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OCR
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GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

J257
For first teaching in 2016

J257/02 Summer 2019 series

Version 1

Contents

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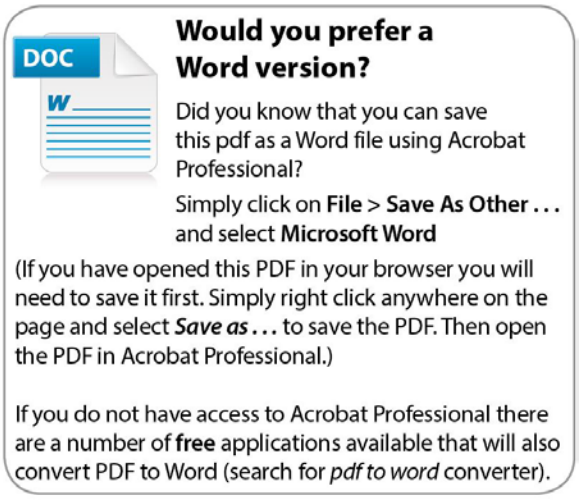
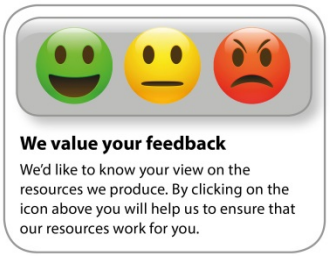
Introduction

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. 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 exam paper can be downloaded from OCR.





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Paper 2 series overview

There are four examination components for 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 responses (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 given for knowledge and understanding of practical work.

This series' papers were the second examinations for the new GCSE (9-1) specification. The examinations assess knowledge from across the specification including some synoptic questions. To do well on Paper 2, candidates need to demonstrate their understanding of ideas from across the whole specification, including *Ideas about Science*. They also need to be able to apply their understanding in novel contexts.

On the whole, candidates rose to the challenges of this Foundation tier examination well. Question omit rates were generally low for this examination. Candidates are to be commended for attempting most questions.

Candidates who did well on this paper typically:	***Candidates who did less well on this paper typically:***
• Attempted every question, even when they were unsure about the context or the answer. • Looked for ways to use their knowledge and understanding to answer questions asked in unfamiliar contexts. • Drew upon their hands-on experiences of practical work in their answers to the practical questions. • Showed their working for calculations, which sometimes allowed marks to be given for correct working even when the final response was incorrect.	• Used up time and answer lines by copying out or re-writing the question before beginning their response. • Did not attempt to answer questions where they were put off by an unfamiliar context. • Only considered one side of the story when answering a six-mark question (e.g. only discussed what the couple should do in Q5(b), without discussing genotypes and phenotypes; or only discussed washing hands in Q7, without discussing the yogurt drink).

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

- Q2(c)(i) – in which candidates were required to write a testable prediction;
- Q3(a)(i) and (ii) – in which candidates were required to interpret a bar chart;
- Q3(b)(i) and (ii) – in which candidates were required to interpret a food web diagram as a model of feeding relationships within an ecosystem;
- Q5(c)(i) and (ii) – in which candidates were required to make quantitative predictions from a Punnett square.

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The following questions candidates found challenging. Some candidates did not seem to attempt these questions:

- Q2(b)(ii) – in which candidates were required to describe the colour change when iodine solution is used to detect starch;
- Q5(b)(i), (ii) and (iii) – in which candidates were required to describe genotypes and phenotypes associated with dominant and recessive alleles;
- Q5(d) – in which candidates were required to predict the possible genotypes and phenotypes of the offspring for a couple, and to discuss ideas about genetic testing.

The whole of Questions 6 and 7 were common with the Higher Tier examination (J257/04).

