

Examiners' report

GCSE

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

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

J257

For first teaching in 2016

J257/02 Summer 2025 series

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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](#).

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Paper 2 series overview

There are four examination components for GCSE (9-1) Science Biology B (Twenty First Century). Paper 2 (Depth in Biology) provide candidates with the opportunity to demonstrate the depth of their knowledge and understanding in biology. This paper differs from Papers 1 in a number of ways, including:

- a higher proportion of the questions require written answers (rather than asking candidates to choose the correct answer from provided options)
- more of the questions are worth 2-5 marks
- each paper includes two 6-mark, extended-writing questions marked using Level of Response mark schemes
- there is a greater emphasis on assessing candidates' ability to apply their knowledge and understanding in novel contexts (Assessment Objective 2) and analyse information to interpret, evaluate, draw conclusions, and develop or improve experimental procedures (Assessment Objective 3)
- more marks are given for knowledge and understanding of practical work.

Paper 2 assesses knowledge from across the specification, including some synoptic questions. Therefore, to do well on Paper 2, candidates need to demonstrate their understanding of ideas from across the whole specification, including Ideas about Science.

Candidates attempted most questions. The number of candidates who did not attempt questions was generally very low.

The whole of Questions 8 and 9 were common with the Higher Tier examination (J257/04).

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
- looked for ways to apply their knowledge and understanding to answer questions asked in unfamiliar contexts; for example, in Question 6 (c) (iv) - attempted every question, including questions that may have looked challenging; for example, Question 5 (e) about mitosis and cancer, Question 7 (b) (iv) about risk factors and type 2 diabetes, and Question 9 (d) about the water cycle - demonstrated confidence in applying their mathematical skills to complete calculations, such as in Question 4 (d) (i) and Question 7 (b) (i) - showed their working for calculations, which allowed marks to be given for correct working even when the final answer was incorrect, for example in Question 7 (b) (iii) and Question 8 (c) - demonstrated good disciplinary knowledge in questions assessing practical apparatus and techniques, such as using a light microscope in Question 4, and investigating physiological responses in Question 8.	- did not attempt to answer questions which may have had an unfamiliar context; for example, Question 4 (d) (iii) about sampling and estimation in the context of stomata on a leaf, and Question 9 (d) about the water cycle in the context of a bottle garden. - re-wrote the question before beginning their answer or constructed an answer by rearranging phrases from the question without adding any additional knowledge or understanding; for example, in Question 6 (b) (iv) they stated that Amaya is at high risk of developing type 2 diabetes. - produced answers that suggested they may not have read the question carefully; for example, in Question 3 (a) (ii) they often stated structures such as the cell wall or vacuole when asked for evidence present in the cell nucleus, and in Question 8 (b) when asked to identify one other variable not included in the table many stated variables from the table (e.g. light level, or the distance between the lamp and the eye). - did not read tables and graphs correctly; for example, in Question 7 (a) (i) they read the percentage from the wrong line (men instead of women). - relied on imprecise, everyday language rather than specific scientific vocabulary and concepts; for example, in Question 6 (b) they referred to animals losing their "home" instead of their "habitat", and in Question 6 (c) (iv) they mentioned the risk that the fungus could "harm the environment" rather than identifying specific effects on plants and animals within the ecosystem.

Question 1 (a), (b), (c) and (d)

1

- (a) Which system transports oxygen and dissolved food molecules around the human body in the blood?

Tick (✓) **one** box.

Circulatory system

☐

Digestive system

☐

Excretory system

☐

Gaseous exchange system

☐

[1]

- (b) Which organ pumps blood around the human body?

Tick (✓) **one** box.

Brain

☐

Eye

☐

Heart

☐

Kidney

☐

[1]

- (c) Which type of blood vessel has valves to stop blood flowing backwards?

Tick (✓) **one** box.

Artery

☐

Capillary

☐

Neuron

☐

Vein

☐

[1]

(d) Draw lines to connect each **part** of the blood with its correct **function**.

