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GCSE (9-1)

Examiners' report

GATEWAY SCIENCE BIOLOGY A

J247
For first teaching in 2016

J247/04 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 question paper can be downloaded from OCR.

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Paper 4 series overview

This is the second examination of the GCSE Gateway Specification A. The J247/04 component includes a multiple-choice question section and a short answer question section that also includes one Level of Response type question. The Level of Response question assesses the quality of communication as well as knowledge and understanding. Throughout the paper there are some questions that are designed to assess candidates' knowledge and understanding of practical skills used in the specification. These questions demand responses that identify a candidate's awareness of the skills required to successfully complete practical activities and investigations.

Candidates who did well on this paper generally did the following

- Performed standard calculations following the required rubric (e.g. clear working, units, significant figures, rounding) relating to calculating percentage decrease: Q20(b)(ii) and calculating percentage: Q22(b)(i) and recognition of the formula for calculating the surface area of a circle shaped disc: Q5.
- Applied knowledge and understanding to identify that the mechanism of drug action would be through 'preventing translation' resulting in 'no protein synthesis': Q21(c).
- Applied their knowledge and understanding of natural selection to a given context: Q19(a).
- Produced clear and concise responses for the Level of Response question, interpreting graphical data and evaluating its usefulness: Q21(b).
- Applied knowledge and understanding to questions set in a novel context.

Candidates who did less well on this paper generally did the following

- As was the case in the previous seasons paper, found it difficult to apply what they had learnt to unfamiliar situations.
- Found using percentages in mathematical calculations challenging: Q20(b)(ii) and Q22(b)(i).
- Demonstrated clear misconceptions including plants producing oxygen by respiring. Some knew that plants produced oxygen and animals carbon dioxide but didn't link them to photosynthesis and respiration: Q17(b)(i).
- Lacked clear knowledge in definitions of the terms gene and allele instead using simplistic terminology such as 'dominant genes are stronger' which is insufficient to define these genetic terms: Q21(a).
- Questions designed to assess candidates' practical abilities were challenging and indicated a lack of awareness of the skills involved in practical activities and investigations.

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Section A overview

Candidates coped well with selecting choices. Encouragingly there were far fewer instances where candidates used lower case letters in their response. Clearly candidates had been well prepared to avoid this. There were a minority of candidates who occasionally omitted to answer, presumably intending to return to the question but forgetting.

Question 6

6 Which row on the table is correct for HIV?

	Destroyed by antibiotics	Causes cervical cancer	Sexually transmitted
A	✓	X	X
B	X	X	✓
C	X	✓	✓
D	✓	✓	✓

Your answer ☐ **[1]**

This is an AO1.1 question testing recall of HIV and interaction with cervical cancer. In general, candidates chose either B or C. Candidates who performed well overall chose the correct answer B.

Question 8

8 In food chains, biomass is lost between different trophic levels.

One reason for this is the release of undigested food from the body.

Which term is used to describe this release?

A Decomposition

B Egestion

C Excretion

D Peristalsis

Your answer ☐ **[1]**

This AO1.1 question testing recall of mechanisms of energy losses in food chains, showed a clear area of misconception. In general, candidates chose either B or a significant number frequently put C and did not score.

?	**Misconception**	Many candidates are unaware of the distinction between egestion and excretion.

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Question 9

9 Which is a definition of cancer?

A An infection of foreign cells which divide uncontrollably.

B Body cells that divide uncontrollably many times.

C Body cells that lose the ability to divide and make stem cells.

D Pathogens that grow and divide unchecked.

Your answer ☐ **[1]**

In this AO1.1 question, many candidates incorrectly put A, indicating they are unsure of what an infection is, and also why cancer is not an infection. They do, however, seem to be aware of cancer being linked to uncontrollable cell division.

Question 10

10 What does a vaccine contain that protects a person from infection?

A Antibiotics that will attach to antigens.

B Antigens that will stimulate antibody production.

C Antibiotics that kill pathogens.

D Antivirals that destroy viruses.

Your answer ☐ **[1]**

Recalling their knowledge of a scientific technique in this AO1.2 question; this was generally well answered by candidates. Some candidates were distracted by A and this may show a rushed approach to reading each option. Care must be taken to read technical terms very carefully.

Question 11

11 Which of these is a feature of an **artificial** classification system?

A It shows evolutionary links between organisms.

B It can be based on similarities in DNA.

C It may compare the amino acids in proteins.

D It uses a single difference or similarity between organisms.

Your answer ☐ **[1]**

Usually candidates scored on this AO2.1 question, choosing D. Candidates who had difficulty applying their understanding often chose B, incorrectly linking their knowledge of the use of DNA in classification.

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Question 13

13 What is the role of antibiotic resistance markers in producing genetically engineered bacteria?

A To identify which genes to insert into the bacteria.

B To identify which bacteria have taken up the plasmid.

C To identify which plasmids contain the genes.

