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Examiners' report

BIOLOGY A

H420
For first teaching in 2015

H420/03 Summer 2019 series

Version 1

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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 question paper can be downloaded from OCR.



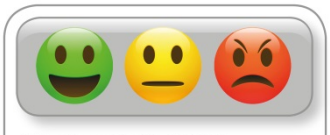
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Paper 3 series overview

H420/03 is one of the three examination components for the A Level examination for GCE Biology A. This component assesses content from across all areas of Biology, and links together the different areas, within different contexts, some practical, some familiar and some novel. To do well on this paper, candidates need to be comfortable with applying their knowledge and understanding to unfamiliar contexts and be familiar with a range of practical techniques. They must also be able to analyse, interpret and evaluate ideas and evidence to be able to reach conclusions and develop and refine practical design and procedures. This, together with the fact it relies on learning and applying knowledge from two years of work, has proved a difficult test for some candidates. However, all questions were accessible to candidates, and there seemed to be no time issues with completing the examination. The examination produced a good spread of marks and most candidates attempted all the questions.

Examiners were pleased to see that many candidates used the additional answer spaces provided at the back of the exam paper to extend answers, rather than continuing their answers outside the provided lines, or using additional item answer booklets, and this is something we would encourage all centres to advise their candidates to do. Candidates should be reminded to clearly label when additional space has been used and clearly identify which question answers relate to.

Centres are advised to encourage candidates to spend time reading the question and ensuring that they supply information that relates to and answers the question. Even if the science is correct, if it does not answer the question then it will not be given marks.

Candidates who do well on this paper generally did the following:	***Candidates who do less well on this paper generally did the following:***
• Have well developed mathematical skills enabling them to perform calculations: Q1(a)(ii), Q5(a) Q6(b)(i) • Produce clear and concise responses for Level of Response questions: Q4(b) and Q6(a)(i) • Have a good practical knowledge, with the ability to understand and apply the information given to the questions being asked: Q1(a)(iii), Q1(a)(iv), Q3(c)(i)	• Found it difficult to apply what they had learnt to unfamiliar situations, scoring most of their marks on questions involving recall and understanding • Produced responses which lacked depth, particularly to practical based questions: e.g.Q1(a)(iv), Q3(c)(i) • Produced responses which were often peripheral to what had been asked, sometimes simply repeating information provided; e.g. Q2(a)(i), Q2(d)(i), Q4(c) • Found it difficult to answer mathematical based calculations: e.g. Q5(a), Q6(b)(i)

Note

From this series students have been provided with a fixed number of answer lines and an additional answer space. The additional answer space will be clearly labelled as additional, and is only to be used when required. Teachers are encouraged to keep reminding students about the importance of conciseness in their answers. Please follow this link to our SIU (https://www.ocr.org.uk/administration/support-and-tools/siu/alevel-science-538595/)

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Question 1 (a) (i)

1 Sago pondweed is an underwater plant that grows in many regions of the world.

Fig. 1.1 shows a transmission electron micrograph of a sago pondweed cell.



Fig. 1.1

(a) (i) Identify the **cellular components** shown at **A** and **B**.

A .....

B .....

[2]

Most candidates correctly identified A as the vacuole, but only a minority of candidates identified B as the nucleolus, with many identifying it as the nucleus. Other answers seen included xylem and phloem, and air space for vacuole.

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Question 1 (a) (ii)

(ii) The real size of the line between **C** and **D** on Fig. 1.1 is 1.4×10^{-6} m.

Calculate the magnification that was used to produce the image in Fig. 1.1.

Give your answer to **2 significant figures**.

magnification = ... **[2]**

On the whole this question was well answered, with the majority of candidates correctly calculating the magnification. However, some candidates lost a mark for failing to round the answer to 2 significant figures.

i	**OCR support**	There are available resources on the 'Maths for Biology' website which can be used to support candidates with the correct use of significant figures: https://www.ocr.org.uk/subjects/biology/maths-for-biology/handling-data/

Question 1 (a) (iii)

(iii) Fig. 1.2 shows a student's drawing of another sago pondweed cell, which was observed under a light microscope. The student used a sharp pencil but did not label the drawing.

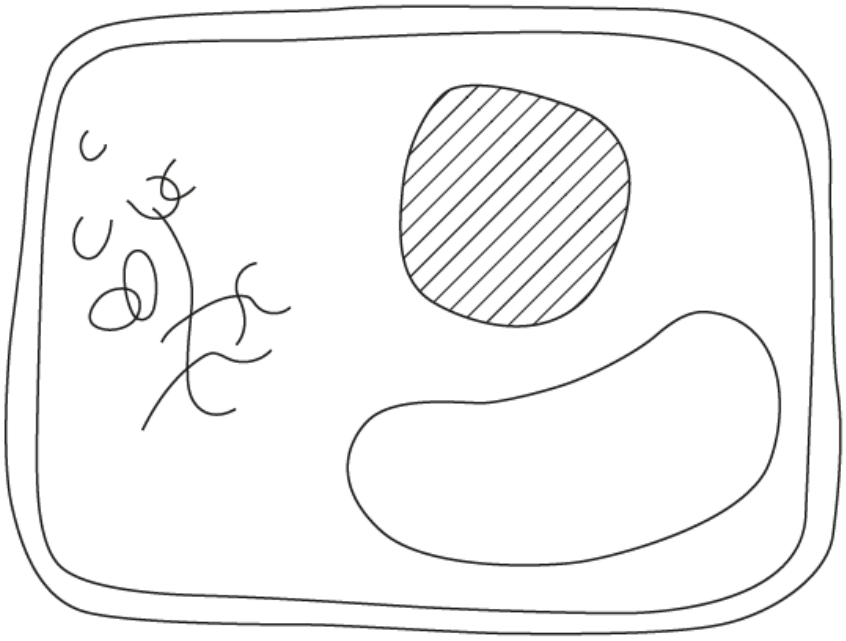


Fig. 1.2

Describe **two other** ways in which the drawing could be improved.