Part	Function
Plasma	Destroy pathogens
Platelets	Help seal wounds
Red blood cells	Transport dissolved food molecules
White blood cells	Transport oxygen

[3]

Candidates performed well on parts (b) and (d), but less than half correctly identified the circulatory system in part (a). The most commonly seen incorrect answer was 'digestive system', perhaps because of the reference to food in the question stem. In part (d) the most common correct answer was to link red blood cells to transporting oxygen. The most common mistake was to mix up the functions of the plasma and platelets. Candidates appeared to find part (c) the most challenging, with a minority correctly selecting vein as the type of blood vessel that has valves. The most common incorrect answer was 'artery', followed by 'capillary' (and 'neuron' was rarely seen).

Question 2 (a)

2

(a) Put these three structures in order of size, from the **largest** to the **smallest**.

Chromosome	Gene	Nucleotide
Largest		
		
Smallest		

[2]

Most of the candidates who answered this question were credited 1 mark for getting part of the order correct, with about a third given full marks for a completely correct order. There was no noticeable pattern in the order of incorrect responses, suggesting candidates may find it challenging to appreciate the relative sizes of these very small (and therefore abstract) structures.

Question 2 (b)

(b) Which statement describes the genome?

Tick (✓) **one** box.

A section of DNA that stores the instructions to make a protein.

All the physical features of an organism.

The combination of alleles that an organism has.

The entire genetic material of an organism.

☐
☐
☐
☐

[1]

Less than half of candidates chose the correct answer. Where candidates didn't choose "The entire genetic material of an organism", they often chose "A section of DNA that stores the instructions to make a protein", so appeared to be mixing up gene and genome.

Question 2 (c)

(c) Draw lines to connect each **description** with the correct **number**.

Description

Number

The number of bases in each nucleotide.

1

2

The number of different nucleotides found in DNA.

3

The number of nucleotide strands in a DNA molecule.

4

5

[3]

Candidates found this question challenging, with few credited 3 marks. Around a quarter of candidates were credited 2 marks. The line that was most commonly drawn correctly was from "The number of nucleotide strands in a DNA molecule" to "2", possibly because candidates were able to apply understanding from familiarity with the term 'double helix'.

Question 3 (a) (ii)

- (ii) State **one** piece of evidence present in the **nucleus** of the cell in **Fig. 3.1** that scientists could use to help classify the organism.

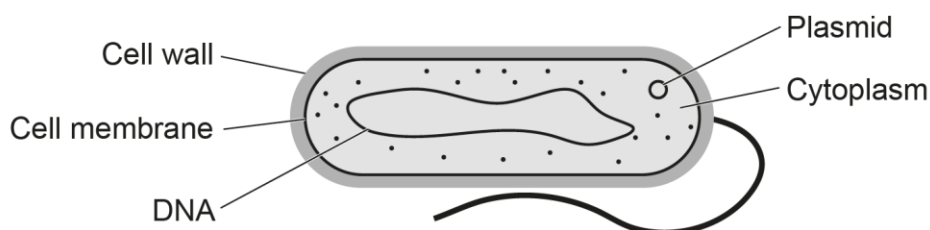
..... [1]

This question challenged candidates to focus on the idea that DNA can be used to help classify organisms (B6.3.1). Although the question asked for evidence present in the cell nucleus, many candidates suggested structures outside the nucleus, such as the cell wall or vacuole.

Question 3 (b)

- (b) Fig. 3.2 is a diagram of a different cell.

Fig. 3.2



State **two** reasons why the cell in **Fig. 3.2** would be classified as prokaryotic and **not** as eukaryotic.

1

2

[2]

Candidates engaged well with this question, with almost half credited 1 mark and another third credited 2 marks.

Misconception



Some candidates correctly used the word flagellum (despite it not being on the specification) but incorrectly stated that it was why the cell would be classified as prokaryotic. It is a misconception that only prokaryotic cells have flagella. Some eukaryotic cells do have flagella. The example that candidates are most likely to be familiar with is sperm cells, where the motile tail is a flagellum.

