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GCSE (9–1)

Examiners' report

GATEWAY SCIENCE BIOLOGY A

J247
For first teaching in 2016

J247/04 Summer 2023 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. A selection of candidate answers is also provided. 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 and the mark scheme can be downloaded from OCR.

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Paper 4 series overview

J247/04 is the second paper candidates take for the higher tier Gateway GCSE Biology suite. It assesses content from specification topics B4-6 and B7 practical skills with synoptic links to B1-3. Therefore, for candidates to perform well on this paper they will need to have sound knowledge of the theory covered in B1-6 and be able to apply this to novel situations. The J247/04 component includes a multiple choice question section and a short answer 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. Candidates also need to apply the skills and understanding that they have developed in the practical activities covered in B7. There are also questions that involve the assessment of key mathematical requirements from Appendix 5f of the specification.

This is the first examination without an advance information notice of topics to be tested in the specification since the Covid pandemic which led to two years of teacher and centre assessed grades. This is the first full series which is comparable with the June 2019 series except that there has been disruption in the learning and the current cohort have experienced remote teaching during their secondary education.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• demonstrated knowledge and understanding of the role of the immune response in Question 18 (a); capture-recapture sampling method in Question 20 (b); describing the method of selective breeding in Question 21 (b); understood asexual reproduction in Question 22 (b) (i) and the enzymes involved in genetic engineering in Question 23 (b) (i) and (ii) • demonstrated application of knowledge and understanding of genetically inherited disease in Question 17 (a) and (b) plus biological control in Question 23 (a) • performed correct calculations in Questions 16 (c), 23 (b) (ii) and 23 (c) (iv) • were able to extract data from graphs/tables in Questions 19 (b) and 23 (b) • demonstrated knowledge and understanding and application of respiration in the Level of Response question, Question 19 (c)* • could correctly draw conclusions on fastest decomposition in Question 16 (c) • could chose a suitable scale and plot data and draw a line of best fit in Question 19 (a).	• could not demonstrate knowledge and understanding of decomposition condition in Question 16 (a); function of the iris and cerebellum in Question 17 (c); and selective breeding in Question 21 (b) • could not demonstrate application of knowledge and understanding of genetic crosses in Punnett squares in Question 17 (b) and natural selection in Question 21 (a) • could not perform correct calculations in Questions 16 (c), 23 (b) (ii) and 23 (c) (iv) • were not able to extract data from graphs/tables in Question 19 (b) and 23 (b) • demonstrated limited knowledge and understanding and application of respiration in the Level of Response question, Question 19 (c)*.

Section A overview

Candidates responded well with selecting choice in this section, attempting all questions. However, there were still some instances where candidates used lower case letters in their response. This should be discouraged as it can be difficult to distinguish the desired letter due to handwriting styles.

Question 1

1   Which group will have the **most** organisms in any ecosystem?

    A   Community

    B   Population

    C   Species

    D   Trophic level

Your answer   ☐   **[1]**

> Over half of all candidates correctly identified community as the group with the most organisms, however a significant number of incorrect responses identified population as the group with the most organisms.

Assessment for learning

Centres could reinforce key terms in ecology as it has been identified as a knowledge gap in understanding the difference in population and community.

Question 2

2   Biomass is lost as it passes through a food chain.

Which processes are responsible for this loss in biomass?

    A   Egestion, excretion and respiration

    B   Egestion, transpiration and respiration

    C   Excretion, transpiration and respiration

    D   Photosynthesis, egestion and excretion

Your answer   ☐   **[1]**

This was one of the most accessible questions on the multiple choice Section A, with most candidates correctly answering A and identifying that egestion, excretion and respiration are responsible for biomass loss in a food chain.

Question 3

3　Lichens grow on trees and can indicate air pollution levels.

A student wants to find out the level of pollution in an area by measuring the abundance of a particular species of lichen.

Which two tools should the student use to find out the abundance of the lichen in the area?

A　Key and net

B　Key and quadrat

C　Line transect and key

D　Pooter and quadrat

Your answer ☐　　　　　　　　　　　　　　　　　　　　　　　[1]

This was one of the more challenging multiple choice questions and less than half of candidates were able to identify that B a 'key and quadrat' would be used to find the abundance of lichen on trees. The most common incorrect responses ranged equally from all A, C and D options.

Question 4

4　What is the definition of the **genome**?

A　All the alleles that are expressed in the phenotype of an individual.

B　All the coding DNA that is present in an individual.

C　All the genetic material that is present in an individual.

D　All the non-coding DNA that is present in an individual.

Your answer ☐　　　　　　　　　　　　　　　　　　　　　　　[1]

This was one of the most accessible questions on the multiple choice Section A, with most candidates correctly answering C and knowing the correct definition of the genome.

Question 5

5   Which sentence describes Gregor Mendel's discovery that helped develop our understanding of genetics?

   A   Characteristics are controlled by DNA found in the nucleus of each cell.

   B   Characteristics are controlled by factors and these factors can be dominant or recessive.

   C   Chromosomes are found in pairs and one from each pair is found in the gamete.

   D   Genes are found on chromosomes and each chromosome is made of DNA.

Your answer ☐   [1]

This was one of the most accessible questions on the multiple choice Section A, with most candidates correctly answering B and knowing that Gregor Mendel helped develop our understanding of dominant and recessive characteristics.

Question 10

10   The table shows some different treatments for cardiovascular disease.

Which treatments for cardiovascular disease work by directly reducing blood pressure?

Treatment	Main method of action
antiplatelets	reduce the action of platelets
beta blockers	block the effects of adrenaline
nitrates	widen blood vessels
statins	reduce cholesterol levels in the blood

   A   Antiplatelets and beta blockers

   B   Beta blockers and nitrates

   C   Nitrates and antiplatelets

   D   Statins and nitrates

Your answer ☐   [1]

This was one of the more challenging multiple choice questions and less than half of candidates were able to identify that beta blockers and nitrates would reduce blood pressure from the information provided.

Assessment for learning	
	Centres could reinforce treatments of coronary heart disease as it has been identified as a knowledge gap.

Question 11

11   In 2022, there were 66 900 000 people living in the UK.

Estimate how many of these people have a Y chromosome in their cells.

