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June 2019

IAL Biology WBI12 01

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Introduction

The paper was the first of the new specification and tested the knowledge, understanding and application of material from the topics 'Cell Structure, Reproduction and Development' and 'Plant Structure and Function, Biodiversity and Conservation'. The range of questions provided ample opportunity for candidates to demonstrate their grasp of these topics.

The paper appears to have worked well, with nearly all questions achieving the full spread of marks. Very few questions were left blank and there was no evidence in the majority of papers that candidates had insufficient time to complete the paper. For example, nearly all candidates wrote lengthy answers to the penultimate question on the paper.

It was evident that some areas of the specification are better understood than others. The application of knowledge regarding the function of prokaryotic structures, fertilisation in mammals and differential gene expression proved more challenging. A significant issue for some candidates on the paper was not applying their knowledge to the given scenario and just giving a stock answer that they had learnt. The application of knowledge and understanding of drug trials to the context of *Y. Pestis* was one example of this.

Another significant issue for some candidates on the paper was not reading the question carefully and, in particular, not taking careful note of the command words in the questions. For example, an 'explain' question often had answers which just described and a 'give two differences' question often had answers which just gave definitions.

It was pleasing to see such large numbers of excellent responses which were clear and comprehensive, answered the question asked and showed good use of technical terms and application of relevant biological knowledge.

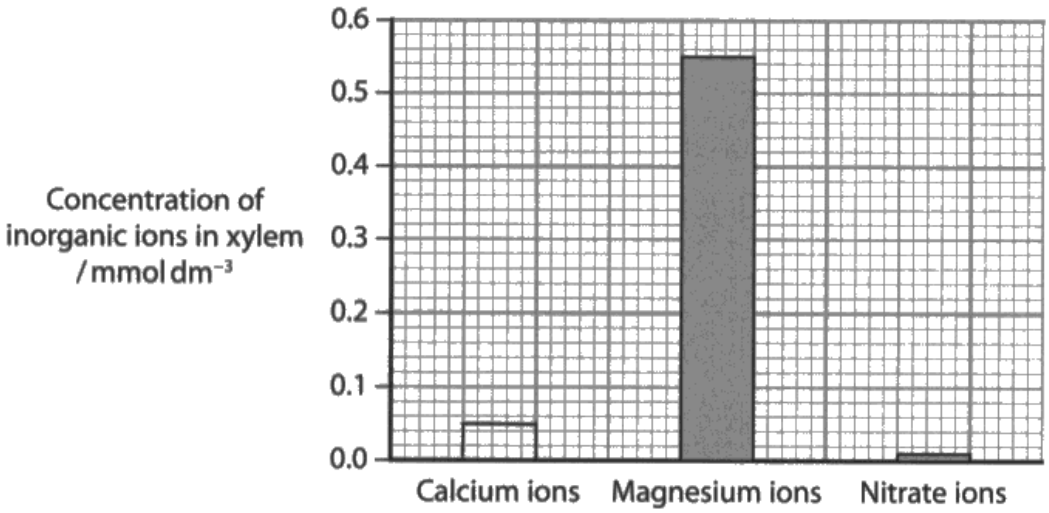
Question 1 (b) (i)

This question was generally answered very well, with the majority of candidates correctly plotting the concentration of calcium ions onto the grid provided.

It was pleasing to see that many candidates drew a bar which was equally spaced and the same width of the other bars.

A minority of candidates plotted a bar at 0.05 or at 0.46 and therefore scored 0.

(b) The graph shows the concentrations of three inorganic ions in the xylem of a plant.



(i) The concentration of calcium ions is 0.45 mmol dm⁻³.

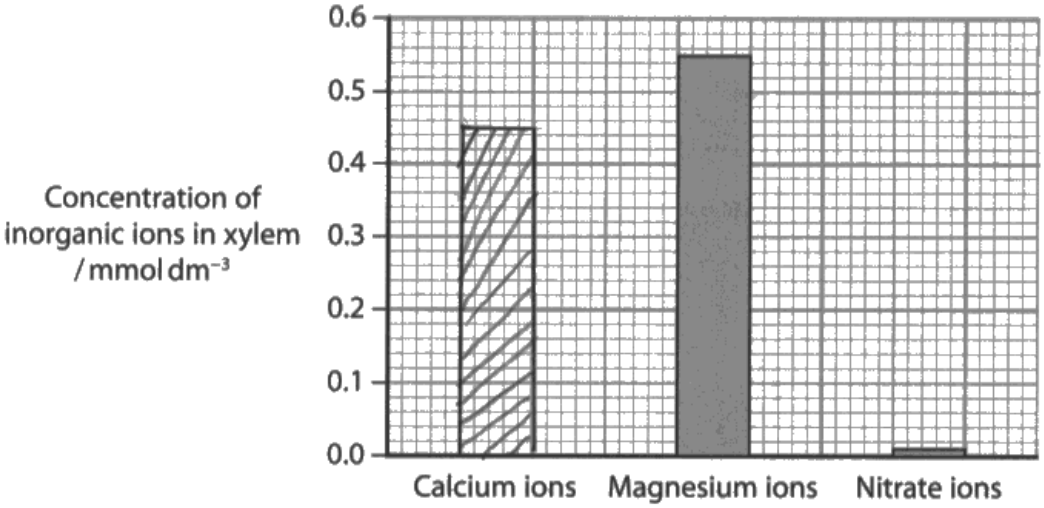
ResultsPlus
Examiner Comments

This is an example of a response where the candidate has incorrectly plotted the concentration of calcium ions.

ResultsPlus
Examiner Tip

It is good practice to replicate the width and spacing of other bars on the graph.

(b) The graph shows the concentrations of three inorganic ions in the xylem of a plant.



(i) The concentration of calcium ions is 0.45 mmol dm^{-3}.

Plot this concentration on the graph.

ResultsPlus
Examiner Comments

This is an example of a correct response.

Question 1 (b) (ii)

This question asked candidates to explain the importance of the three inorganic ions from the graph. Nearly all candidates could explain the importance of nitrate ions to the plant and this was the most commonly awarded marking point.

Fewer candidates could fully explain the importance of calcium and magnesium ions. It was common that they simply stated that calcium ions were needed to make calcium pectate, or that magnesium ions were needed to make chlorophyll, but did not expand the explanations.

A small minority of candidates described what would occur to a plant deficient of these inorganic ions which was not credit worthy.

(ii) Explain the importance of each of these ions to the plant.

(3)

Magnesium ions are used for in chloroplyl.
Nitrate ions are required for the synthesis of p
amino acids.
Calcium ions ~~are~~ to are required ~~for~~ for making
~~a~~ middle lamella of the cells wall.

ResultsPlus
Examiner Comments

This response scored one mark for the importance of nitrate ions to the plant. There is no explanation as to why chlorophyll is needed by the plant so marking point two could not be awarded. There was no reference to calcium ions being needed to form calcium pectate so mark point one could not be awarded.

(ii) Explain the importance of each of these ions to the plant.

(3)

Nitrate ions are required to amino acids and then proteins for the plants.

Calcium ions join with pectin to form calcium pectate. Calcium pectate forms the middle lamellea.

Magnesium ions are ~~stored~~ required to make chlorophyll. Chlorophyll absorbs light during photosynthesis.

ResultsPlus
Examiner Comments

This response fully matched all three marking points to score full marks.

Question 2 (a)

This question required candidates to recall the definition of a species.

The majority of candidates gave a clear definition of a species.

However a significant minority did not appreciate that only organisms of the same species can breed together to provide **fertile** offspring, or missed out the breeding together aspect.

A small minority of candidates referred to classification of species which was not credit worthy.

(a) State what is meant by the term species.

(1)

Species are a group of organisms with similar characteristics that breed to produce a fertile offspring.

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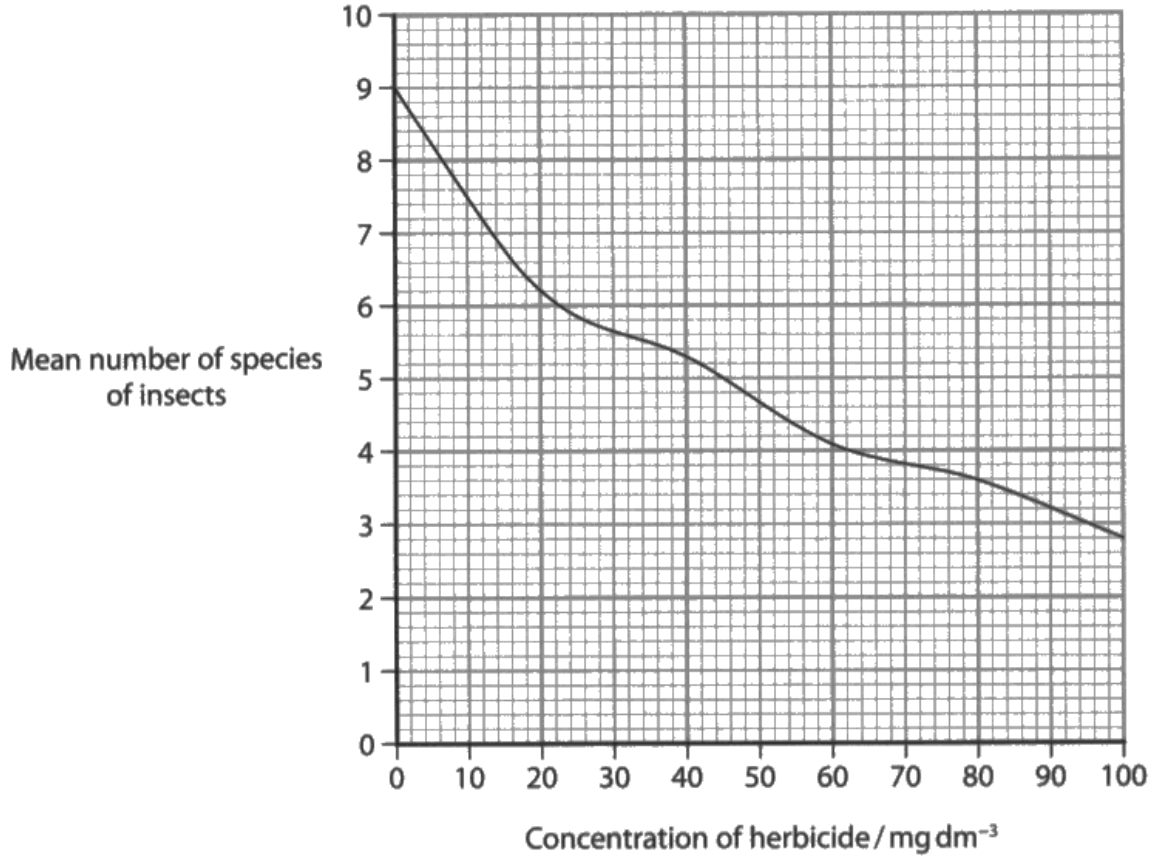
Examiner Comments

This was a clear definition of a species and was awarded the mark.