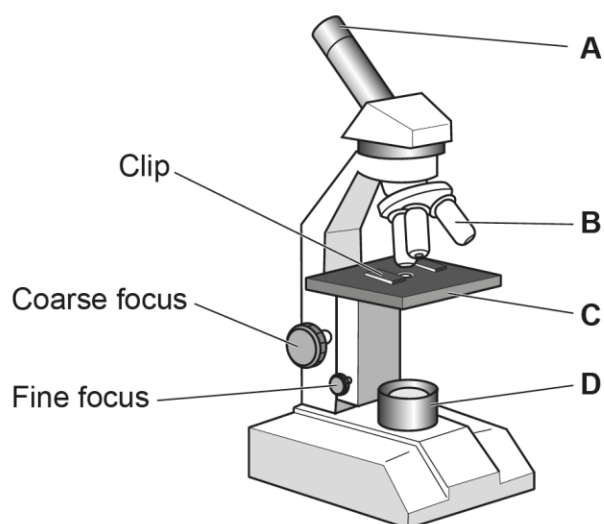
Question 4 (a) and (b)

4 Plant leaves have tiny holes called stomata on their surfaces.

A student uses a light microscope to observe stomata on the underside of a small rectangular piece of a leaf.

(a) Fig. 4.1 shows a light microscope.

Fig. 4.1



Write the correct letter, **A**, **B**, **C** or **D**, next to each part.

Eyepiece lens

Light

Objective lens

Stage

[2]

(b) Complete the method to describe how to set up the light microscope to observe stomata on a slide.

Use words from the list.

eyepiece	light	objective	slide	stage
-----------------	--------------	------------------	--------------	--------------

1. Place the under the clips.
2. Looking from the side, turn the coarse focus to move the stage towards the lens.
3. Looking into the lens, use the coarse and fine focus to adjust the image until it is clear.

[3]

Most candidates demonstrated excellent disciplinary knowledge in parts (a) and (b), clearly familiar with the parts of a light microscope and how they are used. While incorrect answers were rarely seen, the most common mistake in part (a) was to mix up the light (**D**) and the objective lens (**B**), and the most common mistake in part (b) was to write 'stage' in the first gap instead of 'slide'.

Question 4 (c)

(c) Why is it important to look from the side in step 2 of the method?

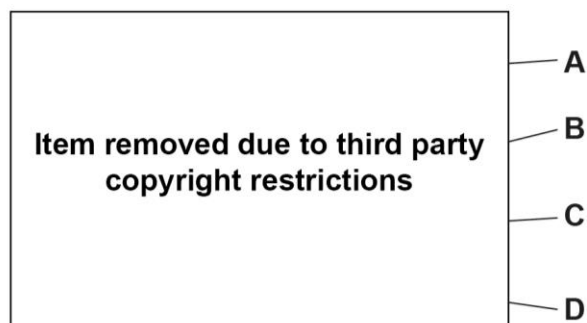
.....
 [1]

Candidates found this part, which related to safety, challenging. Only around a third were credited the mark. A noticeable number of candidates incorrectly referred to focussing the image or ensuring that the slide was positioned such that the sample was visible through the lenses, both of which would require looking through the lenses rather than looking from the side.

Question 4 (f)

(f) Fig. 4.4 shows one of the stomata observed with a more powerful microscope.

Fig. 4.4



Which part is a guard cell?

Tick (✓) **one** box.

- A ☐
 B ☐
 C ☐
 D ☐

[1]

Candidates found this question challenging, with no obvious pattern to the incorrect answers. However, just less than half of candidates did manage to correctly identify the guard cell (**C**).