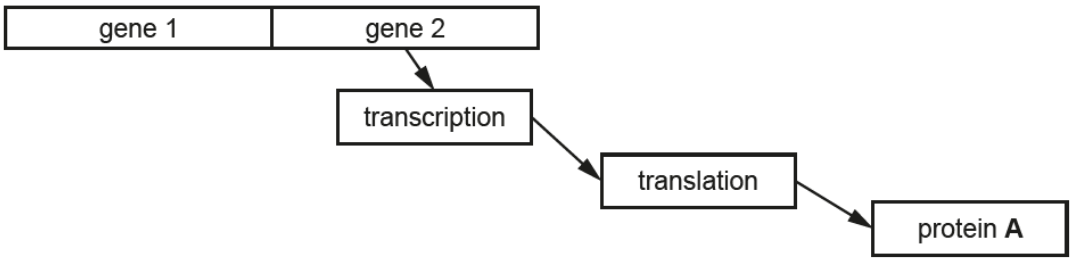
D To identify which proteins are produced by the bacteria.

Your answer [ ] **[1]**

Recalling their knowledge of a scientific technique in this AO1.2 question, candidates generally answered this well. Some candidates were distracted by A and C.

Question 15

15 Gene **1** and gene **2** are both needed for the production of protein **A**.



What is the function of **gene 1** in this process?

A It codes for the amino acids in protein **A**.

B It codes for the mRNA needed to make protein **A**.

C It acts as the site for protein synthesis.

D It controls the expression of **gene 2**.

Your answer [ ] **[1]**

Recalling their knowledge in this AO1.1 question was answered well by higher ability candidates, less so by others. Lower ability candidates were frequently distracted by A.

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Section B overview

Candidates again demonstrated a sound understanding of the application of practical techniques in completing a genetic cross. However, there were some instances where candidates found it challenging to respond to questions that targeted other practical skills. As evident from the previous examination, candidates should further develop their ability in applying their knowledge and understanding of practical skills in questions set in the context of practical activities and investigations. The most common mistake was to plot the incorrect variables on x and y axes. A small but significant number did not label the axes with units. Candidates in general produced balanced arguments in their responses to the Level of Response question. Candidates should be encouraged to read and highlight key parts of questions which provide much of the relevant information, and to not be tempted into answering the question until all the rubric and stem has been read.

	**AfL**	Candidates coped well with interpreting data to draw a bar graph and there were a range of styles used, some overlapping bars and other candidates using separate bars. Occasionally, it was unclear as to which bar was which and the easiest way to identify them is using a key.

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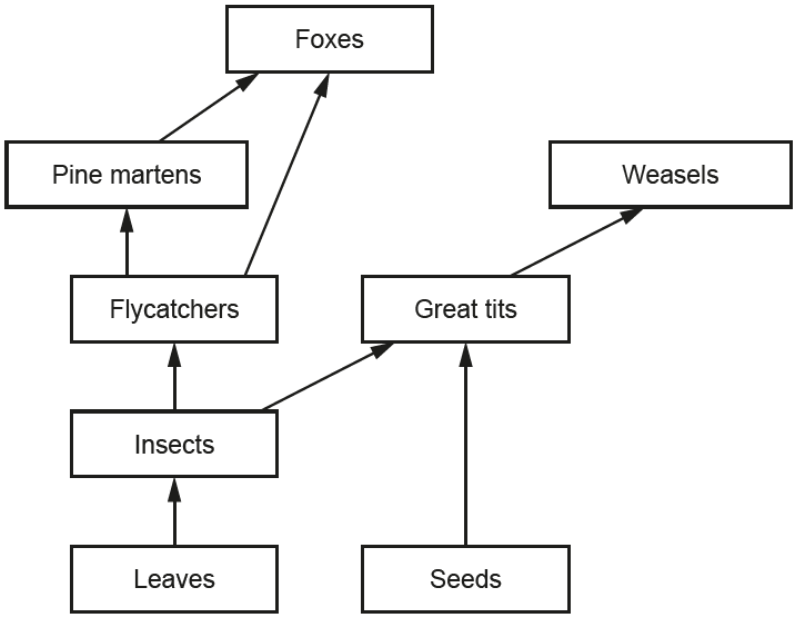
Question 16 (a) (i)

16 The diagram shows part of a food web from a woodland.



(a) (i) Great tits are described as both primary consumers and secondary consumers.

Explain why.

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

This AO2.1 question was generally well answered by most candidates. Some candidates did not match the appropriate terminology to the seed and insect correctly and did not score.

?	**Misconception**	A small number of candidates have the misconception that a secondary consumer refers to the number of steps away from the producer and wrote that the great tit was a secondary consumer of leaves.

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Question 16 (a) (ii)

(ii) Foxes are described as both predators and competitors of pine martens.

Explain why.

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

Generally, candidates coped well with this AO2.1 question. A small number of candidates did not link the animal to the term and simply said foxes eat pine martens and flycatchers, but generally most understood the terms and used them correctly in the context of the food web.

Question 16 (a) (iii)

(iii) Which organism in the food web occupies the second trophic level?

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

Almost all candidates scored on this AO1.1 question. On the rare occasion that an incorrect response was given it was for flycatcher.

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Question 16 (b) (i)

(b) Great tits and flycatchers are both birds.

