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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

J260/08 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 8 series overview

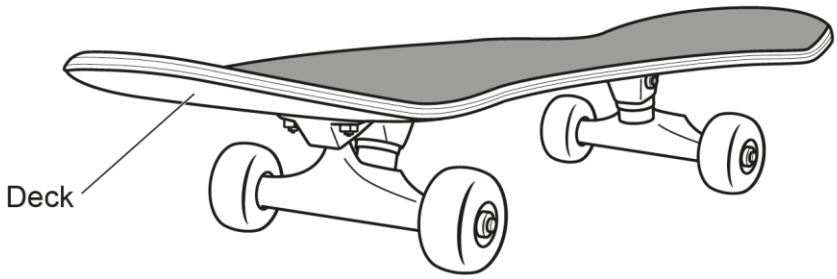
This paper has a more discursive nature, assessing content from across the GCSE Combined Science B (Twenty First Century Science) Higher Tier specification. Candidates found some of the usual content challenging but were able to demonstrate a clear understanding of many of the more complex aspects of the course.

Very few questions were omitted. Candidates appeared to take the care needed when reading the stem of the questions. Extended answers were well thought out and overall well attempted. Calculations were generally clearly laid out and easy to follow, with an improved amount of success.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• were knowledgeable in issues arising from sulfur dioxide pollution • discussed the use of radioactive tracers • calculated velocity using $v^2 - u^2 = 2as$ • calculated of frequency using $v = f\lambda$ • evaluated the trends of data from graphs • explained how natural selection can lead to specific characteristics in plants.	• had misconceptions surrounding sulfur dioxide and the ozone layer • could not explain how to improve accuracy by increasing resolution of apparatus and why this is needed • found challenges in determining the half-life of a substance • described how to carry out a reaction between metals and acid to identify the reactivity • explained how to calculate the resultant force • explained why potassium is extracted by electrolysis from molten potassium chloride but not potassium chloride solution • described how to use a light microscope.

Question 1 (a)

1 A skater wants to buy a new skateboard.



The table shows information about three different skateboards.

Skateboard	Deck material	Tensile strength (MPa)	Stiffness (GPa)	Density (kg / m^3)
A	Wood	4	10	700
B	Glass	3400	75	2500
C	Composite	350	10	900

(a) Suggest why the skater chooses to buy Skateboard **C**.

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

Candidates scored well on this question by determining the properties needed from a skateboard and then selecting the reasons why other materials were not selected.

Question 1 (b)

(b) State why the development of composite materials is beneficial when designing new products.

.....

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

Very few candidates could state that a composite material will have the properties of more than one material.

Question 1 (c)

(c) The skater decides to recycle the old skateboard so that it does not take up space in landfill.

State **one** other factor that should also be considered when disposing of a skateboard.

.....

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

Candidates considered a wide range of properties that need to be considered when disposing of a skateboard. Some of the more popular responses included how the materials will be correctly recycled depending on the material and the consideration of the energy needed to dispose of the material.

Question 1 (d) (i)

(d) The skateboards are transported to shops in lorries that burn diesel.

(i) One gas that forms when diesel burns is sulfur dioxide.

Explain **one** problem caused by increased amounts of sulfur dioxide in the atmosphere.

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

Candidates were able to identify acid rain as the cause of many issues arising from the production of sulfur dioxide. Fewer candidates could then articulate the problems causes by acid rain. Candidates also incorrectly discussed the ozone layer in this question.

Question 1 (d) (ii)

(ii) Carbon monoxide and nitrogen monoxide are also formed when diesel burns.

Catalytic converters help to decrease these emissions into the atmosphere by converting:

- nitrogen monoxide into nitrogen
- carbon monoxide into carbon dioxide.

Complete the equation to show the reaction that occurs in a catalytic converter.

$$2CO + 2NO \longrightarrow 2CO_2 + \ldots\ldots\ldots\ldots$$

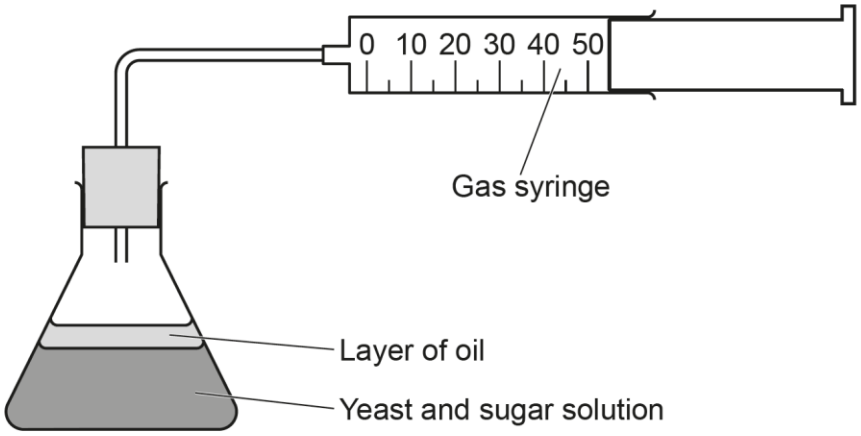
[1]

Only a few candidates could give the formula of nitrogen gas as a diatomic molecule N_2

Question 2 (a)

2 A student is investigating the rate of anaerobic respiration in yeast using this method and the apparatus shown:

- Add glucose to a yeast solution.
- Add a layer of oil on top to prevent oxygen reaching the yeast.
- Measure the volume of carbon dioxide made in 20 minutes.
- Repeat using sucrose and maltose.



