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GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

J257

For first teaching in 2016

J257/02 Summer 2022 series

Version 1

ocr.org.uk/science

Contents

Introduction

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

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

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

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

Advance Information for Summer 2022 assessments

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

Paper 2 series overview

There are four examination components for GCSE (9-1) Twenty First Century Science Biology B. Papers 2 and 4 (Depth in Biology) provide candidates with the opportunity to demonstrate the depth of their knowledge and understanding in biology. These papers differ from Papers 1 and 3 (Breadth in Biology) in a number of ways, including that in the Depth papers:

- 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.

On the whole, candidates rose to the challenges of this Foundation Tier examination well, and candidates are to be commended for attempting most questions. The omit rate was low for most questions, except for the following where approximately one third of the candidates did not attempt the question:

- Question 4 (b) – in which candidates were required to apply their understanding of the roles of chloroplasts and mitochondria to explain how they help a plant cutting to grow.
- Question 4 (c) – in which candidates were required to apply their understanding of meristem cells to explain how they help a plant cutting to grow roots.
- Question 7 (b) – in which candidates had to apply their knowledge of reflex arcs to identify the other two neurons (in addition to the sensory neuron) in the pupil reflex arc.

Candidates seem to continue to prefer questions set in human and animal contexts to those set in plant contexts. Question 4, set in the context of a plant cutting, proved to be the least well answered and most frequently omitted question on the paper. Candidates performed better on the other plant-related question (Question 6), which focused on genetics (of the inheritance of flower colour) and the work of Gregor Mendel.

Candidates had been well prepared for most questions. It is particularly pleasing to note that the following questions were answered very well:

- Question 1 (a) – in which candidates were required to recall the name of the organ that pumps blood around the human body.
- Question 1 (d) – in which candidates were required to recall two gases that are exchanged between the air and the blood in the gaseous exchange system.
- Question 3 (d) (i) – in which candidates were required to analyse and interpret a table of data on antibiotic resistance.
- Question 3 (e) (i) – in which candidates were required to plot a bar on a bar chart using given data.

- Question 3 (f) (ii) – in which candidates were required to calculate the area of a circular bacterial culture.
- Question 5 (b) – in which candidates were required to recall that mutations create new genetic variants.
- Question 5 (c) (i) – in which candidates were required to apply their understanding of natural selection to correctly sequence statements explaining why a mutation became common in mosquitoes.
- Question 7 (d) (i) – in which candidates were required to analyse and interpret a line graph to read off a specific value.

The whole of Question 7 was common with the Higher Tier examination (J257/04).

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• Attempted every question, even when they were unsure about the answer. • Looked for ways to use their knowledge and understanding to answer questions asked in unfamiliar contexts. • Drew upon their experiences of practical work in their answers to the practical questions. • Showed their working for calculations, which often allowed marks to be given for correct working even when the final answer was incorrect.	• Did not attempt to answer questions where they were put off by an unfamiliar context. • Used up time and answer lines by copying out or re-writing the question before beginning their answer. • Did not read the wording of the question carefully enough (e.g. assumed that Question 6 (a) (i) and (ii) both referred to genotype, without realising that part (ii) had switched to phenotype). • Only considered one side of the story when answering a six-mark question that required them to consider more than one point of view (e.g. only discussed benefits in Question 5 (d) (ii) without discussing risks).

Question 1 (b)

(b) Draw lines to connect each type of blood **vessel** with its correct **description**.

Vessel	Description
Artery	Has a thick, muscular wall to hold high pressure blood
Capillary	Has a thin elastic wall that enables the vessel to be squashed
Vein	Has a very thin wall only one cell thick

[2]

The whole of Question 1 was a strong start to the paper for most candidates, allowing them to demonstrate their knowledge and understanding of the human circulatory system. This join-the-boxes question for part 1(b) was well answered, with almost 60% of candidates scoring 2 marks, and no discernible trend in the incorrect responses that would suggest a prevalent misconception.

Question 1 (c)

(c) State **two** nutrients that are absorbed into the blood in the digestive system.

1 .....

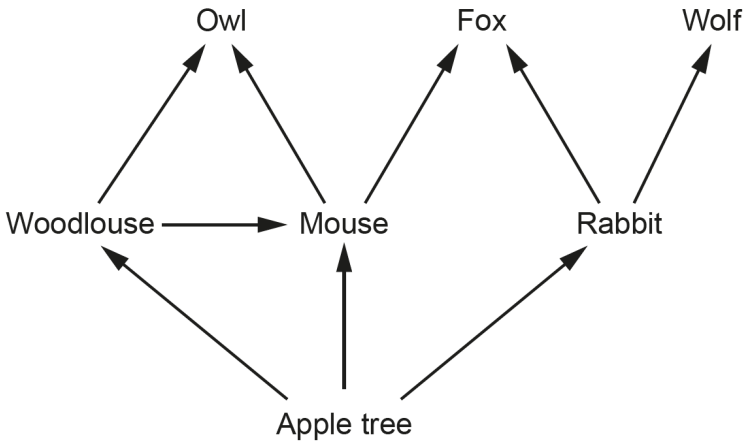
2 .....