.....

.....

.....

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

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Many candidates correctly recognised that the drawing could be improved by removing shading or by adding a scale bar. However, many referred to adding labels or annotations or the use of a sharp pencil which gained no credit, as this was mentioned in the question stem.

	OCR support	The Biological Drawing handbook can be used as a guidance in this case: https://www.ocr.org.uk/Images/251799-biology-drawing-skills-handbook.pdf

Question 1 (a) (iv)

(iv) The student stained a sago pondweed sample to improve the contrast between cellular components when viewed under a microscope.

The student used the following procedure to stain the sample:

- Use forceps to place the sample on a glass slide.
- Use a pipette to place two drops of the stain in the centre of the sample.
- Carefully lower a cover slip onto the sample, ensuring that the cover slip is parallel with the slide as it is lowered.

Describe **two** improvements the student should make to their staining procedure.

1 .....

.....

2 .....

.....

[2]

Candidates who had a practical knowledge of slide preparation scored well, mentioning lowering the cover slip at an angle or using blotting paper to remove excess stain, as ways to improve the method. However, many candidates wrote about aseptic technique, adding water, wearing gloves, or pressing down on the cover slip to remove air bubbles, which gained no credit.

	OCR support	Practical work should be an integral part of the study of Biology. The practicals provided by OCR to support the practical endorsement include Practical Activity Group (PAG) 1 in which there is practical activity on preparing microscope slides which can be applied into different contexts. PAG activities are available on OCR interchange: https://interchange.ocr.org.uk/Downloads/PAG1.zip

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Question 1 (b)

(b) Sago pondweed has evolved many adaptations to its aquatic environment. Three such adaptations are described below.

Explain the advantage of each adaptation.

Adaptation 1: No waxy cuticle

Advantage .....

.....

Adaptation 2: Stem tissue that contains air spaces

Advantage .....

.....

Adaptation 3: A thin, flexible stem

Advantage .....

.....

[3]

The majority of candidates gained at least one mark for this question, with a high proportion gaining 2. Only a few candidates mentioned that the production of a waxy cuticle wastes energy as water loss is not a problem. However, many candidates correctly related the presence of air spaces in the stem to aiding buoyancy and the flexibility of the stem to being able to move without breaking.

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Question 2 (a) (i)

2 Fig. 2.1 shows a naked mole rat, *Heterocephalus glaber*.

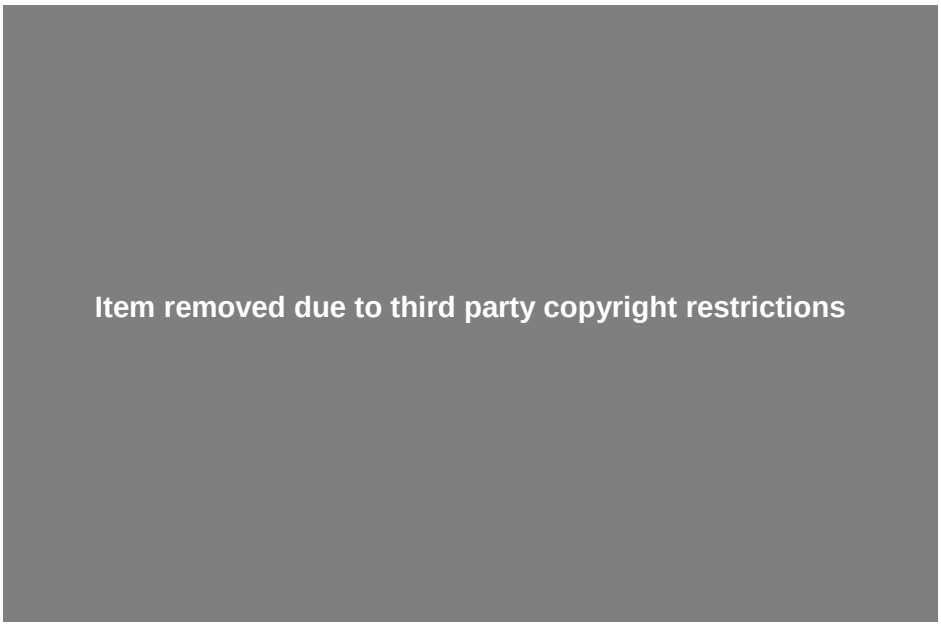


Fig. 2.1

The naked mole rat is a mammal. However, it has several features that are unusual for mammals.

(a) Naked mole rats regulate their temperature in a way that is different from most mammals.

(i) Some features of thermoregulation in naked mole rats are listed below:

- They live in complex underground tunnel systems, which tend to have a stable temperature of 30–32 °C. However, sometimes the environmental temperature can increase or decrease outside this range.
- In experiments that examine environmental temperature changes, the core body temperature of naked mole rats remains close to that of the environmental temperature.
- When tunnel temperature increases they often move to cooler parts of the tunnel system.
- When tunnel temperature decreases they often lie together in large groups.

Outline **two** ways in which thermoregulation in naked mole rats is different from thermoregulation in most mammals.

.....

.....

.....

.....

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

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Candidates were asked for two comparisons but sometimes did not adequately compare naked mole rats with other mammals by using comparative terms such as 'more' or 'less'. Also they didn't describe each mammal in turn, such as mole rats having behavioural means of regulation and other mammals having physiological means. It was common for candidates to refer inappropriately to ectotherms and endotherms in their answer. However, they rarely compared the actual core body temperatures, with other mammals being higher than mole rats, or the degree of stability achieved, with other mammals maintaining a more constant temperature. References to presence or absence of fur or hair often did not relate to insulation or the prevention of heat loss. A general issue was candidates quoting stimulus material from the paper without adding any insight into it. For example, many candidates missed the idea of the mole rat changing temperature with the environment and simply stated that its temperature was 'dependent on' or 'stayed the same as' or 'was similar to' the environmental temperature.