(a) The student controls the temperature of the yeast and sugar solution to make sure their comparisons are valid.

Describe **how** the student should control the temperature.

.....

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

Few candidates could identify a water bath as the best way to control the temperature. Several opted for a room where the temperature could be controlled but could not say 'how' this would be achieved.

Question 2 (b)

The student's results are shown in the table:

Type of sugar	Volume of carbon dioxide collected in 20 minutes (cm^3)
Glucose	35
Sucrose	25
Maltose	30

(b) Explain how the student could improve the accuracy of the gas volume measurements.

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.....

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

Many candidates talked about repeating the experiment a number of times and calculating a mean. This did not answer the question, which required the measurement itself being improved. 'Improving the resolution of the apparatus used to get closer to the true value' was very rarely seen.

Question 2 (c)

(c) Calculate the rate of carbon dioxide production for the yeast and **glucose** solution.

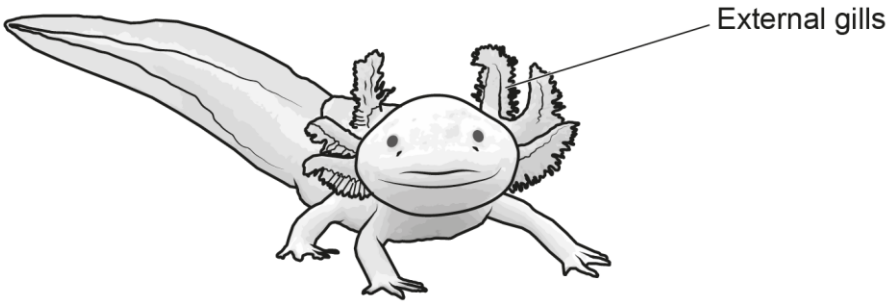
Rate of carbon dioxide production = ... cm^3 / minute **[2]**

Almost all candidates could calculate the rate of carbon dioxide production. This was pleasing to see.

Question 2 (d)

(d) Yeast cells absorb oxygen across their cell membranes.

An axolotl is a multicellular animal that lives in water. It has external gills for gas exchange.



Explain why an axolotl needs external gills for gas exchange.

Use ideas about surface area to volume ratios in your answer.

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

Candidates sometimes discussed 'more gas exchange' rather than 'a greater rate of diffusion'. There is a significant difference between these two statements..

Question 3 (a)

3 Radioactive isotopes have many uses in medicine.

(a) When a person is injected with a radioactive medical isotope, they are contaminated.

A person having an X-ray is irradiated.

State **one** difference between contamination and irradiation.

.....

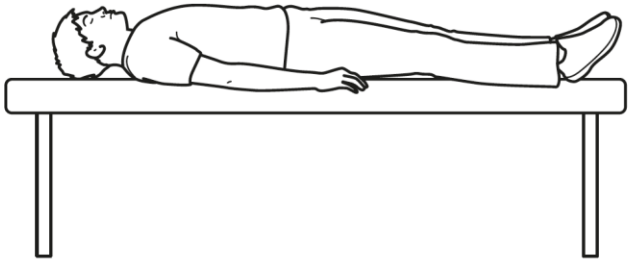
..... **[1]**

Many candidates could say what 'irradiation' is but were less successful at describing 'contamination'. This is not just described as a source of radiation that is inside your body. It could also be on the outside of the body touching the skin.

Question 3 (b)*

(b)* Gallium-67 is a radioactive isotope that emits gamma rays when it decays. It is used in medicine for imaging and to help diagnose diseases. Gallium-67 has a half-life of 78.3 hours.

A radioactive tracer which contains galium-67 is injected into a patient's arm. After a few hours, a set of images are taken on a gamma camera. The gamma camera uses the radiation emitted by gallium-67 to form these images.



Discuss the advantages and disadvantages of using gallium-67 to produce medical images compared to **other** radioactive isotopes.

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

Candidates were readily able to discuss the advantages and disadvantages of using a source of gamma radiation with a particular half-life. They were less successful at discussing and comparing other radioactive isotopes that could be used for creating medical images. Some candidates were unable to articulate why alpha and beta sources would not be used. Those who did discuss the ionising or penetrating properties of alpha, beta and gamma radiation, often got them confused.

Some candidates were articulate in their responses but only answered part of the question, for example they may have discussed advantages and disadvantages but not discussed the use of other radioactive isotopes.