[2]

This question was generally well answered, with all the allowable answers in the mark scheme commonly seen. Some candidates were only given 1 mark for effectively writing the same thing twice, probably without realising it; for example, some wrote "sugar" and then a named sugar such as glucose. References to things made by the body, such as blood cells, were also occasionally seen.

Question 2 (a)

2 The diagram shows a woodland food web.



(a) Complete the sentences to describe the organisms in the food web.
Use the phrases in the list.

a community	**a population**	**an ecosystem**	**an individual**

One rabbit is ..... .

All of the rabbits in the woodland are ..... .

All of the organisms in the woodland are ..... .

All of the organisms and their environment are ..... .

[4]

Most candidates scored well on this recall question. Where candidates did not score full marks, this was most commonly for putting "population" and "community" in the wrong order on the middle two answer lines.

Question 2 (b) and (c)

(b) State **one** example of an organism in the first trophic level of the woodland food web.

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

(c) State **one** example of a producer in the woodland food web.

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

Questions 2(b) and 2(c) both required the same answer of "apple tree", but tested understanding of different bits of terminology related to food webs. Candidates found Question 2(b) much more challenging than Question 2(c), suggesting that they are far more familiar with the term "producer" than the term "trophic level". In a noticeable number of cases there were multiple crossed out attempts in candidates' answers, suggesting that perhaps they were second guessing themselves.

Assessment for learning

It is possible for two different questions to have the same answer. Candidates should be encouraged to have the confidence to believe that their knowledge and understanding has led them to the correct answer, even if they are not accustomed to repeating answers in consecutive questions.

Question 2 (d)

(d) How many trophic levels does the longest food chain in the woodland food web have?

Number of trophic levels ..... **[1]**

Approximately 20% of candidates correctly deduced that the longest food chain (either "apple tree → woodlouse → mouse → owl" or "apple tree → woodlouse → mouse → fox") comprised 4 trophic levels. However, as with Q2(b), many candidates found the concept of trophic levels challenging. Many counted the number of horizontal lines of text in the diagram (3), while others counted the number of populations (7) or arrows (9).

Question 2 (e)

(e) State **one** example of an organism that is in more than one trophic level in the woodland food web.

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

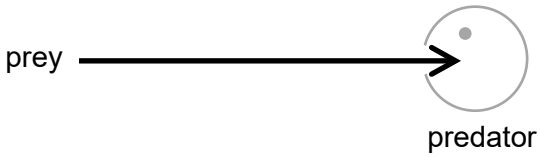
Approximately 40% of candidates correctly identified either the mouse, owl or fox as being in more than one trophic level (the second and third trophic levels in the case of the mouse, and the third and fourth trophic levels in the case of the owl and fox). However, as with Question 2(b) and Question 2(d), many candidates found the concept of trophic levels challenging. The most commonly seen incorrect answer was "woodlouse". The woodlouse is only in one trophic level (the second), because biomass is only transferred to it from the apple tree. However, woodlouse does have two arrows originating from it in the food web diagram, indicating that biomass is transferred from the woodlouse population to two other populations (mouse and owl); if candidates misinterpreted the arrows to mean "eats" (i.e. "woodlouse eats mouse and owl"), they may have mistakenly believed it was in more than one trophic level.

Misconception

Misinterpreting the arrows in a food chain or food web to mean "eats" is a common misconception.

Assessment for learning

It may be helpful for lower ability candidates to use the "Pac-Man predator" aide-mémoire to remind them that the arrows mean "is eaten by".



Higher ability candidates should appreciate that the arrows show the direction in which biomass is transferred through a food chain.

Question 3 (b)

(b) Leo has cardiovascular disease.

Explain why antibiotics will **not** help to cure Leo's cardiovascular disease.

.....

.....

.....

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

Almost 50% of candidates were able to score one or 2 marks on this question, which required candidates to bring together and apply their understanding of both cardiovascular disease and the use of antibiotics to treat diseases. Others included common misconceptions about antibiotics and what they are used for, which could have implications in their everyday lives.

Misconceptions

Some candidates incorrectly stated that antibiotics are used to treat viruses (perhaps using "virus" as an umbrella term for all communicable diseases, regardless of the type of pathogen causing it) or to treat headaches, or that they could only treat symptoms or reduce pain and discomfort (rather than cure a disease). A number of candidates focused on the reference to "disease" in the question and incorrectly stated that antibiotics "cannot cure diseases" (perhaps believing that the term "disease" only refers to non-communicable/lifestyle diseases), and that antibiotics could – in contrast – only cure "infections" (again, as with "virus", perhaps using "infection" as an umbrella term for all communicable diseases, regardless of the type of pathogen causing it).

