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IAL Biology WBI12 01

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Introduction

This paper tested 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 students to demonstrate their grasp of these topics and apply their knowledge to novel contexts.

The questions on this paper yielded a wide range of responses and some very good answers were seen.

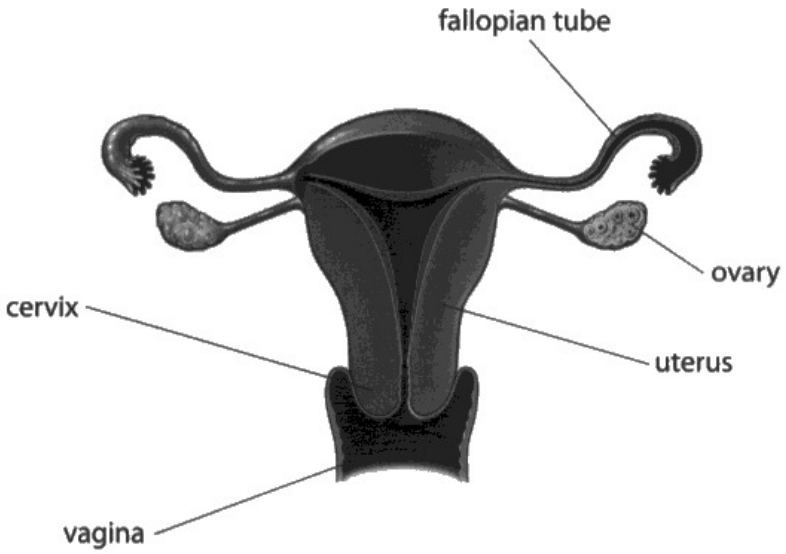
The paper appears to have worked very well with all questions achieving the full spread of marks.

Question 1 (a)

This question asked candidates to state what is meant by the term organ system.

Most students could correctly define this term. However, there were a significant number of responses which lost the mark as they referred to tissues instead of organs.

1 The diagram shows an organ system of a human female.



(Source: © Nucleus Medical Media Inc / Alamy Stock Photo)

(a) State what is meant by the term **organ system.**

(1)

Several tissues joined together to perform a specific role in the body.

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Examiner Comments

This is an example of the most common error made by candidates.

(a) State what is meant by the term **organ system.**

(1)

A group of organs working together to perform the same function

ResultsPlus
Examiner Comments

This is an example of a correct answer for one mark.

Question 1 (b)(i)

This question asked candidates to state what is meant by the term tissue.

It was pleasing to see an improvement in the quality of answers from the similar question in a previous series.

(b) Gametes are produced in one of the tissues in the ovary.

(i) State what is meant by the term **tissue**.

(1)

A group of cells working together to perform the same function.

ResultsPlus
Examiner Comments

This is an example of a correct answer for one mark.

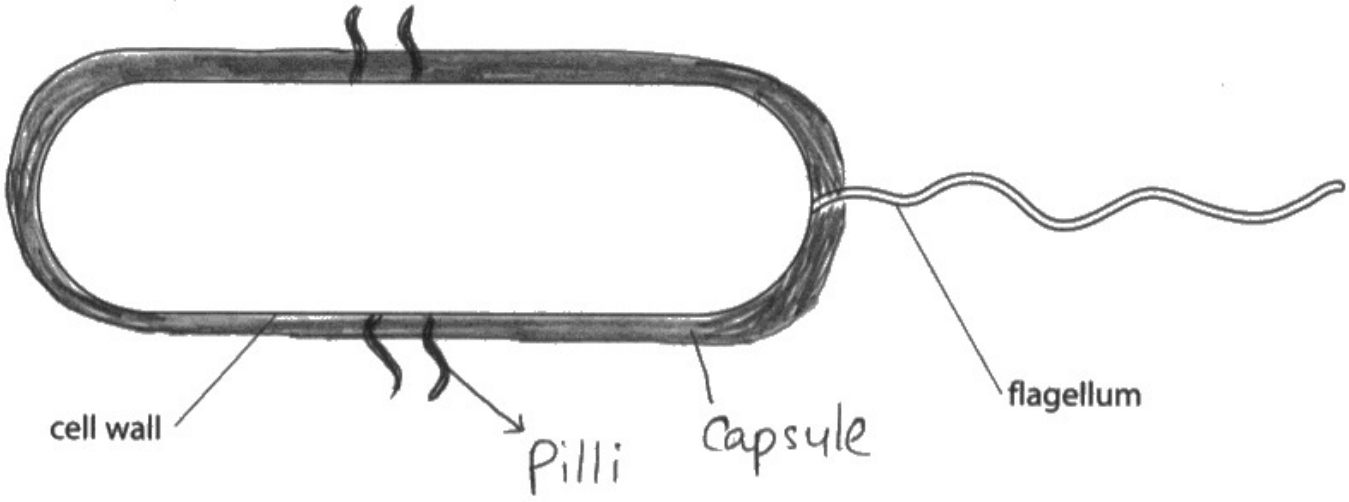
Question 2 (a)