Exemplar 1

- Gallium 67 is good for producing medical images because it emits gamma radiation, which can penetrate human tissue, so it can be detected by a gamma camera outside the body.
- Other radioactive isotopes that emit alpha or beta radiation could not be used because alpha and beta radiation cannot penetrate human tissue, so it cannot be detected outside the body.
- Gallium 67 is also good for producing medical images because it has a half-life of 78.3 hours, which is long enough for the isotope to circulate the body and be detected by the gamma camera, but not long enough for it to contaminate the person. **[6]**

3b
- An isotope with a too short half life would break down too quickly to circulate the body.
- An isotope with a too long half-life would remain radioactive long enough to contaminate the person.

This candidate has clearly given a scientifically correct reason for why gamma radiation can be used for medical imaging. They have also explained the reason for using the gamma rather than other isotopes. Unfortunately, this candidate has not included any disadvantages of using this radioactive isotope as directed in the question so they cannot achieve Level 3 without answering all parts of the question.

Question 3 (c)

(c) Sodium-24 can be used to identify blockages in blood vessels.

The activity of sodium-24 falls by $\frac{3}{4}$ in 30 hours.

Calculate the half-life of sodium-24.

Half-life = ... hours **[2]**

The most common incorrect response was 20 hours. Candidates found it challenging to work backwards from the activity of the sample to find the initial number of atoms to calculate the half-life.

Question 4 (a)

4 This question is about the reactivity series of metals.

(a) Describe how dilute hydrochloric acid can be used to investigate the reactivity of metals.

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

The starting point of describing the process of finding the reactivity of the metal is to place it in the acid. This was a point that several candidates missed. The next point missed by a large number of candidates was how to identify that a reaction had taken place, such as bubbles or fizzing taking place. The next point was how this information would be used to determine the reactivity.

Question 4 (b)

(b) The reactivity of metals can also be investigated using copper sulfate solution.

A student uses this method:

- Put some copper sulfate solution into an insulated cup.
- Add a piece of metal.
- Record the maximum temperature reached during the reaction.

Suggest **two** changes the student can make to improve the validity of the data that will be collected.

Improvement 1 .....

.....

Improvement 2 .....

.....

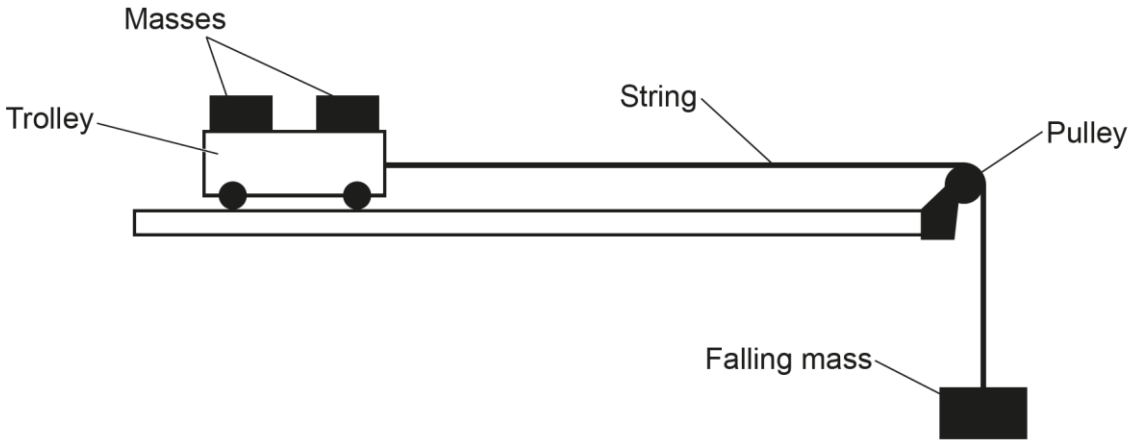
[2]

A large number of candidates talked about 'amount' of copper sulfate rather than 'volume'. Credit was not given for 'amount' as this is too vague and could refer to a number of properties such as concentration, mass, volume, etc. Where marks were scored, it was usually for recording the temperature at the start or to calculate the temperature change. Very few candidates identified the need for a lid or for stirring.

Question 5 (a)

5 A student is investigating how the total mass of a trolley affects its acceleration when the force is constant.

The diagram shows the apparatus used.



(a) The two horizontal forces acting on the trolley are the pulling force of the string and friction of the wheels of the trolley.

The manufacturer of the trolley claims that the trolley is frictionless however.

Explain how the student can calculate the resultant horizontal force acting on the trolley, if the manufacturer's claim is correct.

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

Very few candidates were successful in answering this question. This answer required the candidate to realise that as friction is zero, the resultant force is equal to the weight of the mass that can be calculated using the mass on the trolley and the gravitational field strength.

Question 5 (b) (i)

(b) The student measures the time taken for the trolley to travel a distance of 1.0 m.

(i) Why does the student repeat this time measurement three times and then calculate the mean?

Tick (✓) **one** box.

