Many candidates had a good knowledge of global warming and climate change issues and also knew that fossil fuels are a finite resource – although some said the reason the use of fossil fuels had dropped was because they **had** run out. Some candidates just said that fossil fuels were 'bad for the environment' or renewable fuels were better. A Level 3 answer suggested reasons for the trends as well as describing the trends. Some candidates unfortunately only addressed one of these points and restricted themselves to Level 2. Among less successful candidates, a common error was to think the charts referred to energy use in the home or for transport and not for electricity generation.

Exemplar 2

In the year 2010 the coal was at 28% although we found fossil fuels cause climate change and therefore we have tried to limit the use which has gone down to 02%. Instead we have increased the use of renewable energy sources from 7% to 43% as its much better for the environment and more affordable with the rising costs of non-renewables.

[6]

As this response shows, it is possible to gain Level 3 without writing a lot, by selecting the main differences. The candidate has given the 2010 data for coal, an important reason why it has reduced, and then the 2020 data. They have shown they understand that coal use could not be cut without an alternative being found and quoted the data for the increase in the use of renewables. 'Much better for the environment' is a bit vague, but is a valid reason, and the idea of them being more affordable compared to non-renewables is also valid (although 2020 predates the large price increases that we saw in 2022 and 2023.) The communication was good, with the answer well set out, so 6 marks were given.

Exemplar 3

These have changed because people use Renewable energy resources now as they dont run out, coal + oil are also harming the planet, they are causing global warming

This candidate has given a very clear description of the reason for the trends, but has only said that the use of resources has changed. There is no comment on any increase or decrease for the resources. They have indicated that renewable resources are used now, but not whether they were used at all in 2010. Can we assume the use of coal and oil have dropped because they are harming the planet? Or maybe just not increased. This is a Level 2 answer. The communication statement has been met and the answer was given 4 marks.

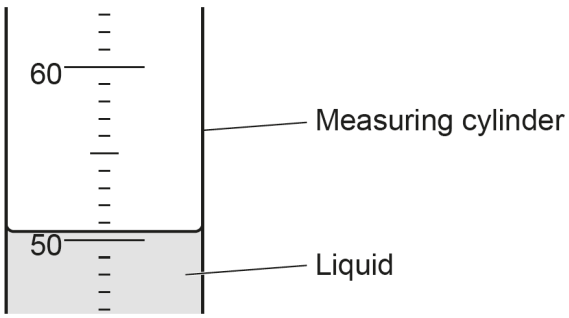
Question 12 (a)

12 A student is doing an experiment to find the density of an unknown liquid.

They pour some of the liquid into a measuring cylinder and measure the volume in cm^3.

Fig. 12.1 shows a close-up of the liquid in the measuring cylinder.

Fig. 12.1



(a) What is the volume of the liquid?

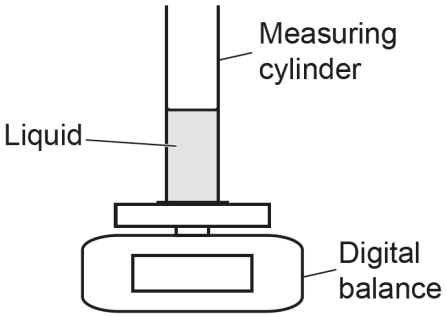
Use **Fig. 12.1**.

Volume = ... cm^3 **[1]**

Most candidates were able to read the correct volume from the scale.