Individuals of each sex in the UK (%)	
males	females
49.2	50.8

A   32 914 800

B   33 985 200

C   50 442 600

D   66 900 000

Your answer ☐   [1]

This was the most accessible question on the multiple choice Section A, with most candidates correctly answering A and calculating the number of males in the population from a percentage.

Question 12

12 Which of these treatments is **not** an example of genomic medicine?

    A   Advising people who have certain alleles to make changes in their lifestyle

    B   Designing drugs that are specific to a person's alleles

    C   Removing a female's ovaries if she has alleles that make her more likely to develop ovarian cancer

    D   Using genetic engineering to produce new medicines

Your answer [ ]   [1]

This was the least assessable multiple choice question with the most incorrect responses. The majority of candidates did not correctly identify that the use of genetic engineering to produce new medicines is not an example of genomic medicine. The most common incorrect response was A with changes in lifestyle advised for people with certain alleles.

Assessment for learning

Centres could reinforce genomic medicine and treatments when teaching genetics. This has been identified as a knowledge gap.

Question 14

14 Why are antibiotic markers used in the process of genetic engineering?

    A   To act as a vector allowing the DNA into the cell.

    B   To identify which cells have taken up the genetic material.

    C   To make the engineered cells resistant to bacterial infections.

    D   To prevent the spread of antibiotic resistant bacteria.

Your answer [ ]   [1]

This was one of the most accessible questions on the multiple choice Section A, with most candidates correctly answering B on why antibiotic markers are used in genetic engineering.

Section B overview

Candidates performed well on questions assessing their knowledge and understanding of the function of the iris and cerebellum and the role of white blood cells in the immune response. In addition, candidates had good knowledge and understanding of the process of capture-recapture, natural selection and selective breeding. The knowledge and understanding of respiration allowed the Level of Response to be a good differentiator.

However, candidates did demonstrate knowledge gaps on enzymes involved in genetic engineering. Some candidates also seemed to find it challenging to analyse and apply information provided by data and graphs, and candidates should have the opportunity to develop these skills. Candidates can further develop their AO2 application of knowledge and understanding in areas of decomposition, autoimmune treatments, genetic engineering and calculating percentage change.

Question 16 (a)

16 (a) Complete each sentence about decomposition.

Decomposition is caused by microorganisms such as ....

The microorganisms use the process of .... to release the energy in dead organisms.

Decomposition also allows minerals to be .... in nature for plants to use.

[3]

Most candidates achieved at least 2 marks, correctly identifying bacteria/fungi as decomposers and that minerals were recycled. The most common incorrect response was confusing decomposition with respiration as the process to release the energy in dead organisms.

Question 16 (b)

(b) Some students investigate plant decomposition.
They put three different plant wastes into compost heaps.
Each type of plant waste contains different ratios of carbon to nitrogen.

They measure the rate of decomposition by measuring the temperature in the compost.

The graph shows their results.
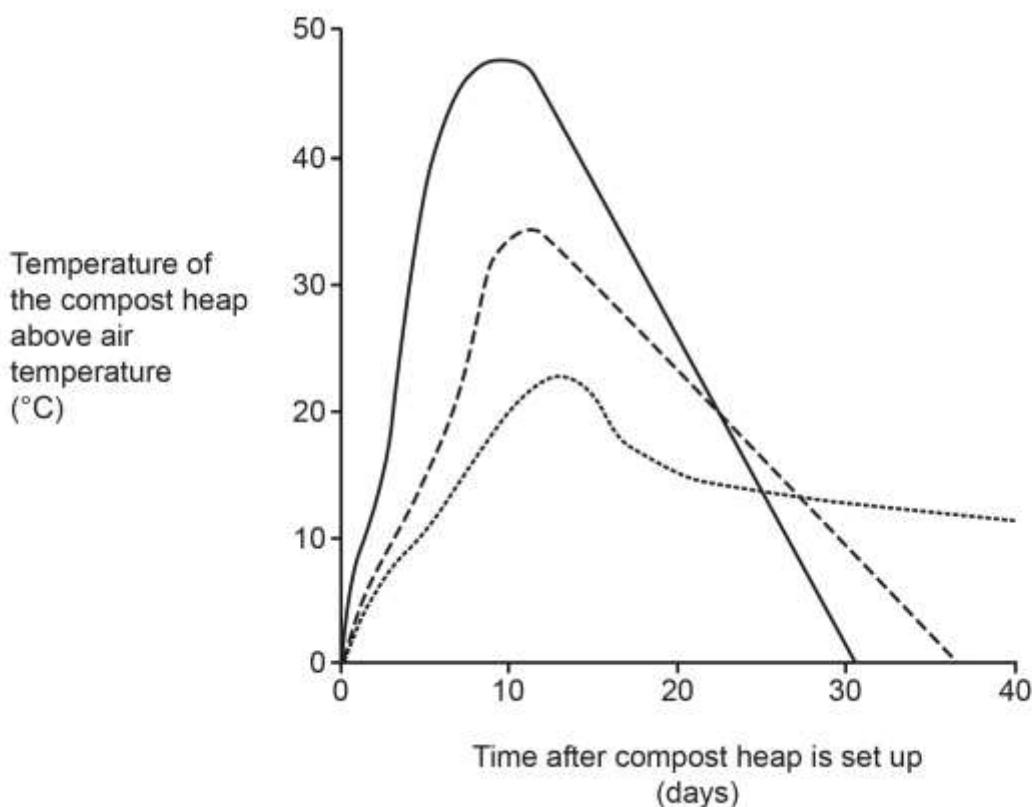
(i) The pupils used the temperature of the compost heap as a measure of the rate of decomposition.

Which statement explains why they could do this?

Tick (✓) **one** box.

Carbon dioxide contains more energy than oxygen.　　　　　　□

Decomposition involves an endothermic reaction.　　　　　　□

Microorganisms give off heat when they decompose waste.　　　□

Mineral salts will increase the temperature of the compost.　　　□

[1]

The majority of candidates correctly identified that microorganisms give off heat when they decompose waste.

Question 16 (b) (ii)

(ii) Which statement describes the results of the investigation?

Tick (✓) **one** box.

High levels of carbon results in faster decomposition. ☐

If the carbon : nitrogen ratio is higher, then decomposition is faster. ☐

Low levels of nitrogen result in faster decomposition. ☐

The higher the nitrogen content compared to carbon, the faster the rate of decomposition. ☐

[1]

Many candidates could analyse the information and draw the correct conclusion that the higher the nitrogen content compared to carbon, the faster the rate of decomposition.