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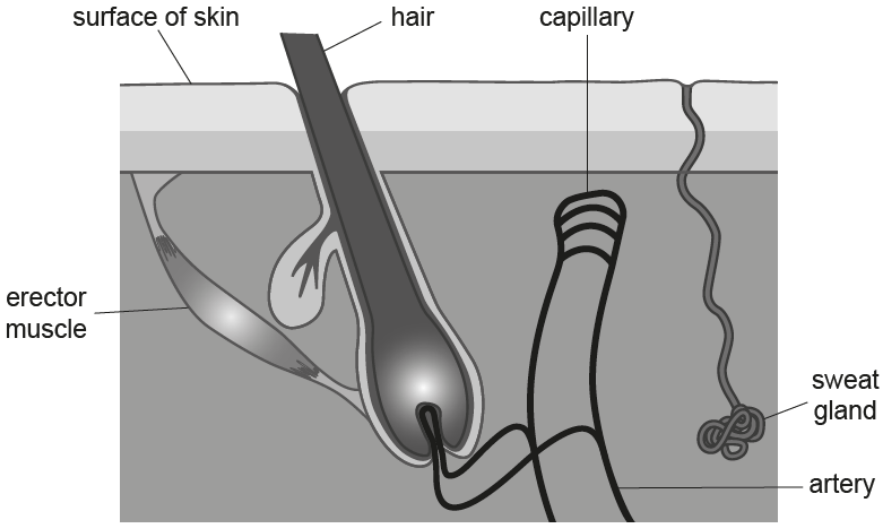
Question 1 (a)

1 The skin helps the human body to control its temperature.

Look at the diagram of structures in the skin.



(a) Complete the table to describe how structures **in the skin** help to cool you down when you are too hot.

Structure	What the structure does	Appearance of skin
		Sweaty
	Relaxes	Hairs lying flat
	Gets wider (vasodilates)	Flushed red

[4]

There were many good responses to this opening question. Most candidates correctly identified the sweat gland as the structure that produces sweat and makes the skin look sweaty. The hair (rather than the erector muscle) was often incorrectly identified as the structure that relaxes to make the hairs lie flat on the skin.

?	**Misconception**	A commonly seen misunderstanding was that the capillary, rather than the artery, is the structure that gets wider (vasodilates) to help you cool down.

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Question 1 (b) (i)

(b) James is feeling cold.

(i) The hairs on his skin are standing on end.

Explain how this helps to warm him up.

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.....

.....

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

Most candidates found the question challenging. While many were able to convey the idea that this would reduce heat loss, only a small percentage of candidates provided a complete explanation by linking this to the idea that the hairs would trap air. The idea that the hairs would trap heat was commonly seen, which mischaracterises heat as a substance.

Question 1 (b) (ii)

(ii) James starts to shiver.

Shivering happens because muscles are contracting rapidly.

Explain how this helps to warm him up.

.....

.....

.....

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

This question was synoptic and proved to be challenging. It required candidates to link together ideas about the role of the skin in the control of body temperature (B5.4 in the specification) with the idea that ATP from an exothermic process (cellular respiration) is required for muscle contraction (B4.1). Very few responses were worthy of credit.

Exemplar 1

As it helps the blood pump around the body when the blood is pumping fast around the body, your temperature will start to rise **[2]**

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The most commonly seen explanation in response to this question was that muscle contraction would increase the flow of blood around the body. The response in the exemplar does not suggest any reason why this would be helpful (e.g. by transferring warm blood from the core to the colder extremities). The best explanation for why shivering warms us up is that cellular respiration in contracting muscle cells is exothermic and thus warms the surrounding tissue.

Question 2 (a)

2 A teacher shows a plant to three students, Ben, Ling and Kai.

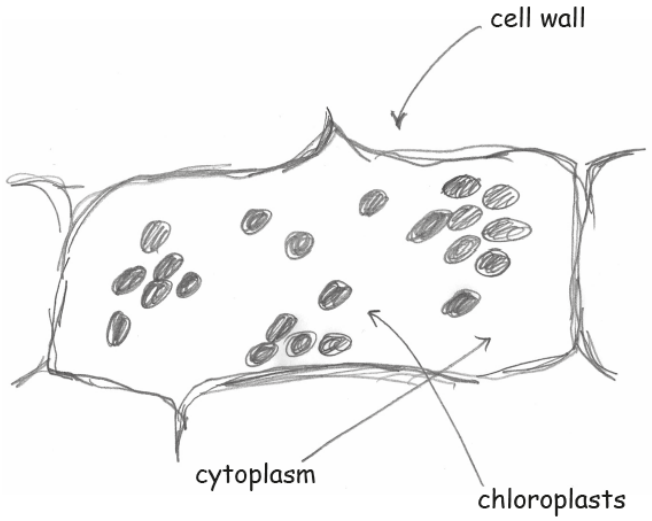
The teacher says it could be either a real living plant or a plastic plant.