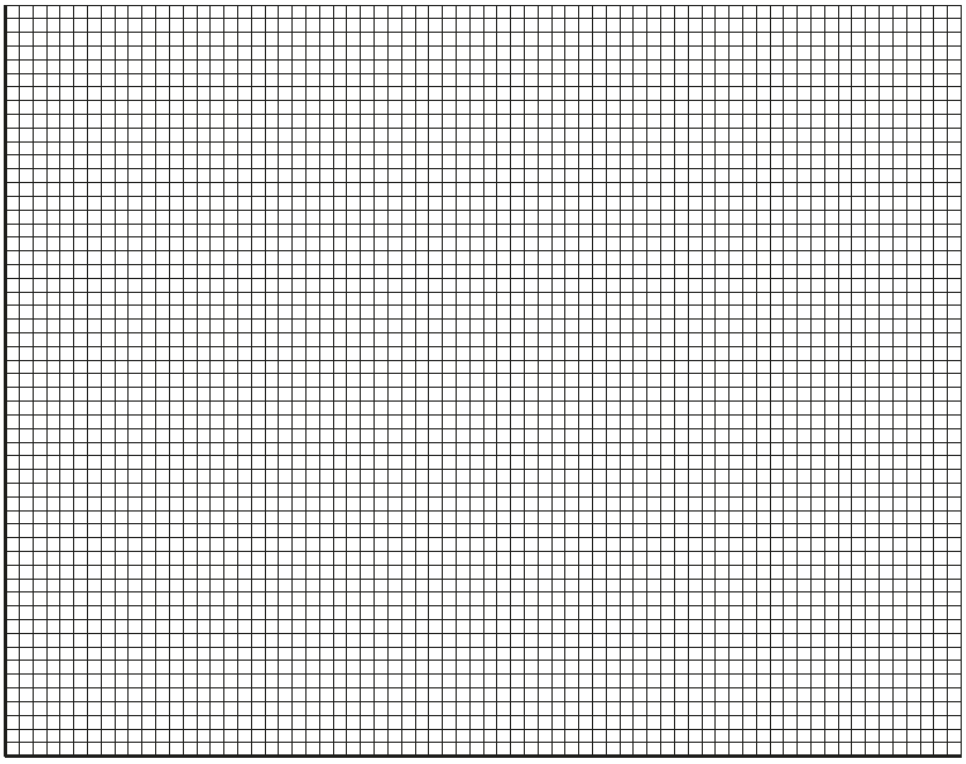
In a conservation project, scientists have built boxes for the birds to nest in. The scientists fixed the boxes on trees at different heights.

The table shows how many birds of each type used the boxes for nesting.

	Number of bird boxes used	
Height of bird box above the ground (m)	**By great tits**	**By flycatchers**
1	1	6
2	7	5
4	10	6

(i) Draw a **bar chart** on the graph paper to show the scientists' results.

The results for great tits and flycatchers should be on the same axis.



[4]

This AO2.2 question testing graphing skills was generally well answered. The majority of candidates drew a good chart with suitable scales and a key. A small but significant number did not label the axes with units

	AfL	Candidates, particularly those of lower ability, need practice at drawing graphs and representing information in ways that have strict rules about using rulers, the size of graphs and bars. This will maximise their opportunity to get full marks on questions like this one.

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Question 16 (b) (ii)

(ii) The food web shows:

- Weasels feed on great tits
- Pine martens feed on flycatchers.

Weasels live on the ground but pine martens live in trees.

How can this be used to explain the results of the scientists' investigation?

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

Most candidates were able to link the preference for height of box in great tits to protection from a ground-dwelling predator in this AO3.2b question analysing information and ideas to draw conclusions. Although many candidates could link the location of the great tits due to the weasel predator being on the ground, only a few candidates were able to explain the results for the flycatchers.

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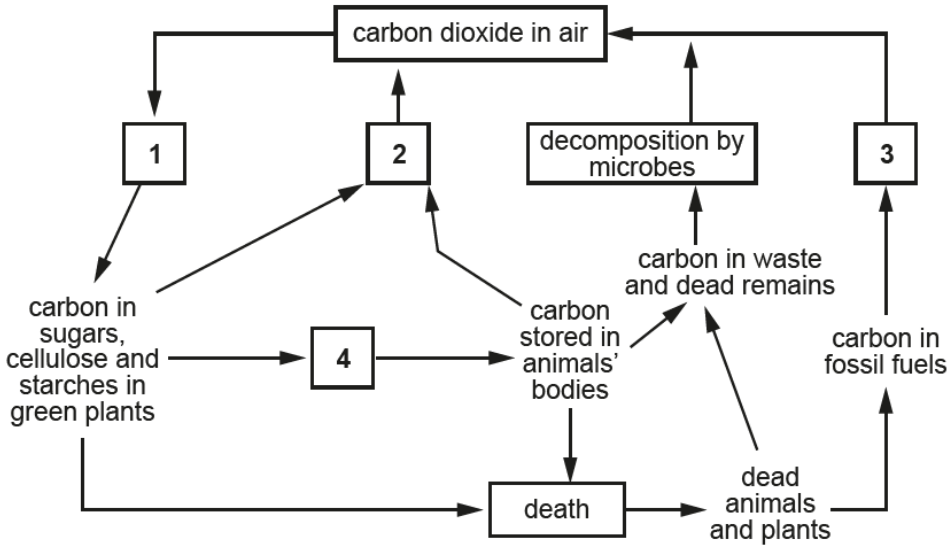
Question 17 (a)

17 (a) The diagram shows the carbon cycle.



Boxes **1–4** represent different processes in the carbon cycle.

Draw lines to link boxes 1–4 to the correct name for the process in the carbon cycle.

1	**Combustion**
2	**Eating**
3	**Photosynthesis**
4	**Respiration**

[2]

Most candidates scored on this AO1.1. On the rare occasion where candidates made an error it was usually on photosynthesis or respiration.