(a) State what is meant by the term species.

(1)

it is a group of organisms that share DNA and therefore are able to reproduce with one another (although there are some exceptions such as a donkey breeding with a horse)

ResultsPlus
Examiner Comments

This response did not refer to the production of fertile offspring and therefore did not gain the mark.

Question 2 (b)

The question required candidates to analyse the graph and describe the relationship between the concentration of herbicide and the mean number of species of insects. They were then required to explain this relationship using relevant biological knowledge and understanding.

The majority of candidates could describe the relationship shown by the graph and gained the first marking point.

It was pleasing to see that many candidates took note of the instruction in the question to 'use the information in the graph to support your answer'. However, just quoting data from the graph was not sufficient. A correct calculation of the reduction of mean number of species was credit worthy for marking point two, as was a correct percentage decrease.

A significant number of candidates did not go on to explain this relationship. Where candidates did, some did not re-read the information given above the graph and thought that the herbicide killed the insects directly, which was not credit worthy. Some responses referred to bioaccumulation.

A significant minority of candidates did understand that the herbicide killed plants and then explained why this loss of food resulted in the decline of the mean number of species.

(b) Explain the relationship between the concentration of herbicide and the mean number of species of insects in the three fields.

Use the information in the graph to support your answer.

(4)

As the concentration of herbicide increase the mean number of species of insects decreases

It is a negative continuous variation Idea that if the concentration of herbicide continue to increase the mean number of species of insects will zero

ResultsPlus
Examiner Comments

This is an example of a response where the relationship was described but not explained.

ResultsPlus
Examiner Tip

Make sure you understand the definitions of the different command words that can be used in the new specification and tailor your response appropriately.

(b) Explain the relationship between the concentration of herbicide and the mean number of species of insects in the three fields.

Use the information in the graph to support your answer.

(4)

When the concentration of herbicide is increased the mean number of insect species decreases. When herbicide concentration increases more and more unwanted plants in fields are killed, this disrupts the food chain so insects relying on these plants have no food to eat. The niches of these insects are destroyed (habitat loss) so insects either die or move to other fields decreasing in species number.

ResultsPlus
Examiner Comments

This is a clear and concise response which gained full marks for a correct explanation of the relationship between the concentration of herbicide and the mean number of species of insects.

Question 3 (a)

This question asked candidates to complete the diagram to show the chromosomes after crossing over had occurred.

This proved to be a good differentiator. Some candidates did not gain either marking point as they did not have complementary shading on the crossing over section, nor did they have the non-crossing over sections shaded correctly. Some gained the mark for the crossing over sections, but did not shade the non-crossing over sections on the left hand homologous chromosome.

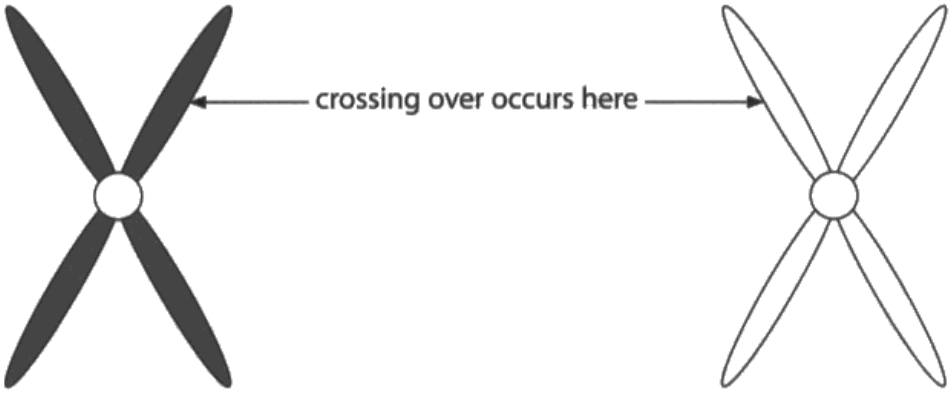
A significant minority however gained both marks.

3 Meiosis and mitosis are involved in cell division.

(a) Meiosis produces gametes that are genetically different.

Crossing over is important to increase genetic variation.

The diagram shows one pair of homologous chromosomes during early meiosis.



Complete the diagram below to show these chromosomes after crossing over has occurred.

(2)

ResultsPlus
Examiner Comments

This is an example of a correct answer which scored full marks.

Question 3 (b) (ii)

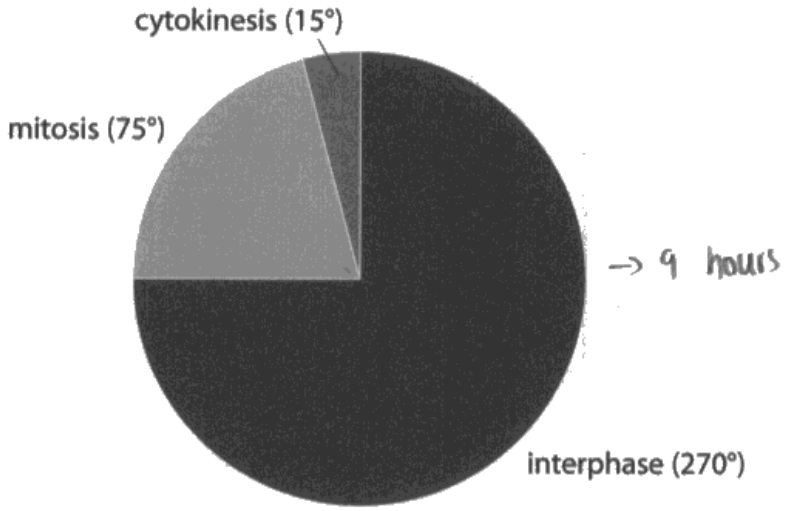
This question provided candidates with a pie chart of the cell cycle in some embryo cells and asked them to calculate how long cytokinesis would take in these cells.

It was disappointing to see that many candidates were not able to use the information provided to calculate the answer of half an hour.

However, approximately a third of candidates were able to correctly calculate how long cytokinesis would take in these cells.

(ii) In some embryo cells, interphase can last an average of nine hours.

The diagram shows the relative proportions of time spent in each part of the cell cycle.



Calculate how long cytokinesis would take in these embryo cells.

(1)

75 + 15 = 90
90 mins = 3 hours
cytokinesis = 15° = 15 mins = 0.25

Answer 0.25 hours

ResultsPlus
Examiner Comments

This is an example of an incorrect response.

Calculate how long cytokinesis would take in these embryo cells.

(1)

270° 9 hours

15° ?

$\frac{9 \times 15}{270} = 0.5$

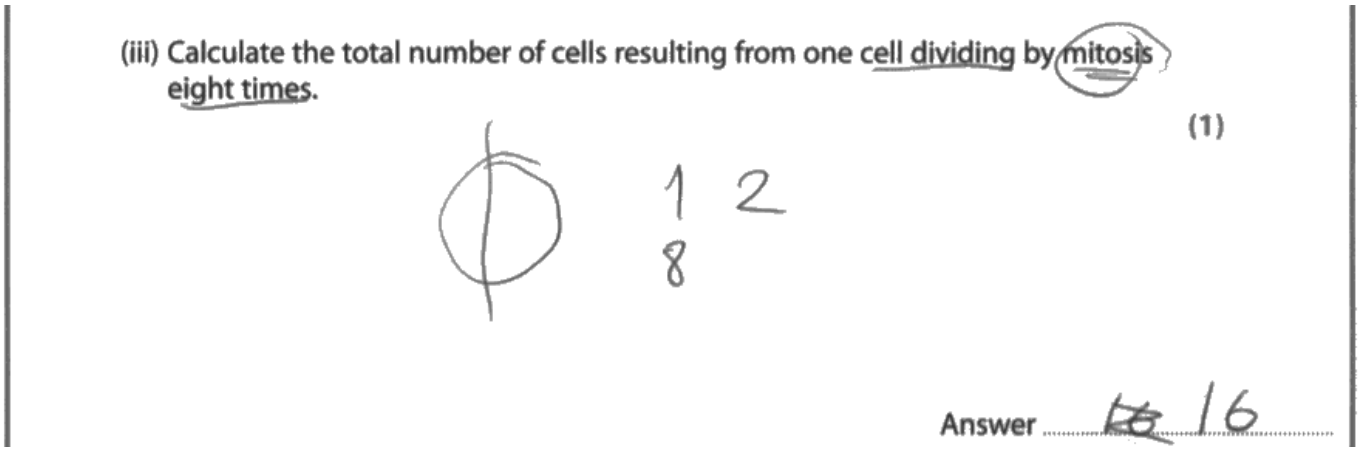
Answer 0.5 hours

ResultsPlus
Examiner Comments

This is an example of a correct response.

Question 3 (b) (iii)

This was a straightforward question, but it was disappointingly answered incorrectly by many candidates. Many candidates incorrectly multiplied 2 by 8 to give the answer 16 instead of calculating 2 to the power of 8.


(iii) Calculate the total number of cells resulting from one cell dividing by mitosis eight times.

(1)

1 2
8

Answer 16

ResultsPlus
Examiner Comments

This is an example of the most common incorrect response.

ResultsPlus
Examiner Tip

Study the maths skills listed in the specification.