She challenges the students to investigate whether the plant is real.

(a) Ben takes a small piece of leaf from the plant. He places the piece of leaf on a microscope slide. He looks at the slide using a light microscope.

The piece of leaf appears to be made of cells.

Ben draws a scientific drawing of what he sees.



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Ben could draw a better scientific drawing **without** changing the slide or the microscope.

Describe **four** ways Ben could improve his scientific drawing.

1 .....

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2 .....

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3 .....

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4 .....

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

This question assessed understanding of the scientific drawing aspect of PAG1. There were many good responses, and most candidates were able to describe at least one or two good ways to improve the drawing. Others may have missed the instruction in the question that the slide and microscope should not be changed; they suggested using a higher magnification lens, increasing the amount of light, or drawing other parts of the plant.

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Question 2 (b) (i)

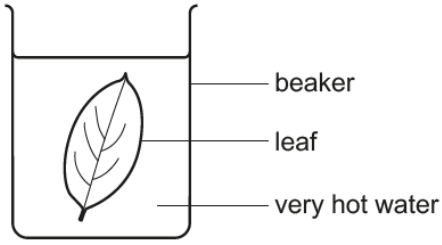
(b) Ling knows that living plants store glucose as starch.

She tests a leaf from the plant for starch.

Here is her method.

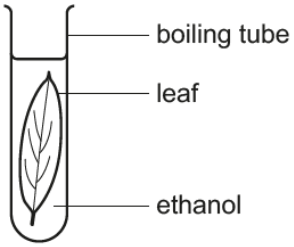
Step 1

Place the leaf in very hot water until it goes soft.



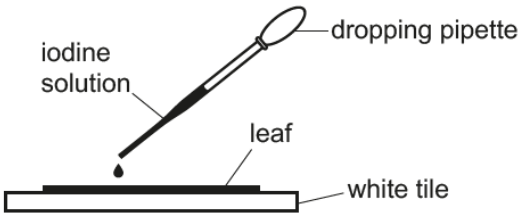
Step 2

Place the leaf in ethanol (HIGHLY FLAMMABLE) and heat until all the green colour has been removed from the leaf.



Step 3

Rinse the leaf with water, and then spread it out on a white tile and add a few drops of iodine solution.



(i) Write down **two** hazards in Ling's method **and** suggest a way of reducing the risk from each hazard.

hazard .....

way of reducing risk .....

.....

hazard .....

way of reducing risk .....

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

Many candidates were able to use their experiences of hands-on practical work in lessons to provide good responses to this question. Others identified hazards without suggesting a way of reducing the risk, and some suggested only general safety precautions such as wearing safety glasses without linking these to a specific hazard.

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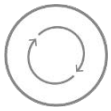	**AfL**	Many candidates suggested that flames should be "kept away from" the highly flammable ethanol. This suggestion was slightly ambiguous, as is implied that flames could be present in the same room. CLEAPPS advises that ethanol vapour may catch fire above 13 °C, and that a vapour/air mixture (of 3.3 to 19% ethanol) is explosive. Therefore, candidates should be clear that no naked flames must be used at all when ethanol is in use.

Question 2 (b) (ii)

(ii) The colour change when iodine solution is added shows that the leaf contains starch.

Describe this colour change.

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

Almost half of the candidates correctly described the change to a blue-black colour when starch is present. Others seemed to confuse the iodine test result with other food tests they may have experienced, suggesting that they would see a brick-red colour (which would result from a positive Benedict's test for reducing sugars) or a cloudy white colour (a positive ethanol test for lipids).

Question 2 (c) (ii)

(ii) Kai finds that the plant has grown towards the window.