This question asked candidates to draw and label a capsule and two pili on the diagram. It was pleasing to see many full mark responses.

A small number of candidates did not attempt this question and went straight onto part (b). Candidates need to read the instructions carefully to ensure they do not miss questions that do have a line to write an answer.

The most common errors were drawing the capsule or pili inside the cell wall, or not labelling the structures.

2 The diagram shows part of a prokaryotic cell, as drawn by a student.



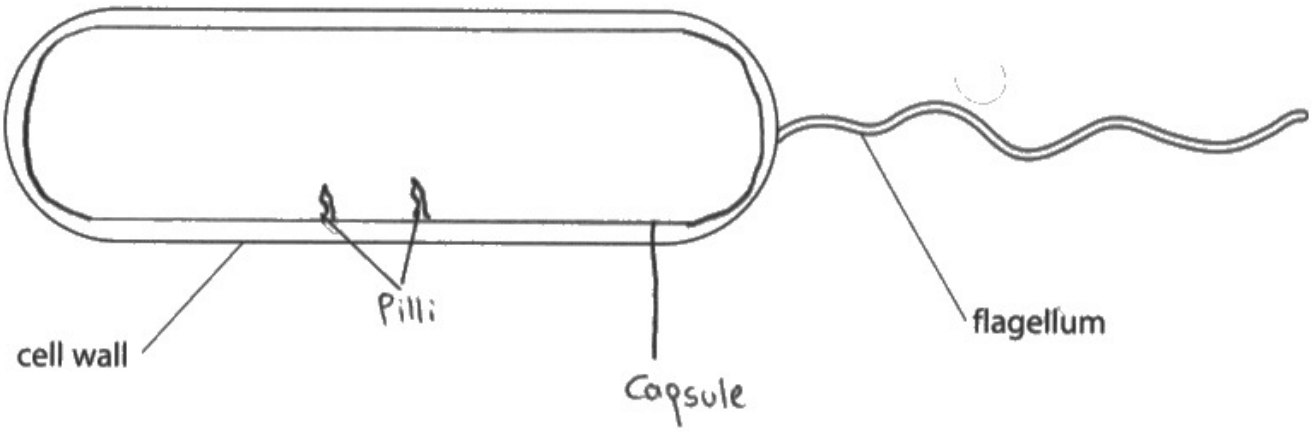
(a) Draw **and** label a capsule and two pili on the diagram.

(2)

ResultsPlus
Examiner Comments

This is an example of an acceptable answer for two marks.

2 The diagram shows part of a prokaryotic cell, as drawn by a student.



(a) Draw **and** label a capsule and two pili on the diagram.

(2)

ResultsPlus
Examiner Comments

This is an example of the common errors made by students. This response scored 0 marks.

Question 2 (b)

Candidates were given data regarding an investigation into the effect of concentrations of sodium chloride solution on the growth of bacteria. Candidates were asked to comment on the results of the investigation.

