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GCSE (9-1)

*Examiners' report*

# GATEWAY SCIENCE BIOLOGY A

**J247**
For first teaching in 2016

## J247/04 Summer 2018 series

Version 1

# Contents

# Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

# Paper J247/04 series overview

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.

***Candidate performance overview***

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 median: Q7, calculating percentage decrease: Q6, calculating population size: Q19b, substituting numerical values into algebraic equations: Q21e(i).
- Identified the correct sequence of the technique for making monoclonal antibodies: Q22b.
- Applied their knowledge and understanding of natural selection to a given context: Q16c(ii).
- Produced clear and concise responses for the Level of Response question: Q23b.
- Applied knowledge and understanding to questions set in a novel context.

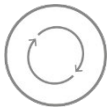
Candidates who did less well on this paper generally did the following:

- Found it difficult to apply what they had learnt, to unfamiliar situations.
- Found using percentages in mathematical calculations challenging: Q23c(i).
- Did not link the data showing lack of growth back to reduced light intensity and rate of photosynthesis and subsequent linking of photosynthetic products to growth: Q17b.
- Lacked knowledge in definitions of the terms gene and allele: Q18a.
- Questions designed to assess candidates' practical abilities were challenging and indicated a lack of awareness of the skills involved in practical activities and investigations.

There was no evidence that any time constraints had led to a candidate underperforming.

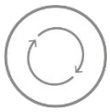
# Section A overview

Candidates coped well with selecting choices, however, there were a minority of instances where candidates used lower case letters in their response. This should be discouraged as it can be difficult due to handwriting styles to distinguish the desired letter.



Also, there were occasionally some candidates who had crossed out answers then written responses that were difficult to then identify over the crossed out response. Any alteration must be clearly distinguishable.

**Key:**



**AfL** Guidance to offer for future teaching and learning practice.

## Question 5

**5** Which of these is an adaptation of white blood cells?

**A** The ability to make clotting enzymes.

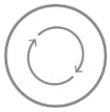
**B** They can change their shape to pass out of capillaries.

**C** They can synthesise antibiotics.

**D** They lack a nucleus.

Your answer ☐ **[1]**

This question was designed to test recall of knowledge AO1.1. It was clear from the responses of the majority of candidates, that there was a lack of the knowledge of white blood cells and their ability to move out of capillaries by changing their shape.



The ability of white blood cells to leave the circulatory system through the capillary walls should be taught in the context of white blood cells destroying pathogens.

## Question 12

**12** A harmful protein can cause pain in the joints. A new treatment is being developed to stop the protein causing pain.

What effect would this treatment have on the person's phenotype and genotype?

**A** Changes both the phenotype and genotype

**B** Changes the genotype only

**C** Changes the phenotype only

**D** No change to their phenotype or genotype

Your answer ☐ **[1]**

This question assessed candidates' understanding of how the phenotype and genotype are affected under different conditions. Many candidates' responses were that it was only the genotype that would be affected by the treatment rather than the correct response being only the phenotype.


This may indicate a misconception in candidates thinking that anything that happens within the body has to do with the genotype.

**Key:**


**Misconception**

## Question 13

**13** Which statement **best** describes the development of the theory of evolution by natural selection?

**A** Darwin and Mendel working together

**B** Darwin and Wallace working independently

**C** Darwin and Wallace working together

**D** Mendel working on his own

Your answer ☐ **[1]**

This question tested recall of knowledge AO1.1. Many candidates incorrectly chose C. This was a very common response indicating that candidates knew the names of the scientists involved but thought that Darwin and Wallace worked together on the theory of evolution by natural selection. It is important for candidates to realise that theories can develop with research from scientists who are conducting this work independently.

## Question 14

**14** Females aged between 12 and 13 are offered a vaccination for the human papilloma virus (HPV).

Which statement describes the reason for offering this vaccine?

**A** Contracting HPV greatly increases the risk of developing AIDS.

**B** Having the vaccination will prevent cervical cancer.

**C** HPV can be treated with antibiotics but cervical cancer cannot.

**D** HPV has been linked to about 70% of cases of cervical cancer.

Your answer ☐ **[1]**

This AO1.2 question required knowledge of scientific enquiry and procedures linked to interactions of diseases. Higher ability candidates were able to identify the link between HPV and cervical cancer, but some candidates assumed incorrectly that the vaccine prevents cervical cancer.