Question 16 (b) (iii)

(iii) Give **one** abiotic factor that the students should keep constant in their experiment.

.... [1]

Roughly half of candidates could correctly identify an abiotic factor that should be kept constant when investigating the rate of decay. The most common incorrect response identified the mass of the waste. A small number of responses incorrectly identified light as a factor.

Misconception
?   Candidates confused light as an abiotic factor affecting the rate of decay. It should be made clear that light intensity is an abiotic factor that effects photosynthesis not decomposition or respiration.

Question 16 (c)

(c) The table shows the mass of carbon and nitrogen in different plant materials.

Plant material	Mass of carbon per kg (g)	Mass of nitrogen per kg (g)
Fruit waste	14	0.350
Horse manure	18	0.600
Straw	9	0.015

Which plant material would decompose the **fastest**?

Explain your answer using calculations and the graph in **(b)**.

Plant material ....

Reason ....

....

....

[3]

This question required applying knowledge and calculating the ratio of carbon:nitrogen for each plant material and then analysing the information which plant material would decompose fastest. This question discriminated between candidates at different grades well. Some candidates could calculate the ratios and identify horse manure but instead of stating it was because it had the highest nitrogen content to carbon, they just said it matched the ratio in Question 16 (b) which had the fastest decomposition.

Question 17 (a)

17 Gillespie syndrome is a rare genetic disorder.
People with Gillespie syndrome have eyes with no iris and damage to their cerebellum.

Fig. 17.1 shows the inheritance of Gillespie syndrome in a family.

Fig. 17.1
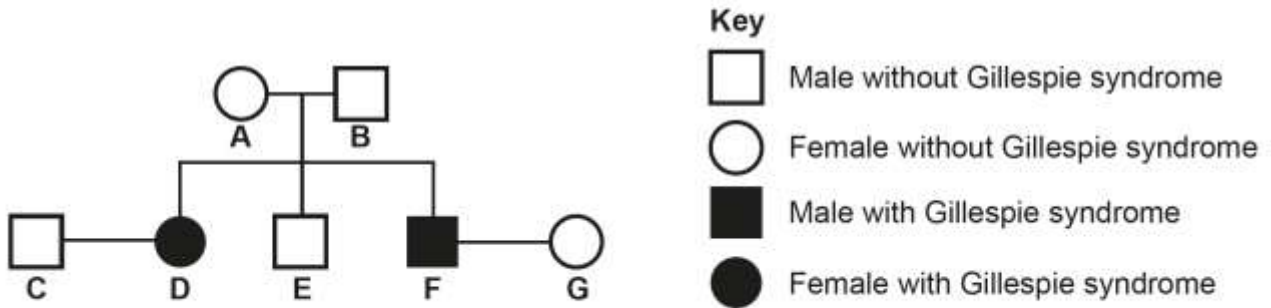
(a) A doctor makes this statement:
The allele causing Gillespie syndrome in this family is recessive.

Explain why this statement is correct. Use evidence from **Fig. 17.1**.

....

....

.... **[2]**

This was one of the most accessible questions with many candidates gaining both marks for explaining why Gillespie is a recessive inherited syndrome. Most unsuccessful responses focused on why it is not dominant instead of why it is recessive.

Question 17 (b)

(b) Person **A** and person **B** are expecting another baby.

Complete **Fig. 17.2** to find the probability that it will have Gillespie syndrome.

(Use G for the dominant allele and g for the recessive allele.)

Fig. 17.2

Person **B**

Person **A**

Probability = ...

[3]

This was one of the most accessible questions and most candidates were able to correctly identify the gametes genotype in person A and B and complete the Punnett square for offspring with the correct probability.

Question 17 (c)

(c) Person **D** is very sensitive to bright light and has difficulty controlling their balance.

Explain why this is.

....

....

....

....

....

.... **[4]**

This question was accessible and most candidates scored at least 3 marks and understood the role of the iris and cerebellum and the consequence of Gillespie syndrome on them. The most common non-scored marking point was stating that the person had Gillespie syndrome.

Question 18 (a)

18 Multiple sclerosis is an auto-immune disease that destroys nerve cells.

The body's immune system usually only destroys invading cells but in auto-immune diseases the body starts to destroy its own cells.

(a) Describe **two** ways that the body's immune system destroys invading cells.

1 ....

....

2 ....

....

[2]

This question discriminated between candidates at different grades well. The majority of responses gained a mark for correctly identifying the body produced antibodies in the immune system's response in destroying invading cells. The more successful responses could correctly describe or state phagocytosis. Some candidates confused the body's immune system with barriers to defence.

Misconception

(?)   Some candidates confused the body's immune response with barriers of defence such as stomach acid. Centres should make sure there is a clear distinction between these.

Question 18 (b)

(b) Suggest **two** reasons why multiple sclerosis is so difficult to treat.

....

....

....

.... **[2]**

This question had the most unsuccessful responses, with many candidates stating difficulties of 'fixing' nerve cells due to their size and fragility and they weren't specific about how treatment would affect the immune system.

Exemplar 1

It is hard to treat nerve cells - so small ~~and~~ that it is risky to try to treat them.

Because the body is destroying its own cells it is hard to get it to stop. [2]

Exemplar 1 states that it is difficult to treat nerve cells and that the body destroys its own cells, which was unable to be given any marks.

Question 19 (a) (i)

19　The table shows the mean mass of four types of rodent and the mean number of years they live.

Type of rodent	Mean mass (g)	Mean number of years they live
Gerbil	40	1.5
Guinea pig	1000	4.0
Rat	200	2.0
Squirrel	600	3.0

(a)　(i)　Choose suitable scales and plot the data from the table onto the graph.　　[3]

This was the most accessible question on the paper with most candidates gaining full marks for choosing suitable scales and plotting the data correctly.