Question 3 (c)

(c) Many bacteria have become resistant to antibiotics.

Suggest why the spread of antibiotic-resistant bacteria is dangerous.

.....

.....

.....

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

Most candidates did well on this synoptic question, which required them to bring together and apply their understanding from specification sections B6 and B2. In some cases, some of the same misconceptions as seen in responses to Question 3(b) about the use of antibiotics were also seen here.

Assessment for learning

Two specification statements (B2.6.1 and B6.1.9, respectively) require candidates to understand the use of antibiotics to treat disease and the issue of antibiotic resistance in bacteria. It's no exaggeration to say that the emergence and spread of antibiotic resistant bacteria is rapidly becoming an existential threat to our way of life, and that it will continue to be an important issue in candidates' personal lives long after they have left school. The misconceptions revealed by Questions 3(b) and 3(c) suggest that some candidates would benefit from exploring this issue further, not just to improve their performance in examinations but also so that they can make better decisions about healthcare for themselves and their families.

Question 3 (d) (ii)

(ii) Scientists can make changes to existing antibiotics. The scientists hope that it will take a long time for bacteria to develop resistance to the changed antibiotics.

Which antibiotic in **Table 3.1** is the best choice for scientists to make changes to?

Tick (✓) **one** box.

Antibiotic **A** ☐ **B** ☐ **C** ☐ **D** ☐

Give a reason for your choice.

Reason .....

.....

[2]

This question required candidates to analyse the table of data and apply their understanding to make a judgement (AO3.2a), and many were given with full marks.

Question 3 (e) (i)

(e) **Fig. 3.1** shows the number of infections (rounded to the nearest 100) with antibiotic-resistant bacteria in England over five years. The data for two of the years have **not** been plotted.

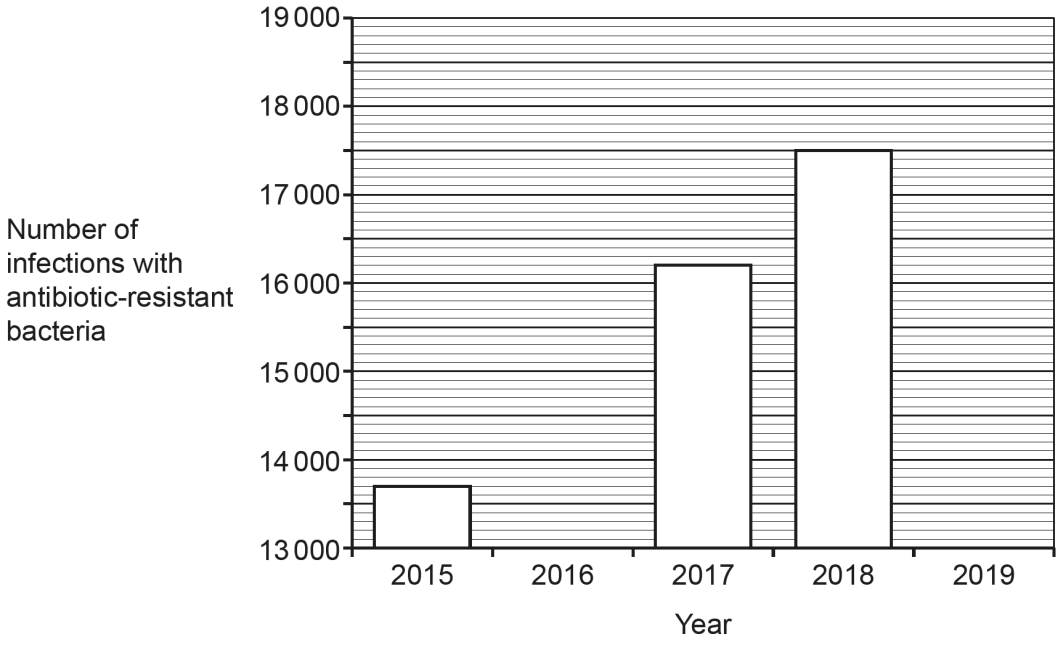


Fig. 3.1

Question 3 (e) (ii)

(ii) Four students predict what the number of infections with antibiotic-resistant bacteria might have been in 2019. Their predictions are shown in **Table 3.2**.

Student	Prediction for 2019
Alex	23 000
Amit	18 600
Ling	16 000
Taylor	17 500

Table 3.2

Which student's prediction do you think is most likely to be correct?

Explain your answer.

Student .....

Explanation .....

.....

.....