(iii) Calculate the total number of cells resulting from one cell dividing by mitosis eight times.

(1)

Answer 256 cells

ResultsPlus
Examiner Comments

This is an example of the correct response.

Question 3 (c) (ii)

This question required candidates to analyse a graph of five drug treatments involving different combinations of three drugs in order to evaluate their effectiveness. As with other questions in this paper, candidates were expected to use the information in the graph to support their answer.

This question proved to be a very good differentiator, with the full range of marks awarded.

Almost all candidates were able to describe the correct order of drug effectiveness when the drugs were given on their own. Some answers then took this further and stated that the combination of SRT1720 and Vincristine was the most effective. Fewer candidates recognised that the combination of Resveratrol and Vincristine was less effective than Vincristine used by itself or more effective than Resveratrol by itself.

It was pleasing to see that many candidates recognised the significance of the size of the {range/SD/error} bars.

(ii) Evaluate the effectiveness of the three drugs used in this investigation.

Use the information in the graph to support your answer.

(4)

There is significant difference in the effect of all the drugs, since there is no overlap. ~~SF~~ SRT1720, is the least effective when it is on it's own, killing ~~only~~ on average almost 10% of the cancerous cells. Vincristine, is the most effective with almost ~~12%~~ 52% of ~~the~~ cancer cells killed. ~~When~~ Resveratrol ~~is~~ kills 17% of the cells. When combined, Vincristine and ~~Re~~ Resveratol, only kill 32% of the cells, so the ~~effectiveness~~ effectiveness of the ~~vin~~ Vincristine falls by 20%. SRT1720 and Vincristine combined have the highest efficiency killing 84% of the cells.

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Examiner Comments

This is an example of a response which gained every marking point and scored full marks.

Question 4 (a) (ii)

This question asked the candidates to explain why the Golgi apparatus cannot be seen using a light microscope.

Nearly all candidates could explain that the magnification or resolution of the light microscope was not high enough to see the organelle. The majority of candidates also included the small size of the Golgi apparatus.

(ii) Explain why this organelle cannot be seen using a light microscope.

(2)

Light microscope has low resolution and low magnification power, because it uses light of wavelength. Curved membrane-bound sacs would not be determined with a low resolution powered microscope.

ResultsPlus
Examiner Comments

This response gained the first marking point for the response as a whole. There was no reference to the organelle being very small so the second marking point could not be awarded.

(ii) Explain why this organelle cannot be seen using a light microscope.

(2)

The orgenelle is very small and the light microscope ~~don't~~ doesn't have enough power of magnification ~~to~~ to allow the orgnelle to be seen.

ResultsPlus
Examiner Comments

This is an example of a clear and concise correct answer which gained both marking points.

Question 4 (a) (iii)

This question asked candidates to give two differences between an organ and a tissue. This proved to be challenging for many candidates.

The most common response was separate definitions of an organ and a tissue which was not credit worthy.

Where candidates did give a difference the most common reason for not gaining marks was for imprecision in the answer. Candidates often referred to tissue having specialised cells instead of similar cells or the same cell type.

Only a minority of candidates correctly gave the difference in the number of functions of an organ and a tissue.

(iii) Give **two** differences between an organ and a tissue.

(2)

1 tissue is a group of similar cells while organ is a group of different tissues

2 tissue, a group of similar cells performing a certain function while organ is a group of tissues performing many functions

ResultsPlus
Examiner Comments

This is an example of a response which gained 2 marks.

(iii) Give **two** differences between an organ and a tissue.

(2)

1 A tissue is a group of cells whereas an organ is a collection of different types of tissues

2 ~~An organ~~ A tissue has one function whereas an organ has many functions that the tissues individually & collectively work for.

ResultsPlus
Examiner Comments

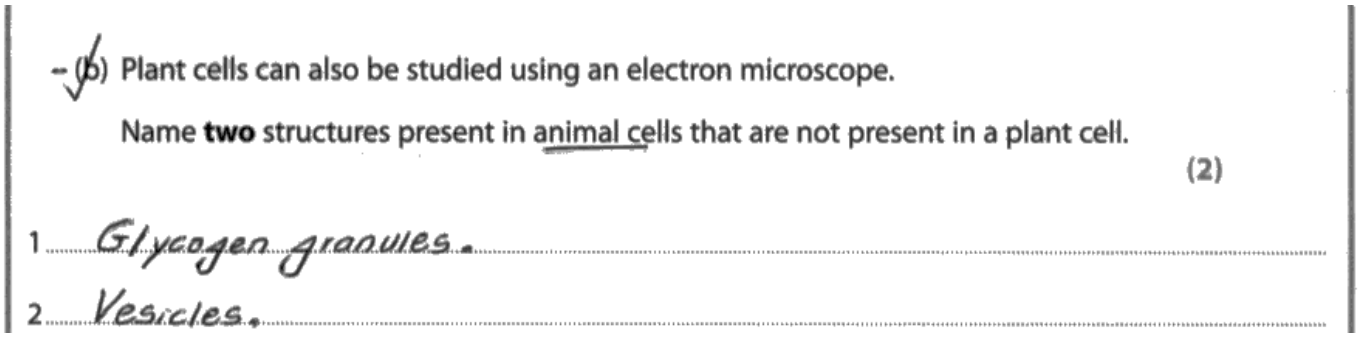
This is an example where the omission of one cell type or similar cells prevented the awarding of the second mark.

Question 4 (b)

This question asked candidates to name two structures present in animal cells that are not present in a plant cell. The candidates were given a numbered line for each of their two answers.

This question was answered well by the majority of candidates, with lysosomes and centrioles being the most commonly given structures. Cilia was rarely given as a response by candidates.

A small minority of candidates gave structures such as named membrane bound organelles that are not present in a prokaryotic cell (instead of a plant cell) or gave more than two structures despite the numbered lines.


(b) Plant cells can also be studied using an electron microscope.

Name **two** structures present in animal cells that are not present in a plant cell.

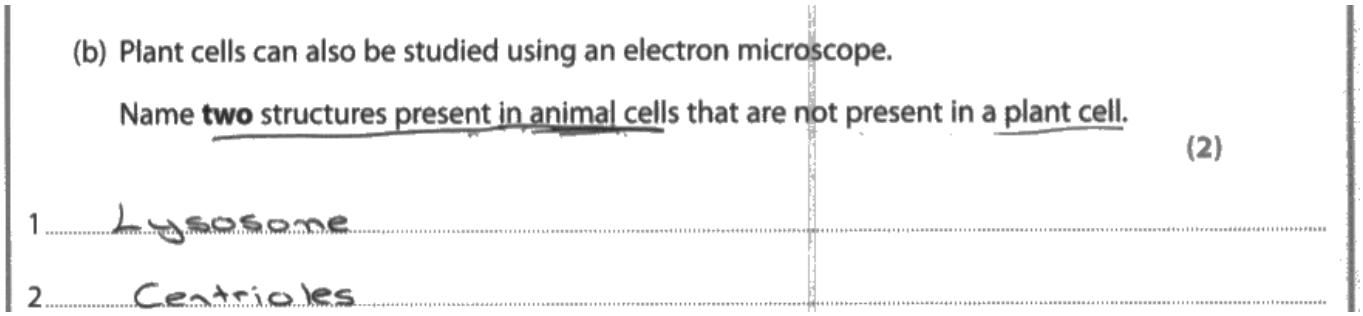
(2)

1 Glycogen granules.

2 Vesicles.

ResultsPlus
Examiner Comments

This response gained one mark for glycogen granules. Vesicles was not a credit worthy structure.


(b) Plant cells can also be studied using an electron microscope.

Name **two** structures present in animal cells that are not present in a plant cell.

(2)

1 Lysosome

2 Centrioles

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Examiner Comments

This is an example of the most common response which scored full marks.

Question 4 (c)

This question related to the specification point regarding the role of the rough endoplasmic reticulum and the Golgi apparatus in protein transport within cells, including their role in the formation of extracellular enzymes.

The candidates needed to use the information they were given above the table to help them to explain the results of the investigation. The information given stated that the amino acids were used by cells to synthesise polypeptides and that the cells secrete enzymes and glycoproteins into the small intestine.

It was clear which candidates read this information provided as they therefore gave a higher quality response which gained more marks.

Unfortunately, a significant number of candidates did not use the information provided and gave an answer describing the diffusion/exocytosis of amino acids out of the cell which was not credit worthy. A small minority of candidates did not take note of the command word 'explain' and just described what the data showed.

(c) Cells in the pancreas use amino acids to synthesise polypeptides.
These cells also secrete enzymes and glycoproteins into the small intestine.

Cells from the pancreas, containing amino acids labelled with a fluorescent marker, were used in an investigation. The fluorescent marker looked green when seen with a special microscope.

The percentage of green fluorescence inside and outside the cells was measured at the start and after 60 minutes.

The results of this investigation are shown in the table.

Time / min	Percentage of green fluorescence (%)	
	Inside the cells	Outside the cells
0	100	0
60	38	62

Explain the results of this investigation.

(4)

* At start, the amino acids are picked up by tRNA. tRNA carry individual amino acids to the surface of the mRNA for translation to take place. Hence, the polypeptide is formed at ribosomes, enters into cisternae of RER where it is folded to tertiary structure and is packaged into vesicles. *These vesicles fuse with golgi apparatus where the protein is modified eg: activation of enzyme. All these processes happen inside cell. So percentage of amino acid inside cell is 100%. * The enzyme is packaged into secretory vesicles by golgi apparatus. These secretory vesicles fuse with cell surface membrane and release enzyme outside cell by exocytosis so % of green fluorescence outside cell increases after 60 minutes. *There are still ~~amino acids~~ protein (amino acid) in the RER or golgi apparatus so percentage of fluorescence is still there inside cells.

(Total for Question 4 = 11 marks)

ResultsPlus
Examiner Comments

This response met all five marking points for the maximum four marks.

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Examiner Tip

Use all information given to you - both quantitative and qualitative.

(c) Cells in the pancreas use amino acids to synthesise polypeptides.
These cells also secrete enzymes and glycoproteins into the small intestine.