Question 19 (a) (ii)

(ii) Draw a line of best fit through the points.   **[1]**

Mean number of years they live
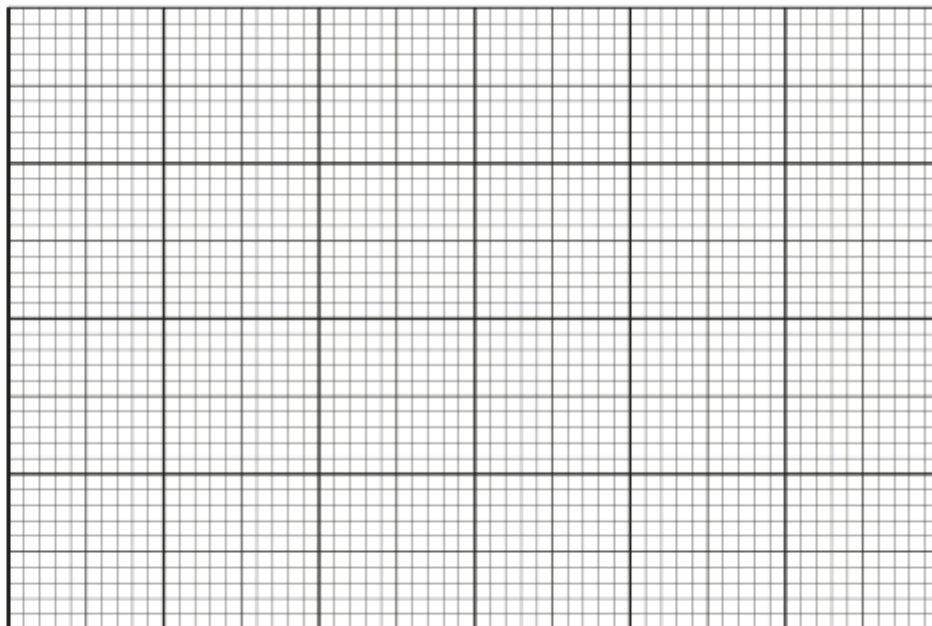
Mean mass (g)

The majority of candidates could plot a line of best fit.

Question 19 (b)

(b) Mole rats are rodents that live in Africa.

The mean mass of a mole rat is 60g and they live for about 18 years.

Use the graph you drew in **(a)** to explain what is unusual about the mole rat data compared to other rodents.

....

....

....

.... **[2]**

This question required candidates to analyse the information regarding correlation between body mass and life expectancy. The vast number of responses were successful in identifying the mole rat for its small body mass lives longer than it should from the pattern from the graph. The more successful responses correctly identified from the graph that the mole rat should live for approximately 1.6 years.

Question 19 (c)*

(c)* Mole rats spend most of their life burrowing underground in tunnels.
Some tunnels have only 5% oxygen in the air compared with 21% above ground.

Scientists have found that the mole rats have several unusual features compared to other rodents.

The mole rats have:

* a very low respiration rate
* haemoglobin that binds to oxygen more easily
* very few pain receptors that respond to acid build up in their body.

Explain how these features would help the mole rats survive in the tunnels.

....

....

....

....

....

.... **[6]**

The Level of Response extended writing question proved to be a good discriminator. There was a full range of responses over the 6 marks. The most successful responses were able to explain the benefits of a low respiration rate with the tunnels only having 5% oxygen, haemoglobin binding to oxygen more easily with more oxygen delivered to muscle cells to carry out respiration and few pain receptors would be able to tolerate high levels of lactic acid from anaerobic respiration better. The least successful responses just copied out the information provided in the question or only addressed few pain receptors being able to tolerate lactic acid from anaerobic respiration. The responses that did not achieve Level 3 were not specific about the role of haemoglobin in the delivery of oxygen to tissue/cells.

Exemplar 2

...As they have a very low respiration rate it means that they won't need to breathe as often as other organisms. This helps them to survive in the tunnels as some only have 5% oxygen in the air which is almost 4 times lower than oxygen above ground. Since haemoglobin binds more easily the mole rat will be getting oxygenated blood to its muscles and organs at a much faster rate so the mole won't have to constantly be respiring to get oxygenated blood around its body. ~~As there is less~~ [6]
~~oxygen the mole rat will have to anaerobically respire more often if it is doing a high level of exercise so the pain receptors will help the mole rat to~~

Exemplar 2 gained Level 1, 2 marks as the candidate gave a limited explanation of how a feature allows the mole rat to survive in the tunnels. They incorrectly stated that having a low respiration rate meant they could breathe less instead of requiring less oxygen for aerobic respiration. They correctly identified oxygen binding with haemoglobin more easily means faster delivery of oxygen to muscles. They crossed out the part addressing pain receptors and acid.

Question 19 (d)

(d) Mole rats rarely develop cancer.
One theory to explain this involves two 'over-crowding' genes.
These genes slow down the cell cycle when cells come into contact with each other.

Explain how slowing down the cell cycle can protect mole rats from developing cancer.

....

....

.... **[2]**

This question required candidates to demonstrate their knowledge and understanding of mitosis and cancer. Most correct responses gained the marking point linking slowing down the cell cycle will protect the mole rat developing cancer. Fewer successful responses also identified that this would prevent tumours developing. The most common non-scoring response given was about cancer not spreading and chance of mutation would reduce during DNA replication.

Question 20 (a)

20

Buddleia, a butterfly's friend?

Buddleia flowers attract butterflies that feed on nectar.

Buddleia bushes produce large numbers of very small seeds. This means that buddleia bushes quickly colonise new habitats.

This has resulted in the populations of other plants decreasing. Scientists have noticed there are large communities of butterflies in these areas but the biodiversity of butterflies is low.

(a) Suggest why the colonisation of land by buddleia bushes has caused a decrease in the populations of other plants.

....

....

.... [2]

This question discriminated well between candidates at different grades. The most successful responses correctly identified that colonisation of buddleia would increase competition for light/minerals/water, etc. Some responses only stated the abiotic factor which would be limited. Most unsuccessful responses did not recognise that the competition for resources would increase and stated that the buddleia would only attract butterflies and therefore pollination would only occur for this species.

Question 20 (b)

(b) Describe a sampling technique that could be used to estimate the number of one species of butterfly in a habitat.

....

....

....

....

.... **[3]**

This discriminated well between candidates at different grades, with a full range of responses for marks given. This question required candidates to be able to identify the capture-recapture method for estimating the population of butterflies. The most common marking point given was use of a net to capture the butterflies. A large number of responses described the method of capture-recapture but some missed the stage of releasing the butterflies once captured and marked. A small number of responses stated you would use quadrats and random sampling as an incorrect sampling method.