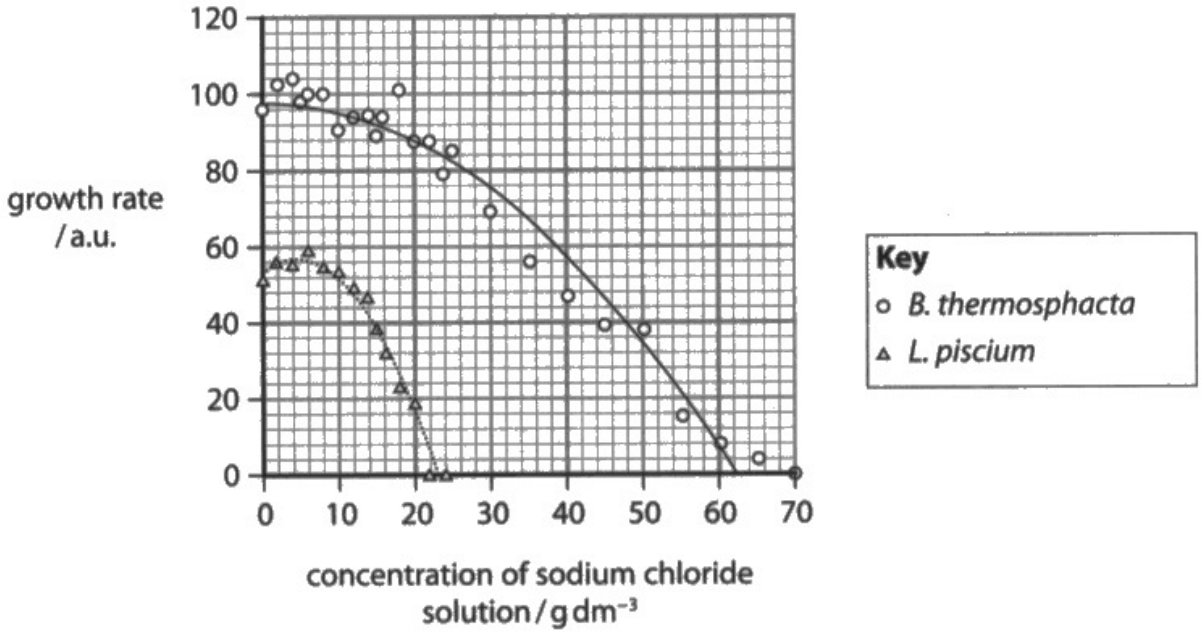
This question proved to be a very good differentiator and the full spread of marks was seen.

Most candidates were able to describe data shown in the graph, identifying correlations and differences between two curves.

Most candidates could identify that by increasing the sodium chloride concentration resulted in a decrease in the growth rate of both bacteria. It was important that this was clearly stated in the candidate responses.

The next frequently awarded marking point was marking point 5, most commonly for the additional guidance.

Few candidates identified that there was an initial increase in the growth rate, or commented on the degree of scatter around the line of best fit.



Comment on the results of this investigation.

(4)

- As concentration of sodium chloride solution increases, the growth rate of both bacteria decrease.
- Growth rate of B. thermosphacta is more / higher than L. piscium by about 46 a.u.
- The growth rate of L. piscium decreases faster than B. thermosphacta. L. piscium growth rate reaches zero at 23 g dm⁻³ sodium chloride concentration whereas ~~concentratio~~ growth rate of B. thermosphacta reaches zero at 62 g dm