Cells from the pancreas, containing amino acids labelled with a fluorescent marker, were used in an investigation. The fluorescent marker looked green when seen with a special microscope.

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The results of this investigation are shown in the table.

Time / min	Percentage of green fluorescence (%)	
	Inside the cells	Outside the cells
0	100	0
60	38	62

Explain the results of this investigation.

(4)

At time zero all the ~~cells~~ amino acids were inside the cells and didn't move outside. After 60 minutes these amino acids started to be secreted to outside the cells by exocytosis, but not all the cells were secreted. ~~as~~

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Examiner Comments

This candidate did not recognise that the amino acids would be used to synthesise polypeptides, nor did they describe the role of the rough endoplasmic reticulum or the Golgi in the transport of protein in order for them to be secreted outside of the cell.

No marks were awarded for this response.

Question 5 (a) (i)

This question provided candidates with the scientific name for an ironwood tree and asked them to state the genus to which the plant belongs.

The majority of candidates were able to correctly state the genus *Tabebuia*. However, there was a significant minority of candidates who gave the species name or the domain of the plant instead which was not credit worthy.

5 There are more than 100 species of trees and shrubs around the world with the common name of 'ironwood'.

One type of ironwood tree, *Tabebuia avellanedae*, is native to South America.

Chemicals from these trees have antibacterial properties.

(a) (i) State the genus to which this plant belongs.

(1)

Eukaryota

ResultsPlus
Examiner Comments

This is an example of one of the most common incorrect responses.

5 There are more than 100 species of trees and shrubs around the world with the common name of 'ironwood'.

One type of ironwood tree, *Tabebuia avellanedae*, is native to South America.

Chemicals from these trees have antibacterial properties.

(a) (i) State the genus to which this plant belongs.

(1)

Tabebuia

ResultsPlus
Examiner Comments

This is an example of a correct response which gained one mark.

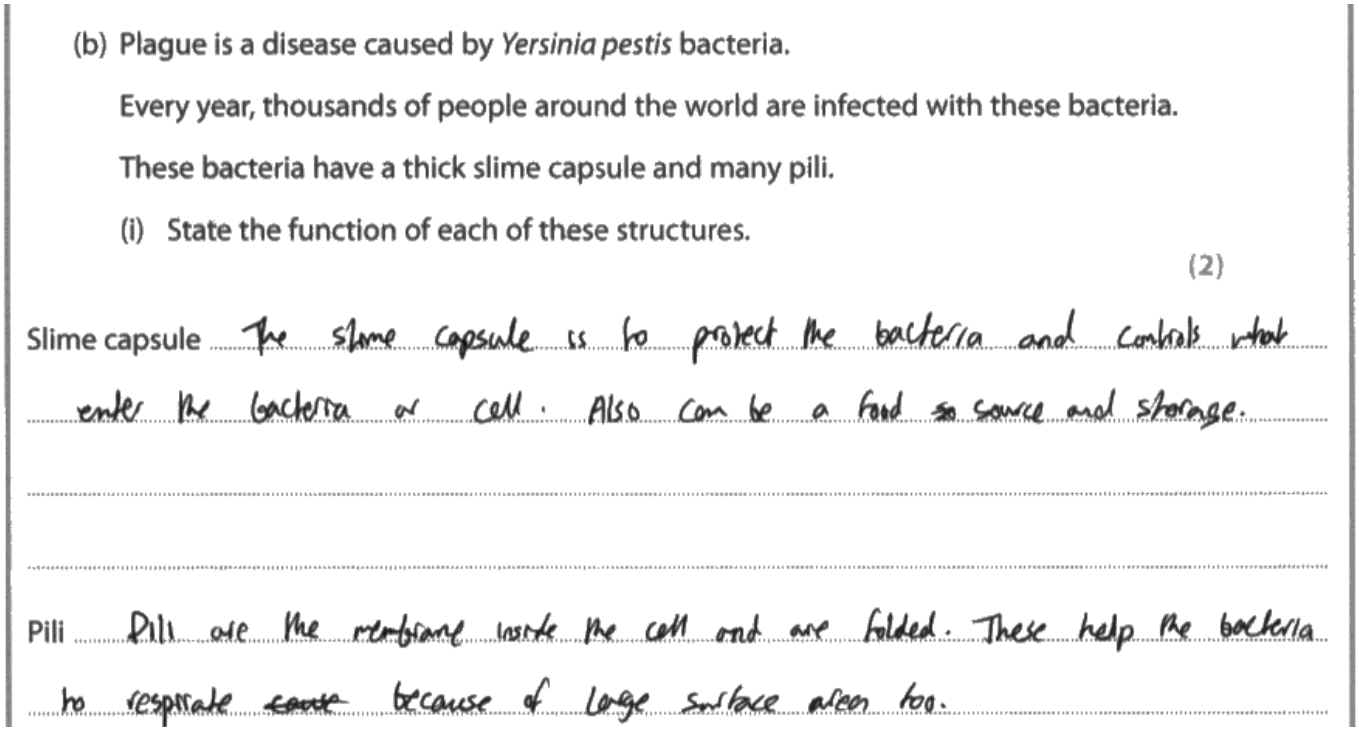
Question 5 (b) (i)

This question asked candidates to state the function of a slime capsule and pili.

This question proved to be a good differentiator as some candidates found this straightforward. Other candidates could give the function of the slime capsule but struggled with the definition of the pili. Some candidates lost marks, either because they could not give a correct function or because they were too vague in their response.

The most common function given for the slime capsule was that it provided protection from white blood cells or phagocytes. The most common response which was too vague was that it provided protection, without going on to give what it would protect the bacterial cell from.

The most common function given for the pili was for attachment to either surfaces or cells. The most common response which was not credit worthy was that pili are used for sexual reproduction.



(b) Plague is a disease caused by *Yersinia pestis* bacteria.

Every year, thousands of people around the world are infected with these bacteria.

These bacteria have a thick slime capsule and many pili.

(i) State the function of each of these structures.

(2)

Slime capsule The slime capsule is to protect the bacteria and controls what enter the bacteria or cell. Also can be a food source and storage.

Pili Pili are the membrane inside the cell and are folded. These help the bacteria to respirate ~~cause~~ because of large surface areas too.

ResultsPlus
Examiner Comments

This is an example of a response which was too vague and was not awarded the slime capsule mark.

(b) Plague is a disease caused by *Yersinia pestis* bacteria.

Every year, thousands of people around the world are infected with these bacteria.

These bacteria have a thick slime capsule and many pili.

(i) State the function of each of these structures.

(2)

Slime capsule to protect the bacteria from antibodies.

Pili for reproduction in bacteria, helps bacteria to attach to others.

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Examiner Comments

This response has given a correct function for both the slime capsule and pili and was awarded two marks.

Question 5 (b) (ii)

This was the first of the level based questions on this paper.

It was pleasing to see that many candidates could describe testing on animals, three phased testing including double blind trials and placebos and many good descriptions of a general drug trial were seen.

However, it was disappointing that a significant number of candidates did not apply their knowledge to the given context of the plague bacteria *Y. pestis* given throughout Q5 and again in the information stem for Q5(b)(ii). This limited them to a level one response. Those candidates who did relate their descriptions to the given context could access levels two and three depending on the depth of detail in their descriptions.

The full 6 marks were awarded for a full description of animal testing, three phased testing including double blind trials and placebos related to the given context of the plague bacteria *Y. pestis* but with the extra detail regarding statistical analysis/testing the drug on the bacteria in vitro.

A number of responses did not give a correct description of the number of people used in each stage of the drug trial and this limited the level they could be awarded.

A small minority of candidates gave a description of the antimicrobial core practical methodology.

*(ii) The ironwood tree has wood containing chemical compounds called naphthoquinones. These compounds have antibacterial properties.

Scientists are investigating whether these compounds could be used to develop a drug to treat people infected with *Y. pestis*.

Describe the methods that would be used to trial a drug containing these compounds.

(6)

The drug can be test using the three based trial. In this, during the pre-clinical trials, the drugs are tested on cultured cells to see the general effects. The drugs are then given to a ~~whole~~ an animal to see the effect on a whole animal. Any side effects away from the target cell is noted. If the drug does not harm the animals, then it is moved to phase 1 in clinical trials. In this a small group of healthy volunteers are given different doses of the drug. They are told what the drug does. The absorbance rate, metabolism, excretion profile of the drugs are asced. The effects of different doses of the drugs are accesed to try and work out the optimum dose. If the drug has no ~~effect~~ side effect, then an independant organisation allow the drug to be in phase II in clinical trials. In this a small group of patients with y pestis are given different doses of the drugs. studies are similar to phase 1. The optimum dose is then worked out. If the drug cures the patient, it is moved to phase 3 where large groups of the patients with y pestis is given the optimum. The patients are either given the drug or a placebo (inactive substance) in a double blind trial. If the treated group has significantly better results than the placebo, the drug has passed the trials and put foward to lisencing authority. The patients and healthy people are the same age and gender.

(total for Question 5 = 10 marks)

ResultsPlus
Examiner Comments

This was a level three response.

The candidate has correctly described testing on animals, small group of healthy volunteers, small number of patients with a *Y. pestis* infection, large number of patients with a *Y. pestis* infection and a double blind trial involving a placebo.

As they have not described testing on the bacteria in vitro or statistical analysis of the data it could not be awarded the higher mark in the level.

5 marks were therefore awarded.

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Examiner Tip

Relate your knowledge and understanding to the given context.

*(ii) The ironwood tree has wood containing chemical compounds called naphthoquinones. These compounds have antibacterial properties.

Scientists are investigating whether these compounds could be used to develop a drug to treat people infected with *Y. pestis*.

Describe the methods that would be used to trial a drug containing these compounds.

(6)

~~Using a placebo so that does not contain the drug to investi~~

Get a small group of healthy individuals and try the drug on them to see if it has any side effects. Now get a larger group of patients and try the drug on them. Use a placebo for this phase as it indicates if the drug really works or the patients are just ~~me~~ saying that they felt better because they took what they thought was the drug. Next, test the drug on a many larger group of people. This time however, the doctor and the patient should not know whether the doctor gave him/her the real drug or the placebo. This is the double-blinded technique. This whole process is called three phase testing.

