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Examiners' report

GCSE

COMBINED SCIENCE B (TWENTY FIRST CENTURY SCIENCE)

OCR Level 1/Level 2 GCSE (9-1) in Combined Science B (Twenty First Century Science)

J260

For first teaching in 2016

J260/07 Summer 2025 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 responses 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 Teach Cambridge.

Paper 7 series overview

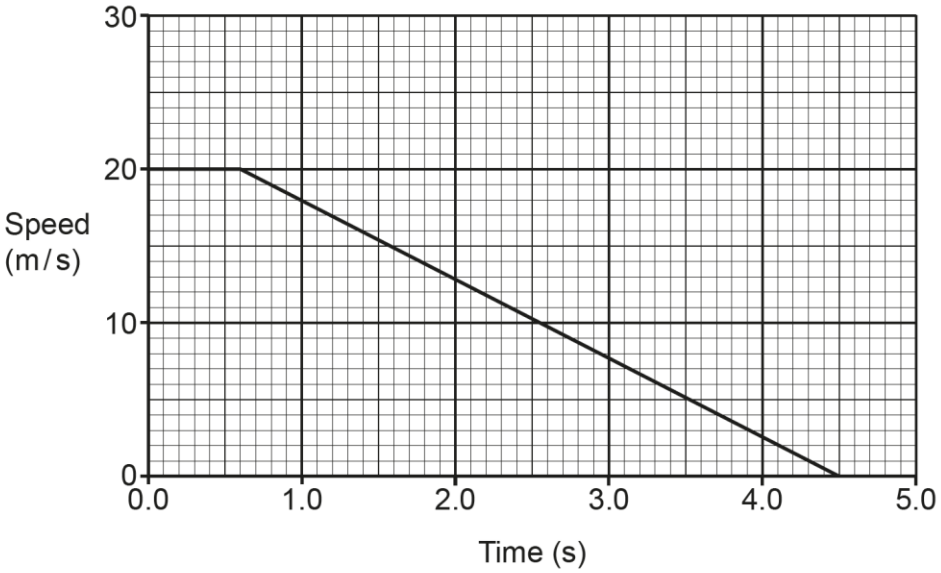
J260/07 is one of the four examination components for the higher tier GCSE (9-1) Twenty First Century Science Combined Science B. This component assesses the contents of the physics chapters P1 to P6 and the practical skills in chapter BCP8. The question styles used include objective, short answer and one extended Level of Response.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• read each question carefully and answered the question that was asked • paid attention to the command word used and used the command word to decide how to answer the question • stated the relevant equation in calculation questions and included full substitution of numbers in working • used appropriate scientific terminology when applying knowledge • used information and data given in the question to give a full and specific answer • applied knowledge of correct scientific units, conversion of units, standard form and rearrangement of equations.	• did not fully answer the question or answered a different question to that which was asked • did not fully explain the reasons in questions using the explain command word, instead often just giving a description • were not specific enough with the language used, often leading to ambiguity • did not show working in calculation questions or produced working that was unclear • did not attempt to convert units for data that was given with a unit prefix • did not use scientific terminology in answers or used scientific terminology incorrectly.

Question 1 (a)

1 Casey is driving a car along a straight, level road when they see a road block ahead.

The graph shows how the speed of the car changes with time immediately after Casey sees the road block.



(a) While Casey is reacting to the obstruction the car continues to travel at constant speed.

Calculate the distance travelled by the car while Casey is **reacting**.

Use the Equation Sheet.

Distance = ... m **[4]**

Candidates were expected to calculate the thinking distance of the car using the graph. The correct method was distance = 20 × 0.6 = 12 m. Many candidates selected the incorrect time here leading to the wrong answer. However, those candidates that selected the incorrect time but gave the correct relationship could still score marks. This demonstrates the importance of showing working.

Question 1 (b)

(b) The initial kinetic energy of the car is 174 kJ.

When Casey presses the brakes, the braking force acting on the car is 4350 N.

The work done by the brakes to stop the car = the kinetic energy lost by the car.

Calculate the distance travelled while the car is braking.

Use the equation: work done = force × distance

Distance = ... m **[4]**

Here the two quantities given must be substituted into the given equation, then the equation rearranged to calculate the distance. Three marks are awarded for this process and the final mark for correctly converting the 174 kJ into 174 000 J. Most managed the calculation but few successfully converted the unit. Candidates gaining higher credit often converted the work done first before attempting the calculation.