Use ideas about plant hormones to explain how this has happened.

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

Candidates are to be commended for their responses to this challenging question. It was pleasing to see how many candidates recalled that auxins were involved in this plant growth response. Most correctly explained that the light was uneven and directional, and many included the idea that auxins would build up on the shady side of the shoot. Only a few provided a full explanation, including the idea that there would be more growth/elongation of cells on the side with most auxin.

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Question 2 (d)

(d) The students conclude that the plant is a real living plant.

Use evidence from the students' investigations to support this conclusion.

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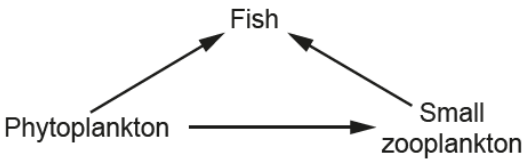
..... **[2]**

Candidates answered this question very well. Testing assessment objective 3, it required candidates to analyse the outcomes of the practical investigations and identify evidence to support the given conclusion. Most candidates were able to correctly identify one or two pieces of supporting evidence.

Question 3 (b) (i)

(b) Look at the food web from the North Sea.



(i) Add the following information to the food web above:

- Phytoplankton are eaten by shellfish.
- Shellfish and fish are eaten by seagulls. **[2]**

Adding the information to the food web diagram was very well done on the whole. A few candidates' attempts were not credited with marks, commonly because they had drawn lines with no arrowheads or with the arrowheads on the wrong ends.

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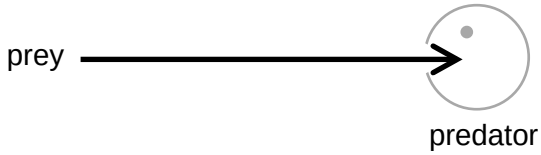
	AfL	A number of candidates incorrectly drew arrows pointing from predator to prey, perhaps because they read the arrows in a food chain or web as "eats" rather than "is eaten by". It may be helpful for lower ability candidates to use the "Pac-Man predator" as an aide-mémoire.  Higher ability candidates should appreciate that the arrows show the direction in which biomass is transferred through a food chain.

Question 3 (b) (iii)

(iii) Phytoplankton are producers.

Zooplankton, fish, shellfish and seagulls are all consumers.

Describe the differences between a producer and a consumer.

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

Many candidates were able to achieve one or two marks for their responses to this question. Some made use of incorrect generalisations such as that producers are plants and consumers are animals. Very few referred to "trophic levels" in their responses.

	Misconception	A commonly seen misunderstanding was that producers exist in order to make food for consumers. Candidates must be clear that producers make their own food. This food is made for the producers' own use, and not for the purpose of supporting any other organism.

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Question 3 (b) (iv)

(iv) Plastic litter in the sea breaks down into very small pieces of plastic.

Fish cannot tell the difference between very small pieces of plastic, phytoplankton and small zooplankton.

Phytoplankton and small zooplankton are digested by enzymes in a fish's gut.

Explain why very small pieces of plastic in the sea could cause fish to die.

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

The most common score for this topical question on plastic pollution in the sea was 2 marks. Most candidates recognised that fish would not be able to digest the small pieces of plastic. Very few explained this using ideas about the plastic not fitting into the enzymes' active sites; although there were a few vague references to the "lock and key" and some incorrect references to the enzymes not being "strong enough". Many candidates gained credit for suggesting that the small pieces of plastic could fill up or block a fish's gut.

Question 3 (b) (v)

(v) Humans eat fish caught from the North Sea.

Explain why very small pieces of plastic in the North Sea could be dangerous for humans.

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

Many candidates correctly explained that plastic would be transferred to humans who ate contaminated fish. Very few responses included the related idea that this could cause plastic to bioaccumulate to harmful levels in humans.