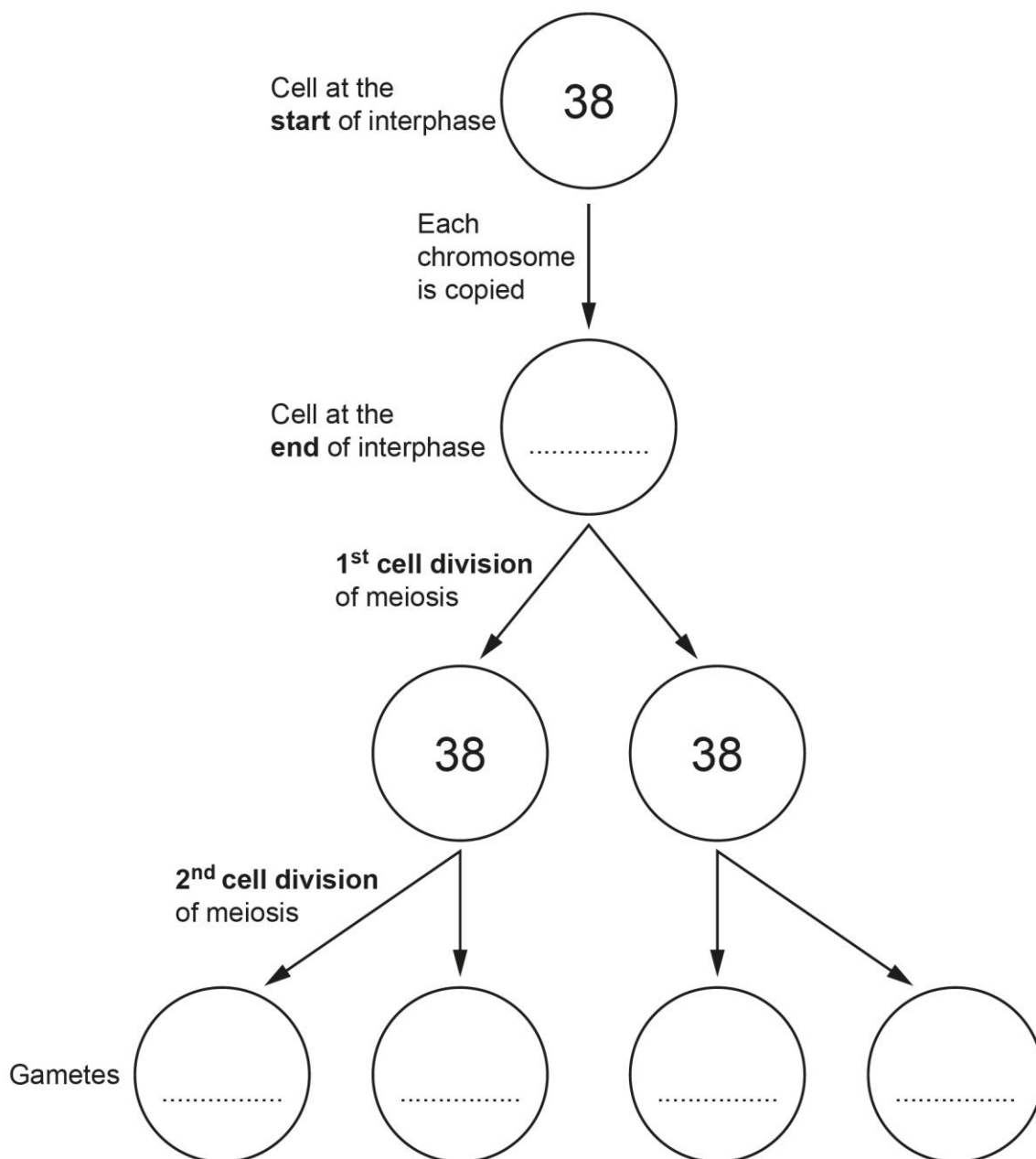
Question 5 (a) and (b)

5 Each body cell in a cat has 38 chromosomes.

(a) Cats reproduce sexually.

The gametes are made by meiosis, starting with one of the cat's cells.

Complete the diagram to show the number of chromosomes found in each cell during the stages of meiosis.



[2]

(b) How many chromosomes will be present in a cat's zygote after fertilisation?