[3]

This question challenged candidate to demonstrate the higher-order thinking skills of analysing and interpreting data (AO3.1a) and applying their understanding to make a judgement (AO3.2a). The majority of candidates correctly identified that Amit's prediction was most likely to be correct. Few achieved all 3 marks, and many could have scored more highly by improving the clarity of their explanation and being more specific. For example, some simply stated that Amit's prediction was the most "realistic" without referring to any supporting evidence from the bar chart.

Exemplar 1

Student ....Amit.....

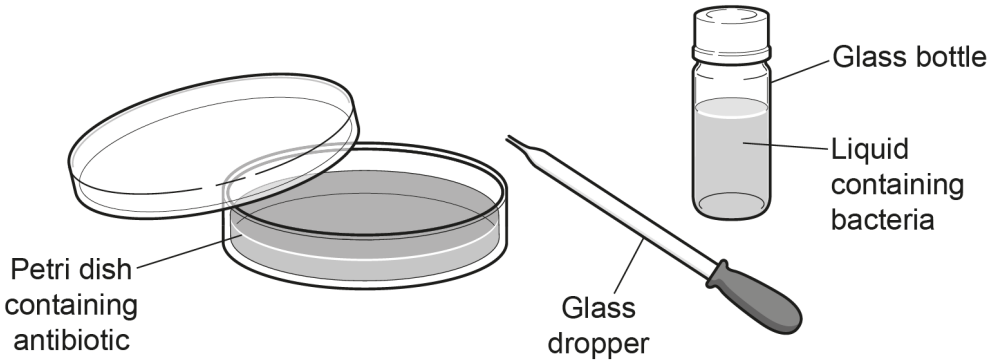
Explanation The increase each year is around 1100-1300 per year. Amits prediction corresponds with the data in the graph as the increase is by 1100.

[3]

This response was given full marks for correctly identifying that Amit's prediction was most likely to be correct and providing a detailed and specific explanation. The explanation in this response is well supported by evidence from the bar chart, including quantitative observations.

Question 3 (f) (i)

(f) Charlie investigates whether different antibiotics can affect the growth of a type of bacteria. The diagram shows the apparatus they use.



Charlie places a drop of liquid containing the bacteria in the centre of each of four Petri dishes. Each Petri dish already contains a different antibiotic.

The method Charlie uses is shown in **Fig. 3.2**.

1. Remove the lid from the Petri dish.
2. Remove the lid from the glass bottle containing bacteria.
3. Wipe the glass dropper with tissue to clean it.
4. Use the glass dropper to transfer a drop of liquid containing bacteria from the bottle to the centre of the Petri dish.

Fig. 3.2

(i) Describe **four** ways to improve Charlie's method to include aseptic techniques.

.....

.....

.....

.....

.....

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

Responses to this practical question suggested that most candidates had experience of this kind of practical procedure and the use of aseptic techniques. Many candidates were able to give one or two correct examples of aseptic techniques, such as working next to a lit Bunsen burner to create an updraft and using appropriate methods to sterilise apparatus. Some candidates would have been given more marks if they had used scientific language such as 'sterilise' or 'disinfect' rather than imprecise everyday terms such as 'clean', 'wash' and 'wipe'.

Assessment for learning

The words 'wash' (as in "wash hands before starting") and 'clean' (as in "clean the glass dropper") were not sufficient. When learning about aseptic techniques and about the spread of diseases, candidates should come to understand the difference between the everyday concept of 'clean' and the scientific concepts of 'aseptic' and 'sterile'; things such as apparatus, surfaces and hands can all be washed and/or appear to be clean but still be contaminated with pathogens.

Question 3 (f) (ii)

(ii) Charlie uses proper aseptic techniques to add a drop of liquid containing the bacteria to the centre of each Petri dish.

Fig. 3.3 shows the Petri dishes after they were incubated for 24 hours.