Misconception

? In estimating the population of butterflies you would use a net and carry out the capture-recapture method. A number of incorrect responses chose the incorrect method of random sampling with grid co-ordinates and a random number generator with quadrats. Centres should make sure that candidates are aware of what sampling method you would choose for estimating the population of a range of species.

Question 20 (c)

(c) Explain how there can be a large community of butterflies but a low biodiversity of butterflies in an area.

....

....

.... **[2]**

The candidates were required to know the difference between community and biodiversity. The responses demonstrated that they could not clearly link large community and low biodiversity with their correct definitions. Successful responses gained 1 mark for stating that there are lots of butterflies but only one species.

Question 20 (d) (i)

(d) Scientists have suggested two possible methods of reducing the damage caused to habitats by too many buddleia bushes.

Explain how each of these methods would reduce the damage to habitats.

(i) genetically engineering buddleia bushes that produce larger seeds

....

....

.... **[2]**

This question required candidates to analyse the information and draw conclusions about why larger seeds would reduce damage to habitats, which candidates seemed to find challenging. The most successful responses were able to link larger seeds having less chance of seed dispersal via wind. The majority of unsuccessful responses stated that the larger seeds meant fewer seeds produced which is why there was less damage to habitats.

Assessment for learning

Centres could provide more opportunities for candidates to analyse information and draw conclusions. These AO3 skills are accessed in the exam and make up 20%. ExamBuilder can be used to filter for questions that focus on analysis for practice with candidates.

Question 20 (d) (ii)

(ii) producing hybrid buddleia bushes that have uneven numbers of chromosomes, which prevent meiosis occurring

....

....

.... **[2]**

A large number of candidates gained at least 1 mark on this question, mostly given for less reproduction/fewer seeds produced when meiosis is prevented. The most successful responses also correctly identified that fewer gametes would be produced as a result. Some responses that were not given any marks just reworded the question and said stopping meiosis would stop cell division and therefore growth of the buddleia bushes. This did not correctly identify that it's stopping gamete production specifically.

Question 21 (a)

21 Sorghum is a crop plant grown in Africa for its seeds.

(a) Sorghum produces a bitter chemical in its seeds.

Birds do not like the taste of this chemical. Some people also find the taste unpleasant.

Explain how sorghum could have evolved to produce the bitter chemical.

....

....

....

....

.... **[3]**

This question assessed the application of knowledge and understanding of natural selection. The question was a good discriminator between candidates at different grades and over half of candidates gained 2 or full marks. Most responses provided evidence that the candidates could identify it was natural selection and they could explain how the sorghum evolved to produce the bitter taste.

Question 21 (b)

(b) In some areas in Africa, farmers have been growing varieties of sorghum that have lower levels of the bitter chemical.
These varieties have been produced by artificial selection.

Describe how the process of artificial selection is carried out.

....

....

....

.... **[2]**

Over half of all candidates gained full marks here, demonstrating knowledge and understanding of selective breeding.

Question 21 (c)

(c) Scientists recorded the types of sorghum grown in different areas of Africa that have higher levels of the bitter chemical.
They also recorded the number of birds that eat sorghum living in the same areas.

The graph shows their results.
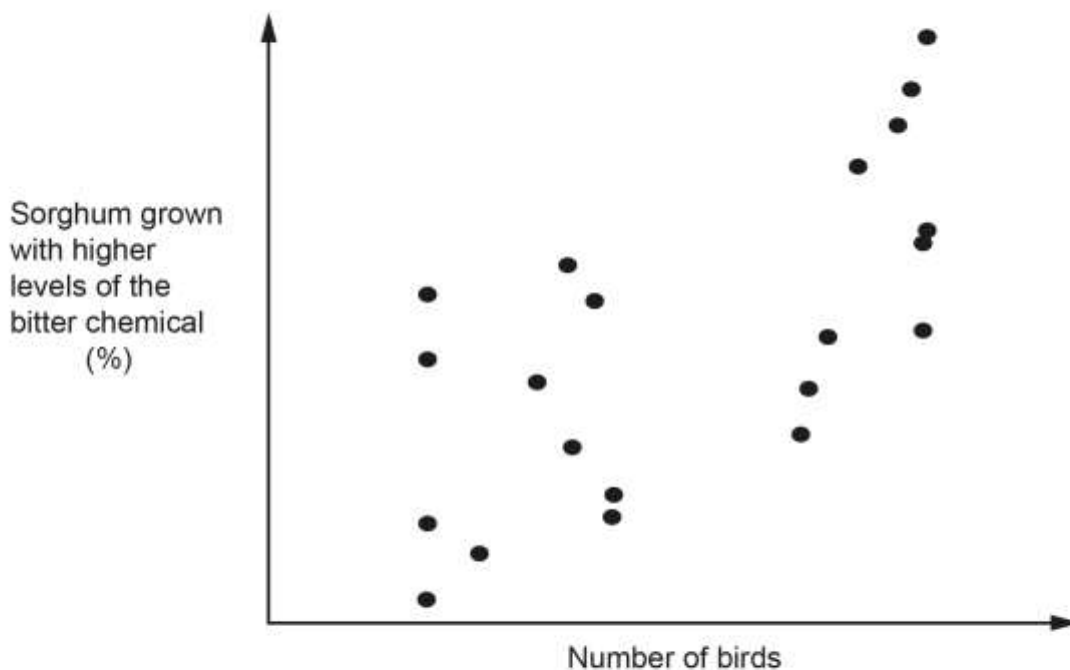
Suggest an explanation for the pattern of results shown in the graph.

....

....

.... [2]

This question required candidates to analyse information to draw conclusions. This proved challenging and most responses did not gain maximum marks. The most common given marking point was correctly identifying the trend from the graph, however less than half of all responses gained this mark. Many responses did not explain that sorghum that had higher levels of the bitter chemical were grown in areas with higher numbers of birds to prevent it being eaten.

Assessment for learning

Centres could provide more opportunities for candidates to analyse information and draw conclusions. These AO3 skills are accessed in the exam and make up 20%.

Question 22 (a) (i)

22 Some students investigate the effect of run-off water from a farm on the growth of plants. The run-off water is washed off the fields in the farm when it rains.