Question 1 (c)

(c) In the village where Casey lives the speed limit has been reduced from 30 mph to 20 mph.

Explain how reducing the speed limit can improve road safety in the village.

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

The idea that the distance travelled while reacting was more commonly scored than the second mark for the idea that braking distance would also decrease. A very common error was to state that the reaction time of the driver would be affected in some way.

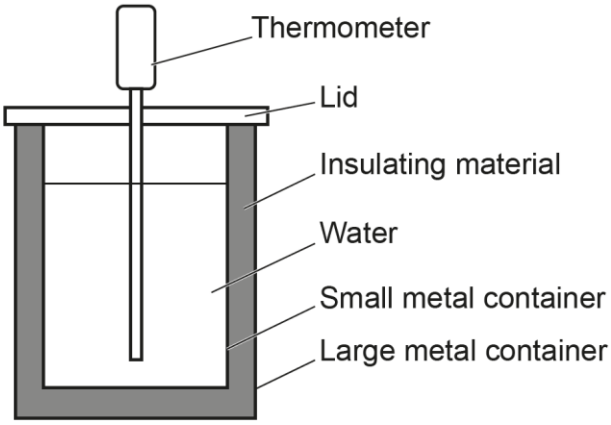
Question 2 (a) (i)

2 Amit does an experiment at room temperature to compare the thermal conductivity of different insulating materials.

(a) This is Amit's method:

- Place a small metal container inside a large metal container.
- Place some insulating material between them.
- Pour water at a temperature of 80 °C into the small container and place a lid on it.
- Measure the temperature of the water every minute for 30 minutes using a thermometer.
- Repeat the experiment using different insulating materials.

This is the apparatus used:



(i) State **two** variables that Amit should control in this experiment.

1 .....

2 .....

[2]

Common incorrect answers included 'temperature' and some reference to 'time'. The 'initial temperature' did receive credit but the temperature of the water is the dependent variable and time is the independent variable for the experiment.

Assessment for learning

Try getting students to write down the independent, dependent and control variables for the experiment they are about to do in lesson. This is a quick check that they have thought about the experiment they are about to carry out.

Question 2 (a) (ii)

(ii) Explain why Amit uses metal containers rather than plastic containers.

.....

.....

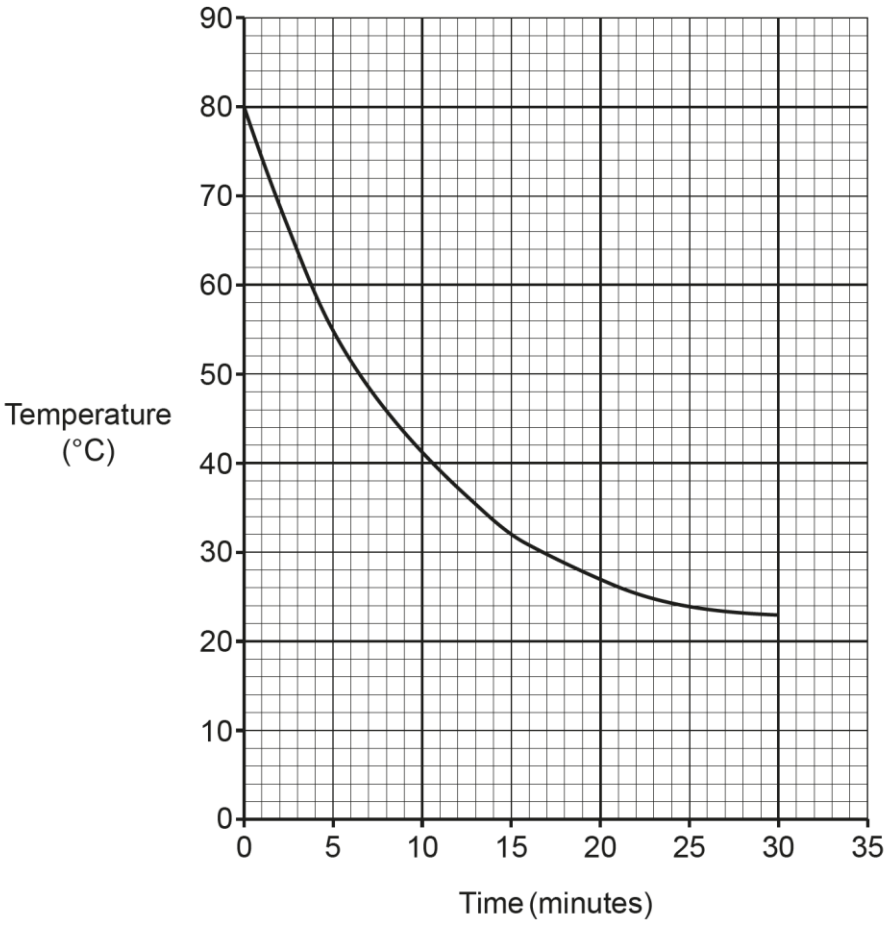
.....