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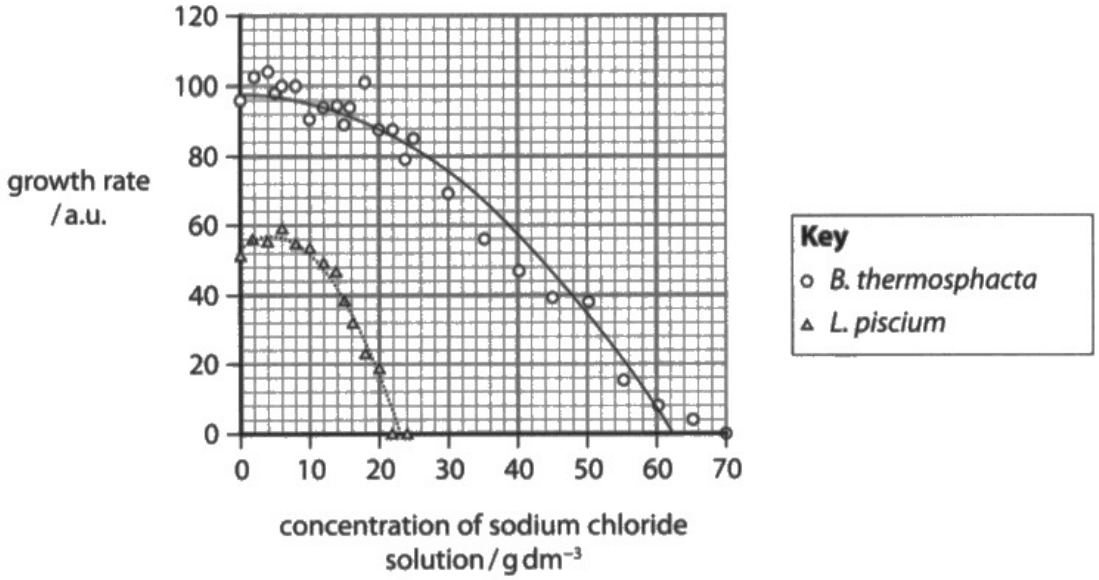
Examiner Comments

This clear and concise response scored 4 marks. Marking points 1, 4, 3 and 5 were awarded.



Comment on the results of this investigation.

(4)

The graph shows how, when the concentration of sodium chloride increases, the growth rate of the bacteria decreases. Also, the graph tells us that B. thermosphacta bacteria has an overall higher growth rate than L. piscium, and that L. piscium also stopped growing completely at a much lower concentration than B. thermosphacta and also stopped growing in a shorter amount of time. You can also see, that for L. piscium, at the very start the growth rate slightly increased then decreased, however, for B. thermosphacta, it only decreased in growth rate.

ResultsPlus
Examiner Comments

This response scored 4 marks. Marking points 1, 2, 3 and 4 were awarded.

Question 3 (a)(i)

Candidates were given a photograph of a bowl made from a calabash fruit.

They were told that the fruit was cut in half to make two bowls. They were asked to calculate the volume of one bowl to the nearest whole number.

The most common mistake made by candidates was stopping after calculating the volume of the sphere which was the volume of two bowls. Few candidates recognised that they needed to halve this answer to get the volume of just one bowl.

Another common mistake was not giving their answer as a whole number.

(i) A spherical calabash fruit was cut in half to make two bowls.

Each bowl had a radius of 25 cm.

Calculate the volume of one bowl to the nearest whole number.

Use the formula: volume of a sphere = $\frac{4}{3}\pi r^3$

(2)

$\frac{4}{3} \times \pi \times (25)^3 = 65449.84695$

Answer 65450 cm^3

ResultsPlus
Examiner Comments

This is as example of the most common mistake made by candidates. This response scored one mark for calculating the volume of a sphere correctly.

ResultsPlus
Examiner Tip

Read the question carefully to ensure what is being asked is clearly understood.

(i) A spherical calabash fruit was cut in half to make two bowls.

Each bowl had a radius of 25 cm.

Calculate the volume of one bowl to the nearest whole number.

Use the formula: volume of a sphere = $\frac{4}{3}\pi r^3$

(2)

$$\frac{\frac{4}{3} \times \pi \times (25)^3}{2}$$

Answer 32 725 cm^3

ResultsPlus
Examiner Comments

This candidate correctly calculated the volume of one bowl and scored two marks.

Question 3 (a)(ii)

This question asked the candidates to explain why bowls made from calabash fruits are a sustainable resource.

Nearly all candidates could explain that calabash bowls were a renewable resource and that more calabash plants could be grown.

Most answers also included either that the bowls were biodegradable or that it was a carbon neutral resource.