Number of chromosomes in cat's zygote = chromosomes [1]

In parts (a) and (b), most candidates appeared to recognise that the missing numbers would be either double or half of the given numbers. Most candidates were given both marks for part (a). Part (b) proved more challenging, with around two-thirds of candidates did not credit the mark. The most common incorrect answers in part (b) were 19 and 76.

Question 5 (c) (i) and (ii)

(c) Adult body cells divide to make more body cells as part of the cell cycle.

Statements **A** to **E** are steps in this process. The statements are **not** in the correct order.

- A** The cell divides.
- B** The cell grows larger.
- C** The chromosomes are copied.
- D** The chromosome copies separate.
- E** The nucleus divides.

(i) Write **one** letter in each box to show the correct order of the steps.

One of the steps has been done for you.

	C			
--	----------	--	--	--

[3]

(ii) The cell cycle is divided into two parts called interphase and mitosis.

Tick (✓) **two** boxes to show the steps that take place during **interphase**.

	Interphase
The cell divides.	
The cell grows larger.	
The chromosomes are copied.	
The chromosome copies separate.	
The nucleus divides.	

[1]

The details of the cell cycle in parts (c)(i) and (ii) proved challenging for candidates. In part (i), just less than half of candidates were credited 1 mark and about a further third were credited 2 marks for getting part of the sequence correct. In part (ii), around one-third of candidates were credited the mark.

Question 5 (d)

(d) Complete the sentence about **mitosis**.

Use a word from the list.

different

fertilised

gametes

identical

The cells produced by mitosis are genetically

[1]

This question was well-answered, with most candidates aware that the cells produced by mitosis are genetically identical. It was rare to see an incorrect answer, but 'different' was the one chosen most often.

Question 6 (a) and (b)

6 Ash trees are common in the UK.

(a) What is the role of an ash tree in a food chain?

Tick (✓) **one** box.

Herbivore

☐

Primary consumer

☐

Predator

☐

Producer

☐

[1]

(b) Describe **two** ways animals can be affected if an ash tree is removed from the ecosystem it was growing in.

1

.....

2

.....

[2]

Candidates appeared to be very familiar with the role of plants as producers. Most chose the correct answer in part (a), with around one-fifth incorrectly choosing either 'herbivore' (possibly because they associate the term with plants and food) or 'primary consumer' (possibly because they knew that food chains start with a plant in the first position). 'Predator' was rarely chosen. In part (b), many candidates noted that the removal of the tree would disrupt the food chain or result in less food being available for animals. About half of candidates were credited 1 mark and around a further third credited 2 marks. Loss of food and loss of habitat were the most common answers.

Question 6 (c) (ii)

(ii) Which **two** of these are used by plants as a defence against pathogens?

Tick (✓) **two** boxes.

Antibodies

☐

Antimicrobial substances

☐

Phloem

☐

Waxy leaf cuticle

☐

Xylem

☐

[2]

Just under half of candidates were credited 1 mark on this question, with about a further third scoring 2. 'Waxy leaf cuticle' was the most commonly seen correct answer, with no obvious pattern to the incorrect answers.

Question 6 (c) (iii)

(iii) A few ash trees are resistant and do **not** die when infected with ash dieback.

Complete the sentences to explain why resistant trees will gradually become more common.

Use words from the list.

adaptation	competition	mutation
natural selection	reproduction	variation

Resistant trees have a genetic variant created by

These trees are more likely to make offspring by

The offspring could inherit the genetic variant for resistance.

This is the process of

[3]

This question challenged candidates to choose between very similar bits of vocabulary to complete the explanation of natural selection. Just under a third of candidates were credited 1 mark, about a further third credited 2 marks and almost a quarter given full mark. There was no obvious pattern to the incorrect answers.

Question 6 (c) (iv)

(iv)* Scientists predict that ash dieback is likely to kill up to 80% of our 3 billion ash trees and cost the UK approximately £15 billion.

Scientists have discovered a species of fungus that releases a chemical that is toxic to the ash dieback pathogen.