They use a pond plant called duckweed, shown in the diagram. A duckweed plant has a single leaf that floats on the surface of the water.
They chose duckweed because it is easy to count the plants.
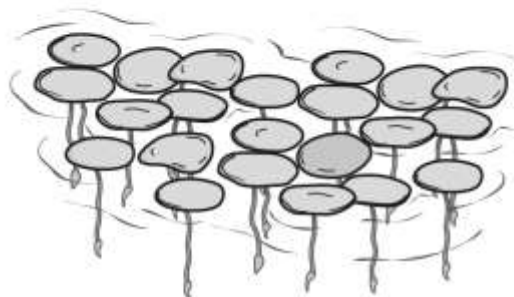
This is the method they follow:

- Put different volumes of clean pond water and run-off water into 4 beakers.
- Add 3 duckweed plants into each beaker.
- Leave the beakers for ten days at the same temperature.

The table shows the results.

Beaker number	Contents	Number of duckweed plants after ten days
1	250 cm^3 of pond water	6
2	230 cm^3 of pond water + 20 cm^3 of run-off	12
3	210 cm^3 of pond water + 40 cm^3 of run-off	24
4	190 cm^3 of pond water + 60 cm^3 of run-off	48

(a) (i) Explain why the students put different volumes of clean pond water into each beaker.

....

....

....

.... [2]

Most candidates scored at least 1 mark here for correctly identifying that the total volume of water needed to be kept the same. Most successful responses stated that different volumes of clean pond water were added as there were different volumes of run-off water added. Most unsuccessful responses stated they were keeping the water the same which isn't the case; the volumes of both clean pond water and run-off have been changed. Some responses just reworded the information in the question that they were changing the concentration of pond water which were not given marks.

Question 22 (a) (ii)

(ii) To improve their experiment, the students should make sure that the carbon dioxide levels are the same in each beaker.

Describe how they could achieve this.

....

.... **[1]**

This was the least accessible question on the whole paper. Unsuccessful responses ranged from various devices to test the carbon dioxide concentrations without stating how they could be controlled.

Assessment for learning
Centres could provide more opportunities for candidates to analyse information and draw conclusions. These AO3 skills are accessed in the exam and make up 20%. Responses suggested candidates did not know how carbon dioxide concentrations could be controlled.

Question 22 (b) (i)

(b) Duckweed plants reproduce by dividing into two.

(i) What is the name given to this type of reproduction?

.... **[1]**

More than half of candidates could correctly identify asexual reproduction as how duckweed reproduce. Most common unsuccessful response was mitosis.

Misconception
Candidates confused mitosis, which is the type of cell division which produces genetically identical daughter cells, with asexual reproduction, which produces genetically identical offspring and does not require fusion of gametes. Centres should make sure this difference is passed onto the candidates when learning about asexual reproduction.

Question 22 (b) (ii)

(ii) In beaker **4**, how many generations of duckweed plants are present after 10 days?

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

Half of all candidates could correctly analyse the information to work out the correct number of generations present after 10 days.

Question 22 (c)

(c) An article said that the run-off water contains waste from cows and this makes the pond water cloudy. The run-off water is reducing the growth of submerged plants that grow in the pond.
The diagram shows this process.
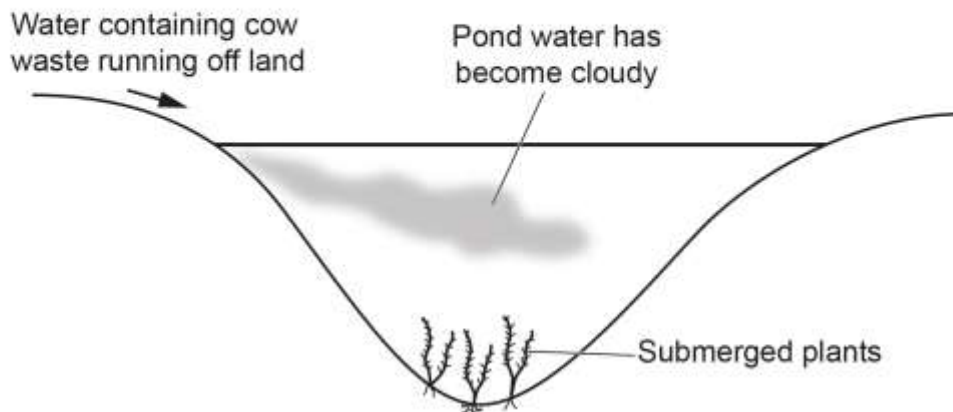
Explain the results of the students' experiment and why using duckweed produces results that do **not** agree with the effect of run-off water described in the article.

....

....

....

....

....

.... **[3]**

The question required candidates to analyse information and draw conclusions. This was challenging for the candidates and just under half of all responses were not given any marks. The most common response seen that gained a marking point was for increased growth. Most responses did not link run-off water containing minerals. Some responses did not link eutrophication not affecting the duckweed as it floats on the surface and its ability to photosynthesise is not affected by the cloudy water.

Assessment for learning

Centres could provide more opportunities for candidates to analyse information and draw conclusions. These AO3 skills are accessed in the exam and make up 20%. Most unsuccessful responses did not link minerals with run-off water and eutrophication to the answer.

Question 22 (d)

(d) The students change their method to use a submerged plant rather than using duckweed.

Describe how the students could change their method to measure the growth of the submerged plant.

....

.... **[1]**

Just under half of all candidates were given this mark. Most unsuccessful responses stated they could measure the growth by collecting the volume of oxygen produced and counting the number of plants.

Question 23 (a)

23 The demand for food in the world is growing. One possible solution to this is the use of aquaculture.

This involves farming fish, such as salmon, in large cages in lakes or the sea as shown in the diagram.
However, growing salmon in cages allows parasites on their body to spread easily from fish to fish.
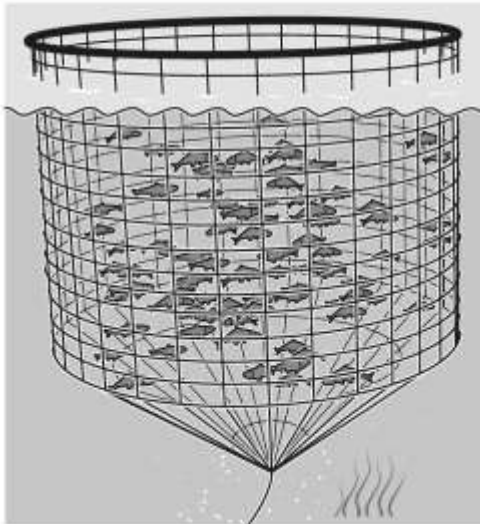
(a) Small fish called wrasse are often kept in the cage with the salmon.
The wrasse act as a biological control mechanism. This results in an increased growth rate of the salmon.