(ii) Explain why bowls made from calabash fruits are a sustainable resource.

(2)

Bowls made calabash fruits sustainable as calabash can be regrown and replanted therefore it is available for future generations as well as being carbon neutral

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Examiner Comments

This response gained marks for marking point 1 and marking point 3. Two marks were awarded.

Question 3 (b)(ii)

This question asked candidates to compare and contrast the structures of phloem sieve tubes and xylem vessels.

It was disappointing that significant numbers of candidates did not take notice of the command ‘compare and contrast’. Answers which gave a paragraph of information about phloem sieve tubes, followed by a paragraph of information about xylem vessels were not creditworthy.

A compare and contrast question requires both similarities and differences. Therefore, full marks could only be awarded if the answer contained both similarities and differences. More candidates identified differences than similarities.

Centres are advised to teach candidates the importance of comparative language in these types of questions, for example the use of the conjunctives ‘whereas’ or ‘but’.

Another important aspect that some candidates did not take careful note of was the use of the word 'structure' in the question. Responses relating to function were not creditworthy.

The most common similarity given by candidates was that both contain cell walls.

A significant number of responses contained just differences. The most common difference was that phloem sieve tubes contain living cells whereas xylem vessels contain dead cells. Few candidates correctly identified that phloem have plasmodesmata whereas xylem have pits. A minority of candidates thought that both structures were lignified.

(ii) Compare and contrast the structures of phloem sieve tubes and xylem vessels.

(4)

Phloem sieve tubes and xylem are both used for transport of materials around the plant and, empty they are

However, xylem has lignified cell walls and is wider than phloem sieve tubes and has dead cells in cell wall.

But, Phloem sieve tubes have companion cells around them to supply them with ATP and nutrients

ResultsPlus
Examiner Comments

This is an example of a response which did not take careful note of the command to compare and contrast. The points made were not comparative. This response scored 0 marks.

✱ (ii) Compare and contrast the structures of phloem sieve tubes and xylem vessels.

(4)

phloem sieve tubes are made of living cells, xylem vessels are made of dead cells.
xylem vessel, has a hollow tube structure, phloem has a sieve tube.
Both xylem vessels, and phloem sieve tubes are used to transport minerals, water, ions.
xylem vessels have lignin, phloem sieve tubes don't.
xylem have thick lignin walls, phloem don't.

ResultsPlus
Examiner Comments

This candidate showed good exam technique by making comparative statements. This scored three marks for marking points S2 and D3.

(ii) Compare and contrast the structures of phloem sieve tubes and xylem vessels.

(4)

Both contain cellulose cell wall. Xylem vessels are dead while phloem living. Phloem have a companion cell while xylem (vessel) doesn't. Xylem vessels have lignin deposited in secondary cell wall while phloem doesn't have lignin. Xylem (vessel) doesn't contain sieve plates while phloem does. Xylem vessel doesnt contain cytoplasm which phloem does. Xylem has pits in cell wall (secondary) and phloem doesn't

ResultsPlus
Examiner Comments

This response scored four marks for clearly identifying similarities and differences. Marking points S1, D2, D3, D1, D4.

Question 4 (a)(i)

This question asked candidates to draw a body cell of the Indian muntjac showing the arrangement of chromosomes in the anaphase stage of mitosis. Candidates were told that body cells have three pairs of chromosomes.

Most candidates could correctly draw centrioles, spindles and chromosomes in anaphase to gain marking point one. A small minority of responses lost the mark as they drew anaphase occurring inside the nucleus.

