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OCR
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GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY BIOLOGY B

J257
For first teaching in 2016

J257/02 Summer 2018 series

Version 1

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. 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 can be downloaded from OCR.

Paper J257/02 series overview

There are four exam papers for the new GCSE (9-1) Twenty First Century Science Biology B. Papers 2 and 4 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:

- 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 slightly greater emphasis on application of knowledge (assessment objective 2) and analysis (assessment objective 3) in novel contexts.
- More marks are credited for knowledge and understanding of practical work.

This series' papers were the first examinations for the new GCSE (9-1) specification. There is a change from modular to linear assessment, and the examinations assess knowledge from across the specification including some synoptic questions.

To do well on Paper 2, candidates needed to demonstrate their understanding of ideas from across the whole specification, including *Ideas about Science*. They also needed to be able to apply their understanding in context.

On the whole, candidates rose to the challenges of the new-style examinations well. Questions omit rates were generally low for this Foundation Tier examination paper. Candidates are to be commended for attempting most questions. The highest omit rates were for questions 3 (c), 3 (d) (iv), 5 (a), 5 (b) (ii) and 5 (b) (iii), with approximately one fifth of the candidates omitting these questions.

The whole of question 5 was common with the Higher Tier examination paper (J257/04).

Candidate performance overview

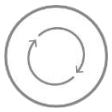
Candidates who did well on this paper typically:

- Attempted every question, even when they were unsure about the context or the answer.
- Looked for ways to apply what they knew to demonstrate their understanding, rather than being put off by unfamiliar contexts.
- Demonstrated knowledge and understanding in their answers to the practical questions, drawing on their hands-on experiences of practical work in lessons.
- Showed their working for calculations, which sometimes allowed marks to be given for correct working even when the final answer was incorrect.
- Showed the ability to link ideas from different parts of the specification to answer synoptic questions [e.g. 2 (b), 3 (c), 5 (b) (ii) and 5 (b) (iii)].

Candidates who did less well on this paper typically:

- Omitted a large number of questions, perhaps intimidated by unfamiliar contexts, rather than giving it a go.
- Did not show their working for calculations.
- Did not give their answers to the required number of significant figures [e.g. for 3 (b) (ii)].
- Did not include data from tables or graphs to support their answers when required [e.g. for 1 (c) (vii)], or did not make clear which specific parts of the data they were referring to [e.g. in 3 (b) (iii)].
- Used up time and answer lines by copying out or re-writing the question before beginning their answer.

Key:



AfL Some guidance to offer for future teaching and learning practice

Misconception

Question 1 (a)

1 Diabetes and cardiovascular disease are common diseases in the UK.

(a) There are two different types of diabetes.

Put **one** tick (✓) in each row of the table to show whether the statement applies to **both types of diabetes**, **only type 1 diabetes**, or **only type 2 diabetes**.

Statement	Both types of diabetes	Only type 1 diabetes	Only type 2 diabetes
The person cannot control their blood sugar level.			
The body stops responding to the insulin it makes.			
The disease can be treated using injections of insulin.			
In the future, the disease could be treated using stem cells to replace insulin-secreting cells in the pancreas.			

[4]

Most candidates scored 1 or 2 marks here, but only approximately 5% of candidates were able to score full marks. This question assesses the depth of candidates' understanding of ideas about type 1 and type 2 diabetes and how they can be treated (B5.6.3), as well as the potential use of stem cells to treat diabetes (B4.5.1).

Question 1 (b)

(b) Ben is a middle-aged man with type 2 diabetes.

He is worried because he has heard that having type 2 diabetes will mean he also gets cardiovascular disease.

What advice would you give to Ben?

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

This question gave candidates the opportunity to demonstrate their knowledge of risk factors for cardiovascular disease (CVD). Many good responses focussed on aspects of lifestyle that would affect the risk of CVD. High-scoring responses were specific about lifestyle changes that would reduce the risk of CVD (e.g. reduce salt/fat in the diet, stop smoking, exercise more), while responses that relied on vague, catch-all advice (e.g. stay healthy, eat healthily, go on a diet) were not credited marks. The idea that having type 2 diabetes increases the risk of CVD but does not make it certain, was rarely seen.

Question 1 (c) (i)

(c) A class of students is learning about cardiovascular disease.