Suggest how putting wrasse in the cage results in an increased growth rate of the salmon.

....

....

.... **[2]**

This question required candidates to apply their knowledge of biological control to salmon and wrasse. Half of all candidates were given a mark for understanding that the wrasse would feed on the parasites. Most unsuccessful responses stated that the wrasse take the parasites away from the salmon but not in any detail how. Many responses did not gain full marks for linking how fewer parasites would increase the food/energy available to the salmon. A number of candidates incorrectly stated that the wrasse provided food for the salmon directly, with the salmon eating them.

Question 23 (b)

(b) Many people in the world eat fish as their main source of protein.
Fish eaten by people can be caught directly from the sea (wild fish) or grown using aquaculture.

The graph shows how the world's total demand for fish has changed since 1950 and how it is expected to change up to 2050. It also shows how the total demand is met by the supply of wild fish and fish from aquaculture.
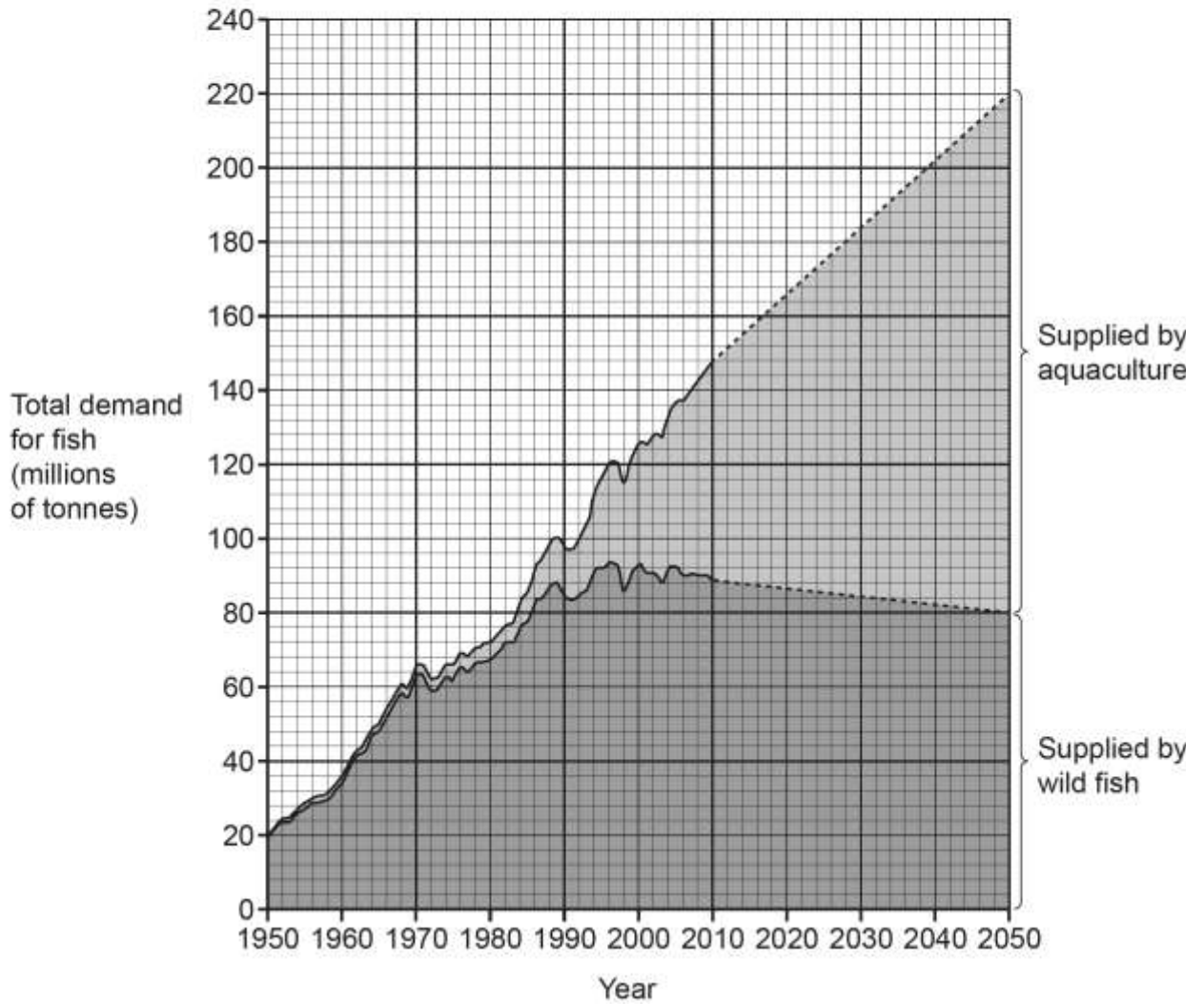
Describe the patterns in past and predicted fish use shown by the graph.

Include data.

....

....

....

....

....

.... **[3]**

Very few candidates did not gain a mark here but less than a third gained maximum marks. The question required skills in application of information provided in the graph. The most successful responses understood that the demand/supply for fish increased over the years and could correctly identify the correct years when demand/supply for aquaculture increased and wild fish decreased. Most unsuccessful scoring marks were for the correct identification that demand/supply from aquaculture overtakes wild fish and that wild fish was the main source of salmon supplied earlier.

Assessment for learning

Centres could provide more opportunities for candidates to apply and extract information from graphs. Responses demonstrated confusion that both aquaculture and wild fish supplied 20 million tonnes in 1950 when in fact it was 20 million tonnes by wild fish alone and that earlier they both increased at the same rate which is not the case. Wild fish supply increased while aquaculture remained the same, very low. Some responses also stated that aquaculture is predicted to supply 220 million tonnes by 2050 which is also incorrect, it is 140 million tonnes and 80 million supplied by wild fish.