Question 2 (a) (ii)

(ii) In humans, when core body temperature falls below 35 °C, positive feedback causes this decrease in core body temperature to continue. This process is known as hypothermia.

Explain how positive feedback could accelerate the process of hypothermia.

.....

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

Answers often described the principle of positive feedback correctly and stated that the temperature would continue to fall, but few showed correct reasoning as to why this would occur. Generally candidates suggested inappropriate physiological responses such as sweating when a mammal was getting colder. Some candidates correctly related a decrease in core body temperature to lower kinetic energy, lower enzyme activity, leading to a lower metabolic rate and less heat release. Some candidates believed that a decrease in temperature would lead to enzymes denaturing which gained no credit.

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Question 2 (a) (iii)

(iii) Mammals, including naked mole rats, have temperature receptors that play a role in thermoregulation.

The table below lists four statements about mammalian temperature receptors.

Write either 'true' or 'false' in the empty boxes to indicate whether each statement is true or false.

Statement	True or False?
Peripheral temperature receptors detect the temperature of internal organs	
Receptors in the hypothalamus detect core body temperature	
Blood temperature is detected by the receptors in the hypothalamus	
Temperature receptors send impulses to the medulla oblongata, which regulates body temperature	

[2]

Candidates generally gained one or 2 marks. Candidates didn't answer well for lines 3 and 4 of the table (role of the hypothalamus and medulla oblongata). The rubric asked candidates to write 'true' or 'false' in the table, but many wrote 'T' and 'F' instead, although on this occasion abbreviations were credited.

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Question 2 (b) (i)

(b) Another unusual characteristic of naked mole rats is their tolerance of pain.

Acid causes pain responses in most mammals. Naked mole rats are tolerant of the pain caused by acid.

This tolerance can be explained by the type of pain receptor found in naked mole rats.

Fig. 2.2 shows a representation of the ion channels present in the pain receptors of naked mole rats and other mammals.

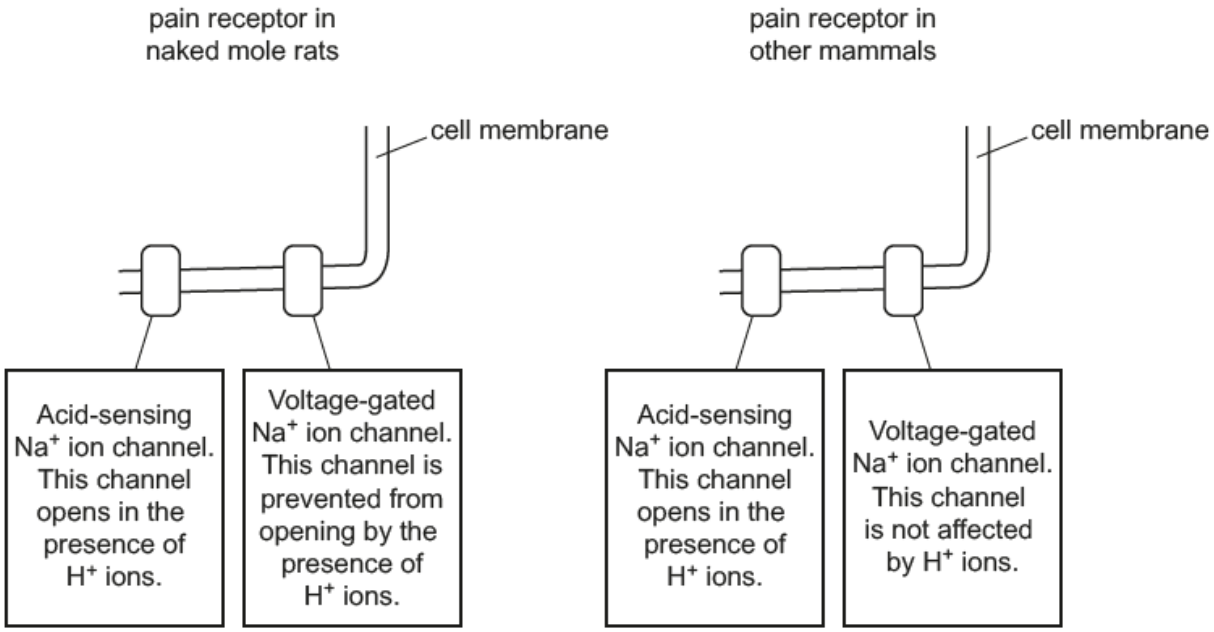


Fig. 2.2

(i) Use the information in Fig. 2.2 to suggest why naked mole rats do not feel pain when exposed to acid.

.....

.....

.....

.....

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

Candidates showed limited awareness of the difference between the initial generator potential depolarisation as a result of sodium ion entry through ligand-gated channels, and the all-or-nothing action potential depolarisation which relies on voltage-gated channels. Most scored at least one mark though for realising that the latter cannot open in the mole rat. Some answers referred to failure to send a signal or message rather than an action potential. A common error was to state that no sodium ions would enter, rather than fewer, or that no depolarisation would occur.

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Question 2 (b) (ii)

(ii) Explain how a pain receptor is an example of a transducer.

.....

.....

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

This was generally well answered, with a number of candidates identifying the form of stimulus energy (mechanical or chemical for example) and stating that it was converted into electrical energy. Lower ability answers stated what a transducer is but did not apply this knowledge in the context of a pain receptor.

Question 2 (c) (ii)

(ii) What conclusion can you draw from Fig. 2.3 about the lifespan of naked mole rats in comparison to other mammals?

.....

.....

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

Many candidates answered correctly but some wrote that the lifespan was greater than expected without referring to mass, and some referred to size instead of mass which was not precise enough.

Question 2 (d) (i)

(d) Naked mole rats can survive without oxygen for up to 18 minutes. This is several times longer than other mammals of a similar size.

The following information might help to explain how naked mole rats can survive without oxygen for a long time:

- In normal glycolysis, the enzymes needed to convert glucose to triose phosphate may be inhibited by lactate.
- Naked mole rats can use fructose as a respiratory substrate.
- Fructose is converted to triose phosphate.
- Triose phosphate can then enter the glycolysis pathway.