They do a practical activity to investigate the levels of fitness of people in the class.

The students work in pairs to measure each other's resting pulse rate.

(i) They start by sitting quietly for five minutes.

Explain why they do this.

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

Most candidates showed understanding that exercise/moving/activity/stress would increase the pulse rate, and that sitting quietly before measuring it would give a more accurate value for the resting pulse rate (though few used the term 'accurate'). Some responses needed to be more specific and less ambiguous – they referred only to these factors as 'changing' or 'affecting' the pulse rate rather than increasing it.

Question 1 (c) (ii)

(ii) Describe how a student could measure the resting pulse rate of their partner.

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

This question was generally well answered. Most candidates had clearly performed this procedure themselves by pressing fingers to a pulse point and counting beats per minute, and could explain well how data would be collected and processed. Others scored one mark for referring to the use of a digital heart monitor, but did not elaborate and did not seem to appreciate that more detail would be required for a 3mark question.

Question 1 (c) (iii)

(iii) The method that the students are working from says they should repeat the resting pulse rate measurement until they have enough data to calculate an average.

There are three types of average: **mean**, **median** or **mode**.

Suggest which type of average the students should calculate.

Put a (ring) around the correct answer.

Mean **Median** **Mode** **[1]**

Question 1 (c) (iv)

(iv) Suggest why it is a good idea to calculate the average selected in **(c)(iii)**.

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

Many candidates correctly picked mean for 1 (c) (iii), but were unable to suggest in 1 (c) (iv) why it is useful to calculate the mean. Some candidates correctly used the idea that it is the best estimate, but few used the term 'accurate' (IaS2.9) and many simply explained how the mean would be calculated (by adding up the measurements and dividing by how many there are).

Question 1 (c) (v)

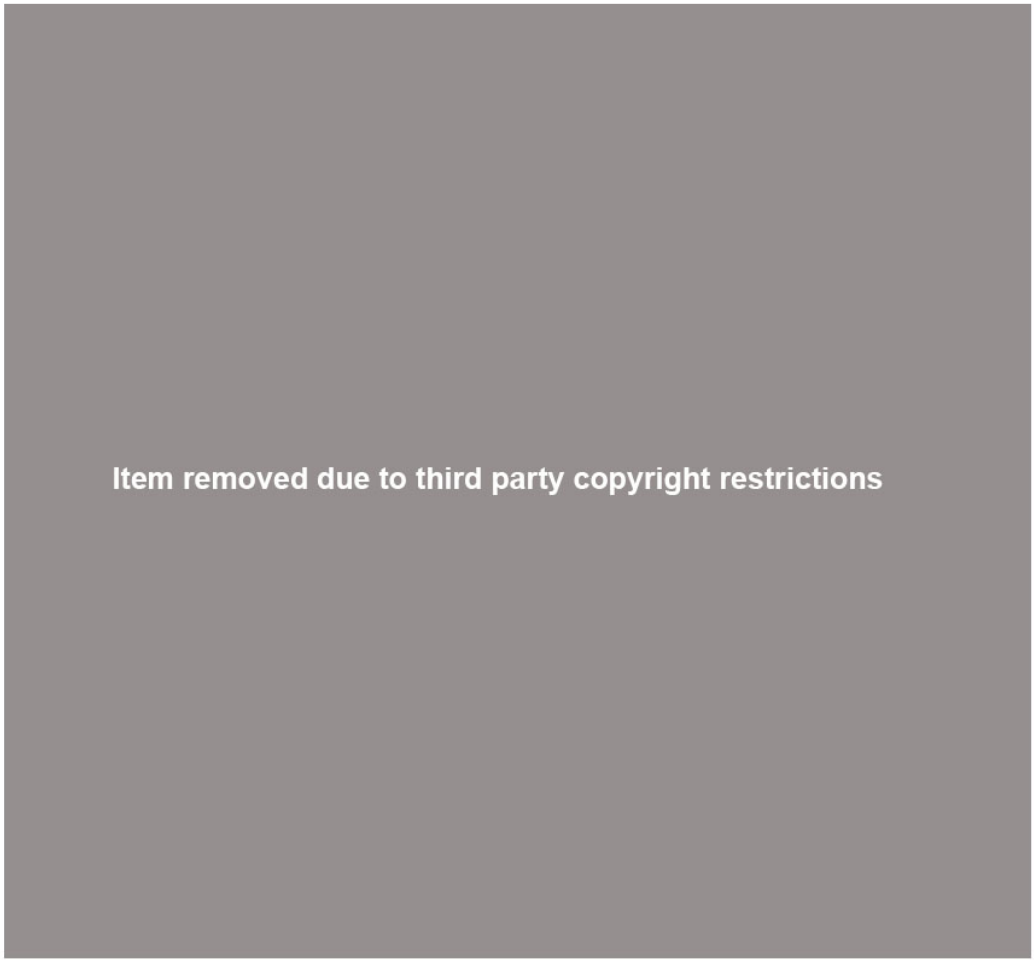
Each student then exercises for 3 minutes by stepping up and down on a bench.