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

Most candidates stated that metal is a conductor but did not go on to explain how this helped with the experiment. Candidates received credit when they explained how the metal allowed energy to transfer through to the insulating material more easily.

Question 2 (b) (i)

(b) The graph shows Amit's results for one insulating material.



(i) Draw a tangent to the curve at time of 15 minutes. **[1]**

When drawing a tangent, candidates should make sure that the straight line touches the curve at the correct point and that it does not cross over the curve.

Question 2 (b) (ii)

(ii) Calculate the gradient of the tangent drawn in **(b)(i)**.

Gradient = ... °C / minute **[2]**

The best responses were a drawing of a triangle on their tangent to show which points they were using. Candidates who did this also wrote down the full substitution of numbers into their "change in y by change in x" equation.

Question 2 (b) (iii)

(iii) Sketch a curve on **the graph** to show the results of the experiment when a material of **higher** thermal conductivity is used. **[2]**

In this question, candidates had to realise that the new curve had to start at 80 °C and would be initially steeper and should stop decreasing at the same temperature as the original curve. Many did show a correct curve but did not level the curve off in the acceptable range.

Question 3 (a)

3 Li is visiting the United States (US).

(a) The domestic supply in the US is a.c. with a frequency of 60 Hz and a voltage of 120 V.

Describe the differences between the domestic supply in the United Kingdom (UK) and in the United States.

.....

.....

.....

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

This was a recall question testing knowledge of the voltage and frequency used in UK mains.

Question 3 (b)

(b) Li buys an electric kettle with a power rating of 1.2 kW.

Li uses the kettle for a total of 8 hours.

Calculate the cost of using the kettle for 8 hours.

Use the Equation Sheet.

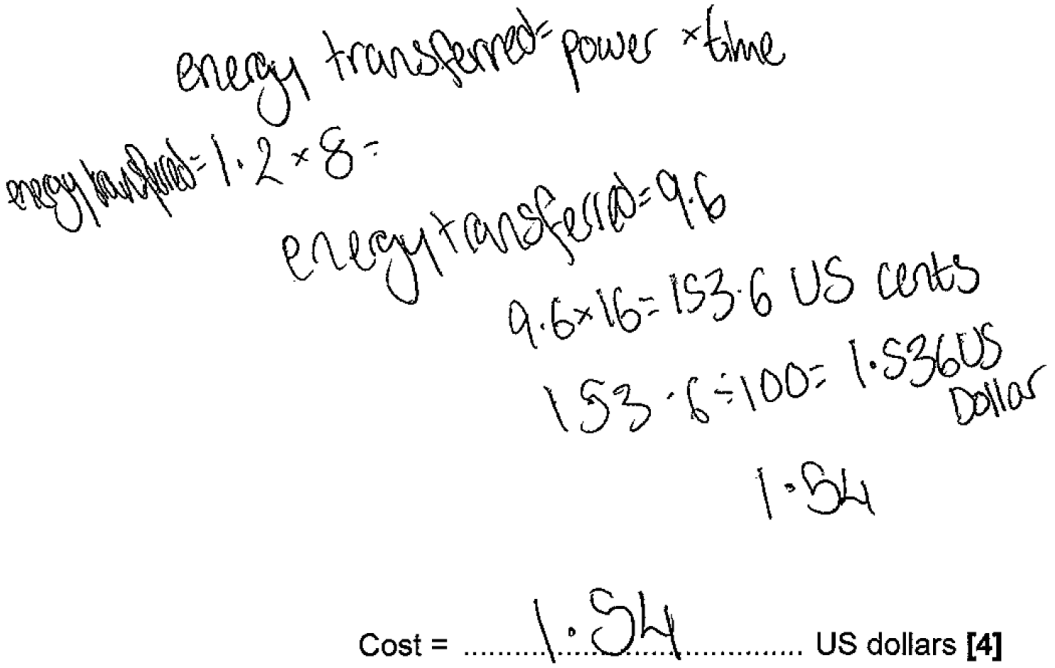
Give your answer in US dollars.