To reduce the effect of air resistance on the result. ☐

To reduce the effect of friction on the result. ☐

To reduce the effect of random errors on the result. ☐

To reduce the effect of systematic errors on the result. ☐

[1]

Many candidates could identify the process of repeating and calculating a mean is to reduce the effect of random errors.

Question 5 (b) (ii)

(ii) In one experiment, the acceleration of the trolley is 0.72 m/s^2.

Calculate the final speed of the trolley after it travels a distance of 1.0 m.

Use the Data and Equation Sheet.

Final speed = ... m/s **[4]**

Even though most candidates could not complete the calculation to give the final answer of 1.2, there were still many candidates that could calculate v^2 as 1.44. The issue came from a possible lack of understanding of what the initial speed was. Those candidates that tried to put a value other than zero to the initial velocity, generally scored 3 of the possible 4 marks.

Question 6 (a) (i)

6 This question is about the extraction of metals.

(a) Mining for metals can result in waste substances being released into rivers and into the soil.

(i) Phytoextraction uses plants to remove metal contamination from soil.

Explain why there is **less** carbon dioxide emitted when phytoextraction is used compared to traditional mining.

.....

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

Most candidates could identify that plants absorb carbon dioxide from the atmosphere and that less burning of fossil fuels from the mining process takes place during phytoextraction.

Question 6 (a) (ii)

(ii) Scientists have developed special filters to remove toxic metal ions from river water.

These filters use nanoparticles. The nanoparticles bond to the toxic metal ions to remove them.

Nanoparticle | Toxic metal ions | Toxic metal ions bonded to a nanoparticle

Suggest **one** risk associated with using nanoparticles for this purpose.

.....

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

There were a number of candidates who could suggest that nanoparticles have not been studied for long enough to understand the risks associated with them.

Question 6 (b)

(b) Some metals are extracted by electrolysis.

Potassium can be extracted by electrolysis of molten potassium chloride.
Potassium **cannot** be extracted by electrolysis of dilute potassium chloride solution.

Explain why.

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

This question was not always successfully answered as responses showed lack of understanding the difference in the two types of electrolysis and how they would give different products at the electrodes.

Misconception

If the substance undergoing electrolysis is in solution rather than molten, this adds the components of water to the list of possible products.

Molten potassium chloride contains ONLY potassium and chloride ions.

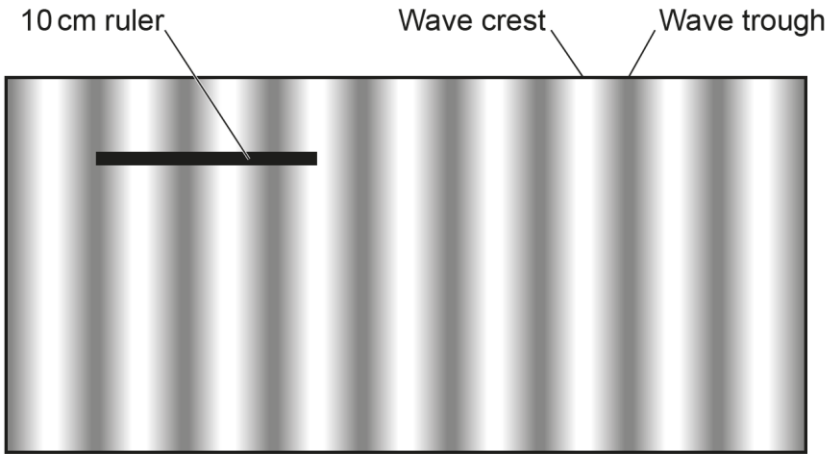
Potassium chloride solution contains potassium ions, chloride ions, hydroxide ions and hydrogen ions. As potassium is more reactive than hydrogen, then hydrogen gas will be released at the cathode.

Question 7 (a)

7 A student is using a ripple tank to investigate how the speed of water waves depends on the depth of the water.

The waves in the ripple tank are generated by a vibrating bar.

The image shows the observations from one experiment.