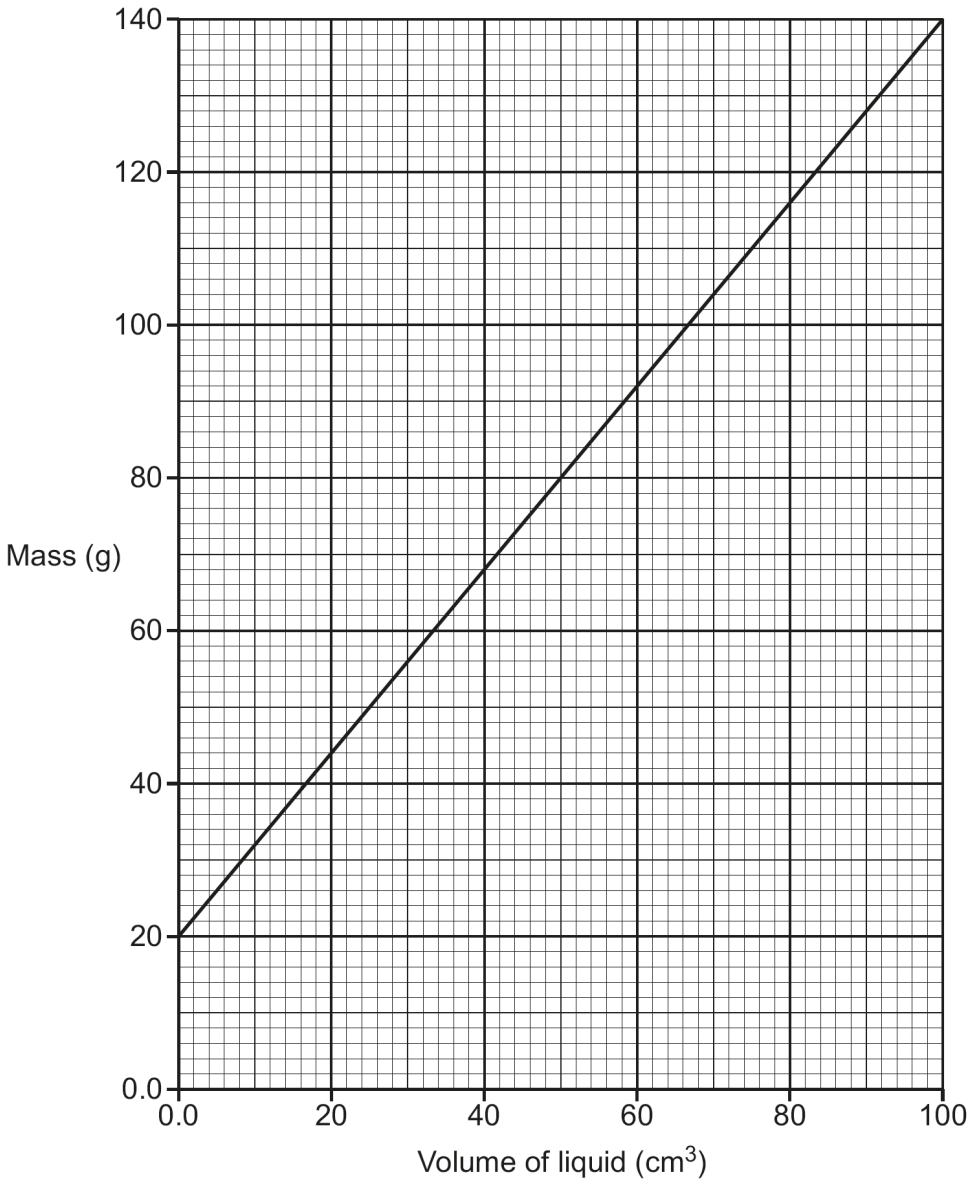
Question 12 (b) (i)

(b) The student places the measuring cylinder on to a digital balance and measures the mass of the measuring cylinder and the liquid.



They increase the volume of the liquid and repeat the measurements.

The graph shows their results.



(i) What is the mass of the empty measuring cylinder?

Mass = ... g **[1]**

Most candidates read the correct mass from the graph.

Question 12 (b) (ii)

(ii) Calculate the density of the liquid.

Use:
- data from the graph
- the equation: density = $\frac{\text{mass}}{\text{volume}}$

Density = ... g / cm^3 **[4]**

Some candidates achieved full marks here, but a larger number achieved 2 marks. Many candidates did not subtract the mass of the cylinder from the mass reading on the scale. In choosing the data to use for their calculation, some chose 100 cm^3 and some chose their value of 50.5 cm^3 from part (a). A very few candidates chose other values, but all could potentially score full marks. One odd choice was 20 cm^3, which may have resulted from some confusion caused by the mass of the cylinder being 20 g, but providing the mass was correctly read from the graph and 20 g subtracted before calculating the density, candidates could calculate the correct value and achieved 4 marks. These candidates generally did not subtract the mass of the cylinder and scored 2 marks.

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