1 kWh = 16 US cents
100 US cents = 1 US dollar

Cost = ... US dollars **[4]**

This is a two-stage calculation where the candidates had to first determine the energy transferred in kWh and then use this to calculate the cost in dollars. Candidates who set their working out carefully were more likely to be successful here.

Exemplar 1



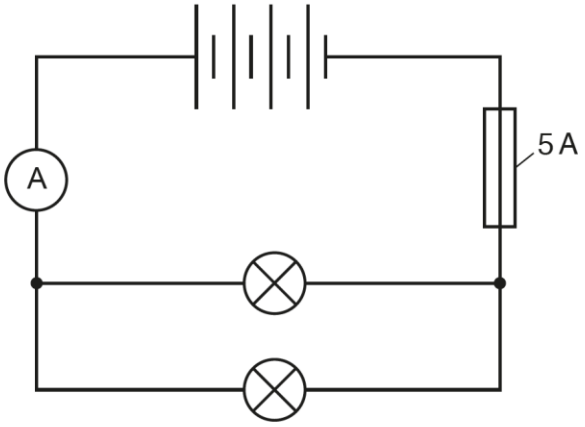
This response starts with the correct word equation, then shows clear substitution to calculate the energy transferred. This is then followed by clear working to show how the cost in cents is determined and finally the cost in dollars. This is a very clear response that would have received partial credit if a calculation error were made.

Question 3 (c)

(c) Electrical appliances in the UK usually contain a fuse but Li finds that the kettle they have bought does **not** contain one.

If the current passing through a fuse is too large, the fuse wire inside the fuse melts and the circuit is broken.

Li uses this circuit to investigate a 5A fuse:



The wire in the 5A fuse melts when the current through it exceeds 5A.

Li adds more identical filament lamps in parallel to the circuit and measures the current in the battery after each lamp is added.

Complete the table by predicting the current in the battery as more lamps are added in parallel.

Number of lamps	Current in battery (A)
1	1.6
2	3.2
3	.....
4	.....

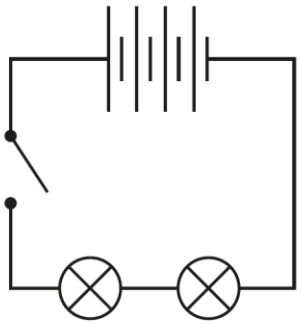
[2]

Many candidates correctly determined the current for 3 lamps to be 4.8 A. However, very few realised that the current at 4 lamps would be zero due to the current exceeding the maximum current the fuse will allow.

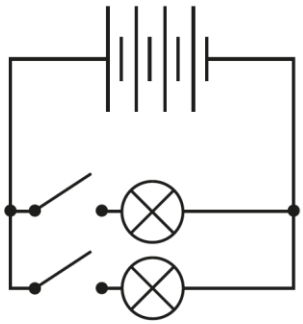
Question 3 (d)*

(d)* Li makes Circuits **A** and **B** to help work out what kind of circuit is used to connect the lights in a house they are staying in.

Circuit A



Circuit B



Explain why Circuit **B** is used in the house rather than Circuit **A and** why the lamps in Circuit **B** are brighter than the lamps in Circuit **A**.

Use ideas about current, potential difference and resistance in your answer.

.....

.....

.....

.....

.....

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

When answering a Level of Response question, candidates should make sure that they read and answer the entire question. In this example, candidates are asked to explain why circuit B is used in the house rather than circuit A **and** to explain why the lamps in circuit B are brighter. Finally, they are also told to use ideas about current, voltage and resistance in their answer. Therefore, a candidate will only receive full credit here if they have fully answered the question by addressing all of these points.

Exemplar 2

Circuit A is know as a series circuit. This means the current is the same throughout. But the potential difference of the battery is split between both components. Also, the resitance is the sum of all the resitors meaning as you add more bulbs the resistance will increase. ~~However, this means~~ Circuit B is know as a parrallel circuit. The current is split between the branches but the potential difference is the same on all the branches. This means the bulbs will be brighter than in circuit A because they have more voltage than circuit A. The resistance is also less the more you add resitors, this means the current can pass through easier! so more efficient so bulbs will be brighter. Circuit B will be more appropiate for a house as the ~~bulbs~~ bulb's can be turned on and off individually by the switches, this is more practical as in circuit A they would all be either on or off. Also, if one bulbs blows in the series ~~of~~ circuit it ~~does~~ means the whole ~~of~~ circuit is cut off. But in parrallel if one blows then they can carry on. This means it is less costly as they don't have to replace the whole circuit. **[6]**