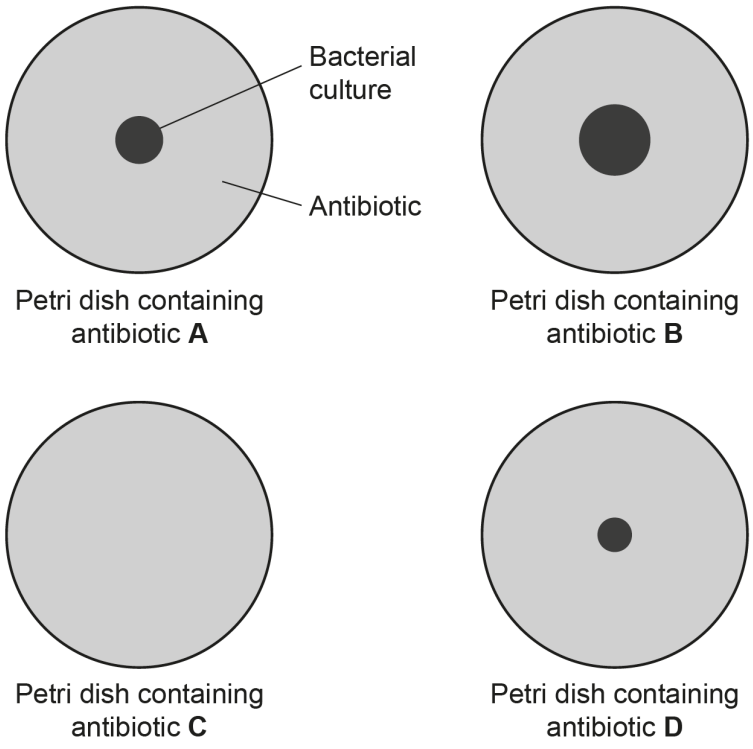


Fig. 3.3

Question 3 (f) (iii)

(iii) Charlie concludes that the bacteria are resistant to all of the antibiotics **except** antibiotic **C**.

Describe the evidence in **Fig. 3.3** that supports Charlie's conclusion.

.....

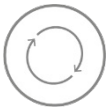
.....

.....

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

Most candidates ably described the evidence in the diagram that showed the bacteria were not resistant to antibiotic C. Fewer described the evidence that the bacteria were resistant to all the other antibiotics, which was also worthy of marks.

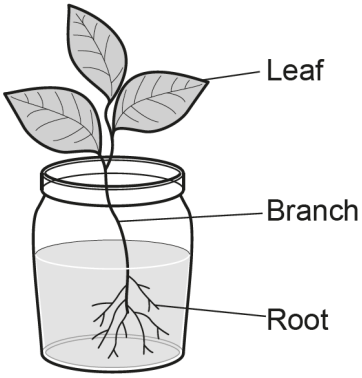
Assessment for learning



Identifying and describing evidence on both sides of an argument is good examination technique, and candidates should appreciate that this can help them gain marks.

Question 4 (a)

4 A cutting is taken from a leafy branch of a plant. When the cutting is placed in water, roots begin to grow from the branch.



(a) The cutting takes in substances from its surroundings to stay alive.

Complete the table to describe the substances taken into the cutting and what they are used for.

Substance	Part of the cutting that takes in the substance from the surroundings	What the substance is used for
Carbon dioxide	.....	Photosynthesis
Oxygen	Leaf stomata	.....
.....	Root hair cells	Photosynthesis
Mineral ions	.....	Making proteins and other biological molecules

[4]

In this succinct but challenging recall question, many candidates were given 1, 2 or 3 marks in the first two columns. The correct answer of respiration in the final column was less commonly seen and was a sign of a good candidate – many either omitted this column or wrote "photosynthesis". Many candidates were given marks for writing "leaf" and "root" in the middle column, although far fewer wrote "leaf stomata" and "root hair cells" despite these terms being modelled in the middle two rows.

Question 4 (b)

(b) The cells that make up the cutting's leaves contain chloroplasts and mitochondria.

Explain how chloroplasts **and** mitochondria enable the cutting to grow.

Chloroplasts .....

.....

.....

Mitochondria .....

.....

.....

[4]

This question had one of the highest omit rates on the paper, and most candidates scored few if any marks here. Where candidates were given marks, these were most commonly for their response to the chloroplasts part of the question.

Assessment for learning

In their responses to the mitochondria part of the question, candidates commonly used the phrase "the powerhouse of the cell" to explain their function. While this phrase may be commonly used and a useful explanatory tool during teaching, it was not worthy of marks here. Candidates need to be able to explain that mitochondria are essential for aerobic respiration (in plants, animals and other eukaryotic organisms), which produces the ATP that provides energy for life processes.

Question 4 (c)

(c) Although the cutting had no roots at first, it could grow new roots because it has meristem cells.

Explain what the meristem cells did to make roots.

.....

.....

.....

.....

.....

.....

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

As with Question 4(b), this question had one of the highest omit rates on the paper and most candidates scored few if any marks here. The most common incorrect answer was that meristem cells absorb nutrients and water from the surroundings and supply them to the rest of the plant.

Question 5 (a)

5 Malaria is a disease that can be deadly. Around the world, there are hundreds of millions of cases of malaria every year.

The pathogen that causes malaria is spread by mosquitoes.

(a) Which type of pathogen causes malaria?

Put a (ring) around the correct answer.

Bacterium **Fungus** **Protist** **Virus**

[1]

The most able candidates answered this question well, but most others seemed unsure of the type of pathogen that causes malaria, with rings commonly seen around all three of the other options. There was no discernible trend in the incorrect responses that would suggest a prevalent misconception.