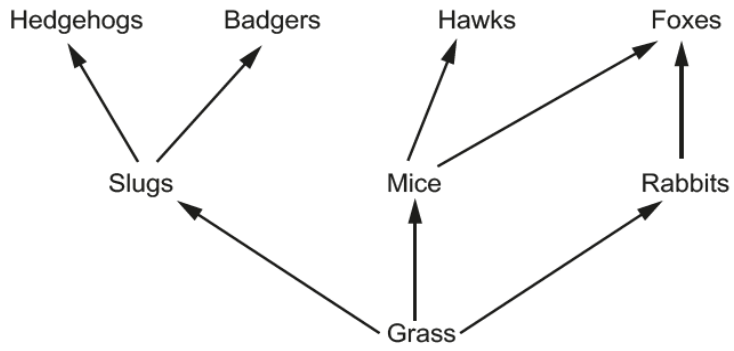
# Section B overview

Candidates coped well with interpreting data to draw a graph and 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. 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 and in producing appropriate lines of best fit for the data presented.

Also, there were some candidates who had written extensively on the Level of Response question but much of this was irrelevant, repetitious or paraphrasing information in the stem of the question. This could be overcome by better preparation by candidates for this type of question. For example, taking time to think about how to answer an LoR, breaking down the elements of the question and identifying the key concepts it is assessing. Candidates are encouraged to make brief notes and think through key areas prior to writing their final response.

## Question 16(a)

**16** The diagram shows part of a food web from a grassland.




**(a)** How many secondary consumers are shown in this food web?

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

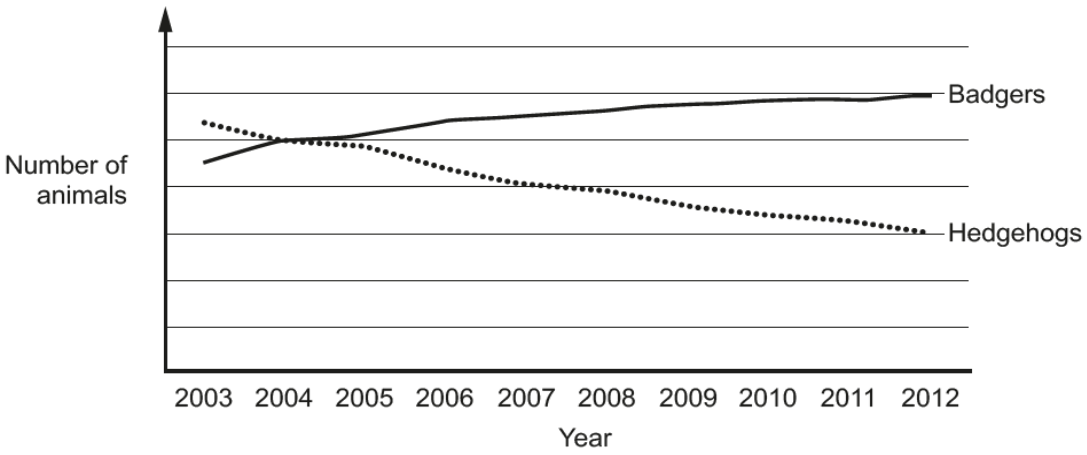
This AO1.2 question required knowledge of scientific enquiry and procedures linked to interactions of organisms in a food web. Many candidates successfully identified four as the correct number. Lower ability candidates opted for the animals feeding on grass, thinking these were secondary consumers and incorrectly gave three as a response.

## Question 16(b)

**(b)** A survey was set up to see if the number of badgers and hedgehogs has changed in the UK.

The number of badgers and hedgehogs were counted in different areas each year from 2003 to 2012.

The graph shows the results.




Use the food web to suggest an explanation for the change in the number of hedgehogs shown in the graph.

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



This question assessed the analysis of information and drawing conclusions in AO3. Most candidates achieved full marks. Where candidates did not get full marks, this was usually due to forgetting to identify the increase in badger population or stating categorically that there would be **no** food or **no** hedgehogs, which did not gain a mark. Candidates need to refer to graphs or tables when given this information, to avoid making this type of error.

## Question 16(c)(i)

**(c)** Hedgehogs are covered in small spines.

When they are frightened they often roll up into a ball and keep still.


**(i)** In country areas, where badgers live, this is an advantage to the hedgehogs.

In cities, where there are many roads, this is a disadvantage.

Explain these two conclusions.

.....

.....

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

This AO2.1 question was answered well overall. Candidates did not gain marks if they didn't correctly link their responses specifically to country or city areas. Just referring to roads was insufficient, however, candidates referring to many roads gained a mark as this distinguished the difference between city and country areas. The terms rural and urban were acceptable alternatives to country and city, in candidates' explanations. A common error was to say the rolling up was camouflage without explaining the answer.