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Question 17 (b) (i)

(b) Scientists investigated if crops could be grown on the planet Mars.

They used a soil that was similar to the soil found on Mars. The soil contained some minerals but no living organisms.

(i) The scientists managed to grow crops in the soil. However on Mars, the minerals in the soil would soon run out.

Explain why.

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

Lower ability candidates didn't realise they needed to identify decomposer or a named type of decomposer and instead repeated the term living organisms from the question, thereby missing the AO1.1 aspect of the question. Higher ability candidates were able to name decomposers or types of decomposers. A significant number did not write about the AO2.1 aspect of the question about decomposition, using terms such as replenish or recycle minerals. Some candidates wrote about the minerals being used up but didn't go on to say why they would not be replaced.

Question 17 (b) (ii)

(ii) Living organisms could be added to the soil but there is no air on Mars. The plants would need to be grown in an enclosed structure.

At first, air would need to be added, but after a while the organisms in the soil and the plants would supply each other with the gases they need.

Explain how this would happen.

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

In this AO2.1 question, many candidates referred to plants only, indicating the importance of careful reading of the question that asked about organisms other than plants. Another frequent response from candidates that did not score was reference to "breathing" out carbon dioxide and not specifically to respiration.

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Question 18 (a)

18 Two farmers grow barley in their fields.

They both have a problem with barley powdery mildew infecting their crops.

(a) Powdery mildew is caused by a fungus.

Describe how fungal infections can spread and how they enter plant leaves.

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

On this AO1.1 recall question, most candidates were able to describe a method of spread. Fewer were able to recall the term spore. A much smaller number of candidates knew that the point of entry was stomata, however, responses referring to entry through damage, cuts or wounds and via the roots were more common but did not score.

Question 18 (b) (i)

(b) The farmers want to prevent their crops from getting powdery mildew.

(i) Explain how burning plants after the barley has been harvested can protect the crops.

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

Many candidates did not score on this AO2.1 question because of the lack of reference to the specific organisms in the question. A common mistake is to give generic responses using terms like disease and infection. Rather unexpected, but throughout this question about a fungus a lot of candidates referred to bacteria and viruses.

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Question 18 (b) (ii)

(ii) Explain how growing barley in the fields one year, then wheat the next year can protect the crops.

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

This AO2.1 question was approached more like a recall question by many candidates. A substantial number described crop rotation ideas about depletion/replacement of nutrients. Again, many candidates wrote about killing infections or diseases rather than spores or fungi.

Question 18 (c)

(c) The farmers test two different fungicides.

They each grow barley in one of their fields. Each farmer sprays a different fungicide on their field. They then compare the crop yield in the two different fields.

How could you improve the farmers' experiment?

Explain your answer.

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

This AO3.3b question was considering ways of improving experimental design. Many candidates were able to describe the need for a control, less were able to apply their ideas to the scenario in the question, often describing inappropriate ideas such as putting plants in greenhouses or closed systems.

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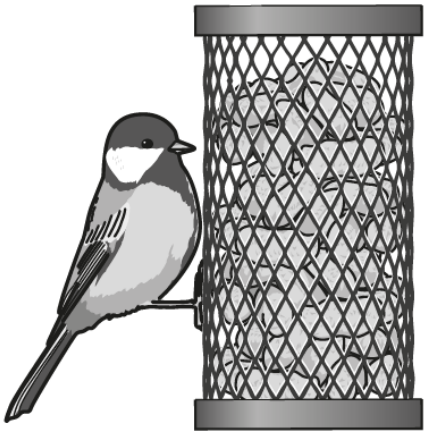
Question 19 (a)

19 Blue tits are small birds seen in gardens.

(a) Many people in the UK feed birds nuts using a bird feeder, as shown in the diagram below.



Scientists measured the mean lengths of blue tits' beaks in the UK.

They found that blue tit beaks in the UK are slightly longer than blue tit beaks in the rest of Europe.

Very few people in the rest of Europe put bird feeders out for their birds.

Use Charles Darwin's theory of natural selection to explain why the blue tits in the UK have slightly longer beaks than those in the rest of Europe.

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

The AO2.1 aspect to this question was well answered by many candidates. Lower ability candidates wrote a generic description of natural selection, not appreciating they needed to link their answers to blue tits.

The first AO1.1 marking point was often missed, with most candidates limiting their marks by not mentioning mutation or variation. Most candidates were able to say that the longer beaks could better access food, leading to better chance of survival. Even the higher ability candidates were not able to distinguish between gene and allele and many referred also to the passing on of characteristics, phenotypes or traits instead of the allele. It is important that candidates demonstrate an understanding that the specific allele is passed on during reproduction, rather than just referencing the gene.

Very few candidates explained the change in the allele frequency over **many** generations, and loose descriptions such as eventually, overtime or a few generations did not score.