Question 5 (c) (i)

(c) The mutation that causes insecticide resistance is now very common in the mosquito population.

Statements **A**, **B**, **C** and **D** can be used to explain why the mutation has become so common. The statements are **not** in the correct order.

A	Insecticide was used in some places where the mosquitoes lived.
B	More mosquitoes in the next generation inherited the mutation.
C	Mosquitoes with the mutation were not killed.
D	These mosquitoes were able to produce more offspring.

Question 5 (c) (ii)

(ii) What is the name of the process described by statements **A**, **B**, **C** and **D**?

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

The correct answer of natural selection was not often seen, although candidates who wrote evolution were given marks. The most common answer was mutation, and selective breeding was also relatively common, both of which were not correct.

Question 5 (d) (i)

(d) Scientists have genetically engineered a fungus to allow it to make a protein that is usually only made by spiders.

(i) Describe what is meant by a 'genetically engineered fungus'.

.....

.....

.....

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

Candidates found this question challenging, with only around 25% scoring 1 mark and very few scoring 2. Many responses went only slightly beyond the wording used in the question itself by suggesting that the fungus had been genetically "modified" (a term candidates have perhaps heard in everyday life). Very few included the idea that the DNA of the fungus had been changed or that DNA had been added. As with Question 5(c)(ii), some references to selective breeding were seen here, suggesting that there is some confusion among candidates between the processes of natural selection, selective breeding and genetic engineering.

Question 5 (d) (ii)*

(ii)* The spider protein made by the genetically engineered fungus can kill mosquitoes. Scientists could release the fungus in areas where malaria is common.

Explain the possible benefits **and** risks of releasing the fungus.

.....

.....

.....

.....

.....

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

Candidates are to be commended for their willingness to engage with this extended-writing question assessing application of knowledge and understanding in an unfamiliar context (AO2.1). Most were able to suggest one or several benefits and risks, although the mark given for some responses was limited because they presented a one-sided answer that only considered either benefits or risks.

Exemplar 2

benefits

- can lower cases of malaria
- can reduce the chance of people dying
-

risks

- could cause other diseases
- may not kill all mosquitos
- mosquitos may become resistant to the protein **[6]**

As illustrated by this response, concise answers can score highly provided they are clear, well structured, relevant and balanced. This response was given 5 marks and could only have been improved by further discussion of risks (such as the risk of disrupting food chains).

Question 6 (a) (i) and (ii)

6 In the 19th century, Gregor Mendel did experiments to investigate the inheritance of flower colour in pea plants.

(a) In his first experiment, Mendel bred two 'parent' plants.

He recorded the flower colour of the 'parent' plants and their offspring in the 'first generation', as shown in **Table 6.1**.

	Flower colour
'Parent' plant 1	The plant had red flowers
'Parent' plant 2	The plant had white flowers
'First generation' plants	All the plants had red flowers

Table 6.1

Scientists have now worked out which alleles the plants in this experiment had, as shown in **Fig. 6.1**.

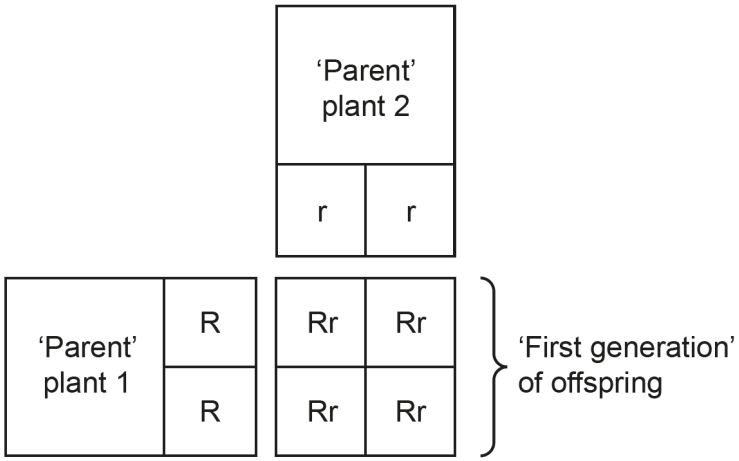


Fig. 6.1

(i) State the genotype of 'parent' plant 1.

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

(ii) Describe the phenotype of 'parent' plant 2.

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

Many candidates either didn't notice the change from 'genotype' to 'phenotype' in part (b), or didn't appreciate the difference, as they wrote either genotypes or phenotypes for both parts. For example, many wrote "RR" for part (a) and "rr" for part (b), or wrote "red flowers" for part (a) and "white flowers" for part (b). It was also common for candidates to write just "dominant" for the genotype in part (a), which was ambiguous and therefore insufficient; to be given a mark, it was necessary to specify either "RR" or "homozygous dominant".