(i) Suggest why the use of fructose allows naked mole rats to survive without oxygen for a long time.

.....

.....

.....

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

Candidates often referred to glycolysis being able to continue, though only a few explained that the alternative pathway would be inhibited by lactate, or that the conversion of TP to pyruvate would yield ATP.

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Question 2 (d) (ii)

(ii) Suggest **one** other aspect of the physiology of naked mole rats that explains how they are able to survive without oxygen for a long time.

.....

.....

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

This question was not well answered by the majority of candidates with many relating this to SA:V ratios or the idea of size. Most correct responses identified the slow metabolic rate of the mole rat, with few using the information gained at the start of the question to state that mole rats spend less energy on thermoregulation.

Question 3 (a)

3 Icefish live in very cold water.

Icefish contain biological molecules that allow them to tolerate cold temperatures.

(a) Adaptations can be grouped into three general categories.

Which category of adaptation is represented by cold-tolerant molecules?

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

Correct responses of 'physiological' or occasionally 'biochemical' were commonly given by many candidates, but a common term seen was 'anatomical', which gained no credit. Others referred to terms like 'natural selection' and 'extremophile', which gained no marks.

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Question 3 (b)

(b) One example of a cold-tolerant molecule present in icefish is a modified form of the protease enzyme trypsin.

Fig. 3 shows how trypsin is converted from a molecule called trypsinogen. This conversion occurs in the lumen of the small intestine.

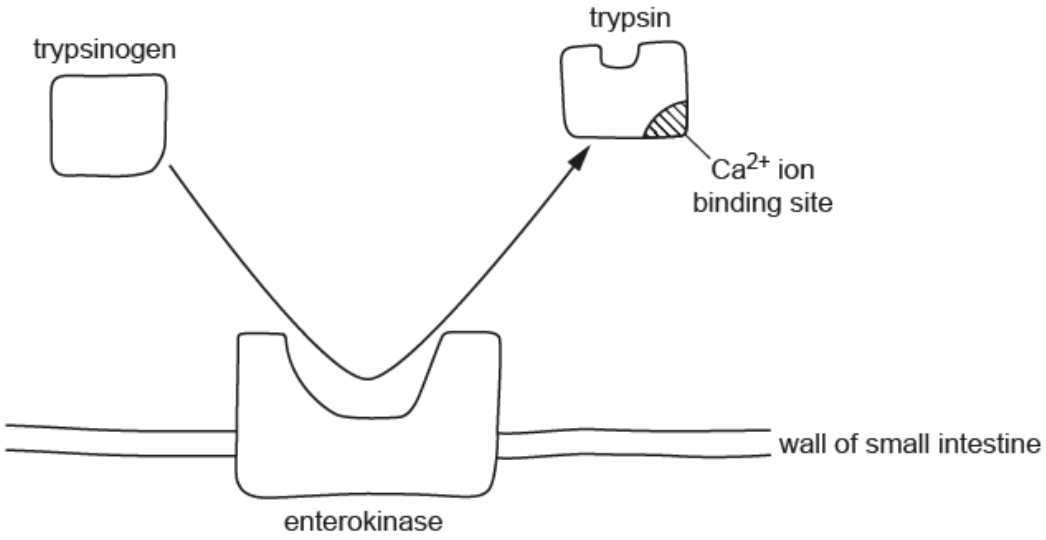


Fig. 3

State **two** conclusions that can be drawn from Fig. 3 about the roles of the molecules and ions that affect how trypsin functions.

1 .....

.....

2 .....

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

A number of candidates didn't read the question carefully in order to narrow down their focus to identifying a molecule (enterokinase) and an ion (Ca^{2+}) and then describe the role of each of these. Many candidates did not use the information shown in Fig.3, either. Common errors were mis-naming the inorganic co-factor Ca^{2+} as a coenzyme or prosthetic group. Those that spotted that enterokinase was an enzyme that converted trypsinogen into trypsin generally scored highly on this question.

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Question 3 (c) (i)

(c) A group of students investigated the effect of temperature on the activity of two forms of trypsin: human trypsin and icefish trypsin.

Part of their method is shown below:

- use 10 cm^3 of 5% trypsin solution for all trials
- measure enzyme activity at 10, 20, 30, 40 and 50 °C for both enzymes
- carry out each trial in the same pH buffer
- repeat the experiment 5 times at each temperature
- measure enzyme activity by recording the area of gelatine on a photographic film that is broken down over a set time period
- calculate the rate of enzyme activity at each temperature.

(i) Suggest **and** explain two improvements that would increase the validity of the students' investigation.

Improvement .....

Explanation .....

.....

Improvement .....

Explanation .....

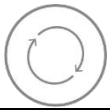
.....

[4]

Candidates did not gain marks for describing improvement aspects of the experiment that were already in place on the exam paper (e.g. controlling pH using a buffer) or variants of this (e.g. saying that the set time period should be stated exactly). The most common correct answers concerned controlling another variable such as the thickness, volume or concentration of the gelatine substrate. Not all could match this improvement with the explanation that variation in this variable would affect the rate being measured. Candidates also sometimes attempted to describe a way of standardising the method, such as using a thermostatically-controlled water bath, although again correct explanations relating to improved precision and reproducibility or repeatability were not always forthcoming. Few candidates considered running a control experiment. Candidates who realised that accuracy could be improved by testing at more temperatures often did not state 'within the range' or to make clear that the more temperature intervals they suggested would be smaller intervals between 10°C and 50°C.

Some students did not understand that this question was about practical measurement and talked about improvements relating to calculations and statistical analysis.

Correct use of terms such as accuracy, precision, reproducibility and repeatability were important in answering this question. Many candidates justified their suggested improvements by simply repeating the term 'validity' from the question.