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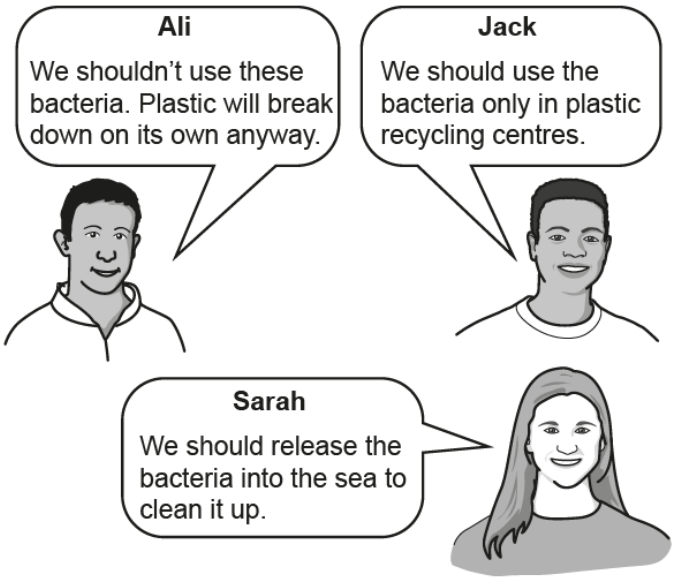
Question 3 (c)

(c) Scientists have discovered some bacteria in a rubbish dump.

These bacteria break down plastic into very small pieces. The pieces can be used to make new plastic products.

People have suggested different ways of using these bacteria.



Whose suggestion would have benefits for the sea **and** minimise the possible risks?

Explain your answer.

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

Most candidates correctly identified Jack, and many of these justified their choice with either a benefit or an explanation of how it would minimise potential risks. Few candidates justified their choice with both a benefit and an explanation of how it would minimise risks.

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Question 4 (a) (ii)

(ii) Twelve fossils of *Archaeopteryx* have been found.

The twelve *Archaeopteryx* fossil animals vary in appearance.

Suggest what could have caused these differences in appearance.

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

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Candidates appeared to have been well prepared to suggest causes of variation between individual organisms. The idea of adaptation to different environments was the most commonly credited marking point. The range of responses showed that candidates were aware of environmental and genetic sources of variation.

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Question 4 (b) (i)

(b) Read the article.

Early humans on Flores

A population of early humans became trapped on an island called Flores 100 000 years ago.

The average height of these early humans was 1.79 m. Their maximum body mass was 68 kg.

There was a very limited amount of food on the island.

Small human skeletons found on the island show that by 50 000 years ago:

- the average height of the humans on Flores had decreased to about 1 m
- the maximum body mass had decreased to 25 kg.

(i) Explain how **natural selection** caused the humans on the island to become smaller over many generations.

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..... **[5]**

In this question, candidates were required to explain how competition for limited resources, variation, reproductive advantage and natural selection could cause a trait to become more common over many generations. Very few candidates included the idea of competition in their response, and only some suggested that mutation was the cause of smaller humans. Most suggested that lack of food caused humans to be small, and then incorrectly suggested that this environmentally acquired characteristic was passed on to offspring. Where candidates discussed inheritance of the trait, most simply said that smaller people would have smaller offspring; some suggested that the parents would pass on their DNA/genes, but very few included the idea that a particular mutation or genetic variant would be passed on.

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Question 4 (b) (ii)

(ii) Some scientists think the small Flores humans from 50 000 years ago should be classified as a different species of humans.

Suggest why they could be classified as a different species.

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.....

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

The majority of candidates scored 1 mark on this question. Many responses correctly identified that differences in the physical features could be the basis for classification as a different species. Few candidates mentioned differences in DNA or the inability to breed to produce fertile offspring. Very few included the idea of isolation on the island contributing to speciation.

Question 5 (a)

5 Cystic fibrosis is a disease caused by a person's DNA.

(a) Describe the structure of DNA.

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

Most candidates were able to score 1-3 marks in response to the question. The most commonly credited idea was that of DNA being a double helix. Many candidates were familiar with the four bases and the letters used to represent them (A, T, C, G). Although not explicitly mentioned in the specification, the idea of base pairing was also commonly included in the responses.

?	**Misconception**	Many responses included the misunderstandings that DNA is made of amino acids or protein. (It was clear in these responses that candidates thought the DNA double helix itself was made of amino acids or protein and were not referring to the histone proteins of the chromatin, as they are not expected to know about this concept at GCSE).