Question 6 (a) (iii)

(iii) What is the probability that a plant in the 'first generation' will have red flowers?

Put a (ring) around the correct answer.

0.25 **0.5** **1** **4**

[1]

The most able candidates answered this question well, but most others seemed unsure about how to either calculate or express the probability, with the incorrect answer 4 being a strong distractor (and being the answer one would get by simply counting the number of offspring with a dominant R allele in the provided Punnett square).

Question 6 (a) (iv)

(iv) What can you conclude about the **R** and **r** alleles?

Use the information in **Table 6.1** and **Fig. 6.1** to help you.

R allele .....

r allele .....

[2]

Almost half of candidates achieved 2 marks on this question, but many others referred to the alleles as "stronger" and "weaker" instead of "dominant" and "recessive". In addition, some candidates incorrectly referred to the **r** allele as "less dominant" rather than "recessive".

Question 6 (b) (i)

(b) In his next experiment, Mendel bred plants from the 'first generation'. This created a 'second generation' of offspring.

The alleles of the plants are shown in **Fig. 6.2**.

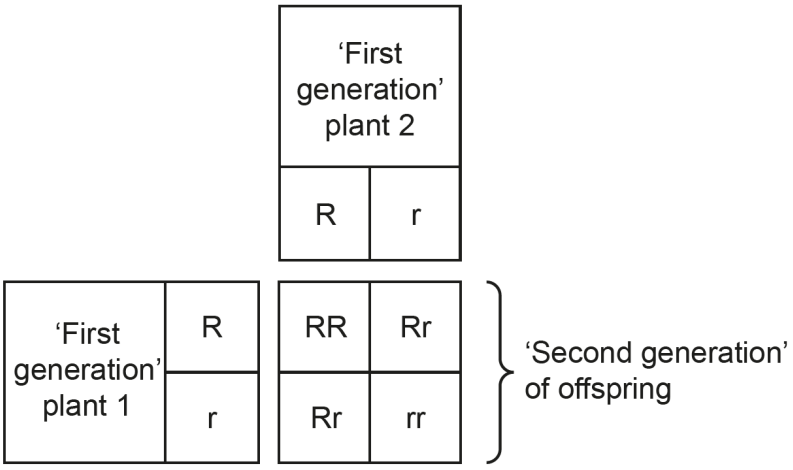


Fig. 6.2

(i) Describe the flower colours Mendel would have observed in the 'second generation' of offspring.

Flower colour of plants with alleles **RR** .....

Flower colour of plants with alleles **Rr** .....

Flower colour of plants with alleles **rr** .....

[1]

Many candidates answered this well. Most identified the correct flower colours for **RR** and **rr**, with the mark most commonly not given because of an incorrect response for **Rr**.

Misconception

The most common misconception was that the genotype **Rr** would produce a mixture of the two flower colours, with some candidates referring to "a mix of red and white", "50:50", or even "pink".

Question 6 (b) (ii) and (iii)

(ii) Calculate the percentage of plants in the 'second generation' that have the alleles **Rr**.

Percentage = ... % **[2]**

(iii) What can you conclude about the ratio of red flowered plants to white flowered plants in the 'second generation'?

Ratio of red flowered plants to white flowered plants = ... : ..... **[1]**

Candidates answered both of these numerical questions well, apparently well prepared to calculate percentages and ratios from a given Punnett square.

Question 7 (a)

7 The pupil of the human eye changes size in different light levels.

(a) A diagram of the eye is shown in **Fig. 7.1**.

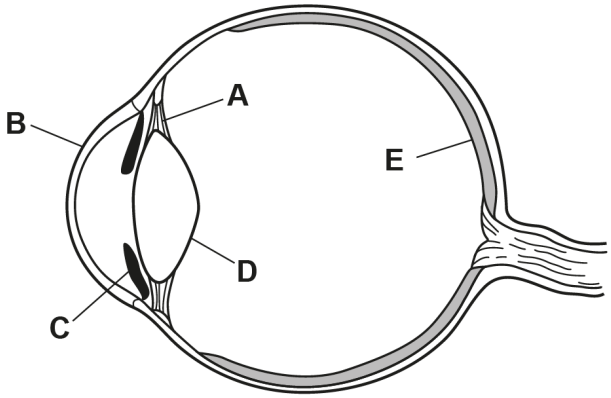


Fig. 7.1

Which structure in the eye changes the size of the pupil?

Tick (✓) **one** box.

A	Ciliary muscles	
B	Cornea	
C	Iris	
D	Lens	
E	Retina	

[1]

Candidates appeared to find this tick-box recall question challenging, even though 40% selected the correct answer of iris. Ciliary muscles proved to be a strong distracter, with ticks often seen in all the other boxes as well.

Question 7 (b)

(b) The pupil changing size is a reflex action that happens in response to light. It uses a reflex arc in the nervous system.