	**AfL**	The word 'amount' is not specific enough and should be avoided by candidates.

	**OCR support**	Appendix 4 of the Practical Skills Handbook, provides information on terms used in measurement and conventions for recording and processing experimental measurements. This is in line with the 'The Language of measurement' booklet:

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		https://www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf

Question 3 (c) (ii)

(ii) Suggest appropriate units to use to represent the rate of enzyme activity in this investigation.

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

A few answers provided correct units for area per unit time such as $mm^2 s^{-1}$ or cm^2 / min. Errors included giving measures of volume (mm^3 and cm^3), combining two conventions such as using a slash and '$^{-1}$' after the time term, and writing in the format of area unit 'per' the time unit. Correct abbreviations of units were needed as opposed to words like 'minutes' or 'sec'.

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Question 3 (c) (iii)

(iii) The students recorded the temperature that produced the fastest reaction rate in each of the five replicates. These results are shown in Table 3.

Replicate	Temperature that produced the fastest reaction rate (°C)	
	Human trypsin	Icefish trypsin
1	40	20
2	10	10
3	30	20
4	40	30
5	40	30
Mean =	32.0	22.0
Mode =	40	20 and 30
Median =	40	20

Table 3

One of the students made the following statement:

I think the mean is a more accurate measure than the median or mode for these results.

Evaluate the student's statement.

.....

.....

.....

.....

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

Many candidates provided descriptions of the terms mean, mode and median, but these gained no marks, as they were not related to the question. Some candidates showed awareness that the mean calculation included an outlier though not all reasoned that, as a result the student's statement was incorrect. Similarly not all considered that a strength of the median or mode is that they are unaffected by outliers. Very few noticed that the existence of two values for the mode for icefish trypsin was a problem. Some candidates are demonstrating their understanding of the command term 'evaluate' by trying to provide a balanced answer, in this year's exams.

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Question 3 (c) (iv)

(iv) The students wanted to know whether there was a difference between the reaction rates of the two forms of trypsin at 30 °C.

They performed a statistical test on the mean of the five replicates for human trypsin and the five replicates for icefish trypsin.

Suggest the most appropriate statistical test for the students to use **and** explain why this test is appropriate.

.....

.....

.....

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

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Many candidates referred to the correct answer which was t-test. . However, most candidates scored only one mark as they did not explain that this allows comparison of two means (they often just stated two data sets, which is too vague). Some candidates showed extended knowledge of the application of statistics to experimental design with the use of terms like unpaired, unrelated and independent. Incorrect answers included the χ^2 test, standard deviation and Spearman's rank correlation.

i	**OCR support**	'Mathematical skills statistics booklet' can help to develop the correct use of statistical tests: https://www.ocr.org.uk/Images/338621-mathematical-skills-statistics-booklet.doc

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Question 4 (a)

4 (a) An individual's immune responses can change throughout their lifetime.

Fig. 4.1 shows one person's immune response to the influenza virus when they were first infected and when they were infected two years later by a new, mutated strain of the virus.

The influenza virus has many antigens to which the immune system can respond. Fig. 4.1 shows the response to four of these antigens (A–D).

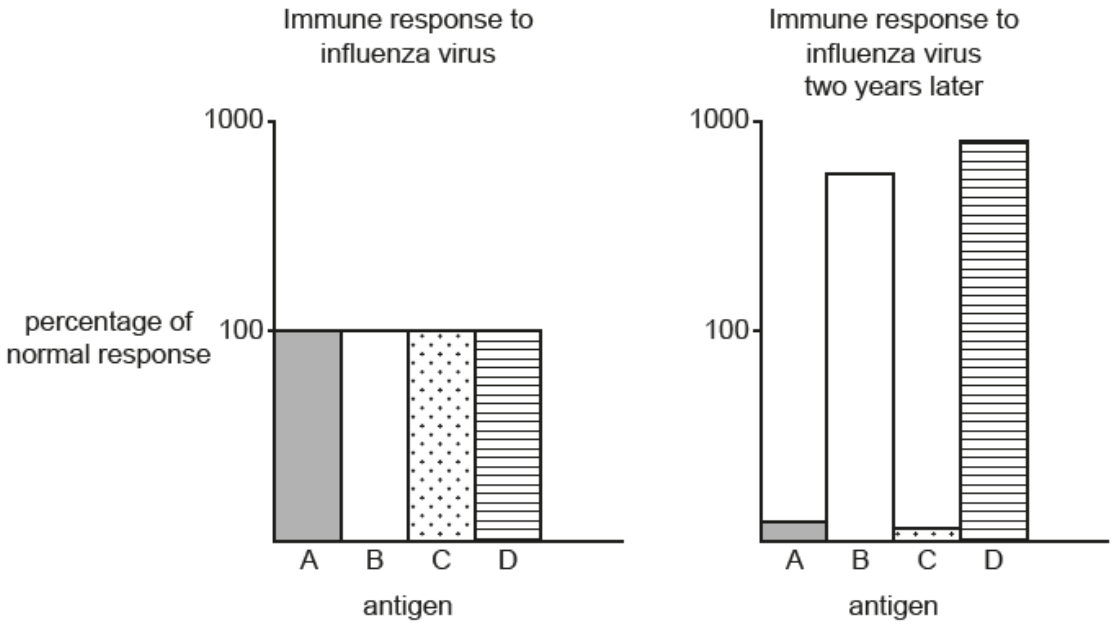


Fig. 4.1

Explain the differences in the person's initial immune response to the influenza virus with their immune response two years later.

.....

.....

.....

.....

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

Candidates who did not score well on this question confused antibodies with antigens, referring to the immune system producing antigens in response to the virus. A number of candidates showed that they had not understood the data presented in the question. They often stated that a larger response had been produced to antigens B and D because they had mutated and the immune system could not recognise them, so it had to produce a primary response again. Some candidates who clearly understood the significance of the data presented did not gain marks because they either didn't refer to any of the antigens named in the question, or they didn't explain the changes shown in the graph.

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Question 4 (b)

(b)* The specific immune response involves B and T lymphocytes.

There is variation in specific immune responses between individual animals.