This response is a good Level 3 response scoring 6 marks. Both elements of the question are well answered and all three quantities are linked to the increased brightness of the lamps in circuit B. Note that a recognition that both the potential difference and current are increased and would therefore make the lamps brighter in circuit B is enough to answer that part of the question. In this response, this is made very clear for the potential difference but not quite as clear for the current. However, there is also a recognition that the resistance would decrease in circuit B as more lamps are added. The other element of the question is also well answered with both benefits of the parallel circuit over the series circuit clearly described.

Question 4 (a) (i)

4 Leo is watching an ant crawling on a wall.

(a) The ant:

- crawls 4.0 cm horizontally to the right at a constant speed
- turns left through 90°
- and then crawls 6.0 cm vertically upwards at the same speed.

(i) Calculate the distance the ant travels in this short journey.

You can include a diagram to support your answer.

Distance = ... cm **[1]**

Most candidates calculated this correctly, some giving a wrong answer presumably through misunderstanding the question.

Question 4 (a) (ii)

(ii) Calculate the displacement of the ant from its starting point to its end point.

Use the equation:

$$\text{displacement} = \sqrt{\text{distance moved right}^2 + \text{distance moved upwards}^2}$$

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

Displacement = ... cm **[3]**

Most managed to calculate the displacement correctly but not as many correctly rounded to 2 significant figures.

Question 4 (a)(iii)

(iii) Explain why the answers to **(a)(i)** and **(ii)** are different.

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

The best responses clearly stated that distance is a scalar and displacement is a vector. Others scored the marks by describing this idea. However, candidates should be careful to not just repeat the question. For example, '4ai is the distance the ant travels and 4aii is the displacement of the ant from its start point to its end point' is a repeat of both questions and so scores 0 marks.

Question 5 (a) (i)

5 The symbol $^{241}_{95}Am$ represents the nucleus of americium-241.

(a)
(i) Complete the table to describe the nucleus of americium-241.

Number of neutrons	
Number of protons	

[2]

A common error was to give the number of neutrons as the mass number here.

Question 5 (a) (ii)

(ii) There are many different isotopes of americium.

Describe what is meant by the term isotope.

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

The clearest way to answer this is in terms of number of protons and neutrons. Candidates who attempted to answer in terms of atomic number and atomic mass were sometimes not clear enough in their response.

Question 5 (a) (iii)

(iii) Americium-241 is radioactive and decays into an isotope of neptunium by emitting radiation X. This is represented by the equation:

$$^{241}_{95}Am \longrightarrow {}^{237}_{93}Np + X$$

Identify X.

Explain your answer.

X = ...

Explanation: .....

.....

.....

[2]

The first mark was for stating that X is an alpha particle. Some candidates demonstrated that they knew what particle X was through a completed equation but then identified X as He, which was not given credit unless they made it clear that it was a He nucleus.

Question 5 (b)

(b) Americium-241 is used in household smoke detectors. It has a half-life of 430 years.

Explain why this half-life makes americium-241 suitable for use in smoke detectors.

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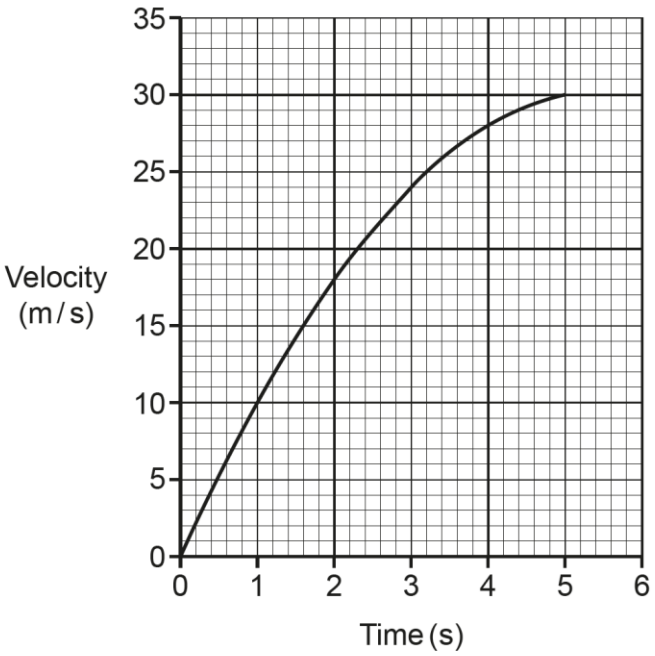
..... **[2]**

Just stating that Americium-241 has a long half-life did not gain credit. Candidates needed to explain how a long half-life would make Americium-241 suitable. This requires a link between the activity of the source and its half-life with the idea that the activity will remain high for a long time.