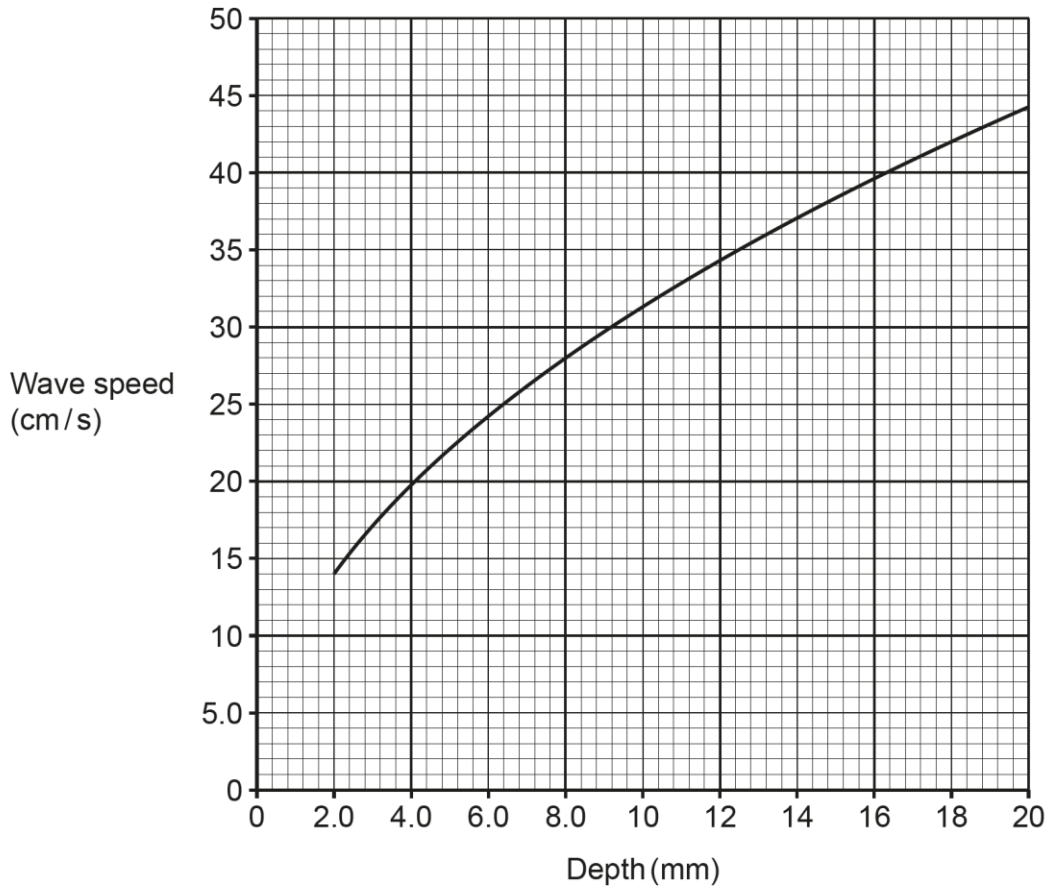
(a) Estimate the wavelength of the waves.

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

Many candidates were unable to accurately measure the wavelength of just one wave or to scale down the size of the bar at 10 cm for 2.5 wavelengths to 1 wavelength being equal to 4 cm.

Question 7 (b)

(b) The graph shows how the speed of a water wave in the ripple tank varies with depth.



When the depth of the water is 14 mm the wavelength of the waves is found to be 3.9 cm.

Calculate the frequency of the vibrating bar when the depth of the water is 14 mm.

Use the graph and the equation: wave speed = frequency × wavelength.

Give your answer to an appropriate number of significant figures.

Frequency = ... Hz **[5]**

Many candidates scored 3 or more marks on this question. Some candidates lost a mark due to the use of an incorrect number of significant figures.

Question 8 (a)

8 A student does an experiment to investigate the number of stomata on the upper and lower surfaces of leaves.

This is their method:

- Remove one leaf from a plant.
- Spread clear nail varnish over a 1 cm by 1 cm square on the upper surface of the leaf.
- Allow the nail varnish to dry.
- Use clear sticky-tape to peel off the nail varnish.
- Spread the tape on a glass microscope slide.
- Repeat method for lower surface of the leaf.

(a) Describe how to use a light microscope to view the stomata on the slide using the highest magnification.

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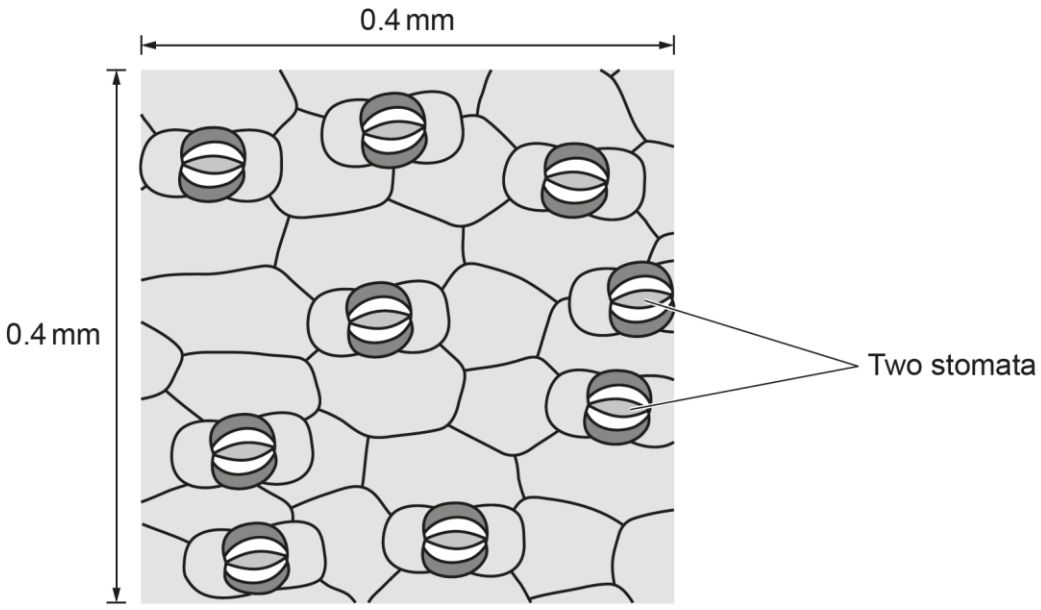
..... **[3]**

Many candidates found it challenging to describe the steps in carrying out this practical activity. Most candidates tried to view the specimens without the use of a light directed through the sample. This would not allow a suitable image to be formed. Many candidates describing going straight to the highest magnification rather than using the lowest magnification objective lens first and building the magnification once the course focus had been used to get a clear image.