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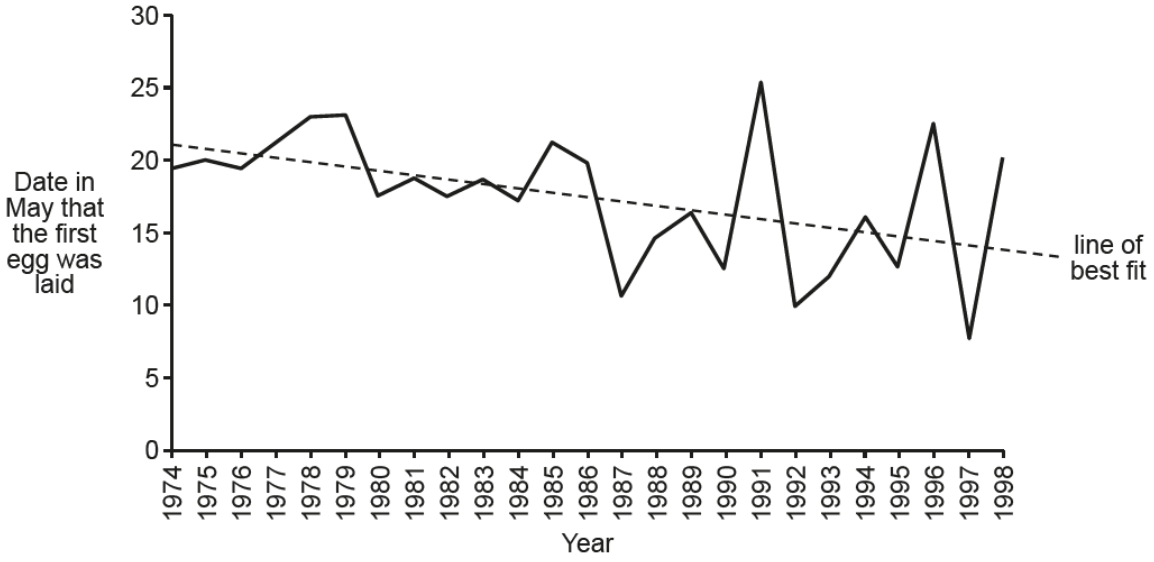
Question 19 (b)

(b) Blue tits usually lay their eggs in the month of May.

For many years, the scientists have recorded the first day that an egg was laid.

This data is shown in the graph.



The scientists made this explanation for the results:

The results are due to climate change.

Suggest arguments **for** and **against** this possible explanation.

Use information from the graph in your answer.

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

In this AO3 question, most higher ability candidates scored well. Most candidates were able to appreciate and describe the fluctuations. Some lower ability candidates wrote about climate change without mentioning an increase in temperature, for example, 'due to climate change eggs were laid earlier'. Some referred to the number of eggs laid rather than the timing, and many that didn't lost track that eggs were laid earlier. Some candidates thought climate change might not be the cause but then didn't suggest that another factor could be involved.

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Question 20 (a)

20 Some people get very painful headaches called migraines.

Scientists think that this is caused by a protein in the brain called CGRP.

Levels of the CGRP protein are higher in the brains of people who get migraines.

Doctors are trying to find a treatment to prevent migraines.

They have produced an antibody against the CGRP protein.

(a) Describe how antibodies are usually made in the human body.

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

Candidates have a very good understanding of this AO1.1 question recalling knowledge of antibody production. Most used the correct term lymphocyte and knew antibody production was in response to antigens.

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Question 20 (b) (i)

(b) The doctors test the antibody treatment on migraine patients.

The patients are divided into two groups:

- One group is given an injection of the antibody
- The second group receives an injection of a placebo.

They record the mean number of days each patient had migraines before and after treatment.

The table shows their results.

Treatment	Mean number of migraine days per patient **before** treatment	Mean number of migraine days per patient **after** treatment	Percentage decrease in migraine days per patient
antibody injection	9.1	4.4	
placebo	9.1	6.4	29.7

(i) Explain why a placebo group is used in drug testing.

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

This AO1.1 question tested knowledge of using a placebo group in drug development. Although it was described in a range of ways, most candidates realised the reason for a placebo group was to make sure that any improvement was not merely psychological. Fewer candidates stated that a placebo was a control, i.e. contains no active drug. Some candidates' responses focused on double blind tests and side effects. Very few candidates referred to the data in the table.

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Question 20 (b) (ii)

(ii) Calculate the percentage decrease in migraine days in the patients that had the antibody injection.

Give your answer to **1** decimal place.

Percentage decrease = ... %

[3]

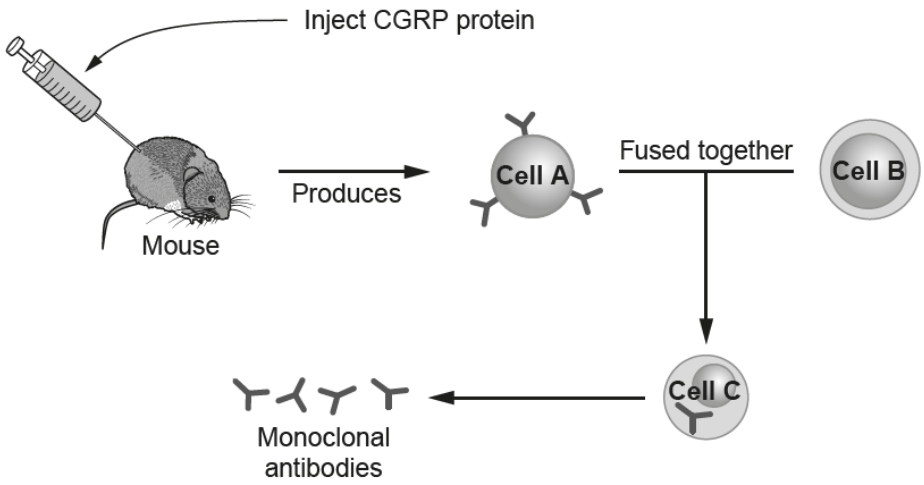
The AO2.2 part of this question resulted in candidates making a common error in not deriving 4.7, but the function and answer to their function were usually correct. Very few candidates scored zero, but a few worked out the correct answer then didn't round it correctly, so did not get the AO1.2 marking point.