## Question 16(c)(ii)

**(ii)** Scientists have noticed that a new type of hedgehog is increasing in numbers in cities.

These hedgehogs do not roll up. They run away when frightened. The scientists think that genes control this behaviour.

Explain how this type of hedgehog may become more common in cities.

Use ideas about natural selection.

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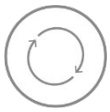
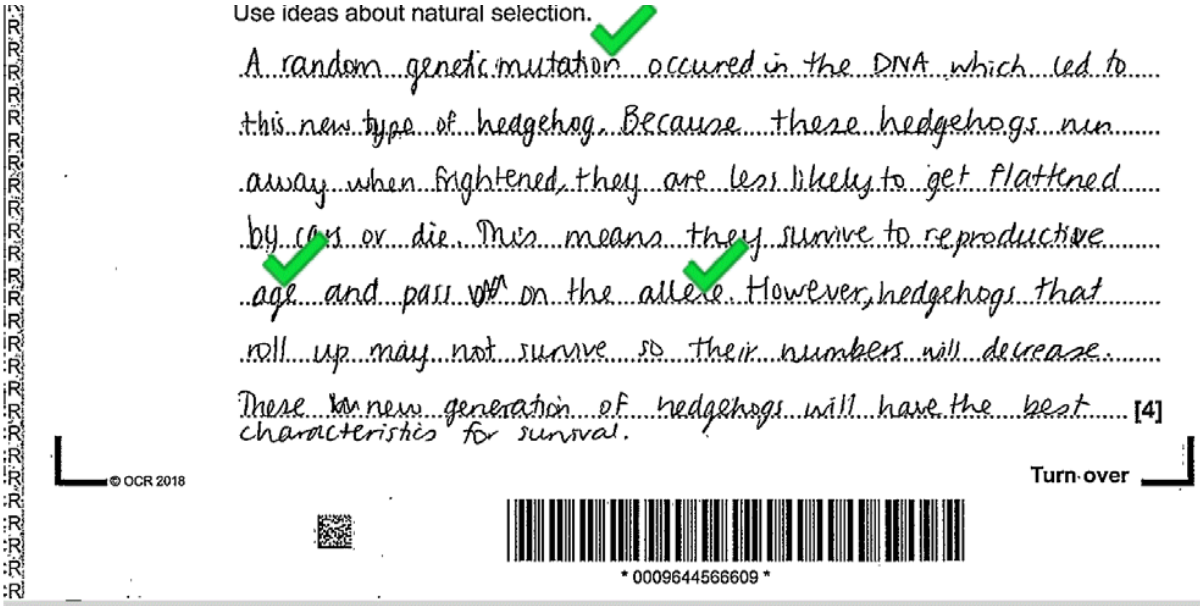
..... **[4]**

This application of knowledge of natural selection question usually resulted in candidates gaining at least two marks. This was usually for identifying that the hedgehogs that could run away had a higher survival rate and could go on to breed. Higher ability candidates were able to link this to the advantageous gene and some could refer to the process occurring over time. Fewer candidates scored the last two marking points because they referred not to the advantageous gene, but in general to genes, mutation (not mutated gene) or to the trait or characteristic or behaviour of running away, and, for the last point, stating that because run away hedgehogs survived to breed, their numbers exceeded the numbers of roll up ones, simply because the roll up ones died.



Examination technique needs candidates to focus on applying their knowledge to a new scenario, and to answer the question asked, not to talk in generic terms.

## Exemplar 1



Use ideas about natural selection.

A random genetic mutation occured in the DNA which led to this new type of hedgehog. Because these hedgehogs run away when frightened, they are less likely to get flattened by cars or die. This means they survive to reproductive age and pass on the allele. However, hedgehogs that roll up may not survive so their numbers will decrease. These new generation of hedgehogs will have the best characteristics for survival. [4]

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pass on the allele was given as this answer is clearly referring to the advantage of running away/the genetic mutation which led to this type of hedgehog (running away hedgehog)

This candidate has been credited 3 marks. A mark is gained for identifying that a mutation has occurred to produce the running away hedgehog. They have gained a second mark for recognising they survive to reproductive age. Many candidates just referred to breeding or producing offspring which were deemed acceptable responses for that particular marking point. Also a third mark was gained for 'pass on the allele' has been given as they clearly understand that it is referring to the advantage of running away/genetic mutation for the advantageous gene. The candidate has not gained a mark for the new generation of hedgehogs as this does not reference the idea of the process repeating over several generations/overtime.