Question 8 (b)

(b) The image shows part of the view down the light microscope.



Calculate the stomatal density of the leaf.

Use the image and the formula for stomatal density:

$$\text{Stomatal density} = \frac{\text{Number of stomata in field of view}}{\text{Area of field of view}}$$

Give your answer to the **nearest whole number**.

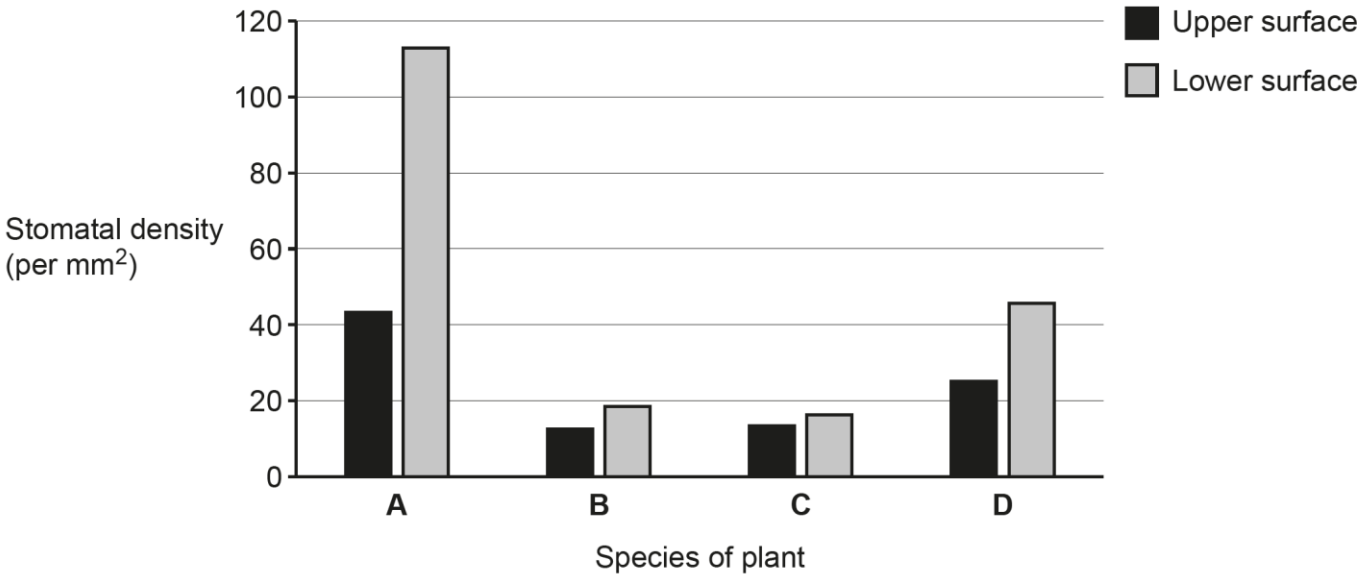
Stomatal density = ... per mm^2 **[4]**

Most candidates could correctly calculate the stomata density, however some candidates did not convert their calculated value into a whole number, so they were not given 1 of the 4 marks available.

Question 8 (c) (i)

(c) The graph shows data collected by the student for stomatal density of 4 other plant species.

Species **A** is a plant that is found in **woodland** in the UK.
Species **B**, **C** and **D** are plants from **dry climates** around the world.



(i) State **one** conclusion from the graph.

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[1]

Most candidates could successfully identify the trend in data of upper and lower stomata density.

Question 8 (c) (ii)

(ii) Explain why you can only have limited confidence in any conclusions made from the graph.

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

Few candidates could identify a reason for limited confidence in the data and their explanations were often limited.

Question 8 (d)

(d) Plant **C** is a species that is commonly found in **hot deserts** in Central America.

Explain how natural selection can lead to a plant population having fewer stomata.

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

Some candidates could explain that plants with fewer stomata are more likely to survive in hot regions, whereas plants with more stomata would die out due to the loss of water. Fewer candidates could explain that natural selection takes place due to the variation in species. Even fewer could explain the part of the cell which passes on this information is called 'an allele'.

Question 9 (a)

9 Some scientists say that human activities such as burning fossil fuels have affected the total area of arctic sea ice.

Fig. 9.1 and **Fig. 9.2** show how some environmental factors have changed over many years.