Exemplar 3

In the past the demand for fish was lower. For example in 1950 it was 20 million tonnes whereas in 2020 it was around 84 million. In the future the demand of fish is expected to be higher e.g 220 mil tonnes in 2050 but most will be supplied by aquaculture and the use of wild fish is expected to decline whereas in the past almost [3] 100% of demand was supplied by wild fish e.g in 1950

Exemplar 3 gained maximum marks. The candidate correctly identified that the demand/supply for fish has increased (by ORA), they extracted the data that it increases from 20-220 million tonnes and that earlier supply/demand came mainly from wild fish.

Question 23 (c) (i)

(c) Scientists are trying to increase the mass of Atlantic salmon produced by aquaculture using genetic engineering and a fish called ocean pout.

The growth of fish is controlled by growth hormone.
Atlantic salmon only grow for part of the year but ocean pout grow throughout the year.

The diagram shows how scientists are producing genetically engineered Atlantic salmon.

Ocean pout

Eggs of Atlantic salmon

Genetically engineered Atlantic salmon
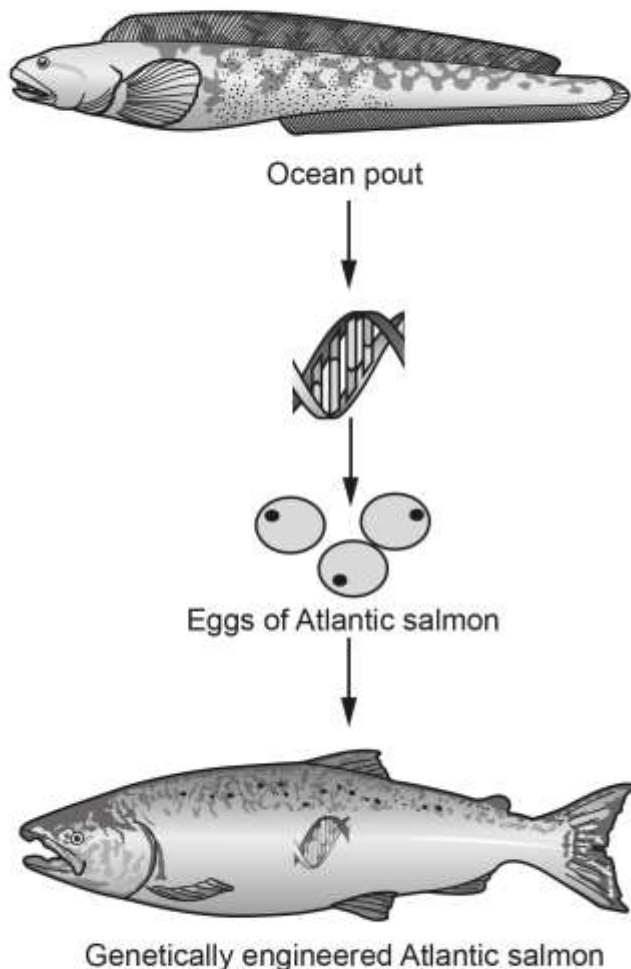
(i) What is the name of the enzyme used to cut out the gene from the DNA of the ocean pout?

.... [1]

Over half of candidates correctly identified that a restriction enzyme is the cutting enzyme involved in genetic engineering. This had the highest omit in the paper with candidates not answering this question.

Assessment for learning

Centres could provide more opportunities for candidates to learn the names of the enzymes involved in genetic engineering as it has been highlighted as a knowledge gap in the number of unsuccessful responses seen.

Question 23 (c) (ii)

(ii) What is the name of the enzyme used to join the gene from the ocean pout into the DNA of the Atlantic salmon?

.... **[1]**

Over half of candidates correctly identified that ligase enzyme is the joining enzyme involved in genetic engineering. This had the highest omission rate in the paper with candidates not answering this question.

Assessment for learning

Centres could provide more opportunities for candidates to learn the names of the enzymes involved in genetic engineering as it has been highlighted as a knowledge gap in the number of unsuccessful responses.

Question 23 (c) (iii)

(iii) Explain how the addition of the gene from ocean pout can cause the Atlantic salmon to grow faster.

....

....

.... **[2]**

Over half of all candidates gained a mark when applying their knowledge and understanding of genetic engineering. Very few responses gained maximum marks and the most successful given mark came from knowing the salmon would grow throughout the year (with gene inserted).

Question 23 (c) (iv)

(iv) This diagram shows a genetically engineered salmon and a non-engineered salmon of the same age. The drawings are to the same scale.

Genetically engineered salmon
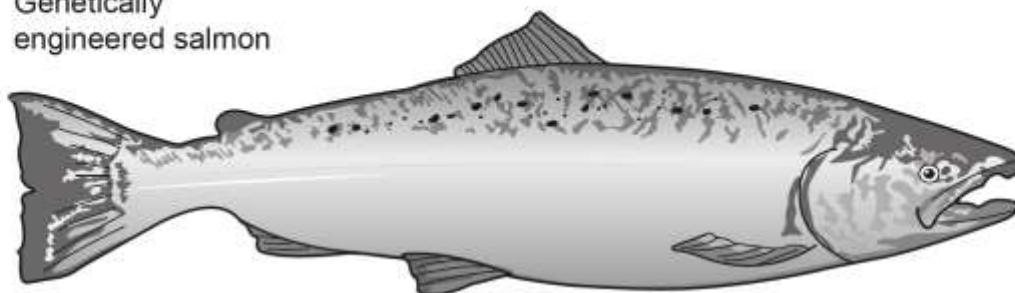
Non-engineered salmon
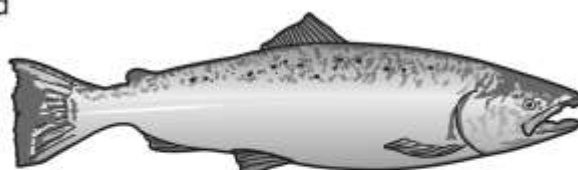
Use a ruler to measure the length of each salmon.

Calculate the percentage increase in length caused by genetic engineering using your measurements.

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

Percentage increase in length = ... % **[3]**

This question was a good differentiator between candidates at different grades. Candidates had to correctly measure the non-genetically engineered and genetically engineered salmon and calculate the percentage increase then further process the answer to 2.s.f. There was a good spread of marks given with many candidates scoring maximum marks. The least successful responses did not apply the correct calculation for percentage increase and did not correctly give the answer to 2.d.p.

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