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Question 5 (b) (i)

Cystic fibrosis is caused by a single gene.

There are two alleles of the gene:

- the dominant allele, **F**, does not cause cystic fibrosis
- the recessive allele, **f**, causes cystic fibrosis.

(b) (i) What is the phenotype of a person who has the alleles **FF**?

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

Question 5 (b) (ii)

(ii) What is the phenotype of a person who has the alleles **Ff**?

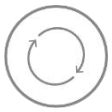
..... **[1]**

Question 5 (b) (iii)

(iii) What is the genotype of a person who has cystic fibrosis?

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

Questions 5(b)(i), (ii) and (iii) were questions that the candidates found challenging. Of the candidates who did attempt Questions (i) and (ii), it was pleasing to see many using specific language to describe the phenotypic trait associated with the genotype (i.e. "does not have cystic fibrosis") rather than imprecise and incorrect generalisations (i.e. "healthy"). The incorrect responses "female" and "male" were seen occasionally for parts (i) and (ii).

	**AfL**	When writing down letters to represent dominant and recessive alleles, as in part (iii), candidates must be reminded to make the distinction between uppercase and lowercase letters clear in their responses. Ambiguous responses cannot be credited.

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Question 5 (c) (i)

(c) A couple is thinking about having a baby.

The woman and the man both have the alleles **Ff**.

The Punnett square shows the possible combinations of alleles in their offspring.

	F	**f**
F	FF	Ff
f	Ff	ff

Use the Punnett square to help you answer the questions.

(i) What proportion of their offspring is likely to have the allele combination **FF**?

..... in every ..... **[1]**

Question 5 (c) (ii)

(ii) What percentage of their offspring is likely to have the allele combination **Ff**?

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

Question 5 (c) (iii)

(iii) What is the probability that any one of their offspring will have cystic fibrosis?

Probability = ... **[2]**

Questions 5(c)(i) and (ii) were very well answered, with almost all candidates who attempted them giving correct responses. Part (iii), which requires candidates to determine a probability, was less well answered. Some candidates expressed the probability as a fraction (1/4), while most expressed it as a percentage (25%). It was rare to see it expressed as a decimal (0.25). While the expected response was 0.25, marks were allowed for mathematically equivalent expressions.

	AfL	The Association for Science Education (ASE) publication 'The Language of Mathematics in Science' (ISBN 978 0 86357 455 9) states that probability should be expressed as a decimal on a scale of 0 to 1, where 0 is impossibility and 1 is certainty.

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Question 5 (d)

(d)* A different couple is also thinking about having a baby.

- The woman has had a genetic test. It showed that she has the **f** allele.
- She does **not** have cystic fibrosis.
- The man does not know what alleles he has.
- He does **not** have cystic fibrosis.

Explain the possible genotypes and phenotypes of their baby **and** explain what things the couple should consider before deciding to have a baby.

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

It was pleasing to see some good responses to this challenging six-mark, extended writing question. Higher ability candidates were able to achieve Level 3 by quantifying the chances of the couple's offspring having various genotypes/phenotypes and by discussing risks and ethical issues associated with various actions the couple could consider. Marks were limited for responses that only considered one side of the story (i.e. only discussed what the couple should do without discussing genotypes and phenotypes; or vice versa). The question required candidates to link genotypes to phenotypes in a particular couple's context (assessment objective 2) and to discuss possible courses of action. These demands may have been off-putting for some candidates, as a minority did not attempt to answer it.

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Exemplar 2

- The woman has had a genetic test. It showed that she has the **f** allele. — Ff
- She does **not** have cystic fibrosis.
- The man does not know what alleles he has.
- He does **not** have cystic fibrosis. FF/Ff

Explain the possible genotypes and phenotypes of their baby **and** explain what things the couple should consider before deciding to have a baby.