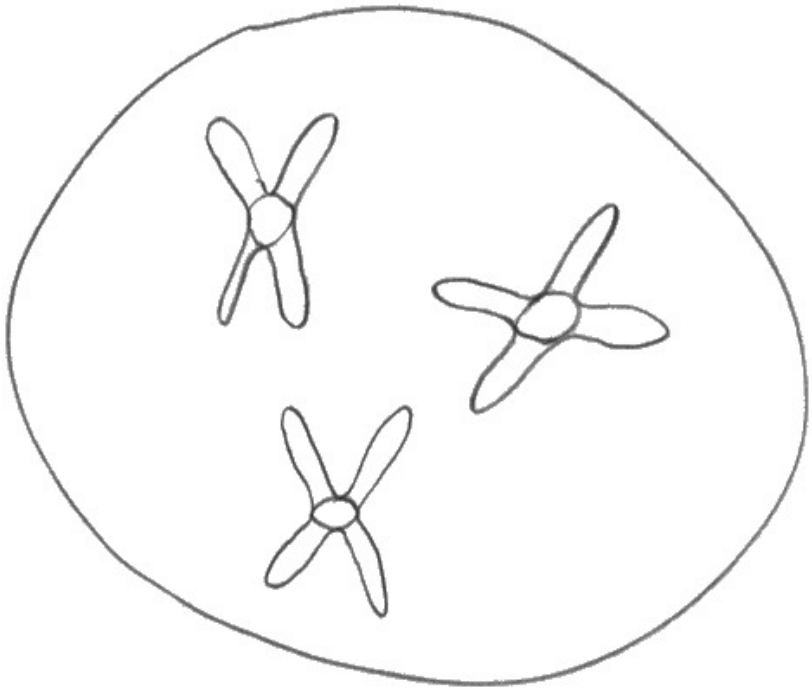
However, fewer candidates gained marking point 2 as they did not draw 6 chromosomes being pulled to each pole. Most responses showed three chromosomes being pulled to each pole of the cell.

(a) The female Indian muntjac body cells have three pairs of chromosomes.

(i) Dividing cells can be taken from the body of a female Indian muntjac.

Draw one of these body cells showing the arrangement of chromosomes in the anaphase stage of mitosis.

(2)



ResultsPlus
Examiner Comments

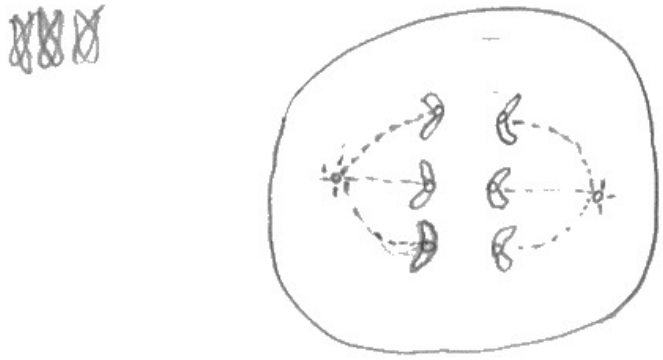
This response does not show the arrangement of chromosomes in the anaphase stage of mitosis and scored 0 marks.

(a) The female Indian muntjac body cells have three pairs of chromosomes.

(i) Dividing cells can be taken from the body of a female Indian muntjac.

Draw one of these body cells showing the arrangement of chromosomes in the anaphase stage of mitosis.

(2)



ResultsPlus
Examiner Comments

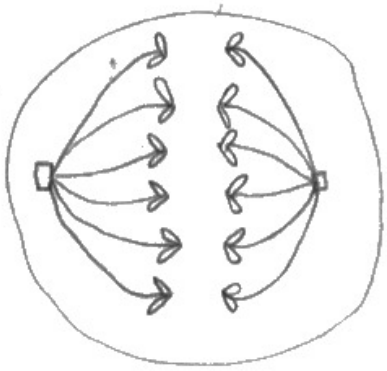
This response gained marking point 1 only. This is an example of the most common mistake made by candidates.

(a) The female Indian muntjac body cells have three pairs of chromosomes.

(i) Dividing cells can be taken from the body of a female Indian muntjac.

Draw one of these body cells showing the arrangement of chromosomes in the anaphase stage of mitosis.