After 3 minutes, the student sits down and their partner immediately measures their pulse rate.

Their partner measures the student's pulse again 1 minute and 2 minutes after exercise.

The resting and other pulse rates are used to calculate a 'fitness index score'.

A person's fitness index score gives an estimate of their level of fitness.



Use the table and the graph to help you answer these questions.

(v) How many of the students in the class have a fitness index score of 79 or lower?

Number of students = ... **[1]**

Question 1 (c) (vi)

(vi) One of the students in the class has a fitness index score of 80.

How does their level of fitness compare to that of their classmates?

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

Question 1 (c) (vii)

(vii) Some of the students in the class have suggested that the school should organise regular lunchtime exercise sessions.

Do you agree with their suggestion?

Explain your answer and include supporting evidence from the class data.

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.....

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

A good number of candidates were able to interpret the two data sources (table and graph) to score marks on 1 (c) (v). Higher ability candidates also scored on parts (vi) and (vii), but many candidates would have gained more marks by quoting data from the table/graph to support their answer or by being clearer about which parts of the data they were referring to.

Exemplar 1

I agree with this suggestion because too many people have poor or very poor fitness levels. There

This response needed to quote a number from the data to score a mark. The phrase "too many people" is not specific enough.

Exemplar 2

lunchtime exercise sessions could be beneficial for the school to keep NBOD their students fit and healthy

[3]

This candidate needed to be more precise in their use of language to score a mark. The phrase "keep their students fit" does not imply that fitness would improve or that any students would move up through the categories – merely that current levels would be maintained.

Question 2 (a)

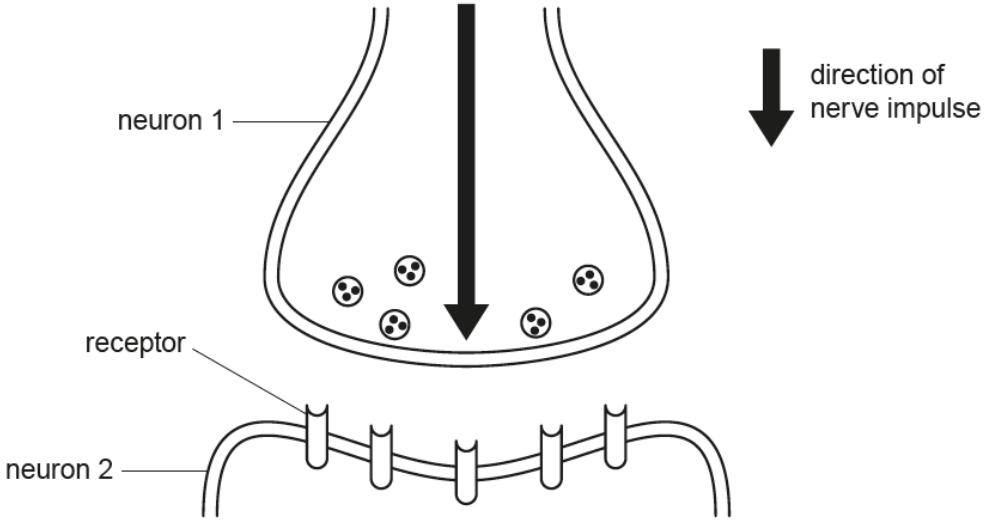
2 Insecticides called neonics are widely used by farmers.

Neonics kill insect pests that live on crop plants.

(a) Neonics block receptors in synapses in the nervous system of an insect.