ResultsPlus
Examiner Comments

This response was a level one response as there was a description of a general drugs trial which was not related to the given context.

*(ii) The ironwood tree has wood containing chemical compounds called naphthoquinones. These compounds have antibacterial properties.

Scientists are investigating whether these compounds could be used to develop a drug to treat people infected with *Y. pestis*.

Describe the methods that would be used to trial a drug containing these compounds.

(6)

Prepare a nutrient agar which has the chemical ~~compount~~ compounds. Prepare 4 nutrient agar meduims with each different concentration of the compound. Get a know bacteria and through loan spreading use the same amount for all the ~~4 aga~~ 4 agar plates. Then after put the agar meduim to the agar plate e.g agar with 2% compound in agar plate 1, agar ~~plate~~ with 4% into agar plate 2 respectively till the 4th and add filter discs ontop. ~~the~~ leave the plates in all the same condutions e.g same temperature room ~~as~~ for 24hrs. After the 24hrs is up, measure the inhibition zone, ~~as the big bigger~~ by getting the diametre and area of zone. The ~~higher~~ bigger the zone the more effective the compound. Repeat this experiment to ensure reliable results, and you can use other bacteria to see if the ~~bacter~~ ~~cou~~ compound is ~~va~~ valid

ResultsPlus
Examiner Comments

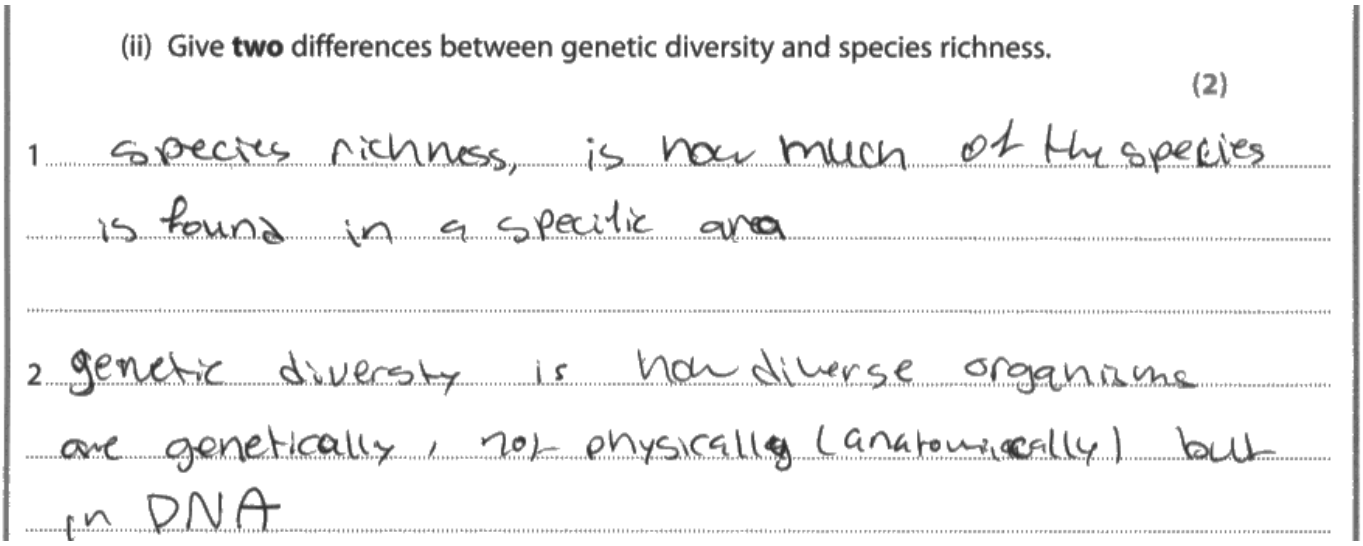
This response is an example of a description of the antimicrobial core practical method which was limited to level one.

Question 6 (a) (ii)

This question asked candidates to give two differences between genetic diversity and species richness.

As with the previous questions on this paper which also asked for differences, candidates often gave separate definitions despite the numbered answer lines.

It was pleasing to see that many candidates knew the meanings of these terms, although there were some responses that referred to genes instead of alleles which was not credit worthy.



(ii) Give **two** differences between genetic diversity and species richness.

(2)

1 species richness, is how much of the species is found in a specific area

2 genetic diversity is how diverse organisms are genetically, not physically (anatomically) but in DNA

ResultsPlus
Examiner Comments

This is an example of separate definitions.

Both of these definitions were not credit worthy so this response scored 0 marks.

(ii) Give **two** differences between genetic diversity and species richness.

(2)

1 Species richness → Is the number of different species in a habitat at a particular time while genetic diversity is the number of different alleles of the same species present within a habitat.

2 Species richness involves different species while genetic diversity is for the same species.

ResultsPlus
Examiner Comments

This was an excellent response which scored two marks. They met both marking points in the first three lines.

Question 6 (b)

This question was one of the few 'suggest' questions on this paper. Candidates were asked to suggest two reasons why seed banks store seeds instead of growing whole plants.

The full range of marking points was frequently seen and it was pleasing to see so many clear and concise answers to this question. Candidates clearly understood why it was preferable to store seeds instead of whole plants.

A small minority of candidates gave both alternatives to the first marking point and were limited to one mark.

A small minority of candidates described how storage of seeds in seed banks was useful in case of plant extinction which did not answer the question.

(b) Suggest **two** reasons why seed banks store seeds instead of growing whole plants.

(2)

1 storing large numbers of seeds require less space than growing ~~fully matured trees~~ trees to full maturity.

2 seeds ~~dont~~ do not require constant maintenance as they can remain dormant, however trees must be constantly ~~it~~ tended for. which costs more.

ResultsPlus
Examiner Comments

This is an excellent answer.

This candidate gained one mark for recognising that storing a large number of seeds requires less space than growing plants. They gained a second mark for recognising that it would cost more to provide the maintenance needed by the plants whereas the seeds do not require constant maintenance.

Question 6 (c) (i)

This question presented the candidates with a table showing the mass of bananas imported by three countries in 2007 and 2011. They were then expected to extract the correct information in order to calculate the percentage increase in the mass of bananas imported by China.

Nearly all candidates were able to extract the correct information from the table and gain one mark for 8.2-3.3. However, fewer candidates divided by the correct number (3.3) to calculate the percentage increase correctly. The most common error was to divide 4.9 by 8.2.

(c) Bananas are a popular food and seed banks are involved in the development of disease-resistant varieties.

The table shows the mass of bananas imported by three countries in 2007 and in 2011.

Country	Mass imported in 2007 / tonnes $\times 10^5$	Mass imported in 2011 / tonnes $\times 10^5$
China	3.3	8.2
Iran	6.3	6.2
Japan	9.8	1.1

(i) Calculate the percentage increase in the mass of bananas imported by China.

(2)

$$\frac{820000-330000}{330000} \cdot 100 = 148.48\%$$

Answer 148.48 %

ResultsPlus
Examiner Comments

This is an example of a correct calculation which scored 2 marks.

ResultsPlus
Examiner Tip

If there are units on the answer line then you do not need to give them.

However if there isn't then you will need to.

(c) Bananas are a popular food and seed banks are involved in the development of disease-resistant varieties.

The table shows the mass of bananas imported by three countries in 2007 and in 2011.

Country	Mass imported in 2007 / tonnes × 10^5	Mass imported in 2011 / tonnes × 10^5
China	3.3	8.2
Iran	6.3	6.2
Japan	9.8	1.1

(i) Calculate the percentage increase in the mass of bananas imported by China.

(2)

$\frac{8.2 \times 10^5}{3.3 \times 10^5} \times 100\% = 248\%$

Answer 250 %

ResultsPlus
Examiner Comments

This is an example of a response which did not gain any marks as they have not given a correct percentage increase, nor have they worked out the increase in the mass of bananas imported by China.

ResultsPlus
Examiner Tip

Ensure you have looked at the maths skills you may be tested on.

(c) Bananas are a popular food and seed banks are involved in the development of disease-resistant varieties.

The table shows the mass of bananas imported by three countries in 2007 and in 2011.

Country	Mass imported in 2007 / tonnes × 10^5	Mass imported in 2011 / tonnes × 10^5
China	3.3	8.2
Iran	6.3	6.2
Japan	9.8	1.1

(i) Calculate the percentage increase in the mass of bananas imported by China.

(2)

$\frac{8.2-3.3}{8.2}$ $\frac{8.2-3.3}{8.2} \times 100$

Answer 59.8 %

ResultsPlus
Examiner Comments

This is an example of the most common mistake made by candidates. They have divided by 8.2 instead of 3.3. Therefore only one mark could be awarded for 8.2-3.3.

Question 6 (c) (ii)

This question proved to be one of the most challenging on the paper for the candidates.

They were given information on the left hand side of the double page spread which they needed to read and understand in order to answer the question. It was disappointing to see that many candidates did not do this and therefore could not answer the question asked.

The information stated that most of the banana plants grown around the world were clones of the Cavendish banana plant and underneath the diagram there was a statement that these Cavendish banana plants were not resistant to the fungus.

The linkage of this information would have enabled the awarding of the first marking point. Unfortunately many candidates did not link this information nor give the information in the additional guidance which was that the Cavendish plants do not have an allele for resistance to the fungus.

Few candidates understood the idea that different varieties of banana may have an allele for resistance to the fungus and that breeding them with the Cavendish bananas could result in offspring with resistance to the fungus. Many candidates instead focused on the random mutations that would occur in breeding bananas together and that one of these mutations might be advantageous.

The most commonly awarded marking point was for the idea that there would be an increase in genetic diversity.

Explain why scientists are breeding the Cavendish banana with different varieties of banana.

(4)

The scientists are doing so to increase the genetic diversity of the banana plants through sexual reproduction. A different variety of banana may have alleles that are resistant to the disease-causing fungus. The fungus is a selection pressure. When the Cavendish banana breeds with the variety of banana with the advantageous allele, the ~~offsprings~~ advantageous allele will be passed onto the offspring and it will be able to survive. This changes the allele frequency of this certain allele in the gene pool overtime.
All the clones from the Cavendish plant ~~with~~ initially were not resistant to the fungi too. Now, the clones will have the advantageous allele.