(2)



ResultsPlus
Examiner Comments

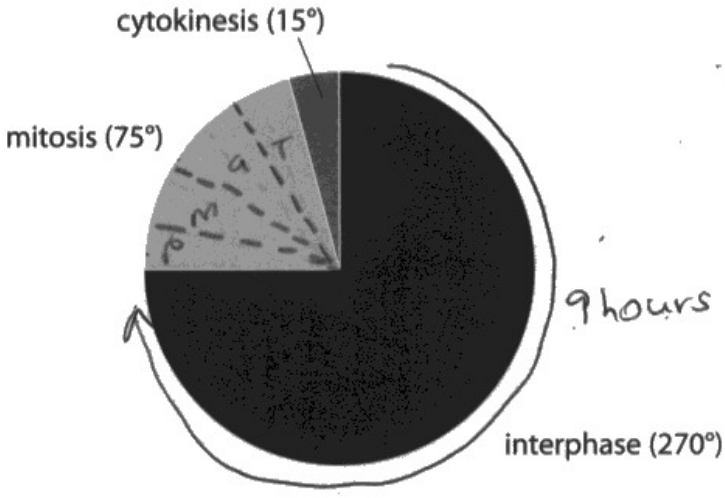
This response met both marking points and therefore scored two marks.

Question 4 (a)(ii)

The candidates were provided with a pie chart showing the relative proportions of time that a cell spends in each part of the cell cycle. They were asked to calculate the angle that would represent anaphase.

Most candidates could calculate the angle correctly and gained two marks.

(ii) The diagram shows the relative proportions of time that a cell spends in each part of the cell cycle.



$\frac{270}{9} = 30°$ per hour

The cell was in interphase for nine hours.

The cell was in anaphase for 20 minutes.

$15° = 30$ min

Calculate the angle that would represent anaphase plotted on this pie chart.

(2)

$9 \times 60 = 540$ min $\quad \frac{270}{540} = 0.5°$ per min.

$5°$ in 10 min

$10° = 20$ min

Answer 10°

ResultsPlus
Examiner Comments

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

ResultsPlus
Examiner Tip

Always ensure workings for calculations are shown.

Question 4 (b)(i)

This question asked candidates to state what is meant by the term locus.

Most candidates were able to give the correct answer. However, there were a number of candidates who confused locus with chiasmata or centrosome.

(i) State what is meant by the term **locus**.

(1)

location of a gene on a chromosome

ResultsPlus
Examiner Comments

This is an example of a correct answer and scored one mark.

(i) State what is meant by the term **locus**.

(1)

The location of the gene

ResultsPlus
Examiner Comments

This candidate gave an incomplete answer and scored 0 marks.

Question 4 (b)(ii)

This question asked candidates to explain how the chromosomes of an Indian muntjac egg cell could differ from those in a body cell.

The majority of candidates could explain that the egg cell would contain half of the chromosome of a body cell due to being haploid.

It was pleasing to see that most responses also recognised that the chromosomes themselves might differ due to random assortment or crossing over of alleles.

(ii) Explain how the chromosomes of an Indian muntjac egg cell could differ from those in a body cell.

(3)

The egg cell would contain half the number of chromosomes (23) because it's produced by meiosis, which forms haploid cells. This is because when the haploid nuclei of the gametes fuse together, they will form the full set of chromosomes (46). A body cell has the full set of chromosomes (46) because it's produced by mitosis, which forms diploid cells. This means that chromosomes in the egg cell contain half of the genetic material.

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Examiner Comments

This response gained marking point 1 twice and scored one mark

(ii) Explain how the chromosomes of an Indian muntjac egg cell could differ from those in a body cell.

(3)

The chromosomes of an egg cell would contain a different genetic sequence compared to the body cell (the DNA isn't identical) because the egg cell would have undergo been produced through meiosis and therefore crossing over ~~not independent assortment~~ would have resulted in new alleles, ABO in an egg cell there is a haploid number of chromosomes but in a body cell there is a diploid number of chromosomes.

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Examiner Comments

This is an example of a response which gained all three marking points.

Question 4 (c)

Candidates were provided with information about a Chinese muntjac. They were asked to suggest why the offspring of a Chinese and Indian muntjac pairing would be infertile.

Most candidates could correctly explain that the parents were from different species.