This stops the transmission of a nerve impulse across the synapse.

The diagram shows these receptors in a synapse.



Explain how neonics blocking receptors in a synapse stops the transmission of a nerve impulse across the synapse.

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

Two of the three marks in this question were credited for direct recall (from specification statement B5.2.2) of how a nerve impulse is transmitted across a synapse by transmitter substances. However, this question proved to be very challenging for candidates, and very few correct answers were seen.

Misconception The most common misunderstanding in candidates' responses was that an electrical impulse (rather than chemical transmitter substances) travels across the gap from neuron 1 to neuron 2. Another misunderstanding that was seen occasionally was that the ends of the two neurons move and join, closing the gap, to transmit the nerve impulse.

Question 2 (b)

(b) Explain why a farmer would want to use neonics to kill insects that live on their crops.

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

Higher ability candidates were able to answer this synoptic question well, by linking ideas about insects spreading plant diseases (B2.1.3) and the effects pests and pathogens can have on food security (B6.4.3).

Question 2 (c) (i)

(c) One farmer grows a crop called oilseed rape.

Honey bees feed on the oilseed rape, as shown in the food chain in **Fig. 2.1**.

The measurements below the food chain show the amount of biomass in each trophic level.

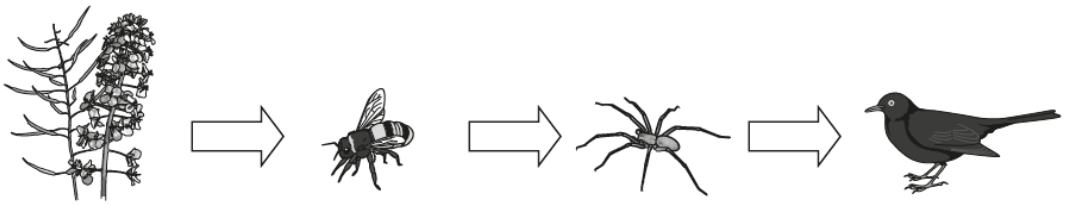

Fig. 2.1

(i) A food chain is one way of showing the feeding relationships in this ecosystem. A pyramid of biomass is another way.

Complete the pyramid of biomass for this ecosystem.

Species		Biomass (g/m^2)
birds		40
spiders		550
.....		.....
oilseed rape		8000

[2]

Many candidates scored a mark for correctly labelling the left and right sides of the diagram. Far fewer candidates were able to draw a bar of appropriate length to complete the pyramid of biomass, and many did not attempt to draw a bar at all.

Question 2 (d)

(d) Research studies have suggested that use of neonics on crops can cause honey bee populations to decrease.

Other studies have linked neonics to decreases in bird populations.

Question 2 (d) (ii)

(ii) Write down **two** ways in which use of neonics could have caused a decrease in the numbers of birds.

1 .....

.....

2 .....

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

A good number of candidates were able to use the food chain provided in the question to work out that if neonics were killing bees there would be less food for spiders, and that this would lead to a decrease in the spider population and therefore there would be less food for birds. Few candidates suggested that neonics could be passed along the food chain, and it was rare to see 2 marks here.

Question 2 (d) (iii)

(iii) Do you support the continued use of neonics on flowering crops?

Justify your answer.

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

No marks were credited for saying yes or no in answer to this question – all of the marks were for the justification. More than 50% of candidates were able to score 1 mark, but many did not go beyond one reason in support of their answer. Less than one third of candidates scored 2 marks, and very few scored 3. Some responses switched between reasons in support of yes and no without making it explicit which side of the argument they were supposed to be supporting, which made it more difficult to award marks.

Question 3 (a)

3 Amir works in a laboratory. His job is to identify the pathogens that cause plant diseases.

(a) Different types of pathogens cause different diseases in plants.

Draw lines to join each **type of pathogen** with the correct **disease** it causes.

Type of pathogen	Disease
Bacterium	Ash dieback
Fungus	Tobacco mosaic
Virus	Crown gall

[2]

Plant pathogens and plant disease are new to the specification this year, so it was pleasing to see almost half of candidates scoring 1 mark here, and a quarter of candidates scoring 2 marks.