## Question 17(a)

**17** A student investigates the plants growing underneath a tree.

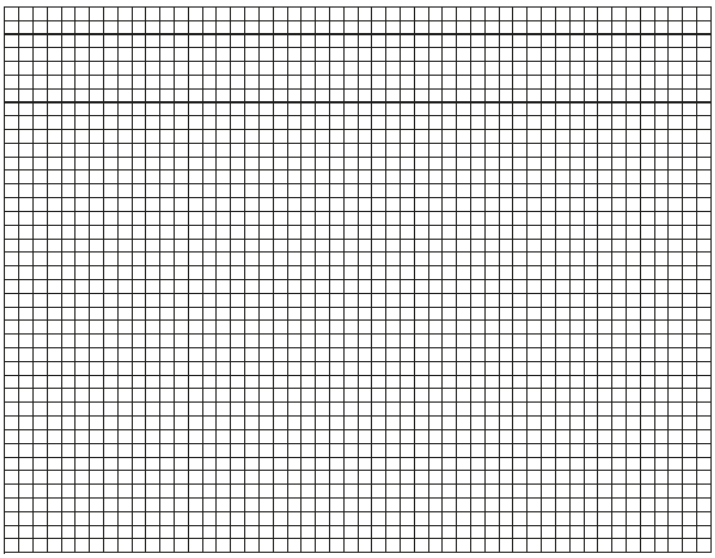
He lays out a tape measure on the ground, starting at the tree. He then places a quadrat on the ground.

He measures the percentage of the ground in the quadrat that is covered by plants. He repeats this every metre away from the tree.

The table shows his results.

| Distance from the tree (m) | Percentage of ground covered by plants (%) |
|---|---|
| 1 | 10 |
| 2 | 15 |
| 3 | 18 |
| 4 | 22 |
| 5 | 50 |
| 6 | 58 |
| 7 | 62 |
| 8 | 64 |

**(a)** Plot a graph of the student's results and draw a line of best fit.



**[5]**

This question assessed candidates' ability to apply knowledge and understanding of scientific enquiry, techniques and procedures in graphing skills. Many candidates scored 4 marks and missed out on the mark for the line of best fit as they drew straight lines that did not go through or near any of the points. The mark scheme looked for the line through most of the points and this was best achieved by a curved line. There were a significant number of candidates who plotted the variables on the wrong axes. This did lose them a mark, but they were able to score the other marking points if all points were plotted accurately, to a suitable scale and a suitable line of best fit was drawn.

## Question 17(b)

**(b)** The student thinks that shade from the tree is affecting the plants.

Explain how the student's results show this.

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

This question assessed four different assessment objectives. Candidates had to identify the trend from the graph and apply their knowledge and understanding to give a reason for the trend. They also had to interpret reasons for the trend and draw conclusions about how the shade was affecting the plants. Most candidates identified the trend. Higher ability candidates linked this to less light closer to the tree so reduced rate of photosynthesis. However, only the highest ability candidates concluded that this would result in less glucose/food production. Most candidates just referred to reduced growth, which on its own did not score a mark.

## Exemplar 2

The results show that the further away from the base of the tree (where the shade is strongest) the more plants are growing. For example, 1m away only 10% of the ground is covered by plants whereas 8m away a greater percentage of 64% of grand is covered. This means that the higher the light intensity (away / less shade), the higher rate of photosynthesis showing it is a limiting factor and helps more plants to grow. Whereas the shade limits the light intensity and limites growth. [4]

This candidate has been credited with 3 marks. A mark is gained for identifying the trend as a reverse argument. They have gained a second mark for recognising that this is due to a higher light intensity further from the tree. A third mark was gained for linking the increase light intensity to an increased rate of photosynthesis. The candidate has not gained the final conclusion mark as they have only referenced the plant growth and not the food/raw materials produced to enable thegrowth to occur.

## Question 18(a)

**18** Retinitis pigmentosa is a genetic condition that affects the eyes.

It is caused by a mutation to a gene. This mutation produces a recessive allele.

The condition causes rod cells in the retina to break down.

**(a)** Explain the meaning of these terms.

Gene .....

.....

Allele .....

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

This question tested recall knowledge AO1.1 of the definitions of two genetic terms. The most common error was to only describe the gene as a section of DNA coding for a characteristic rather than coding for a protein. Candidates had a better knowledge of what an allele was.