Explain possible benefits **and** risks of releasing this fungus with its toxin into woodland in the UK.

.....

.....

.....

.....

.....

.....

..... [6]

Most candidates made a good attempt at this synoptic 6-mark extended-writing question. Candidates were required to apply their knowledge and understanding of interdependence within ecosystems (B3) in a new context to explain possible benefits and risks of this method of maintaining biodiversity (B6.4.4; laS 4.3). They suggested a good range of benefits and risks associated with the release of a fungus to tackle ash dieback, with most candidates achieving Level 2 and a good number achieving Level 3. Some candidates' marks were limited due to a lack of specificity in their answer, for example saying that the fungus could "harm the environment" rather than identifying specific effects on plants and animals within the ecosystem.

Exemplar 1

Benefits	Risks
- the fungus being toxic to the ash dieback pathogen will mitigate it from spreading - If the ^{ash} trees are saved, animals will have habitats, maintaining biodiversity - the If the ash trees are saved from the ash dieback pathogen, more oxygen will be excreted into the atmosphere	- The fungus could cause another disease to occur, such as rose black spots - A fungus would cause a fast spreading disease as it would be airborne and would spread in spores carried by the wind

[6]

This candidate scored Level 3, 5 marks. They have neatly divided their answer into benefits and risks and have provided plenty of detail on the benefits side (including the ideas that the fungus could kill the ash dieback pathogen and stop its spread, that this would save trees, and that this in turn would preserve animals' habitats). There is a slight lack of balance in the answer, with less detail about risks. The candidate has suggested that the fungus could itself cause a disease, and that it could spread to other areas. A little more detail, such as the idea that either of these outcomes could harm animals, humans or other plants, would have resulted in a more secure Level 3 answer and 6 marks.

Question 7 (a) (iii)

- (iii) The percentages of women and men with **cardiovascular disease** also increased from 2000 to 2019.

Suggest how the data in **Fig. 7.1** could be linked to the increase in cardiovascular disease.

.....

.....

.....

..... [2]

This question challenged candidates to pull together the evidence in the graph in Fig. 7.1 and their knowledge of risk factors for cardiovascular disease (B2.5.1a) to suggest an explanation for the increased incidence of CVD (B2.5.2). Almost half of candidates were credited 1 mark, most commonly for the idea that obesity increases the risk of CVD, but few were given 2 marks. Mechanisms linking obesity and CVD, such as fatty deposits in arteries, were only occasionally mentioned.

Question 7 (b) (i)

- (b) Measurements of a person's body can be used to draw conclusions about their health.
- (i) An adult has a mass of 81 kg and a height of 1.80 m

Calculate the body mass index (BMI) of the adult.

Use the equation: $\text{BMI} = \frac{\text{body mass}}{\text{height}^2}$, where body mass is in kg and height is in m.

BMI = kg/m² [2]

In common with the other calculation questions on this paper, this question was well-answered. Although incorrect answers were not often seen, the most common mistake was to divide 81 kg by 1.80 m without squaring the 1.80, producing the incorrect answer of 45.

Question 7 (b) (iii)

- (iii) Some doctors think that a person's BMI alone can be misleading. They recommend that a person's waist-to-height ratio should also be considered.

Zayn has a waist circumference of 81 cm and a height of 179 cm.

Calculate the waist-to-height ratio for Zayn.

Use the equation: waist-to-height ratio = $\frac{\text{waist circumference (cm)}}{\text{height (cm)}}$

Give your answer to 2 decimal places.

Waist-to-height ratio = [2]

This was a well-answered calculation question, with over three-quarters of candidates scoring 2 marks.

Question 7 (b) (iv) and (v)

- (iv) Table 7.3 shows how waist-to-height ratios can be categorised.

Table 7.3

Waist-to-height ratio	< 0.40	0.40 – 0.49	0.50 – 0.53	> 0.53
Category	Underweight	Ideal	Overweight	Obese

Amaya does very little exercise.

She has a BMI of 31.6 kg/m² and her waist-to-height ratio is 0.56.