Fig. 9.1: Global surface temperature and atmospheric carbon dioxide (1850–2022)

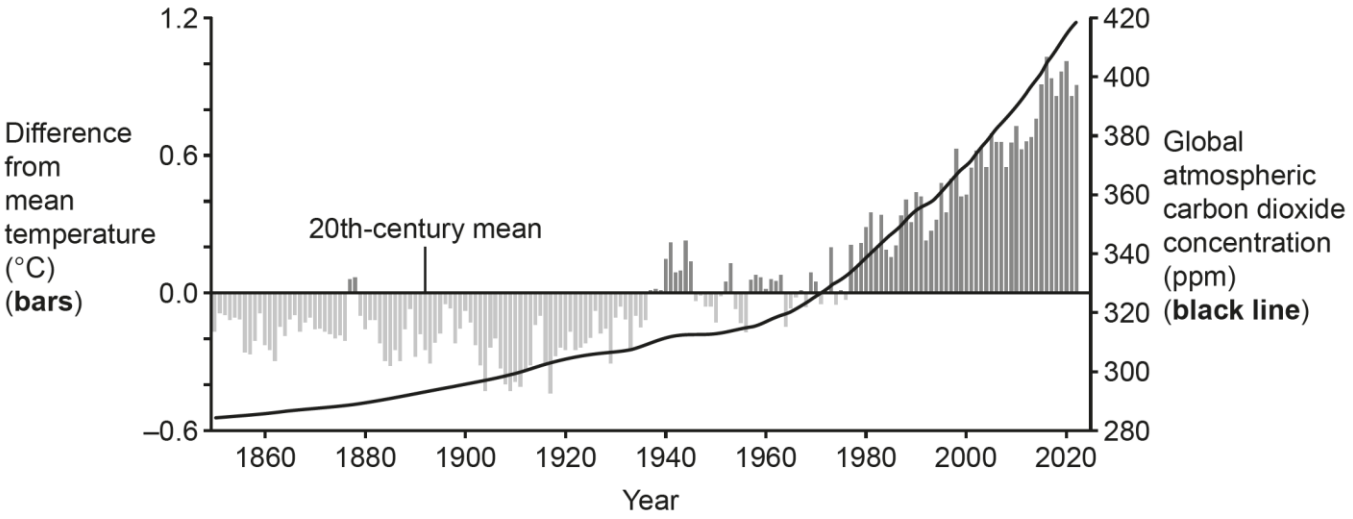
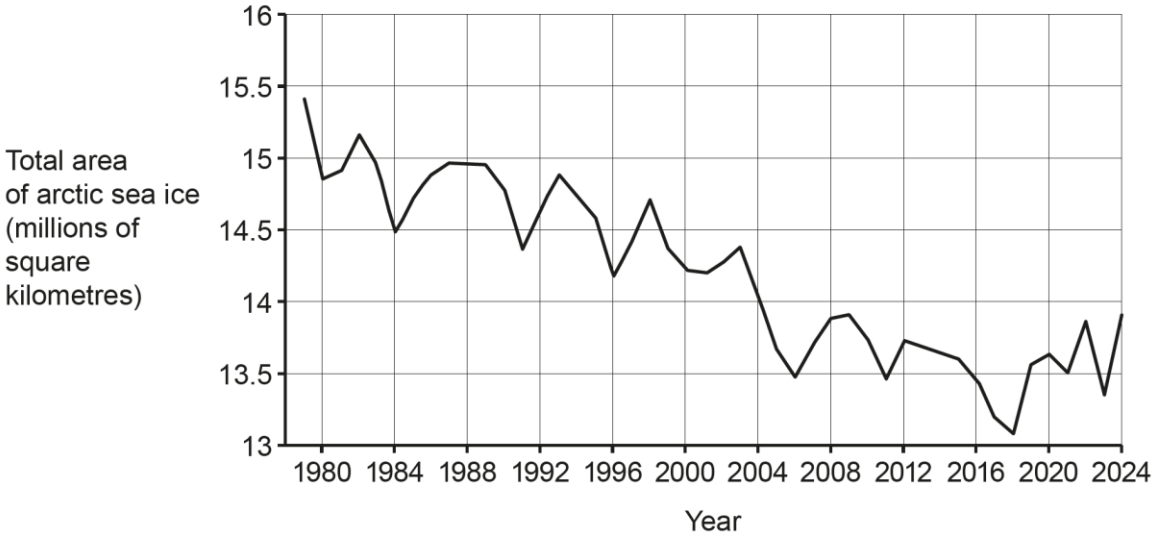


Fig. 9.2: Total area of arctic sea ice (1979–2024)



(a) Evaluate the scientists' theory that human activities have affected the total area of arctic sea ice.

Use information from **Fig. 9.1** and **Fig. 9.2** in your answer.

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

Most candidates could describe the trends of carbon dioxide and temperature increasing as the area of sea ice decreases. The 'evaluate' command word prompted candidates to link the human activity to these trends in data. Some candidates successfully identified the increase of burning of fossil fuels which release carbon dioxide as the reason for the increase in atmospheric carbon dioxide in figure 9.1. Some candidates discussed the start of the Industrial Revolution, without linking the industry with the production of carbon dioxide. It is important to link the information together when suggesting the causal link.