Question 6 (a)

6 The graph shows how the velocity of a ball varies with time after it is dropped from the roof of a building.



(a) Explain the differences in the motion of the ball at 2 and 4 seconds.

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.....

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

This question is a good example of the importance of understanding the command words. A description of how the velocity changes will score a maximum of 3 marks if the description includes how the acceleration changes. To explain the differences candidates would need to link the change in air resistance or the resultant force acting on the ball to its change in motion.

Question 6 (b) (i)

(b) The ball has a mass of 0.60 kg and it hits the ground with a speed of 31 m/s.
The ball then bounces vertically upwards.

The change in **momentum** of the ball due to hitting the ground is 25.8 kg m/s.

(i) Calculate the upward velocity of the ball immediately after it leaves the ground.

Use the equation: change in momentum = mv – mu

m = mass
u = initial velocity
v = final velocity

Velocity = ... m/s **[3]**

To obtain the correct answer here, candidates needed to realise that the velocity after bouncing is in the opposite direction to the velocity before the bounce. Therefore, a negative sign is required either with the initial velocity or with the change in momentum. Many candidates omitted this negative, therefore obtaining an incorrect answer.

Question 6 (b) (ii)

(ii) The ball is in contact with the ground for 0.5 s.

Calculate the resultant force acting on the ball while it is in contact with the ground.

Use the equation: change in momentum = resultant force × time for which it acts

Resultant force = ... N **[3]**

This question required candidates to select the correct number from the previous question part and substitute it into the given equation before rearranging. Some candidates selected the wrong value here.

Question 6 (b) (iii)

(iii) Calculate the kinetic energy of the ball as it hits the ground.

Use the Equation Sheet.

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

A common error when using the kinetic energy equation is to either omit the squared from the speed or to include it in the working but then not square the speed when using the calculator. Students should be encouraged to double check they have included the square with equations that include them.

Question 6 (b) (iv)

(iv) Explain why the maximum height of the ball after bouncing is lower than the roof of the building.

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

Many candidates' explanations were too vague here or attempted to use incorrect ideas. The best responses were those that explained how some of the energy in the kinetic store of the ball transferred into the ground during the collision therefore transferring less into the gravitational store of the ball.

Assessment for learning

Questions are designed so that each question part follows from the previous. Looking back to question part (iii) we see that students are asked to calculate the kinetic energy of the ball as it hits the ground. Candidates should refer to the previous question part when trying to decide which part of physics to use in their explanations. In part (iv) the explanation requires use of energy transfers and the idea that not all the energy in the kinetic store will transfer back into the gravitational store of the ball.

Question 7 (a)

7 Sara investigates the resistance of a metal wire.

(a) Draw a circuit that Sara can use to measure the resistance of **different lengths** of wire.

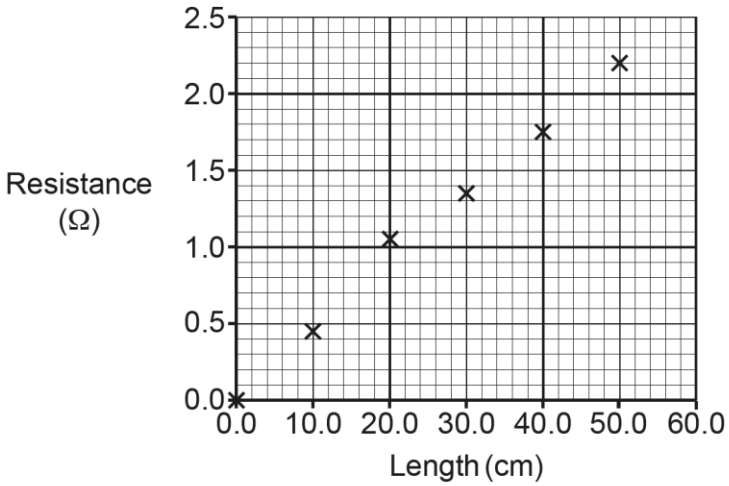
Include a voltmeter and an ammeter in the circuit.