	F	f
F	FF	Ff
f	FF	Ff

	F	f
F	FF	Ff
F	FF	ff

50% carri

25% sufferer

If the man has the alleles FF then there will be a 0% chance for their child to be a sufferer but there will be a 50% chance to be a carrier.

if the man has the alleles Ff then there will be a 25% chance for their child to be a sufferer of cystic fibrosis [6]

In this response, the candidate has provided a good discussion of the possible phenotypes of the offspring, including quantifying the chances of each phenotype, and has related these correctly to the parental genotypes using Punnett squares. However, the marks are limited because there is no discussion of the other side of the story – i.e. no discussion of courses of action the couple should consider.

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Question 6 (b)

Eve is investigating the effect of temperature on photosynthesis in pondweed.

This is her method.

1. Put a piece of pondweed in a boiling tube.
2. Cover the pondweed with sodium hydrogen carbonate solution (a source of carbon dioxide).
3. Put the boiling tube in a beaker of water at one of six temperatures.
4. Use a gas syringe to collect the bubbles of gas released from the pondweed.
5. Record the volume of gas collected in five minutes.
6. She repeats the experiment three times at each temperature.

Fig. 6.1 shows the apparatus Eve uses.

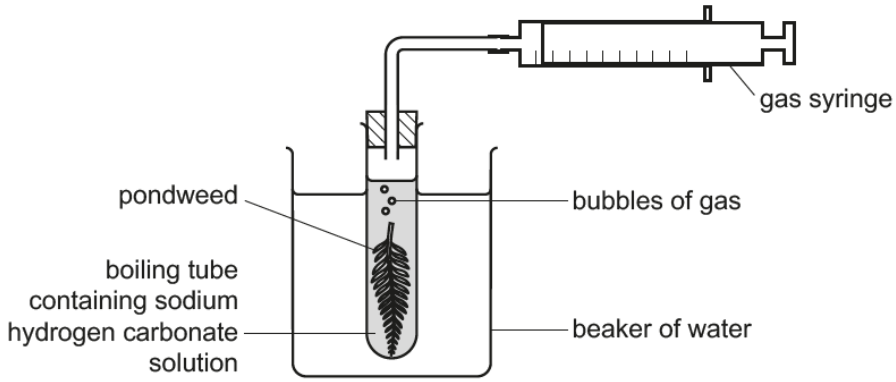

Fig. 6.1

(b) Temperature is the variable that Eve will change.

Write down **one** variable that Eve should control **and** describe how she could control it.

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

A good number of candidates were able to identify a variable that should be controlled. The most common response was the amount of sodium hydrogen carbonate solution. The size or amount of pondweed was also commonly seen. Many of the candidates who identified a variable stated only that it should be controlled by measuring it, without identifying a piece of apparatus or a technique that could be used to measure it. Some candidates suggested that Eve should control the temperature, even though the question states that temperature is the variable that she would change.

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Question 6 (c) (i)

(c) After she has finished the investigation, Eve uses her data to plot the graph in **Fig. 6.2**.