Explain:

- why Amaya is at high risk of developing type 2 diabetes
- how she can reduce her risk.

Use Table 7.2 and Table 7.3 to help you.

.....

.....

.....

.....

.....

..... [3]

(v) Alex is thinking about his health. Here are some notes about Alex.

Waist-to-height ratio: 0.43

Body type: Very muscular.
Low levels of body fat.

Exercise: Running daily.
Regular muscle-building at the gym.

Alex finds out that his BMI is classed as obese.

He thinks he should lose weight to lower his risk of disease.

Explain why Alex is **not** correct.

Use **Table 7.3** and the notes on Alex to help you.

.....

.....

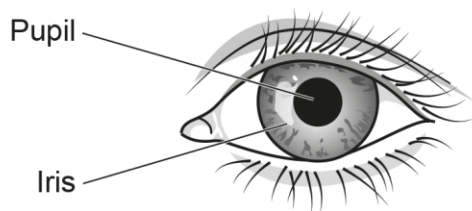
.....

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

Candidates provided good answers in response to the new context of waist-to-height ratio. They made good use of the data about Amaya and Alex to offer good explanations about their conditions.

Question 8 (a)

8 The pupil is part of the human eye.



A student investigates the effect of changing the light level on pupil diameter.

The student uses a lamp with adjustable brightness, measured in lumens.
The maximum brightness of the lamp is 1200 lumens (100%).

Table 8.1 shows the data the student records.

Table 8.1

Light level (%)	Light brightness (lumens)	Distance between lamp and eye (m)	Pupil diameter (mm)
80		1.5	4
40	480	1.5	6
20	240	1.5	8

(a) Complete **Table 8.2** to identify the variables in the investigation.

Put **one** tick (✓) in each row to show whether the variable is the **dependent variable**, the **independent variable** or **neither**.

Table 8.2

	Dependent variable	Independent variable	Neither
Distance between lamp and eye (m)			
Light brightness (lumens)			
Pupil diameter (mm)			

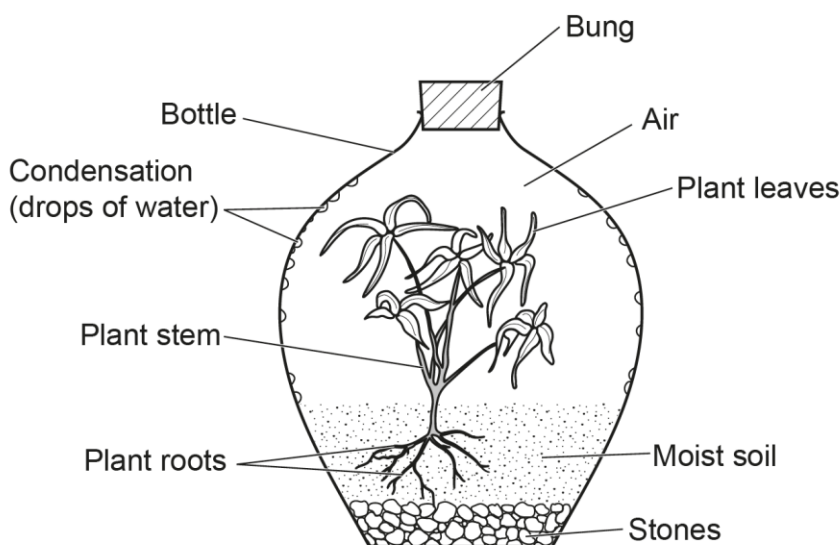
[2]

Candidates found this question challenging. Although over half of candidates were credited 1 mark for a partially correct table, relatively few managed to correctly identify all three variables for 2 marks.

Question 9 (a) and (b)

9 The diagram shows a living plant growing in a bottle garden.

The bottle garden is a small but complete ecosystem.



(a) Which part of the bottle garden ecosystem is **biotic**?

Tick (✓) **one** box.