Question 3 (b) (i)

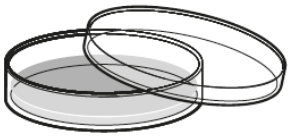
(b) Amir has a sample of bacteria from an infected plant.

He wants to test the effectiveness of different antibiotics against the bacteria.

Amir writes a method for transferring bacteria from the sample onto a Petri dish.

glass bottle containing the sample of bacteria

wire loop



Petri dish containing agar jelly

Method:

1. Pick up the wire loop from the bench.
2. Open the glass bottle containing the sample of bacteria.
3. Dip the loop in the sample of bacteria
4. Take the lid off the Petri dish.
5. Wipe the loop over the agar jelly in the Petri dish to spread bacteria.
6. Put the lid back on the Petri dish.

(i) Suggest **three** improvements Amir could make to his method to reduce the risk of contaminating the Petri dish with unwanted bacteria.

1 .....

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2 .....

.....

3 .....

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

Responses to this question suggested that most candidates were familiar with this kind of practical procedure, most likely through having done it themselves in a hands-on practical activity. Many candidates were able to give two or three correct examples of aseptic techniques. Some candidates needed to use scientific language such as 'disinfect' or 'sterilise' to score marks, rather than imprecise and everyday terms such as 'wipe', 'wash' and 'clean'.

AfL

The word 'clean' (as in "clean the wire loop") was not sufficient to score a mark. When learning about aseptic techniques and about the spread of diseases, there is an important distinction to make between 'clean' and 'sterile', because apparatus, surfaces, water, food, cooking utensils and hands can all look clean but be contaminated with pathogens, as most pathogens are too small to see.

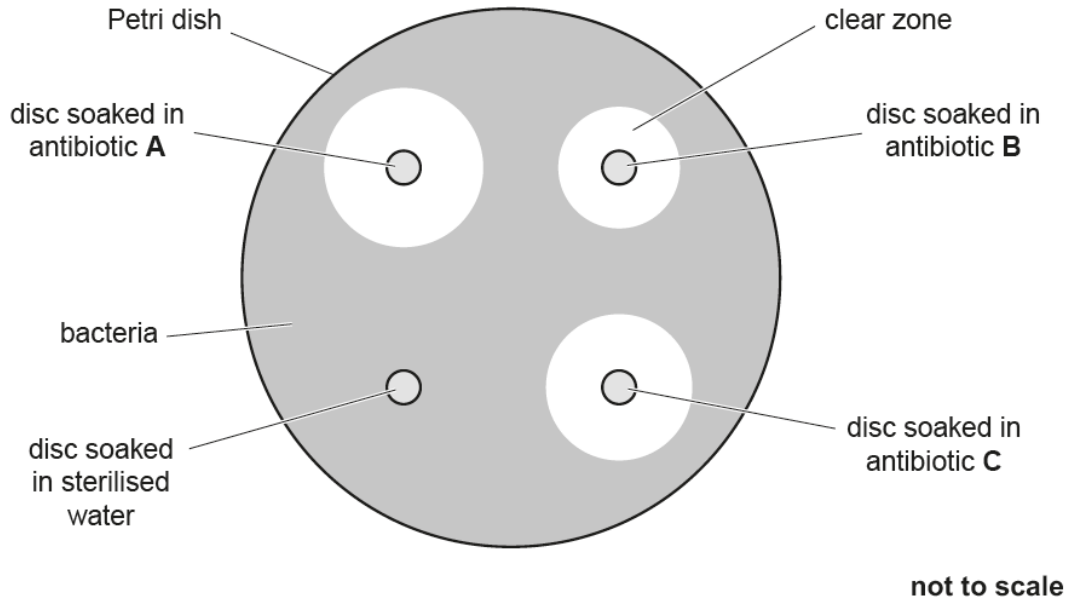
Question 3 (b) (ii)

After transferring bacteria from the sample onto a Petri dish, Amir adds four different paper discs to the agar.

Three of the discs have been soaked in solutions of different antibiotics, **A**, **B** and **C**. One disc has been soaked in sterilised water.

Amir places the dish in an incubator overnight. The bacteria grow to cover the surface of the agar jelly.

The diagram shows what he sees after the dish has been incubated.



(ii) The radius (r) of the clear zone around the disc soaked in antibiotic **A** is 11 mm.