## Question 18(b)(i)

**(b) (i)** Two people who are heterozygous for retinitis pigmentosa are expecting a baby.

Draw a genetic diagram to calculate the probability that the baby will have the condition.

Use R for the normal allele and r for the allele for retinitis pigmentosa.

Answer = ..... **[3]**

This question assessed AO2.2 with the application of practical techniques in completing a genetic cross. This was particularly well done by most candidates, except some candidates did not choose the symbols recommended in the question and this caused them confusion in interpretation. The question also included an AO3 mark for interpreting and drawing a conclusion from the Punnett square. The most common error was to give 75% as the response. Some candidates also made an error by describing the ratio as 1 in 3 when they should have written 1 in 4 or 1:3. These errors could be minimised by improving examination technique, where candidates are made aware of common errors in interpreting genetic diagrams.

## Question 18(b)(ii)

**(ii)** If the baby has retinitis pigmentosa, it will have normal colour vision but will not be able to see well in dim light.

Explain why.

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.....

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

This question covered AO1.1 and AO2.1. Candidates often did not identify that rod cells were damaged. They frequently just put rod cells break down, missing out it was '**only**' the rod cells, and hence were just repeating what was in the stem of the question. Good responses also discussed cones cells so got the reverse argument.

## Question 18(c)(i)

**(c)** **(i)** Explain why stem cells could be used as a treatment for this condition.

.....

.....

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

Most candidates were able to describe what a stem cell is assessing AO1.1, and many had the AO2.1 idea that they could become rod cells. Some missed the AO2.1 mark by referring to damaged or mutated cells, instead of the rod cells.

## Question 18(c)(ii)

**(ii)** Why is it an advantage to use stem cells from the patient rather than from another person?

.....

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

This AO2 question was generally answered well. Lower ability candidates stated that stem cells from another person "wouldn't work". Marks are scored more frequently when candidates avoid general terms, and responses are specific to the question asked.

## Question 19(a)

**19** The data in the table shows the ratio of males to females in England and Wales.

| | **Ratio of males to females in England and Wales** |
|---|---|
| At birth | 105 males : 100 females |
| Average over the whole population | 98 males : 100 females |

**(a)** Describe how sex is determined in humans.

You may use a genetic diagram in your answer.

.....

.....

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

Most candidates scored well on this AO1 question. Candidates who didn't gain marks either mixed up the genders, saying females were XY, or occasionally they used incorrect nomenclature **m** and **f,** and some had **YY** as a possible genotype.

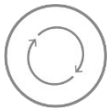
## Question 19(b)

**(b)** In 2015 there were approximately 698 000 babies born in England and Wales.

Calculate how many of these were male.

Answer = ..... **[2]**

This question assessed candidates' mathematical skills in AO2.2. In the main, many candidates got maximum marks. Common incorrect responses were due to rounding errors, including rounding before multiplying. Lower ability candidates simply halved 689000. Some candidates made rounding errors but only wrote the final answer and had not shown any working. They were not able to gain the mark for correct working out even though they had most likely done this. Improved examination technique and practice would overcome this.


Examination technique needs candidates to focus on candidates showing their working out on calculations.

## Question 19(c)

**(c)** There are more females than males living in England and Wales as an average over the whole population.

Suggest **one** reason why there are more females.

.....