(Total for Question 6 = 11 marks)

ResultsPlus
Examiner Comments

This is an excellent answer which gained all four marks. The candidate has clearly read and understood the information provided in the question. Mp3 was awarded for the first sentence, mp2 was awarded for the second sentence, mp3 was awarded for the second half of the response and mp1 was awarded near the end of the response.

Explain why scientists are breeding the Cavendish banana with different varieties of banana.

(4)

To create new species of bananas that can become resistant to fungus. Since Cavendish banana is not resistant to fungus, ~~it will soon be infes~~ all the Cavendish bananas will soon be infested with this fungus and then ~~they~~ they will ~~become~~ ~~uneatable~~, not be safe to eat. Therefore, breeding Cavendish bananas with different varieties of bananas may be ~~rest~~ resistant to Panama disease.

ResultsPlus
Examiner Comments

This response only gained mp2 for different varieties may have resistance to the fungus. 'To create new species of banana that can become resistant to fungus' was not sufficient for marking point four.

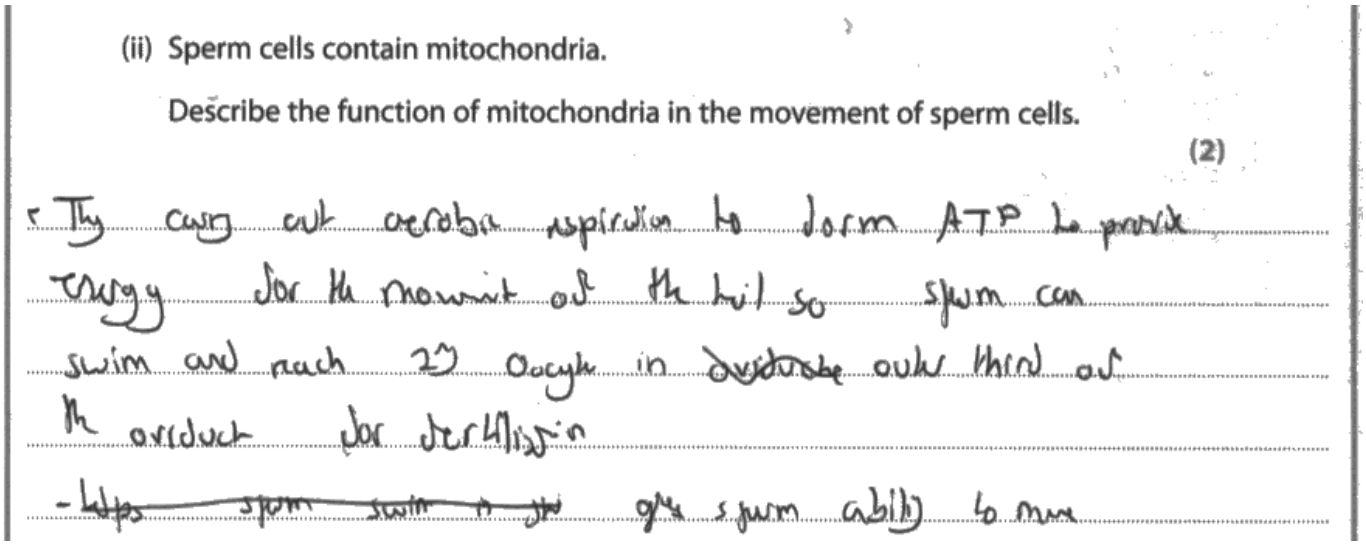
There was no reference to alleles or genetic diversity in this response.

Question 7 (a) (ii)

This question provided candidates with a diagram of a sperm cell and asked them to describe the function of mitochondria in sperm cells.

This question was answered well by the majority of candidates, with nearly all candidates recognising that respiration provided energy that was needed to move the flagellum/tail of the sperm cell.

There was a significant minority of candidates however, who wrote that energy would be **produced** by the mitochondria which was not credit worthy.



(ii) Sperm cells contain mitochondria.

Describe the function of mitochondria in the movement of sperm cells.

(2)

- They carry out aerobic respiration to form ATP to provide energy for the movement of the tail so sperm can swim and reach 2° oocyte in oviduct ~~outer~~ third of the oviduct for fertilisation
- ~~helps sperm swim to get~~ gives sperm ability to move

ResultsPlus
Examiner Comments

This is an example of a response which met all three marking points to gain full marks.

(ii) Sperm cells contain mitochondria.

Describe the function of mitochondria in the movement of sperm cells.

(2)

Mitochondia contain ATP which gives energy to the sperm cell to move ~~and~~ to the ovum.

ResultsPlus
Examiner Comments

This response scored just one mark for providing energy. There was no reference to either respiration or what part of the sperm cell would cause the movement of the sperm cell.

Question 7 (a) (iii)

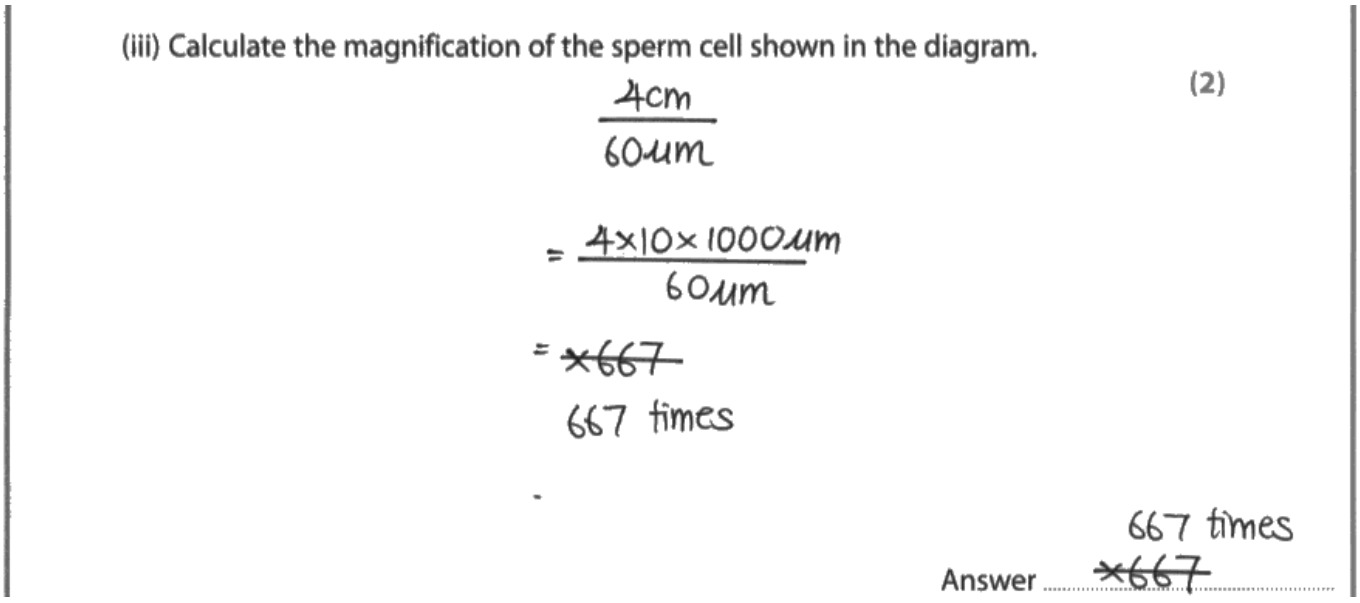
This question asked the candidates to calculate the magnification of the sperm cell shown in the diagram.

The easiest way for candidates to do this was to measure the width of the scale bar and convert it into micrometres. Then they needed to divide this measurement by 60 to gain the correct magnification.

It was surprising that many candidates did not measure the scale bar provided and instead tried to measure the actual size of the sperm cell, despite the curved flagellum.

A significant number of candidates also struggled with converting cm into micrometres, multiplying by 1000 instead of 10,000.

A minority of candidates did a correct calculation, but had a rounding error which lost them a mark.



(iii) Calculate the magnification of the sperm cell shown in the diagram. (2)

$\frac{4\text{cm}}{60\mu\text{m}}$

$= \frac{4 \times 10 \times 1000\mu\text{m}}{60\mu\text{m}}$

= ~~×667~~

667 times

Answer 667 times ~~×667~~

ResultsPlus
Examiner Comments

This is an example of a response which scored full marks.

The candidate measured the width of the scale bar in cm and correctly converted it into micrometres. They then divided it by 60 to get the correct magnification.

(iii) Calculate the magnification of the sperm cell shown in the diagram.

(2)

$M = \frac{A}{B} \frac{D}{A}$ $\frac{40000}{60} = 666$

4cm = 40000 μm

Answer X666

ResultsPlus
Examiner Comments

This is an example of a rounding error which caused the candidate to lose a mark.

Question 7 (b)

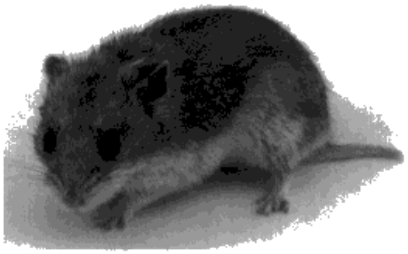
This question provided candidates with a diagram showing the relative size of a Chinese hamster sperm cell compared with a human sperm cell. Candidates were asked to suggest why the Chinese hamster sperm cell has such a large flagellum.

Nearly all candidates explained that the long flagellum would enable the sperm cell to swim faster.

Lack of relevant terminology was the main reason that the second marking point was not awarded. It was not sufficient to say that the sperm cell reached the egg cell, the candidate needed to refer to the fertilisation of the egg cell.

However, it was pleasing to see that some candidates could link the idea of mating with many males to competition with other sperm cells in order to explain why it was important that the sperm cell should swim faster.