Question 20 (c)

(c) The antibodies used in the investigation were monoclonal antibodies.

They can be made by injecting CGRP protein into a mouse.

The diagram shows this process.



Draw lines to identify each type of cell shown in the diagram.

Cell A	**Cancer cell**
Cell B	**Lymphocyte**
Cell C	**Hybridoma**

[2]

The vast majority of candidates managed to score both marks on this AO1.1 question.

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Question 21 (a)

21 Huntington's disease is a genetic condition. It is caused by a **dominant allele**.

(a) Explain what is meant by the term dominant allele.

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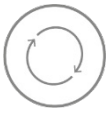
..... **[2]**

This AO1.1 question proved to be very challenging, even for some higher ability candidates. Many candidates did not define the term allele at all, limiting their maximum mark to 1.

	**AfL**	Candidates should be encouraged to learn definitions. Many candidates didn't seem to really understand the term dominant, in a biological context, using words like stronger, override or overpower.

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Question 21 (b)

(b)* The symptoms of Huntington's disease usually appear after the age of 40.

There is no cure and people with the disease usually die after 10–15 years.

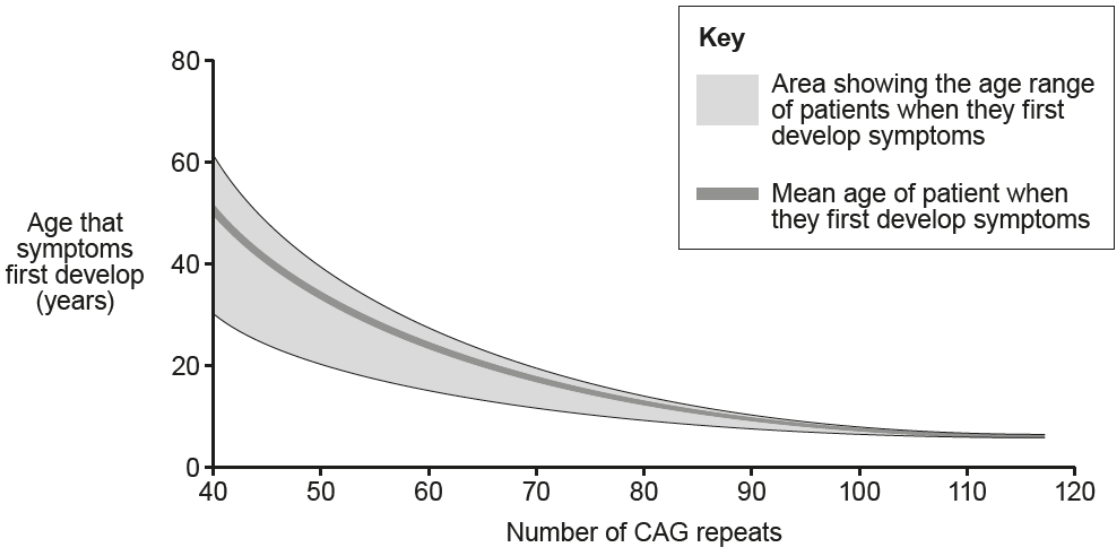
Scientists now know that there are a number of different forms of the allele that causes Huntington's disease. The allele has a sequence of three bases, CAG, that repeats many times. The number of repeats varies between patients.

Patients can be tested to see if they have the allele and how many repeats it has.

Doctors have studied many patients to see:

- The number of CAG repeats a patient has
- The age that the patient starts to show symptoms of the disease.

The results are shown on the graph.



Discuss how useful the gene test and the graph are for people who have a history of Huntington's disease in their family.

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

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There were a lot of good responses to this Level of Response question covering AO2 and AO3. Many candidates understood what was going on regarding the test and graph, and were able to evaluate the usefulness of these, in some cases in a very well-developed response. Most candidates understood that the test could tell the patient how many CAG repeats they have, and this information, together with the graph, may tell them when symptoms may present. Higher ability candidates appreciated that the information from the graph had limitations. There was, however, some confusion about what the test and graph were for in lower ability candidates. Some were using the graph to decide if they were old enough the take the test so they could find out if they had a history of Huntington's disease. Quite a few suggested the test and graph would allow them to be cured. Quite a few incorrectly explained how somebody's age determined the number of repeats they would have and that this would decrease as they got older. A common misconception was that if "caught" early, the disease could be prevented or cured. Some candidates seemed to have read the next part of the question (Q22(c)) about potential treatments and adapted their Level of Response answer, despite it saying a cure was not possible in the stem of the question.

Exemplar 1

It's useful to because there is no cure so people with the diseaise die after 10-15 years so by knowing if u doing the test and seeing how many CAG bases you have or alleles you can make the decision to not have children so they cant get the disease. Huntingtons disease. The graph is useful because it shows the mean age of patients when they first develop systems and symptoms are lower which means if you see how many CAG repeats you have you'll be prepared. However it may not be useful as it could stress people out or scare people if they see how many CAG repeats they have. [6]

This exemplar represents an excellent example of how to gain maximum marks. The candidate has clearly identified that the gene test identifies how many CAG bases are present. They also identify that the test will show if the allele is present and links this to a usefulness of making decisions about having children. The graph analysis is also evidenced in the recognition that it identifies the mean age when first symptoms develop and there is a link to the usefulness of being able to prepare, avoid stress and also mentioned about being scared. Communication is clear, concise and as all aspects of the AO2 and AO3 assessment targeted by the question have been covered it gains maximum 6 marks.