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

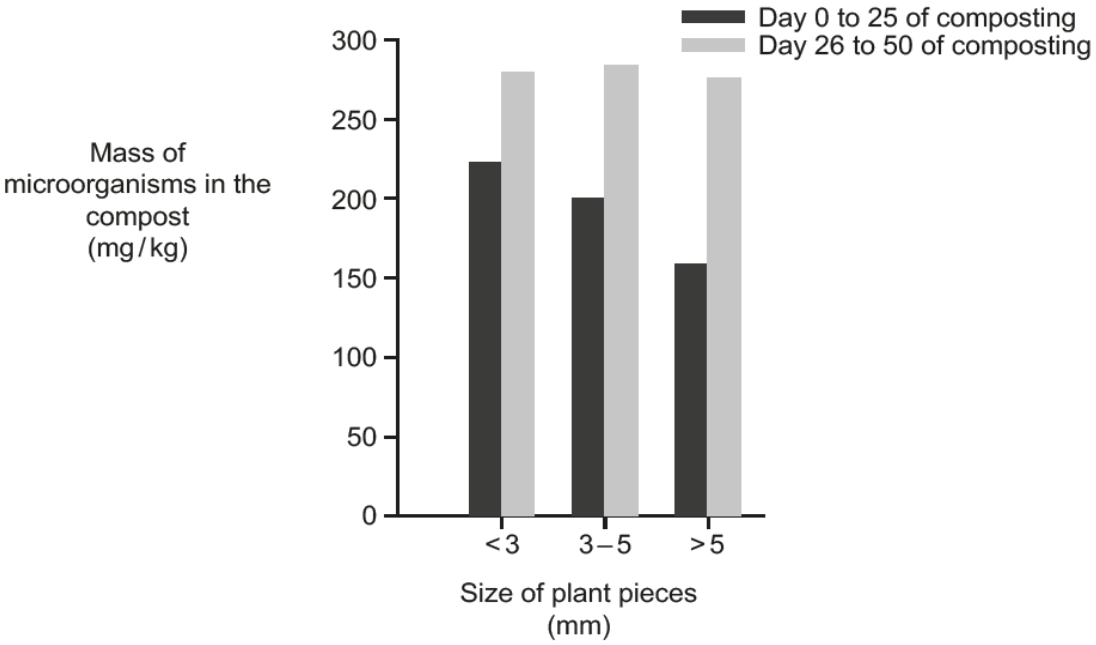
In this AO3 question many candidates tried to explain why it was likely that males die, but few referred to them dying earlier than females, or that females live longer. Higher ability candidates correctly referred to the longer life expectancy of females.

## Question 20(a)

**20** This machine helps shred plants for a compost heap.

The machine can shred plants into three different sizes.

This graph is in the instruction booklet for the machine.




**(a)** Which size of plant pieces is best for making compost?

Explain your answer.

.....

.....

.....

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

In this question assessing AO3, many candidates scored at least two marks. They had two opportunities from the data to gain the first marking point, but to gain the second marking point they needed to correctly match this to the day range, some did not do this. Far fewer candidates then went on to link this to the faster rate of decomposition.

## Question 20(b)

**(b)** The size of the plant pieces has an effect on the number of microorganisms in the compost.

Suggest why.

.....

.....

.....

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

In this AO2 question, few candidates linked size to area and a number incorrectly thought large pieces had large surface area. Very few candidates were able to link the size to rates of respiration or reproduction.

## Question 20(c)

**(c)** The decomposition of dead plants and animals is an important process for ecosystems.

Explain why.

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.....

.....

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

Most candidates understood the concept of recycling nutrients and often correctly named examples. Only a few understood the importance of this, beyond the idea that the nutrients are needed. Occasionally did they say specifically why.

### Exemplar 3

It is an important process because decomposed plants and animals contain a lot of carbon and decomposing carbon also releases oxygen ($CO_2$) and this is very important because living plants use carbon dioxide to photosynthesise and release oxygen which all living animals are dependent on.

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

This candidate has been credited maximum marks. They have identified a named element that is recycled and indicated that this is released by decomposition. The description of it being further used by living plants is sufficient to demonstrate an understanding of recycling. They complete their response by explaining why the plants take in the carbon dioxide by referencing its use in photosynthesis.

Although this last marking point was seldom seen, where it was, this was usually associated with plants photosynthesising and only very occasionally with plants producing proteins.

## Question 21(b)

**(b)** State why the student changed the volume of water in each flask.

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

In this AO3 question many candidates found difficulty in communicating that the same volume overall was needed, or to change the concentration of acid. Where candidates did gain marks, it was often for stating 'so volume adds up to $20cm^3$'.

## Question 21(c)

**(c)** The student kept each flask at the same temperature during the experiment to make it a fair test.

Explain **one** other reason why she kept each flask at the same temperature.

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

This AO3 interpretation question provided challenge for most candidates. Often responses were seen referencing prevention of evaporation, which did not gain marks. Few candidates correctly linked the temperature to its effect on germination rate. Some higher ability candidates did give correct references to enzyme action.

## Question 21(d)

**(d)** Explain what this experiment shows about the effect of acid rain on seed germination.

.....

.....

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

This question assessed AO3 evaluation. Most candidates correctly identified the effect of acid on germination, but none commented on the pattern in the data. On the very rare occasion that a second mark was obtained, it was for identifying that germination still did happen with highest concentration stating that 'the higher acid concentration reduces germination rate, but it doesn't stop it altogether' which got maximum marks.

## Question 21(e)(i)

**(e)** The student used a formula to describe the germination of seeds called the viability index (**VI**).

**(i)** For the seeds in 20 $cm^3$ of sulfuric acid, the mean root length was 5 mm and the mean shoot length was 2 mm.

Calculate **VI** for these seeds.