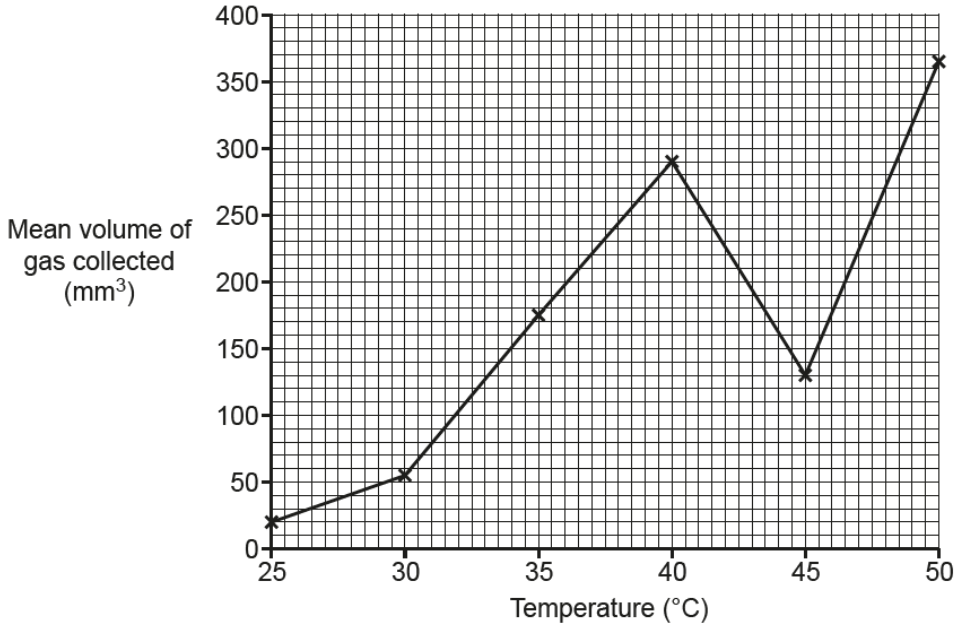

Fig. 6.2

(i) Eve decides to repeat the experiment at 45 °C so that she can take new measurements at this temperature.

Use evidence from **Fig. 6.2** to justify Eve's decision.

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

The language used by candidates to describe the result at 45 °C distinguished between higher and lower ability candidates.

Higher ability candidates…	*Lower ability candidates…*
• used terms from IaS2.9, in keeping with the ASE publication 'The Language of Measurement'. • described the result at 45 °C as an outlier or an anomaly. • suggested that the result 45 °C may have been due to an error.	• used everyday, non-scientific language and terms. • described the result at 45 °C as "unexpected" or "surprising". • suggested that the result 45 °C was observed because "something went wrong".

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Question 6 (d)

(d) Describe the trend in the data shown in the graph in **Fig. 6.3**.

Use data from **Fig. 6.3** to support your answer.

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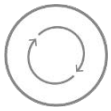
.....

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

It was pleasing to see a good number of candidates describing the trend correctly and using the correct scientific term 'positive correlation'. Many candidates used data from the graph to support their response.

	**AfL**	Where candidates used data from the graph to support their response, most quoted individual data points, which are insufficient to describe a trend. Higher ability candidates quoted the change in volume over a range of temperatures to illustrate the trend (e.g. "the mean volume increased by 235 mm^3 from 30 °C to 40 °C").

Question 6 (e)

(e) The volume of gas collected changed as the temperature changed.

Calculate the change in volume per degree between 35 °C and 40 °C.

Change in volume per degree = ... mm^3/°C **[2]**

This challenging question for Foundation tier assessed IaS2.8 and mathematical skill M4d. The most common error was for candidates to calculate the change in volume between 35 and 40 °C (115 mm^3), but then forget to divide it by 5 to give the change in volume per °C.

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Question 7

7* Layla is a doctor. She works with patients in a hospital.

Explain why it is good that Layla does the following things:

- She washes her hands regularly while she is at work.
- Each day she drinks a yogurt drink that contains living bacteria.

.....

.....

.....

.....

.....

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

This extended writing question was relatively well answered, and it was pleasing to see a good number of responses at Level 3. Response to the 'washing hands' aspect of the question were usually very good. Candidates were less sure about the yogurt drink aspect, which drew on knowledge of microbial defences against disease (B2.2.1).

Exemplar 3

- It is good for Layla to wash her hands because bacteria can be on them and as you use your hands to touch and grab items such as food that you eat that bacteria can get inside you.

- It is good for her to drink the yogurt with bacteria as then your body can kill it and next time you ever have that bacteria in your body your memory cells will remember it and be able to kill it off a lot quicker and it will make you immune to many diseases.

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

This response demonstrates the most commonly seen misunderstanding: that the yogurt drink containing living bacteria is some sort of vaccination that would strengthen the immune system, perhaps through the action of memory cells, and provide immunity against future illness caused by communicable disease.

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Question 2

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Question 6c, Fig.6.2

Adapted from 'The effect of temperature on photosynthetic rate of Elodea (Pondweed)', 24 March 2015, www.bnwkepler62e.wordpress.com, Brave New World Web blog. Permission to produce all copyright material has been applied for. In some cases, efforts to contact copyright-holders have been unsuccessful and OCR will be happy to rectify any omissions of acknowledgements in future papers if notified.

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