[3]

Many candidates represented the wire as a fixed resistor here, which is perfectly acceptable. If drawing an unfamiliar component into a circuit diagram (such as a piece of metal wire) students should be encouraged to label the components. When standard symbols are used, labels are not required.

Question 7 (b) (i)

(b) The graph shows Sara's results.



(i) Draw a line of best fit on the graph. **[1]**

Whenever a line of best fit is drawn, candidates should make sure that they have an equal number of points on either side of the drawn line or curve. This is why best fit lines should be drawn in pencil so that an incorrect line can be rubbed out and drawn again in the exam.

Question 7 (b) (ii)

(ii) For a length of wire of 50 cm, the resistance is 2.2 Ohms.

Calculate the length of wire that would have a resistance of 20 Ohms.

Length = ... cm **[3]**

This question could be answered in two different ways. The first method is the recognition that resistance is directly proportional to length. Therefore, they are related by a constant allowing the length at 20 Ohms to be calculated using the given data. The second is to use the drawn straight line on the graph to read a point and then use proportionality to calculate the length. Either of the two methods is valid and can score full credit.

Question 8 (a)

8

(a) Describe the similarities and differences between radio waves and ultraviolet waves.

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.....

.....

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

Many candidates only scored partial credit here for giving just similarities or just differences. A maximum of 2 marks were awarded for each. Those candidates who separated their answer into two sections were more likely to score all four marks for giving at least two clear differences and two clear similarities.

Question 8 (b)

(b) Atoms can absorb ultraviolet radiation.

Suggest **one** way in which the arrangement of electrons in an atom may change when the atom absorbs ultraviolet radiation.

.....

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

Those candidates who described a change in energy level only scored the mark if the direction was correct. This again highlights the importance of being as specific as possible with the answer.

Question 9

9 Zayn moves a helium filled balloon into their house from outside.
The inside of the house is much **warmer** than the outside.

Zayn notices that the **balloon expands** and becomes **more rigid** when the balloon is inside.

Explain Zayn's observation.

Use ideas about the relationship between the temperature of a gas and its pressure at constant volume.

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

This is another question where full credit can be gained only if an explanation is given. This requires candidates to explain how the temperature increase causes the pressure increase. This should be done at a particle level, using ideas such as particles gaining more kinetic energy and so colliding with the container walls more frequently and with more force.

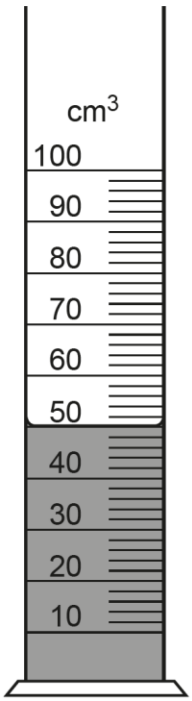
Question 10 (a)

10 Hiro has been given a rock sample to identify.

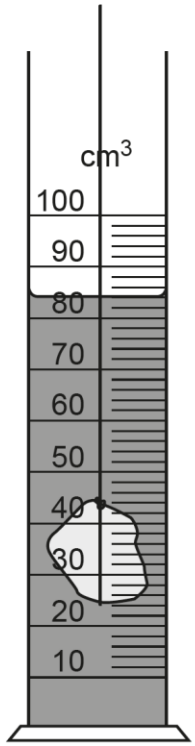
(a) Hiro uses a 100 cm^3 measuring cylinder and a balance that can measure up to 100.00 g to find the density of the rock.

The diagram shows the steps followed by Hiro.

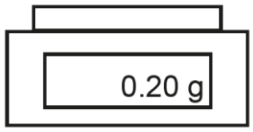
Step 1: Put water in the measuring cylinder and note the initial volume.



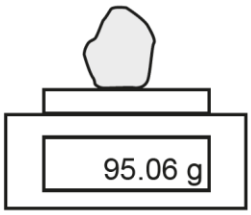
Step 2: Lower the rock into the water using some string and note the new volume.



Step 3: Note the initial reading on the balance.



Step 4: Place the rock on the balance and note the new reading on the balance.



Calculate the density of the rock.

Use the diagram.

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

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

The best responses on this question carefully set out their working to clearly show that the mass of the rock is 94.86 g and the volume is 34 cm^3. By setting the working out clearly in this way it helps the candidate to carefully check that the values they are using are the correct ones before substituting into the given equation.