Question 9 (b)

(b) Pentane is a fossil fuel. It is part of the hydrocarbon mixture in petrol and in aircraft fuel.

This is the equation for the complete combustion for pentane:

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

Calculate the mass of carbon dioxide formed when 28.8 g of pentane is burned.

Use the relationship: number of moles = $\frac{\text{mass of substance}}{\text{relative formula mass}}$

Mass of carbon dioxide formed = ... g **[5]**

This multistage calculation was well attempted by almost all candidates with varying success. Those that were successful followed a sensible approach of firstly calculating the relative formula mass of pentane as 72. Most candidates could not calculate this correctly. Any errors from this were carried forward through the calculation to allow processing marks to be awarded. Candidates should then divide the mass of pentane by their value for relative formula mass to give the number of moles (28.8 ÷ 72 = 0.4 moles). They then needed to use the equation to look at the stoichiometry and multiply this value by 5 to give the moles of carbon dioxide. The final step of multiplying their value by the relative formula mass of carbon dioxide (44) should have given the mass of carbon dioxide as 88 g.

There were several variations in the methods used and this was perfectly acceptable. The mark scheme covered the common methods seen at each key point in the calculation.

Common errors were incorrectly calculating the relative formula mass of pentane and carbon dioxide (although 'error carried forward' was applied in the marking process), dividing 28.8 by the wrong relative formula mass or an incorrect rearrangement of mass = moles x relative formula mass.

Question 10 (a)

10 Cardiovascular disease (CVD) is a general term for a group of diseases affecting the heart or blood vessels.

(a) Red blood cells are specialised cells which have no nucleus.

Explain why this is a useful adaptation.

.....

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

Very few candidates could identify the lack of a nucleus and an advantage to be able to fit in **more** haemoglobin or to carry **more** oxygen.

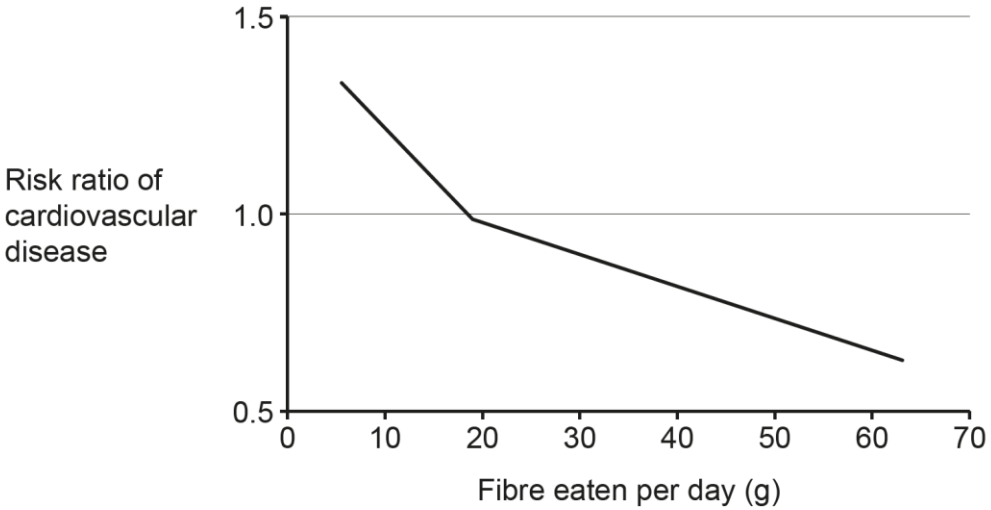
Question 10 (b)

(b) Some scientists produced a graph from 50 studies on the effect of fibre on the risk of CVD.

Fibre is food that cannot be digested and absorbed.

The graph shows the risk ratio of developing CVD based on the mass of fibre in a person's diet.

A risk ratio of 1.0 means that the risk of developing CVD is equal to the mean risk of the general population.



Describe the trend shown by the graph.

.....

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

Almost all candidates could identify the trend in the data on the graph as increasing the daily intake of fibre reduces the risk of CVD.

Question 10 (c)

(c) The recommendation from the study is that everyone should increase their fibre intake by 7 g per day.

Scientists suggested people could increase their fibre intake by eating another four portions of fruit or vegetables each day.

Evaluate this as a strategy to lower the risk of CVD.

Use the graph to help you.

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

The command word of 'evaluate' required the candidates to use their own knowledge as well as the data to answer the question. Where candidates scored one of the marks available, it was usually for commenting on the studies supporting the idea that an increase in fibre does reduce the risk of CVD. Very few candidates went on to explain other factors may play a part in the risks of CVD but responses were limited in the amount of information given about the large data set used or the idea that correlation does not mean there is a causal link. Centres could look more carefully at the working scientifically aspect of the specification in preparation for such questions.

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

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