Calculate the area of this clear zone.

Use the equation: area of clear zone = $3.14 \times r^2$

Give your answer to **3** significant figures.

Area of clear zone = ... mm^2 **[3]**

This calculation was generally well answered, but some candidates did not score the third mark because they did not give their (otherwise correct) answer to three significant figures.

Question 3 (b) (iii)

(iii) Amir sets up three more Petri dishes in the same way as the first.

The table shows his results for all four dishes.

Disc	Soaked in	Area of clear zone (mm^2)			
		Petri dish 1	Petri dish 2	Petri dish 3	Petri dish 4
1	Antibiotic **A**		363	346	346
2	Antibiotic **B**	227	363	227	214
3	Antibiotic **C**	314	283	298	314
4	Sterilised water	0	0	0	0

Amir thinks one of the discs was soaked in the wrong solution.

Suggest which disc may have been soaked in the wrong solution.

Give a reason for your answer.

Disc ..... in Petri dish .....

Reason .....

.....

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

Many candidates needed to make clear which specific parts of the data they were referring to in order to score the reason mark.

Exemplar 3

Amir thinks one of the discs was soaked in the wrong solution.

Suggest which disc may have been soaked in the wrong solution.

Give a reason for your answer.

Disc ..2.. in Petri dish ..2..

Reason ..Because the result is significantly bigger the the other ^ reults.....

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

This candidate has identified the correct disc and dish for 1 mark, but does not get the mark for their reason. The candidate needed to refer to the other results 'for this disc' or 'for this antibiotic', or even 'in this row', rather than referring non-specifically to "the other results".

Question 3 (c)

(c) Plant cells make their own antimicrobial substances.

Explain how antimicrobial substances help plants to survive and why this is essential for **human** survival.

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

Higher ability candidates were able to answer this synoptic question well, by linking understanding of plant defences against disease (B2.2.6) to ideas about the interdependence of organisms (B3.3.5) and why humans depend on plants (B3.1.1, B3.3.2 and B3.3.9).

Question 3 (d) (i)

(d) Amir plans to look at a sample of infected plant tissue using a light microscope.

The table shows some information about the cells in the sample.

Cell type	Diameter (μm)	Diameter (m)
Plant cell		8×10^{-5}
Bacterium	2	

(i) What is the diameter of the bacterium, in m, in standard form?

Put a (ring) around the correct answer.

2×10^{6} m **20^{6} m** **2×10^{-6} m** **20^{-6} m** **[1]**

Question 3 (d) (ii)

(ii) What is the diameter of the plant cell, in μm?

Put a (ring) around the correct answer.

80^{-6} μm **80 μm** **75 μm** **40 μm** **0.00008 μm** **[1]**

Question 3 (d) (iii)

(iii) Amir knows that:

- most viruses measure less than 250 nm in diameter
- his light microscope will not allow him to see objects smaller than 1 μm in diameter.

Can Amir use his light microscope to see viruses in the sample of infected plant cells?

Explain your answer.

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

Question 3 (d) (iv)

(iv) Suggest a piece of apparatus that Amir could use to see viruses in the infected plant cells.

Explain your answer.

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

The highly variable responses to parts (i) – (iv) of question 3 (d) suggest that candidates need to develop a better understanding of size, scale and the relationship between units (B4.2.2a). In addition, it was common to see incorrect references to "electric", "electrical" and "electronic" microscope in part (iv).

Question 3 (e)

(e) Humans can be vaccinated to protect them from pathogens. However, plants cannot be protected in the same way.

Explain why vaccination cannot work in plants in the same way as it works in humans.

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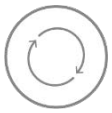
..... **[3]**

This was a challenging question for candidates, requiring them to apply what they know about how vaccinations establish immunity in humans to the context of why a vaccination would not work in a plant. Some responses such as "plants do not have blood" were not specific enough to score marks. Some candidates needed to refer specifically to the lack of white blood cells, antibodies and memory cells in plants to score marks.



AfL

The general statement that "plants do not have an immune system" was not sufficient for a mark. Although plants lack circulating immune cells and antibodies, other defence and disease-resistance mechanisms present in plants are generally regarded as forming a primitive immune system.

Question 4 (a)

4 Warfarin is a medicine that helps to prevent the formation of blood clots.

It is given to people who are at risk from a blood clot blocking one of their veins.