Assessment for learning

Students should be encouraged to set numbers equal to the name of the quantity before starting to process the data using the equation. This is both to check that they have the correct value and to check that the unit for that quantity is correct.

Question 10 (b)

(b) Hiro does another experiment to find the specific heat capacity of a different sample of the same rock. This is the method:

1. Measure the mass of the rock
2. Heat the rock in boiling water for 10 minutes to ensure that it reaches a temperature of 100 °C.
3. Move the rock from the boiling water to water with a mass of 200 g and an initial temperature of 20 °C, using tongs.
4. Measure the temperature of the 200 g of water once it has stopped increasing.
5. Calculate the energy transferred to the water.

These are Hiro's results:

Mass of the rock (kg)	0.078
Energy transferred to the water (J)	4310
Initial temperature of rock (°C)	100
Final temperature of rock (°C)	26

Calculate the specific heat capacity of the **rock**.

Assume that all the energy transferred by the rock when it is put in the 200 g of water is transferred to the water.

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

Specific heat capacity = ... J/kg °C **[4]**

Like in Question 10 (a), this question gives the candidates many different numbers. Therefore, a candidate who works methodically through the given data, writing each next to the matching quantity, is more likely to be successful and less likely to make a mistake.

This question also required the candidates to round their answer to an appropriate number of significant figures. The given data is to a minimum of two significant figures. Therefore, the calculated value should be given to two significant figures.

OCR support

The OCR GCSE mathematical skills handbook can be found here. Guidance on significant figures is found on page 14.

OCR GCSE (9-1) Science Mathematical Skills Handbook

Question 10 (c) (i)

(c) Hiro thinks that the rock could be granite.

Hiro repeats both experiments multiple times and calculates a mean density and specific heat capacity for the rock.

The table shows Hiro's mean values from the experiments and data collected from the internet:

Mean values from experimental data	Data collected from the internet
Density = 2.83 g / cm^3	Density of granite is between 2.50–2.81 g / cm^3
Specific heat capacity = 768 J / kg °C	Specific heat capacity of granite = 774 J / kg °C

(i) Suggest why Hiro cannot be certain that the rock is granite.

Use information from the table.

.....

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

To fully answer this both quantities require a comparison between the experimental data and the data from the internet.

Question 10 (c) (ii)

(ii) Describe how Hiro can change each of the experimental methods in **(a)** and **(b)** to be more certain that the rock is granite.

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

Being more certain means removing uncertainty from the collected data. There are various ways to do this, such as from changing the experimental method to remove random error or changing apparatus to improve measurement resolution. Many candidates suggested more repeats. This would normally be a valid answer but was not credited here since in part (c) it is stated that Hiro repeated the experiments multiple times.

Question 10 (d)

(d) Pumice is another type of rock which contains microscopic bubbles of gas.

Suggest how the density of pumice compares to most other rocks.

Use the particle model of matter to **explain** your answer.

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.....

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

The question tells candidates to use the particle model to explain their answer and three out of the four marks are for doing this. Some candidates only received partial credit for not fully comparing the particle arrangement in a solid and gas. A comparison requires a description of both states being compared.

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Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Access to Scripts

We've made it easier for Exams Officers to download copies of your candidates' completed papers or 'scripts'. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular professional development courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is the exam paper builder platform for a range of our qualifications. Find out more.

Free for all OCR centres with an Interchange account, it allows unlimited users per centre. We require an Interchange username to verify your centre's users for ExamBuilder.

If you do not have an Interchange account, please contact your centre administrator (usually the Exams Officer) to request a username.

Once you have an Interchange username, use the form on this page to sign up for ExamBuilder, or ask an existing user at your centre to create an ExamBuilder account for you.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals (examined units only).

Find out more.

Tell us what you think

Your feedback plays an important role in how we develop, market, support and resource qualifications now and into the future. We want you and your students to enjoy and get the best out of our qualifications and resources, but to do that we need your honest opinions to tell us whether we're on the right track or not.

You can email your thoughts to resources.feedback@ocr.org.uk or visit our feedback page to learn more about how you can help us improve our resources.

Designing and testing in collaboration with you and your students

Helping young people develop an ethical view of the world

Equality, diversity, inclusion and belonging (EDIB) are part of everything we do

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Contact the team at:

01223 553998

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To stay up to date with all the relevant news about our qualifications, register for email updates at ocr.org.uk/updates

Visit our Online Support Centre at support.ocr.org.uk

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