Use the equation:
VI = mean root length × mean shoot length × percentage of seeds that germinated

Answer = ..... **[2]**

This AO2 question assessed mathematical skills in a practical context. Many candidates did well and scored both marks. Some had an incorrect answer but scored the working out mark for getting 10%. Again, this emphasises the advantage of candidates ensuring that they show their working out in the space provided for them to put their response.

## Question 21(e)(ii)

**(ii)** Using **VI** is a better way of comparing the effects of acid rain than just using the number of seeds germinated.

Explain why.

.....

.....

.....

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

This AO3 question linked to improving experimental procedures was looking for the idea that VI, by measuring length of roots/shoots, looked at growth not just germination. However, candidates simply repeated the question (just referencing about the length of shoot/roots) and used terms such as accurate, precise and reliable to try and cover the improvement aspect of the question. Very few were able to identify that percentage germinated was a better value to use than number of seeds germinated.

## Question 22(a)

**22** Methamphetamine is a drug.

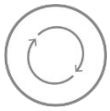
Scientists are investigating the use of antibodies as a treatment to control the negative effects of the drug.

**(a)** What is an antibody?

.....

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

This AO1 recall question did identify some areas for improvement. Candidates struggled with using correct terminology, referring to disease instead of pathogen and attacking and fighting instead of describing the mode of action of antibodies. Few candidates stated that an antibody is a protein.



When developing examination technique, candidates should be encouraged to use mark schemes to appreciate the importance of detail and terminology appropriate to GCSE level of study.

## Question 22(b)

**(b)** As the human body does not naturally make antibodies against methamphetamine, scientists are using mice to make antibodies.

Describe how large amounts of the antibodies can be made using monoclonal antibody techniques.

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.....

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

This AO1.2 question allowed candidates to demonstrate their knowledge of a scientific technique. There were some excellent maximum mark responses by higher ability candidates and most were able to gain 1 or 2 marks. Whilst some candidates knew this process, many forgot what the role of the antibodies specific to this question was, talking in generic terms and mixing up this example with others. Those that did know this process often wrote about fusing antibodies not lymphocytes with cancer cells, however, many scored the mark for knowing the term hybridoma. Those that scored zero often got confused and wrote about genetic engineering in terms of cutting and splicing DNA.

## Exemplar 4

techniques.

A mouse is injected with the methamphetamine. Lympacytes within the mouse do not replicate enough so they bind to the methamphetamine to form hybridomas. This then replicate to form monoclonal antibodies which are large amounts of antibodies to fight off this methamphetamine. [4]

This candidate has been credited with 3 marks. They have identified specifically that it is methamphetamine that is injected rather than generic antigens. The have identified that lymphocytes are involved, but not gained a mark as they haven't recognised the need to harvest these. Likewise they have incorrectly linked the fusing of these to methamphetamine rather than tumour cells, so have missed that marking point. However, they have recognised that a hybridoma is formed, so get that marking point.

Although this last marking point was seldom seen due to many candidate responses describing antibody production in generic terms, here the candidate has identified that the production of large amounts of antibodies is specifically for the methamphetamine so gets a third mark.

## Question 22(c)

**(c)** These antibodies would **not** work against other drugs.

Explain why.

.....

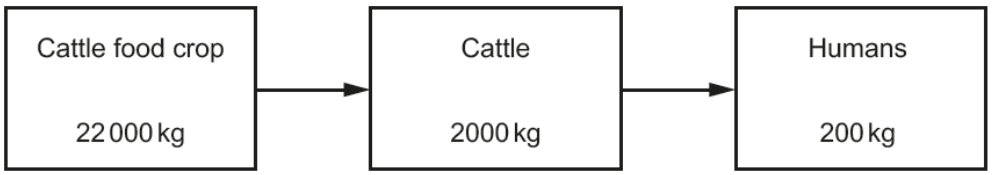
.....

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

Although this AO1.1 question was mostly answered successfully there were common errors shown by lower ability candidates. Often lower ability candidates referred to specific antigen rather than specific antibody. Occasionally they would write about bacteria, and in some cases confused this with the lock and key hypothesis and ideas about enzymes.

## Question 23

**23** The diagram shows the flow of biomass through an agricultural food chain.




## Question 23(a)(i)

**(a) (i)** Calculate the percentage efficiency of transfer of biomass between the cattle food crop and humans.

Answer = ..... % **[2]**

Candidates found this AO2.2 question quite challenging, often over-complicating it. Many performed incorrect divisions, and a few candidates rounded up to 1, then were only able to gain the mark for showing their working out.