The pupil reflex arc includes a sensory neuron that connects the eye to the spinal cord.

State **two other** types of neurons that must be part of the pupil reflex arc.

1 .....

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

This proved to be a challenging question for candidates, requiring them to apply their knowledge of the neurons that make up a reflex arc to the context of the pupil reflex. Almost a third of candidates did not attempt the question. Of those who did, many referred to parts of the eye (perhaps drawing upon the list of parts provided in part (a)). Some rewrote sensory as one of the two neurons, despite this having been given in the question. Where marks were given, this was most commonly for the motor neuron; fewer candidates included the relay neuron.

Question 7 (c) (i) and (ii)

(c) Ali plans to investigate the effect of light brightness on the diameter of the pupil of a person's eye.

The method Ali plans to use is shown in **Fig. 7.2**.

1. Shine a bright light into the person's eye.
2. Hold a ruler up to their eye and measure the diameter of the pupil.
3. Repeat with light at a different brightness.

Fig. 7.2

Ali's teacher says that Ali's method is not safe and could damage the person's eye.

(i) Identify the structure in the person's eye that could be damaged by step **1**, and suggest why the damage would affect the person's vision.

Structure that could be damaged .....

Why this would affect the person's vision .....

.....

.....

[2]

(ii) Identify the structure in the person's eye that could be damaged by step **2**, and suggest why the damage would affect the person's vision.

Structure that could be damaged .....

Why this would affect the person's vision .....

.....

.....

[2]

Questions 7 (c) (i) and (ii) required application of knowledge and understanding of the structures of the eye and their functions to suggest how unsafe practical procedures could affect vision and proved challenging for candidates. Where marks were given for part (i), it was most commonly 1 mark for the idea that bright light could cause the person to go blind, although few candidates identified the retina (or the cells that make up the retina) as the structure(s) that would be damaged. In part (ii), many candidates referred to poking, scratching or damaging parts of the eye without explaining how or why this would affect the vision.

Question 7 (d) (ii)

(ii) What would you conclude is the smallest possible diameter of the person's pupil?

Explain your answer.

Smallest possible diameter = ... mm

Explanation .....

.....

[2]

This question required candidates to interpret the provided graph and draw a conclusion from it and was well answered. Many candidates correctly identified 3 mm as the smallest possible diameter, and most (but not all) of those were able to provide a good explanation for their chosen diameter by referring to the data on the graph.

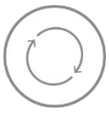
Question 7 (d) (iii)

(iii) Calculate the rate at which the pupil diameter changed between 25% and 50% light brightness.

Rate = ... mm / % **[2]**

A very challenging mathematical question for Foundation Tier candidates, but they are to be commended for their willingness to attempt it. Very few worked out the correct rate, but just over a third of candidates were given 1 mark for their working or for the partial answer of 0.1.

Assessment for learning



Although candidates are no longer instructed to show their working, space is provided for it and it is good examination technique to make use of it, as marks can often be given for correct working even if the final answer is not correct.

Question 7 (e)*

(e)* Describe a method that can be used to collect the data shown in **Fig. 7.3**.
Assume that 100% light brightness is a normally lit room.

In your answer you should describe:

- how you would safely change the light brightness and measure the results
- things you would do or control to make sure the measurements are as accurate as possible.

.....

.....

.....

.....

.....

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

This extended-writing question tested candidates' ability to apply their knowledge and understanding of practical work to describe a safe procedure that would generate accurate results in the context of measuring pupil diameter (AO2.2 and AO3.3a). Candidates are to be commended for their willingness to engage with this challenging question, only a small proportion of candidates described all three required aspects, namely how they would change the light brightness, how they would measure the diameter of the pupil, and steps they would take to increase accuracy (or safety). Overall, candidates more commonly described how they would change the light brightness (although not always in sufficient detail) than how they would measure the pupil diameter. Of those who did describe how they would measure the pupil diameter, some suggested taking and measuring pictures, although others described using a ruler held up to the eye despite this having been identified as unsafe earlier in the question. Many also gained marks for references to blocking out natural light, not using a camera flash, or repeating measurements as ways of increasing the accuracy of the results.

Exemplar 3

I would change the light brightness by a little from complete darkness to normal light just to get accurate results while also keeping the person safe.
Id also use a ruler but stay a bit away from the eye to prevent any further damage I could possibly cause to that person.

In this response, it is stated that the light brightness would be changed (an idea already given in the question) but no description of how it would be changed, so that part of the response was not given marks. The idea of using a ruler to measure the pupil diameter was not, in itself, sufficient for marks; but in this case there is also a reference to safe working (staying away from the eye to prevent any damage to it). Because only one aspect (safety) is described, this response was limited to Level 1 and was given 1 mark.

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