Variation between immune responses can be influenced by genes and the environment.

Using examples, explain how both genes and environment can cause animals to vary in their specific immune responses.

.....

.....

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

Successful candidates produced concise, well thought responses that answered all aspects of the question. Most candidates recognised the role that genetic variation had on the production of immune system cells and antibodies. Although here again there was confusion between the terms antibody and antigen. The role of mutation in this was often referred to, although inappropriate examples of this such as haemophilia were sometimes given. Many referred to autoimmune conditions often giving arthritis or *lupus* as an example. Many lower ability candidates gave inappropriate examples of this type of condition, most commonly cystic fibrosis. Many candidates quoted previous exposure to pathogens and vaccinations as environmental factors causing variation in immune response. Some recognised the role of diet or disease, such as HIV, in affecting the immune response, but only a few referred to epigenetic changes. Many very knowledgeable responses were limited to Levels 1 and 2 due to a lack of examples quoted.

?	**Misconception**	Candidates seem to confuse the two terms 'antibody' and 'antigen'. It will be useful if candidates were able to develop their own aide-memoir in order to distinguish between the two terms.

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Exemplar 1

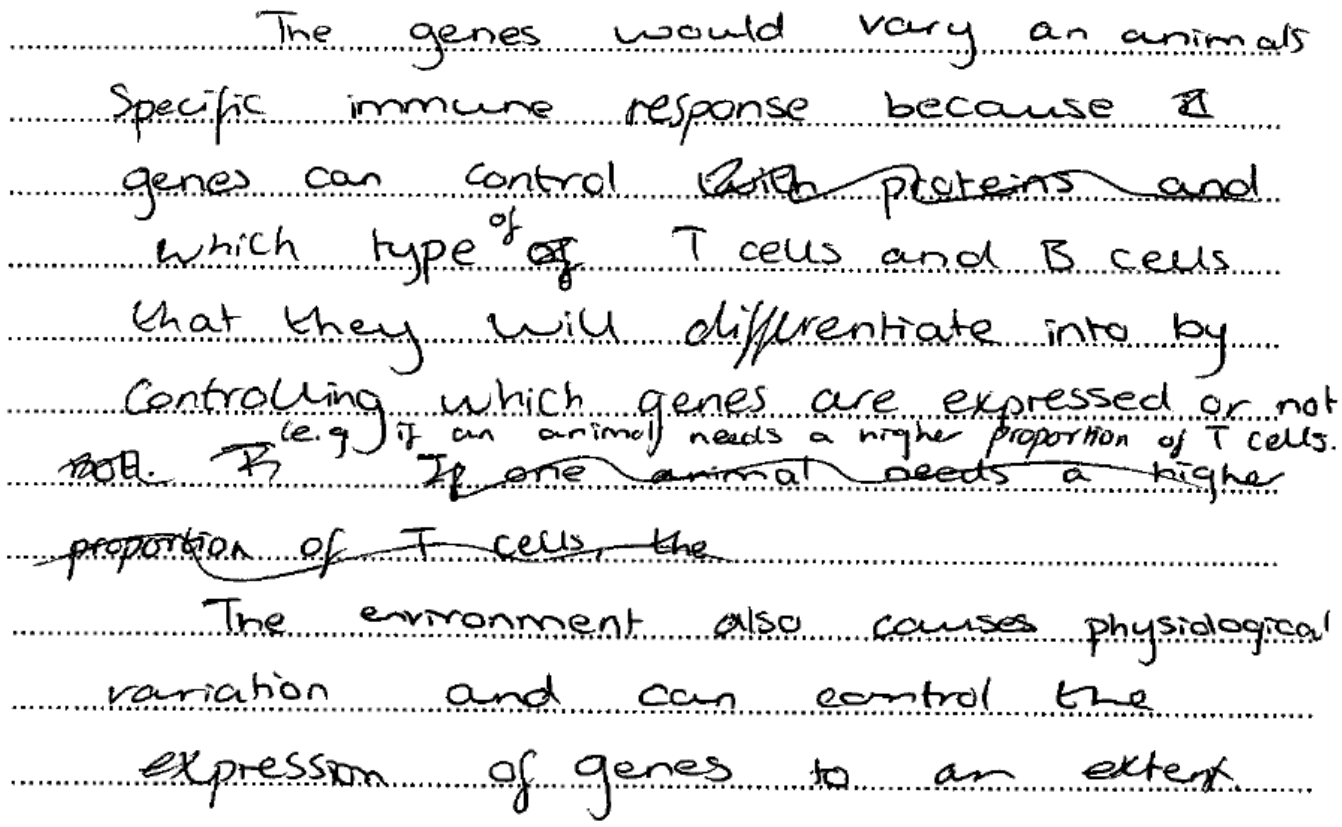
as some people may have a genetic autoimmune disease such as cystic fibrosis which would mean that their body cannot use their B and T lymphocytes effectively causing them to be more prone to having on serious symptoms of a disease the environment can cause animals to vary in their specific immune response as it depends on whether the individual has been previously exposed to the pathogen ~~if~~ the such as for example those who have been previously exposed to the influenza virus would have a quicker secondary immune response than those who haven't and so will recover quicker. The Another environmental influence would be the whether the individual has been vaccinated. This means that some individuals who have been vaccinated will have a greater chance of not being caused serious health issues if exposed to any harmful diseases or viruses.

Genes can cause animals to vary in their specific immune responses [6]

Exemplar 1 has included environmental points (the idea of exposure to pathogens and vaccination) and a genetic point (autoimmune disease), although the example given is a genetic disease though not an example of an autoimmune disease. Examiners were looking for examples such as rheumatoid arthritis, lupus or type 1 diabetes. They have one relevant example (influenza virus, in the context of exposure). This is a good example of a comfortable Level 2 answer worth 4 marks.

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Exemplar 2



Exemplar 2 has mentioned that genes code for immune cells and given examples of immune cells which are coded for, but lacks any explanation of variation to the immune system caused by the environment. Therefore it is limited to a Level 1 response. There is an attempt at a logical structure to the answer and most of the information is relevant, and so the answer can be given 2 marks.