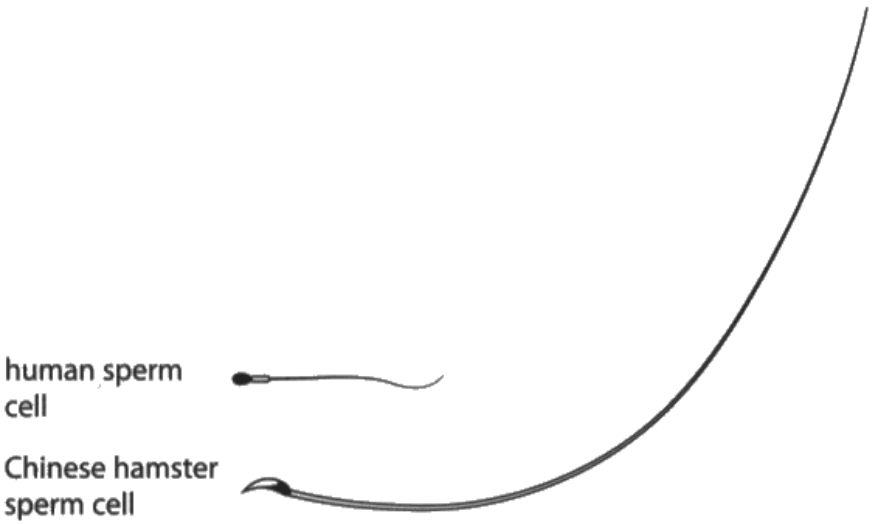
(b) The photograph shows a Chinese hamster.



Magnification ×1

A female Chinese hamster mates with many males in a short period of time.

The diagram shows the relative size of a Chinese hamster sperm cell compared with a human sperm cell.



Suggest why the Chinese hamster sperm cell has such a long flagellum.

(3)

allow faster swiming because there is competition between the many sperms of others male hamster. faster ~~Swiming~~ Swimming also increase chance of fertilization. also male have to fertiliz and reach egg in short period of time so the need long tail to swim faster and compete with other male

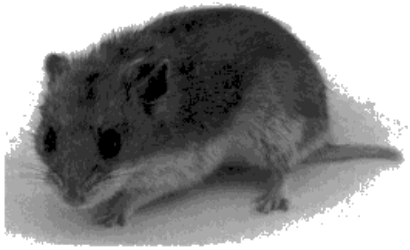
ResultsPlus
Examiner Comments

This response gained full marks as they have explained the advantage to the sperm cell of having a longer flagellum and linked this to the competition with other sperm cells.

ResultsPlus
Examiner Tip

Check to make sure you have used all the information you have been provided with.

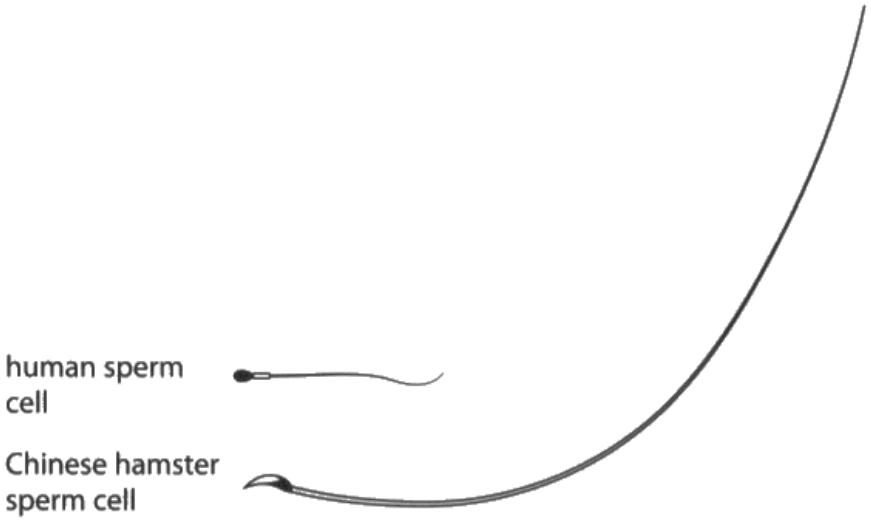
(b) The photograph shows a Chinese hamster.



Magnification ×1

A female Chinese hamster mates with many males in a short period of time.

The diagram shows the relative size of a Chinese hamster sperm cell compared with a human sperm cell.



Suggest why the Chinese hamster sperm cell has such a long flagellum.

(3)

The flagellum allows movement to the sperm cell. Hence, the long flagellum allows easier movement into the ovum cell. ~~This~~ the long flagellum may also allow faster movement to it as well. and increased

ResultsPlus
Examiner Comments

This response was awarded just the first marking point for recognising that the longer flagellum would allow faster movement. The candidate has not explained why this would be an advantage.

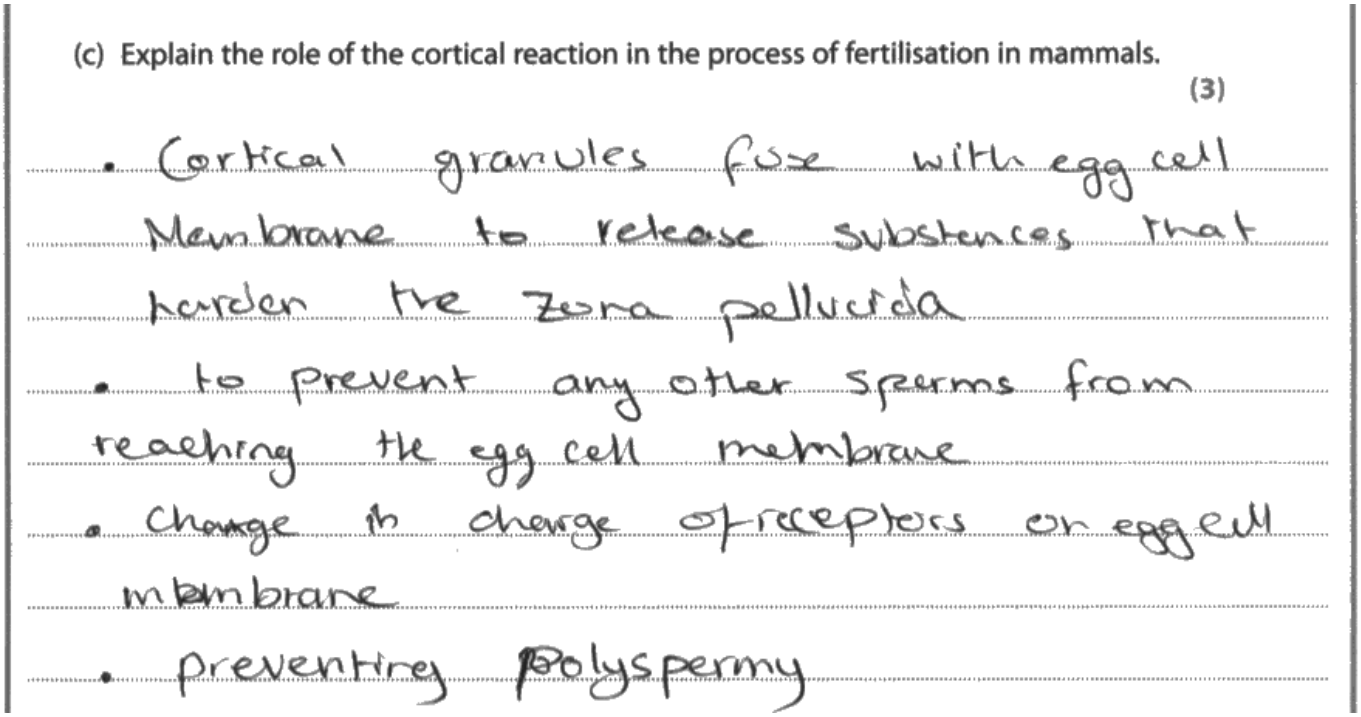
Question 7 (c)

This question asked candidates to explain the role of the cortical reaction in the process of fertilisation in mammals.

As this was more of a recall type question instead of an application of knowledge question, the performance of candidates was generally very high.

The majority of candidates gained two marks for the second and third marking points. They correctly explained that the zona pellucida hardens and that this would prevent polyspermy.

The lack of precision in their explanation was the most common reason why candidates did not gain marking point one. Many candidates referred to the release of chemicals/substances instead of enzymes which was not sufficient. In some cases there was no reference to the vesicles fusing with the membrane.



(c) Explain the role of the cortical reaction in the process of fertilisation in mammals.

(3)

- Cortical granules fuse with egg cell Membrane to release substances that harden the zona pellucida
- to prevent any other sperms from reaching the egg cell membrane
- Change in charge of receptors on egg cell membrane
- preventing Polyspermy

ResultsPlus
Examiner Comments

This is an example where the candidate did not gain the first mark point as they did not refer to enzymes.

Both mark points 2 and 3 were awarded.

(c) Explain the role of the cortical reaction in the process of fertilisation in mammals.

(3)

• Cortical reactions prevents polyspermy.

• This is due to the cortical granules that fuse with the cell surface membrane, when a sperm cell enters the egg cell. the cortical granules release enzymes by exocytosis that harden zona pellucida and form the fertilisation membrane.

ResultsPlus
Examiner Comments

This excellent response gained all three marking points.

Question 7 (d)

This question tested content that was new to this specification and was found challenging by the majority of candidates, with 49.6% of candidates scoring no marks.

Candidates were asked to describe how a totipotent stem cell becomes a pluripotent stem cell.

The most commonly awarded mark was for the description of some genes being switched off. Unfortunately few candidates explained how these genes were switched off.

Relevant terminology such as 'differential gene expression' and 'epigenetics' was rarely seen.

Many candidates just described the differences between totipotent and pluripotent cells or described changes in the developing embryo which led to totipotent cells becoming pluripotent which were not credit worthy.

(d) After fertilisation, the egg cell divides by mitosis to form a blastocyst.

During this process, totipotent cells become pluripotent.

Describe how a totipotent stem cell becomes a pluripotent stem cell.