Question 4 (a) (ii)

(ii) Warfarin blocks the active site of the blood clotting enzyme.

The diagram represents a molecule of warfarin.

Which **one** of the following diagrams, **A**, **B**, **C** or **D**, could represent the enzyme's normal substrate?

A **B** **C** **D**

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

The most commonly seen answer, by far, was option **A**. This was designed to be a strong distractor, as it represents the shape of the enzyme's active site. Most candidates did not spot that the question asks for the shape of the enzyme's normal substrate, which would have to match the shape of warfarin as both fit into the active site.

Question 4 (b) (i)

(b) Warfarin helps to prevent the formation of blood clots when it is given to a patient in the correct amount.

The amount of medicine given to a patient is called the dose.

However, there is not one correct dose of warfarin that works for everybody. Different patients need a different dose.

(i) Doctors usually start by giving a low dose of warfarin to a patient. They then increase the dose if necessary.

Explain why it is better to start with a low dose of warfarin **and** suggest what could happen if the dose is too high.

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

Most candidates were able to make a sensible suggestion about what could happen if the dose was too high, with many scoring a mark for a mention of side effects or overdose. However, this question also draws on ideas about risk from IaS4 in asking candidates to explain why it is better to start with a low dose, and relatively few candidates scored marks for this aspect.

Question 4 (b) (ii)

(ii) Doctors think that different people need a different dose of warfarin because of differences in their genomes.

Explain how differences in the genome could cause a person to need a different dose of warfarin.

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

Question 4 (b) (iii)

(iii) Explain how gene technology could be used to help a doctor to give the correct dose of warfarin to a patient.

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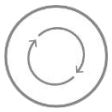
..... **[2]**

Questions 4 (b) (ii) and 4 (b) (iii) were not well answered. In part (ii), candidates were not able to communicate understanding that differences in the genome are caused by mutations, which create new alleles/genetic variants, or to apply their understanding to suggest that these could affect how the body would interact with warfarin. In part (iii), candidates did not seem to recognise the term 'gene technology', or could not apply their understanding of it to this context to select examples of gene technology that might be helpful.



AfL

Two examples of gene technology are introduced in Section B1.3 of the specification. These are:

- genetic testing for particular alleles/genetic variants and the development of personalised medicine based on test results;
- genetic engineering.

The first of these would be helpful to doctors in the context described in question 4 (b).

Question 4 (c)

(c)* Warfarin has also been used as rat poison since 1948.

However, many populations of rats are now resistant to warfarin.

Explain how a population of rats could have become resistant to warfarin.

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

Ideas about natural selection and adaptation now appear in the curriculum in Key Stages 2 and 3. Candidates should be well practised at explaining changes in the characteristics of populations using these ideas by the time they get to the end of Key Stage 4. The idea that is new to candidates at Key Stage 4 is that natural selection acts at the genetic level, such that genetic variants/alleles that give rise to advantageous phenotypes which are selected and become more common over a number of generations. Candidates were required to demonstrate understanding of this idea to achieve Level 3. Few Level 3 responses were seen, with most candidates operating at Level 2 or Level 1.

Question 5 (a)

5 Nina is learning about substances absorbed by plants. She finds out that plants absorb nitrate ions from the soil.

(a) Explain why nitrate ions are essential for plant growth and survival.

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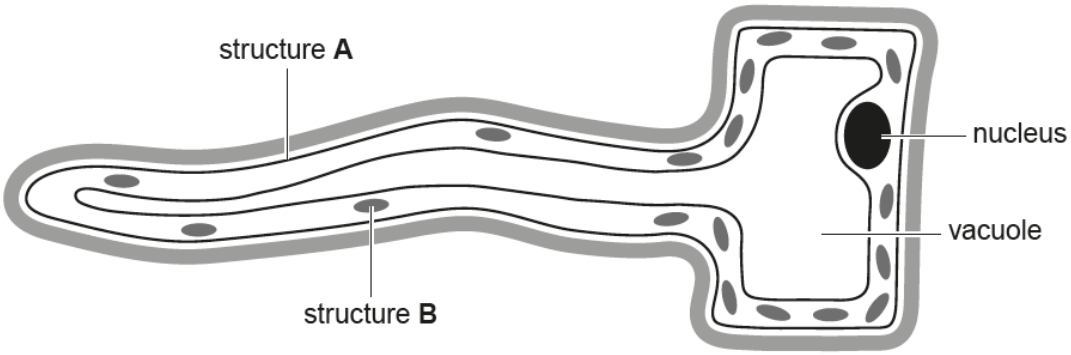
..... **[2]**

Very few candidates showed understanding that nitrate ions are the plant's source of nitrogen, or that this is necessary for making amino acids and therefore proteins.