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Question 4 (c)

(c) It is possible to manufacture antibodies to treat certain diseases. These are known as synthetic antibodies.

DNL-Fab3, shown in Fig. 4.2, is an example of a synthetic antibody.

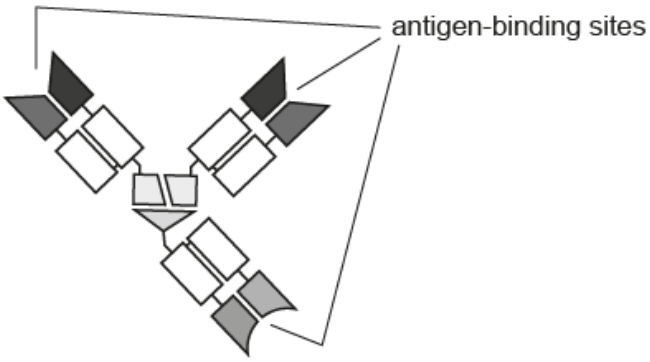


Fig. 4.2

State **two** conclusions that can be drawn from Fig. 4.2 about the differences between the way DNL-Fab3 functions and the functioning of normal antibodies.

1 .....

.....

.....

2 .....

.....

.....

[2]

Candidates who referred only to structural differences rather than describing differences in the way DNL-Fab3 functioned compared to normal antibodies did not gain marks. Most candidates recognised that having more antigen binding sites would allow DNL-Fab3 to bind with more antigens and many recognised that it could bind with more than one type of antigen. Fewer referred to its inability to bind to immune cells or being more flexible.

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Question 5 (a)

5 All organisms exchange gases with their environment.

(a) Organisms can use simple diffusion to exchange gases when the diffusion pathway is less than 1 mm.

A beet armyworm larva:

- has a cylindrical shape
- is 15 mm long
- has a volume of 30 mm^3.

Calculate the diffusion pathway of the larva and state whether it **could** or **could not** rely on simple diffusion across its external surface to meet its gas exchange requirements.

Use the formula: Volume of a cylinder = $\pi r^2 l$

diffusion pathway = ... mm

larva ..... rely on simple diffusion

[2]

Most candidates scored well on this question. Those who lost a mark for an incorrect calculation often gained the mark for understanding the significance of their answer regarding the ability of larva to rely on simple diffusion.

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Question 5 (b) (i)

(b) Beet armyworm larvae eat a variety of plants, including tomato plants.

Scientists wanted to investigate how effective a chemical called methyl jasmonate was in stopping beet armyworm larvae from eating plants. They sprayed tomato plants with different concentrations of methyl jasmonate and recorded the final biomass of the plants.

The results are shown in Fig. 5.1.

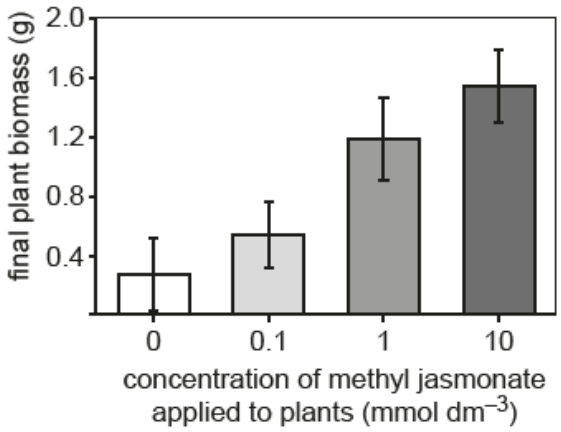


Fig. 5.1

The scientists wrote the following hypothesis:

Plants use methyl jasmonate as a defence against herbivory.

(i) What additional information do the scientists need to confirm their hypothesis?

.....

.....

.....

.....

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

Successful candidates avoided describing improvements in the method, since this is not required by the question. Many recognised the need to know if methyl jasmonate was produced naturally by plants and if the concentrations used in the investigation were close to those produced by plants. A smaller number of candidates recognised the need to understand if methyl jasmonate increased biomass as a result of increasing the plant's growth rate rather than reducing herbivory. Candidates who stated that scientists need to know whether other herbivores respond in same way, rather than specifying other insects, did not gain credit.

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Question 5 (b) (ii)

(ii) Suggest **one** valid conclusion it is possible for the scientists to draw from the results in Fig. 5.1.

.....

.....

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

This was answered well by most candidates, who used the terms from Fig. 5.1 in their answers. A few candidates wanted to expand their answer to include reasons, which often lost them the mark since they were concluding something they could not validly obtain from the graph.

Question 5 (b) (iii)

(iii) The scientists also recorded the level of cannibalism amongst the beet armyworm larvae. Cannibalism was measured as the number of beet armyworm larvae eaten by other beet armyworm larvae.

The results are shown in Fig. 5.2.

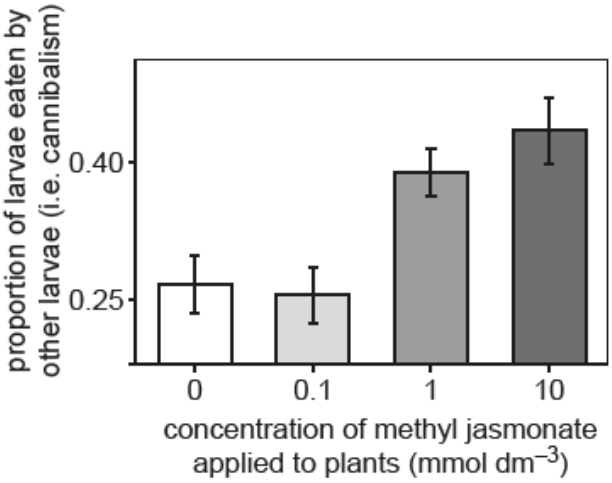


Fig. 5.2

Suggest **one** valid conclusion it is possible for the scientists to draw from their results shown in Fig. 5.2.