(3)

- The genes coding for placenta and fetal membranes are permanently switched off while all other genes are switched on
- This could be the result of epigenetic changes modifying the gene expression
- In order for cells to specialise, a certain stimulus arrives to them which may be chemical such as a hormone. It switches off some genes permanently while it leaves some other genes switched on and active. Only switched on genes are transcribed into mRNA which is then translated into a protein. This protein leads to permanent alterations to function and structure of cell

(Total for Question 7 = 14 marks)

ResultsPlus
Examiner Comments

This response gained marking points 2, 3 and 4 for a clear description of how some genes are switched off and how proteins synthesised from active genes would permanently alter the function/structure of the cell.

A to F mult Most pluri

(d) After fertilisation, the egg cell divides by mitosis to form a blastocyst.

During this process, totipotent cells become pluripotent.

Describe how a totipotent stem cell becomes a pluripotent stem cell.

(3)

Totipotent stem cells are undifferentiated cells capable of producing all types of cells. Therefore these cells can develop into cells of a blastocyst. By dividing themselves by mitosis, genetically identical cells are formed. ~~Pluri~~ Blastocyst cells are pluripotent because they are ~~un~~differenciated cells than can produce most cell types.

ResultsPlus
Examiner Comments

This response scored 0 marks as the candidate has not described how a totipotent stem cell becomes a pluripotent stem cell.

Question 8 (a)

This question gave candidates information about the reintroduction of beavers to Scotland. They were provided with information and a photograph showing that beavers build dams out of tree branches.

It was pleasing to see that many candidates read and used this information in their responses.

The majority of candidates could recognise that the reintroduction of the beavers increased biodiversity. Many excellent links to the increase in species richness were seen in responses.

Many candidates did not go on to explain how the beavers' activities could increase or decrease biodiversity, of those that did, the most common mark point was for the decrease in biodiversity due to the beavers cutting down trees.

Only a minority of candidates recognised that the building of a dam would create a new pond habitat which could increase biodiversity.

A significant number of candidates referred to genetic diversity and natural selection which was not credit worthy.

8 Beavers were hunted to extinction in Scotland in the 16th century.

In mainland Europe, populations of beavers have become isolated from each other.

In 2009, 11 beavers were reintroduced to Scotland from Norway.

Beavers are adapted to live on land and in water. They can cut down trees. They gnaw branches from trees, which they use to build dams.

The photograph shows two beavers and a pond that has been created due to a beaver dam.

(a) Explain how the reintroduction of beavers resulted in a change in the biodiversity in Scotland.

(4)

Beaver population increased so biodiversity increased. The beavers cut down trees, reducing tree population, reducing biodiversity. The dams they build isolate parts of pond from one another, which can lead to speciation to increase number of species of water organisms, increasing biodiversity. The beavers may provide more food for predators, increasing ~~prey~~ predator number, increasing biodiversity. Predators can eat more species reducing species number, decreasing biodiversity.

ResultsPlus
Examiner Comments

This excellent answer was one of the few responses which gained full marks. This candidate has carefully considered all aspects of the impact that the reintroduction of beavers could have on the biodiversity in Scotland.

8 Beavers were hunted to extinction in Scotland in the 16th century.

In mainland Europe, populations of beavers have become isolated from each other.

In 2009, 11 beavers were reintroduced to Scotland from Norway.

Beavers are adapted to live on land and in water. They can cut down trees. They gnaw branches from trees, which they use to build dams.

The photograph shows two beavers and a pond that has been created due to a beaver dam.

(a) Explain how the reintroduction of beavers resulted in a change in the biodiversity in Scotland.

(4)

Reintroduction of beaver causes the species richness of the ecosystem in Scotland to increase. ~~This is~~ The ~~because the~~ dams made by beavers provide shelter and a source of food ~~as~~ for many different varieties of animals so the number of species could increase (species abundance). Beavers ~~It~~, also provide predators with a new food source so ~~it~~ they are able to survive ~~and~~ to adulthood and reproduce which reduces its chances of extinction. However the number of trees in the area ~~could~~ would reduce but this effects is insignificant as there is only 11 beavers compared to the increase in abundance of new animals and species so overall the biodiversity would increase.

ResultsPlus
Examiner Comments

This response also gained full marks due to the additional guidance in the mark scheme.

8 Beavers were hunted to extinction in Scotland in the 16th century.

In mainland Europe, populations of beavers have become isolated from each other.

In 2009, 11 beavers were reintroduced to Scotland from Norway.

Beavers are adapted to live on land and in water. They can cut down trees. They gnaw branches from trees, which they use to build dams.

The photograph shows two beavers and a pond that has been created due to a beaver dam.

(a) Explain how the reintroduction of beavers resulted in a change in the biodiversity in Scotland.

(4)

It would have an affect on biodiversity because they would change the environment in order to suit them as much as possible. This could lead to a reduction in biodiversity because it could destroy certain species' habitat eg. they pull branches from trees which birds might need so it could lead them to migrate somewhere else where they have a better suited environment to them.

ResultsPlus
Examiner Comments

This response only considered the reduction in biodiversity and therefore was limited to just one mark.

ResultsPlus
Examiner Tip

'Change' could be either an increase or a decrease so make sure you consider both possibilities in your answer.

Question 8 (b)

This question required candidates to use information from the previous two pages in the examination paper to discuss the two solutions proposed by the scientists.

Unfortunately many candidates found this question harder than expected, with almost half of the candidates gaining level 1 or below.

One of the main reasons that candidates performed poorly was they failed to pick up on the scientists' concern that the genetic diversity of the beaver population in Scotland would be affected. There were a number of responses that did not refer to genetic diversity at all and therefore could not access level one.

Where candidates did discuss how the solutions could affect genetic diversity it was often a generalised response, and did not address each solution separately.

It was pleasing to see some candidates recognised that the isolated populations on the map may have geographical isolation and that different alleles may be present in the populations as a result.

Some candidates extended their answer further to consider reproductive isolation and/or inbreeding which moved them into level 3.

Discuss the solutions, proposed by these scientists, to overcome the concern of introducing only 11 beavers into Scotland from Norway.

Use the information in the map to support your answer.

(6)

Introducing more beavers from Norway has ~~lots~~ little effect on Scotlands genetic diversity since the beavers would've had similar genes.

In order to increase genetic diversity, it is more effective to introduce beavers ~~beavers~~ also belonging to different areas since these beaver would've had more different genes due to different selection pressures ~~including~~ such as different environmental conditions. Moreover, to ~~increase~~ increase genetic diversity, ensure that the (11) beavers introduced are not selected (using stud books) to prevent inter breeding where the ~~offspring will have similar genes to~~ parents have even more similarity in their genes.

ResultsPlus
Examiner Comments

This response considered both solutions' effect on genetic diversity and had a description of geographical isolation which lifted it into level 2. Lack of precision in the terminology used e.g. 'similar genes' limited this response to 3 marks.

Discuss the solutions, proposed by these scientists, to overcome the concern of introducing only 11 beavers into Scotland from Norway.

Use the information in the map to support your answer.

(6)

The maps shows that beavers live in big groups together. This is shown by the massive amount of land they all live in together. Introducing only 11 species means that there is a high chance of beavers interbreeding, which reduces genetic diversity and could cause bad genetic mutation. The idea to bring in more beavers is a good idea because it increases genetic diversity as the beavers are coming from different locations. This is because the beavers will have adapted to different locations, making the population of beavers more diverse. And will over come the concern.

ResultsPlus
Examiner Comments

This is an example of a response where the two solutions were not considered separately.

Discuss the solutions, proposed by these scientists, to overcome the concern of introducing only 11 beavers into Scotland from Norway.

Use the information in the map to support your answer.

(6)

Introducing more beavers from Norway will not greatly increase the genetic diversity much as since the population of scottish beavers being a due to their extinction only Norwegian beavers will be present & there will be non change in gene pool. However increasing the beaver population will lower the chance of inbreeding which could have further decreased genetic diversity. Furthermore this is less costly than other solution as beavers will be transported only from one country.

Beavers who live in other countries other than Norway who have lived in diffrent environmental conditions and since they have been isolated they would have diffrent adaptations. Introducing beavers from other countries can increase the genetic diversity more than the first solution as more new alleles will be introduced. However there is a chance that no breeding will occur with the introduction of beavers from countries other than scotland as being endemic for many years they would have possibly evolve into a sub species and may not be able to produce a fertile offspring or they might not recognise beavers from other countries as mates which can lead to inbreeding which can lead to low of alleles and low genetic diversity. In addition to that as the environmental conditions in other countries are diffrent the selective pressure could also be diffrents which may lead to some beavers from specific countries not being able to adapt to Scotland's environment due to being adapted to their own. This can lead to death and decrease population as well as beaver diversity

ResultsPlus
Examiner Comments

This is an excellent response which covered all aspects required for level three and was awarded 6 marks.

Question 8 (c)

This question provided the candidates with the Hardy-Weinberg equation and asked them to calculate the percentage of beavers in the population that were homozygous for the dominant allele.

This was a very good differentiator and around a third of candidates gained full marks.

The most common error was that candidates did not recognise that the value of 0.09 was the value for q^2 and therefore did not calculate the square root of 0.09.

A very small minority of candidates did everything correctly up to the last point and then gave their answer as 0.49 instead of multiplying by 100 to get the percentage.

(c) In a beaver population, the frequency of a recessive homozygous genotype is 0.09.

Calculate the percentage of beavers in this population that are homozygous for the dominant allele, using the equation

p^2

$$p^2 + 2pq + q^2 = 1$$

$p + q = 1$

(3)

$q^2 = 0.09$

$q = \sqrt{0.09} = 0.3$

$p = 1 - 0.3 = 0.7$

$p^2 = 0.7^2 = 0.49$

$= \frac{0.49}{1} \times 100 = 49\%$

Answer 49 %

ResultsPlus
Examiner Comments

This response correctly calculated the percentage of beavers and scored full marks.

Paper Summary

Based on their performance in this paper, candidates are offered the following advice:

- Read the questions carefully and take into account the command words as well as the context given
- Do not try and make a mark scheme you have learnt from a previous paper fit a different question with different command words and a different context
- Use all of the information provided in the question to help you with your answer, for example diagrams, graphs and tables of data
- Use appropriate biological terminology in your answers
- Look at the mathematical content of the specification to see the maths skills you may be tested on.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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