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Question 21 (c)

(c) A new study is giving hope for a treatment for Huntington's disease.

Doctors gave patients an injection of a drug that blocks the action of mRNA that is produced by the Huntington allele.

Explain how this drug could prevent the symptoms of Huntington's disease.

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

In this AO2.1 question a significant number of candidates thought that blocking the code meant the code would not be made at all (i.e. no transcription). A large number thought the method would somehow reduce the number of CAG repeats, and lower ability candidates thought this would get rid of the defective allele somehow. For candidates gaining 2 marks this was often for responses including ideas on 'preventing translation' so 'no protein synthesis or protein made'.

Question 22 (a)

22 A salt marsh is a large muddy area of land where a river joins the sea. This is a rare habitat and some plants grow on salt marshes but nowhere else.

(a) When the tide comes in the salt marsh gets covered with seawater.

Explain the effects of salt water on plant cells.

.....

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

On this AO2.1 question, even higher ability candidates found it challenging. Quite a few understood that water would be lost but did not mention osmosis or refer to the cells being plasmolysed. Many responses considered cell turgidity and possible lysis. Some even thought salt water was beneficial for providing the cells with minerals.

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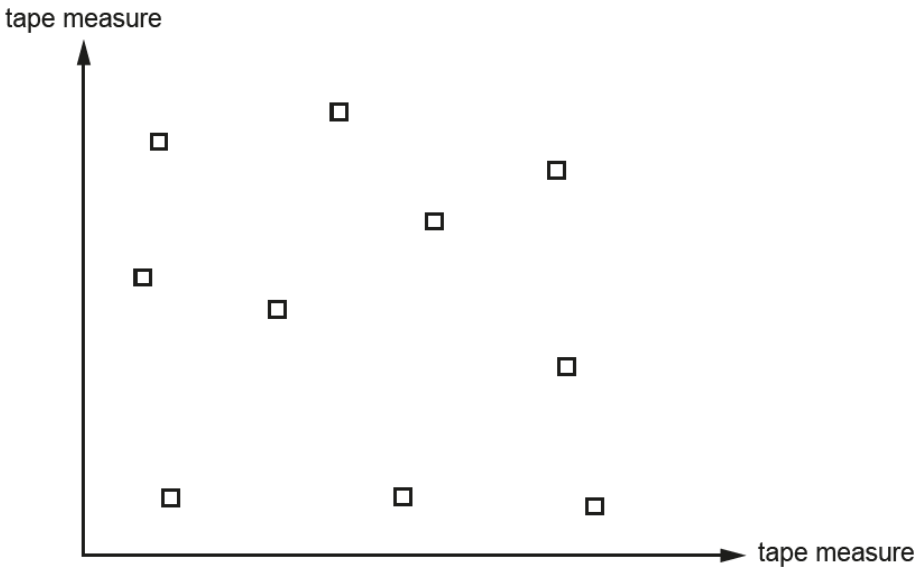
Question 22 (b) (i)

(b) A student investigates the plants growing on a salt marsh. He uses a quadrat to sample the plants.

He puts down two long tape measures at right angles to each other across the salt marsh. He then picks numbers at random and uses them to decide where to place a quadrat.

The diagram shows the position of all his quadrats across the salt marsh.



(i) The salt marsh measured 50 m × 50 m.

Each quadrat measured 0.5 m × 0.5 m.

Calculate the percentage of the whole salt marsh that was sampled by the student.

Percentage = ... %

[3]

This AO1.2 and AO2.2 question was generally answered well. Some candidates incorrectly rounded their answer and others did not multiply the area of 1 quadrat by 10, therefore using 0.25 instead of 2.5 in their calculation. Very few candidates scored zero, as often candidates were able to get marks for error carried forward. This emphasises the importance of candidates showing their working out.

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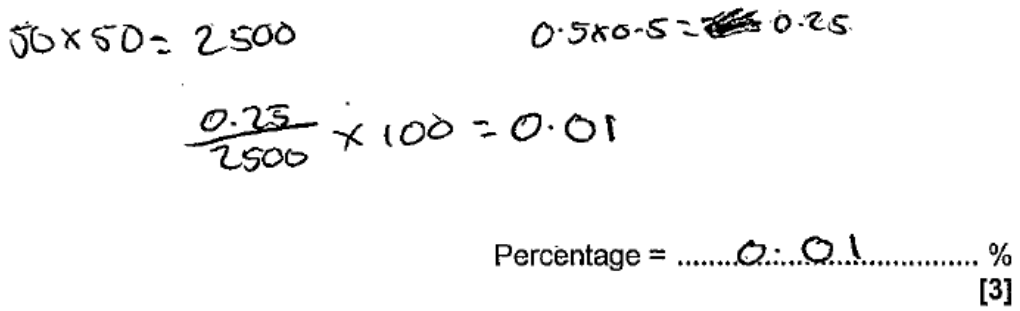
Exemplar 2



	AfL	In this exemplar, it shows how ECF was applied to incorrect responses. ECF was applied to the percentage calculation method with incorrect value for the area of the quadrats, then ECF for the percentage calculation value. This highlights how important it is for candidates to show their working out as the candidate would not have scored any marks if all they had put was 0.01 on the answer line, as it would not have been possible to apply ECF.