Question 5 (b) (i)

(b) Nitrate ions are absorbed into a plant root through root hair cells.

Nina finds this diagram of a root hair cell.



(i) State the names of structures **A** and **B**.

A .....

B .....

[2]

The names of many different cell structures were given for both A and B, suggesting that many candidates were simply guessing using terms they knew from lessons about cells.

Misconception It was common to see chloroplasts suggested as the name of structure B. This could be evidence of the misunderstanding that all plant cells have chloroplasts, as one of the features that sets them apart from animal cells, regardless of the cell's position and function in the plant. Root hair cells, of course, do not need chloroplasts because they are underground where there is no light.

Question 5 (b) (ii)

(ii) Explain the roles of **A** and **B** in transporting nitrate ions into the root hair cell.

A .....

.....

B .....

.....

[2]

To score marks here, candidates needed to link ideas about active transport (B3.2.2a) and cellular respiration (B4.1.3).

Question 5 (b) (iii)

(iii) The shape of the root hair cell is an adaptation.

Explain how this adaptation helps the root hair cell to absorb nitrate ions more effectively.

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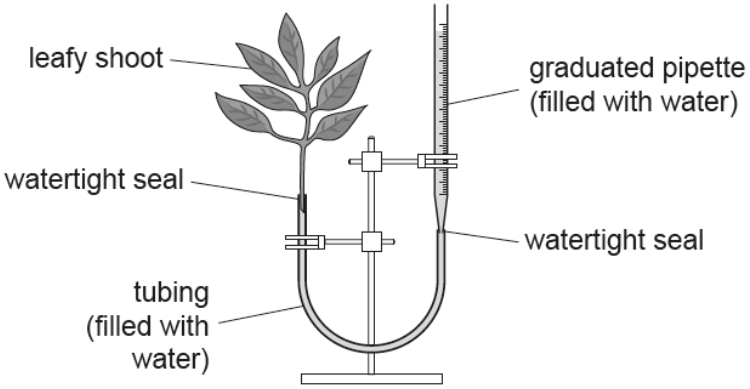
..... **[2]**

To score marks here, candidates needed to link ideas about active transport across the cell membrane (B3.2.2a) to the benefits of increasing the surface area of an exchange surface (B5.1.7).

Question 5 (d)

(d)* Nina wants to investigate how changing the light intensity affects the rate of water uptake by a leafy shoot.

She sets up a leafy shoot in a simple potometer as shown in the diagram.



Nina has access to other apparatus including:

fan **glass tank filled with water** **lamp** **metre ruler**

small heater **stopwatch** **thermometer**

She does **not** have to use all the apparatus.

Describe the experimental procedure Nina should follow and how she should process her results.

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

Most candidates were able to identify which pieces of apparatus should be used from the list, and many also gave some description of the measurements that would be taken. Some candidates undermined their description of which apparatus would be appropriate for this experiment by including incorrect examples such as the small heater or fan, or by attempting to describe how all of it could be used. Some even indicated that the metre ruler should be used to measure human reaction time by dropping and catching it, indicating that they were confusing memories of different practical experiences they had in the classroom.

There was ample evidence that candidates had opportunities to carry out this practical experiment for themselves, as many seemed quite familiar with the use of a potometer. Indeed, some described the experiment using a bubble potometer rather than the type shown in the diagram, suggesting that they were relying on knowledge of the particular apparatus they had used in class. These candidates were able to score credit so long as the approach they described made sense and would allow useful data to be collected.

Description of variables to control or keep the same was least commonly seen. Some consideration of variables is necessary to fully describe the experimental procedure. It was therefore required for Level 3. Some Level 3 responses were seen in this Foundation Tier examination, though most candidates' responses were Level 2 or Level 1.

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