## Question 23(a)(ii)

**(ii)** Write down **two** ways that biomass is lost from the food chain.

1 .....

2 .....

**[2]**

This recall AO1.1 question was generally answered well. Movement on its own did not score but some candidates correctly linked this to respiration and so gained the mark for respiration.

## Question 23(b)*

**(b)*** High levels of light intensity can damage plants. To prevent damage, plants have a protection mechanism.

When light intensity levels get **too high**, the protection mechanism switches on. This stops the plant absorbing too much light.

When the light intensity drops to safe levels, the protection mechanism switches off **slowly**.

Explain why this mechanism would **reduce** the biomass available to humans.

.....

.....

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

This Level of Response question assessed all three main assessment objectives. It was common to be limited to a low level mark due to repeating the stem of question regarding less biomass all through their response instead of linking the protection mechanism's impact to less light, less photosynthesis so less glucose/food made and consequently less food for cattle and humans. Candidates that did not appreciate that a reduction in light resulted in a reduction in photosynthesis, which also limited their answer to a low level.

There was little evidence of candidates planning their response. Taking time to consider how to answer a LoR, might encourage them to make notes and think through key areas. A common low level answer was to refer to the loss of energy due to the energy needed to switch on the mechanism. It was noted how many candidates did not link biomass to growth or production of food. However, those candidates that realised that the key to the answer was essentially linked to factors influencing photosynthesis, produced excellent responses.

## Exemplar 5

L3

High light intensity levels cause the plant to absorb less light, reducing the amount of photosynthesis that takes place. This means the plant will not grow as much/as quickly so there is less ~~&~~ crops that grow. ~~available for humans to consume~~ As a result yield decreases so the mass of crops decreases. This means there is less food ~~to~~ available for humans to consume. When the protection mechanism switches off slowly, there is a gradual increase in the amount of glucose the plant makes which slowly increases biomass available. However if it slowly increases ~~the~~ to level of photosynthesis there is still less energy available for human consumption. [6]

This answer has less light/less photosynthesis and less crop and links this to the impact on the food chain so all Level 3, 6 marks

This candidate has been credited Level 3 maximum 6 marks. They have structured their answer in a concise manner but included all the relevant marking points. The candidate describes the protection mechanism's impact in reducing light andphotosynthesis. The candiates states that thedecrease in mass of crops and food made means there is consequently less food for the humans to consume. They continue to give a reason why there will still be less energy available even when the plants resume photosynthesis due to the mechanism switching off slowly.

## Question 23(c)(i)

**(c)** Switching off the protection mechanism described in part **(b)** involves the plant making a **protein**.

Scientists have put extra copies of the gene for this protein into the plants. This makes the plant make more mRNA molecules.

**(i)** Explain why making more mRNA will switch off the mechanism faster.

.....

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

This question assessed AO2.1. Many candidates were able to link mRNA to either more or faster protein synthesis, but very few referred to the term 'code' to link mRNA and protein synthesis.

## Question 23(c)(ii)

**(ii)** Scientists have found that the genetically modified plants make 20% more biomass.

Use the agricultural food chain on page 21 to calculate the increase in biomass this would provide for humans.

Answer = ..... kg **[2]**

Candidates found this AO2.2 mathematics skills question quite challenging. 240 was a common incorrect response. Candidates need to have more practice at similar questions using percentages to develop their mathematical skills in this area.

## Question 23(c)(iii)

**(iii)** Inserting extra copies of a plant's gene into a plant is a type of genetic modification (GM).

Another example of GM involves inserting a bacterial gene into a plant which makes the plant produce an insecticide.

People are more likely to support genetic modification involving extra copies of the plant gene, rather than inserting the bacterial gene.

Suggest reasons why.

.....

.....

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

This question assesses both AO2 and AO3. Candidates were most likely to score a mark for the AO3 marking point, but it was rare for them to gain the AO2 mark. Many candidates described the effect of the gene on the plant, not consumers, or did not pick up on the possible problems of the insecticide itself. There were several responses written about the concern about genetic modification not being a natural process. This is an idea that mark schemes are unlikely to credit, preferring instead to focus on the effects of GM food on all consumers. Candidates also frequently missed out writing about the plants own genes and just focused on the AO3 marking point of the bacterial gene so missed the AO2 marking point. It was common for candidates to write about general dangers of bacteria and infections and not specifically the gene.

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