Question 22 (b) (ii)

(ii) A second student sampled by placing five quadrats close together in the centre of the salt marsh.

Evaluate the sampling method of the second student compared to the method of the first student.

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

The majority of candidates gained some marks on this AO3.1b question, with a minority gaining maximum marks. Most candidates were able to recognise that second student's method was not random and not representative of the entire marsh. Fewer commented on the fact that 5 quadrats cover less area than 10. Very few candidates observed that the plants would probably be different in different areas of the marsh.

	AfL	Candidates should be prepared to evaluate by processing information, graphs and diagrams before attempting answers, as this will help them construct responses that will cover the marks available in the question.

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Question 22 (b) (iii)

(iii) Suggest **one** factor that the students should consider in a risk assessment for their experiment.

.....

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

This AO3.3 question targeted practical skills and specifically improvement of experimental procedures. Many candidates misunderstood 'risk assessment' and suggested things that could go wrong with experiment; 'losing the quadrats', 'damaging or killing plants/animals', etc. rather than health and safety.

Question 22 (c)

(c) In some salt marshes large sand banks have been built. This stops tides from entering the salt marsh.

The level of soil on the salt marsh builds up and the marsh turns into dry land.

This dry land shows a greater biodiversity of plants than a salt marsh.

Explain why some scientists want to limit the building of sand banks, even though they increase biodiversity.

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

This AO3.2b question required suitable conclusions to be drawn from the evidence in the question. Many candidates realised a marsh is a rare environment and that plants that grow there would be lost if the sand banks were built. As the question mentions increased biodiversity, lower ability candidates incorrectly considered other, more general reasons linked to the sand banks, with a frequent response being 'it would cause flooding' or that 'it would be expensive'.

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Question 23 (a)

23 Rats are a major pest in many areas of the world. They can reduce food security and spread diseases.

(a) Warfarin is a chemical that is used as a rat poison. It stops the correct functioning of platelets in the blood.

Explain why warfarin can be used as a rat poison.

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

Many candidates were able to score both marks on this AO2.1 question although some did not mention platelets. A significant number of candidates, however, linked the poison to clotting incorrectly, saying blood would clot too much or in the wrong place. In that type of response, there were references to heart attacks and strokes. Some candidates referred to wounds clotting.

Question 23 (b)

(b) In 1958, some rats were found that were resistant to warfarin. They did not die, even when fed with large amounts of the poison. Scientists found that the resistance was due to dominant allele **R**.

Two resistant rats can mate and produce non-resistant rats.

Draw a genetic diagram below to show how these non-resistant rats can be produced.

[3]

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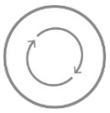
Many candidates scored on this AO2.2 question. The most frequent way candidates did not get maximum marks was by omitting to identify the correct offspring genotype.

Candidates needed to annotate rr. A significant number of candidates only identified the non-resistant rate, not noticing that homozygous dominant rats were also present in that ratio; and therefore only stating 25% were homozygous. Candidates should be encouraged to routinely include the phenotypic ratio.

	**AfL**	Some candidates made errors on the Punnett square diagram. The main error was to cross R with r and derive RR. Candidates should be encouraged to check their answers for this type of error.

Question 23 (c)

(c) When scientists studied the resistant rats they found that there were two different types.

Homozygous rats are resistant to warfarin but need to eat 20 times more vitamin K.

Heterozygous rats are resistant to warfarin but only need slightly increased amounts of vitamin K.

The scientists found that the non-resistant rats never died out completely.

Explain why.

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

Where candidates successfully answered this AO2.2 question, it was from developing ideas from the previous question and linking the vitamin K survival rate in the heterozygous rat to when two Rr rats mate rr rats will be born. Many responses to this question showed confusion. Candidates referred to a variety of incorrect explanations such as non-resistant alleles becoming dominant and rats finding enough vitamin K to become non-resistant but immune to warfarin. Other incorrect responses included non-resistant rats surviving because they don't need much vitamin K and rats in some areas not getting access to warfarin.

Question 23 (d) (i)

(d) Scientists now think that they might be able to reduce rat populations by using genetic engineering. They want to insert a gene into male rats that destroys all sperm that contain an X chromosome.

(i) Name the enzyme used to join two sections of DNA together in genetic engineering.

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

Although many candidates did score on this AO1.1 question, the most common error was to refer to restriction enzymes. A significant minority gave lipase as their answer.

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Question 23 (d) (ii)

(ii) Explain how this method of genetic engineering would rapidly reduce the rat population.

You may use a diagram in your answer.

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

Higher ability candidates scored well on this AO1.1 and AO2.1 question. Several candidates thought the space for a diagram required them to illustrate how genetic engineering was carried out, rather than showing what would happen in a cross without an X sperm. Many candidates unfortunately replaced the X sperm with a Y, saying males were now YY. Also, there was evidence of a few candidates still mixing up the chromosomes and incorrectly recalling the male as XX and female as XY and others who had correctly done a Punnett square but did not annotate the genotypes. Lower ability candidates showed little understanding about sex-determination or the difference between a gene and a chromosome.

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