.....

.....

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

Most candidates gained this mark. Some attempted to explain the cause of the increase in cannibalism (rather than describe the correlation), which is not what the question required.

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Question 6 (a) (i)

6 Bacteria and fungi can be used to make food for human consumption. The use of microorganisms in food production creates fewer ethical issues than the use of animals.

(a) (i)* Using examples, describe and explain some **other** advantages of using microorganisms to produce food for human consumption.

.....

.....

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

As with Q4(b), a good range of marks were seen for this level of response question. A fair proportion of candidates did not mention examples of foods or microorganisms used in food production; they were consequently restricted to Level 1. Quorn was by far the most commonly referenced example. Candidates tended to describe and explain advantages quite confidently.

	AfL	Candidates should be aware of some common examples of microorganisms used in food production.

	OCR support	OCR delivery guide on 'Cloning and biotechnology': https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/module-ba06-module-6-genetics-evolution-and-ecosystems/delivery-guide-badg023-cloning-and-biotechnology-621

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Exemplar 3

Microorganisms have a very fast growth rate - exponential growth - therefore their production is very efficient to produce large quantities of food. Microorganisms require low temperatures for optimum growth, therefore have a low energy demand production and do not use much electricity, and less fossil fuels are required to be combusted. Furthermore, they require very little nutrients for optimum growth therefore are relatively easy to synthesise. They can be easily genetically engineered using DNA transfer and vectors to produce desired [redacted] food using specific genes. They can be produced using continuous or batch fermentation, and only require a supply of oxygen, nutrients, an optimum pH, and a stirring mechanism. There is a very large number of microorganisms available, and they all produce different useful metabolites. [6]

Exemplar 3 has plenty of advantages and explanations, but unfortunately it lacks any named responses of foods or microorganisms. This limits the mark to 2/6 (L1).

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Exemplar 4

Microorganisms reproduce very quickly and produce lots of useful products quickly: they are easy to maintain and don't require complicated conditions. They can be grown in fermentation vessels with specific conditions for temperature, pH, nutrients and sterile air. Microorganisms, like yeast can be used to produce beer and bread. They respire anaerobically to produce ethanol for beer and produce a ~~Acidity~~ rising affect in bread: Microorganisms can also be used to produce lactose-free dairy products for lactose-intolerant people: Eg. they are used to for milk, cheese and yoghurt. They are also needed in these products to cause them to become the right consistency. Microorganisms like bacteria can be used to make GM [6] crops to create a large yield and contain beneficial genes. Microorganisms are cheap to use and can be grown easily, hence it being beneficial to use them.

Exemplar 4 has several advantages and explanations, and has listed several responses of microorganisms and foods produced by them. This allows this answer to access Level 3 - 6 marks

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Question 6 (a) (ii)

(ii) On an industrial scale, microorganisms can be cultured using either batch fermentation or continuous fermentation.

The table below lists statements about industrial culturing of microorganisms.

Place ticks (✓) in the table to indicate whether each statement applies to batch or continuous fermentation.

Statement	Batch	Continuous
Waste is removed during the fermentation process		
A fixed volume of nutrient medium is used		
Secondary metabolites are more likely to be produced		
The growth rate tends to be faster		
The culture is grown for a fixed period of time		

[3]

On the whole, this question was well answered, with most candidates gaining 2 or 3 marks. The most common errors were for statements 3 and 4 in the table, with many candidates believing secondary metabolites are produced in continuous fermentation, and that growth rate is faster in batch fermentation.

Question 6 (b) (i)

(b) (i) Serial dilutions can be used to estimate the size of a bacterial population in a culture.

A scientist used 20 cm^3 of a bacterial culture that contained 1.0×10^6 bacterial cells.

- 5% of the 20 cm^3 culture was transferred to a new test tube and made up to 10 cm^3 with water.
- An additional ten-fold dilution was carried out, which produced a final 10 cm^3 solution.
- 0.1 cm^3 of the final 10 cm^3 solution was transferred to an agar plate.

Each colony that developed on the agar plate was assumed to represent a single bacterial cell in the bacterial culture.

Estimate the number of colonies that you would expect to develop on the agar plate.

number of colonies = ... **[3]**

This was a difficult question for many candidates, involving a multi stepped calculation, where a few candidates did not attempt. Many candidates who miscalculated either the second or third division still scored one or 2 working marks (for 50000 or 5000), and many gained full marks.

i	**OCR support**	The mathematical skills handbook can be used to support candidates with serial dilutions: https://www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf

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Question 6 (b) (ii)

(ii) A student carried out a different serial dilution to estimate the size of another bacterial population.

The serial dilution resulted in four colonies developing on an agar plate.

Explain why the student's estimation of this bacterial population is likely to be inaccurate.

.....

.....

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

Very few candidates recognised the implications of the low colony count for generating error when scaling up. Several candidates knew that too many dilutions had occurred, but found it difficult to express the correct idea clearly.

Question 6 (c)

(c) Some microorganisms can be used by humans in industry. Some microorganisms are pathogenic.

Pathogenic microorganisms are transmitted in various ways.

Complete the following passage about the transmission of pathogenic microorganisms using the most appropriate terms.

Some pathogens are carried between host organisms by animals, which are often insects.

These animals suffer no symptoms of the disease and are known as ..... .

Other pathogens, such as *P. infestans* that causes potato blight, produce reproductive structures

called ..... , which can be carried on air currents to infect other hosts.

[2]

This was answered well by the majority of candidates, but some did not realise that potato blight is a fungal disease and so did not identify the reproductive structures as spores.

Copyright information

Q5b, Fig 5.1 - 5.1 J Orrock, B Connolly, A Kitchen, 'Induced defences in plants reduce herbivory by increasing cannibalism,' Fig 1, pp1205-1207, Nature Ecology & Evolution, Vol.1 10 July 2017. Reproduced by kind permission of Springer Nature.

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