Condensation

☐

Plant

☐

Soil water

☐

Stones

☐

[1]

(b) Explain why the air in the bottle is an **abiotic** part of the ecosystem.

.....

..... [1]

In part (a), around a half of candidates were credited the mark. Of those candidates who were not credited the mark, the incorrect answers of condensation, soil water and stones were all commonly chosen. In part (b), almost three-quarters of candidates were credited the mark. A range of various incorrect answers were seen, but noticeable subsets of candidates said that the air was abiotic because it was released from the plant or because it was trapped inside the bottle.

Misconception



It is a common misconception that air and oxygen are the same thing, or – similarly – that plants make and release air during photosynthesis.

Question 9 (c)

(c) The bottle allows light to pass through it.

Explain why this is essential for the plant to survive.

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

This question was well-answered, with well over half of candidates credited the mark. However, a noticeable subset of candidates appeared to be relying on knowledge from primary science as they stated that “plants need light to grow”. This question was common with the Higher Tier paper and candidates were required to be more specific and mention photosynthesis or the idea that the plant needs light to make food/glucose/carbohydrate.

Question 9 (d)*

(d)* A bung is used to seal the bottle closed.

The plant stays alive even though the bottle is kept sealed for years and no extra water is added.

Explain:

- why the plant needs water
- how the plant gets enough water even though the bottle is kept sealed.

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

This was a challenging 6-mark extended-writing question, common with the Higher Tier paper. It required candidates to combine their knowledge and understanding of photosynthesis (B3.1), transport in plants (B3.2), and the water cycle (B3.3.9 and B3.3.10) and apply this in the new context of a bottle garden. Many candidates recognised that plants need water for photosynthesis, but the other examples in the mark scheme of why plants need water were not often seen. A minority of candidates seemed to use the word “bung” to refer to the bottle, for example by stating that air was “trapped inside the bung” or “cannot leave the bung”.

Misconception



A noticeable number of candidates incorrectly described water as the plant's food. The incorrect idea that plants take in food from their surroundings, and that water, minerals, gases and even light are the plant's food, is one of the most commonly reported misconceptions in the school science education research literature. This misconception can be difficult to overcome, but it might be helpful to explicitly explore with candidates the specific meaning of the word "food" in science. "Food" is a very familiar word in everyday life, but in science the word "food" specifically refers only to something that a living organism uses as **both** a source of materials for growth & repair **and** a source of energy. That is why the glucose made by photosynthesis is food for the plant (it's used to build carbohydrates, lipids & proteins, **and** it's the fuel for cellular respiration which provides energy), but the water, minerals, gases and light taken in by the plant are not food (the water, minerals and gases are not sources of energy, and the light is not a source of materials for growth & repair).

Misconception



Many candidates incorrectly stated that when the bottle warmed up this caused water vapour to condense. The correct idea is that condensation occurs when the walls of the bottle are cooler than the air inside it, and water vapour (water in the gas state) inside the bottle changes state to a liquid on the cooler walls. Hence cooling, not heating, causes condensation. Some candidates also incorrectly stated that air or oxygen (rather than water vapour) condensed to form drops of water on the walls of the bottle.

Exemplar 2

- The plant needs water in order to photosynthesis which is what keeps the plant alive.
- The plant gets enough water because the soil is moist and the bottle is closed with a bung.
- When any water is lost through transpiration, the water cycle happens within the bottle meaning that after it evaporates it condenses and falls back into the soil which is then absorbed by the plant.
- The water cannot leave the bottle as it is closed shut.

[6]

This candidate scored Level 3, 5 marks. The candidate explains in detail how the plant gets enough water, including the idea of there being a water cycle inside the bottle. They also refer to the processes of transpiration, evaporation, condensation, runoff of condensed water into the soil, and absorption of water into the plant from the soil. However, the explanation of why the plant needs water is very limited, with only photosynthesis mentioned. Hence, even though the detail about water cycling was enough to score Level 3, more detail about why the plant needs water would be required for 6 marks.

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Question 4 (f); Micrograph of open stomata

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