However, fewer candidates correctly recognised that 3 and 23 chromosomes would not be able to form homologous pairs and therefore meiosis could not occur.

A significant number of responses referred to the offspring having an odd number of chromosomes which was not creditworthy.

The Chinese muntjac looks similar to the Indian muntjac. However, if they breed together, they produce offspring that are infertile.

Suggest why the offspring would be infertile.

(2)

The Chinese and Indian muntjacs are of different species. The offspring resulting from the mating of two different species is often ~~results in~~ infertile.

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Examiner Comments

This candidate gained marking point 1 for recognising that the Chinese and Indian munjacs were different species.

The Chinese muntjac looks similar to the Indian muntjac. However, if they breed together, they produce offspring that are infertile.

Suggest why the offspring would be infertile.

(2)

This is because they are diffeerent species. ~~therefore when the egg and sperm cell fuse they~~ The Indian muntjac has 23 pairs of chromosomes whilst the chinese muntjac has 23 pairs. Because of this, at fusion of the gametes during fertilisation, there would be unpaired chromosomes therefore meiosis won't be possible.

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Examiner Comments

This candidate used the given chromosome information to give a response which gained both marking points 1 and 2.

Question 5 (a)(ii)

This question asked candidates to calculate the percentage change in the estimated population of the Hawaii palila honeycreeper. Instructions were given to candidates to give their answer to two significant figures.

It was pleasing to see an improvement in the ability to calculate percentage change with very few incorrect methods seen.

However, there was still a considerable number of candidates who either did not take careful note of the instruction to give their answer to two significant figures, or confused significant figures with decimal places.

(ii) In 2003, it was estimated that there were 7100 Hawaii palila honeycreeper birds on this island. In 2020, it was estimated that there were 950 of these birds.

Calculate the percentage change in the estimated populations of these birds.

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

(2)

$\frac{7100 - 950}{7100} \times 100$

$= 86.619$

$= 87\%$

Answer 87 %

ResultsPlus
Examiner Comments

This is an example of the correct calculation and answer for two marks.

(ii) In 2003, it was estimated that there were 7100 Hawaii palila honeycreeper birds on this island. In 2020, it was estimated that there were 950 of these birds.

Calculate the percentage change in the estimated populations of these birds.

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

$\frac{7100-950}{7100} \times 100 = 86.62\%$ (2)

Answer 86.62 %

ResultsPlus
Examiner Comments

This is an example of the most common incorrect answer. The candidate gave their answer to two decimal places instead of two significant figures.

ResultsPlus
Examiner Tip

Read the question carefully to ensure what is being asked is understood.

Question 5 (b)

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

Candidates were supplied with both quantitative and qualitative information and were expected to use this information, and their own knowledge, to support their answer.

Candidates were expected to analyse the table of data to help them explain how these two species of honeycreeper could have evolved from the same common ancestor.

The majority of candidates achieved level one by explaining how speciation could occur in a general context, without any reference to the honeycreepers.

Candidates needed to explain how these two species of honeycreeper could have evolved in order to access level two and level three. Candidates used information from the table to link the given context in with the speciation theory, for example what the selection pressures could have been or what phenotypic features could have been beneficial as a result of mutation.

Candidates who gave a detailed explanation of how both species of honeycreeper could have evolved from the same common ancestor were awarded level three.

*(b) It is suggested that both of these Hawaiian honeycreeper species evolved from the same common ancestor.

Explain how these two species of honeycreeper could have evolved from the same common ancestor.

Use the information in the table, and your own knowledge, to support your answer.

(6)

The common ancestor must've had a group travel to a different place either by choice - the founder effect, or due to a natural disaster that seperated them - the bottleneck effect. This isolation and change would've meant that that group of birds would've had to adapt to their new environment. Mutations would've caused change in the allelic frequencies if those mutations proved to be advantageous to the bird. Years of isolation and changes in the genetic diversity and allelic frequencies between species would have meant that their behaviour, physiology, or structure would've changed as they adapted to their new environments meaning that the genes were no longer compatible, producing infertile offspring. Especially if the mating behaviours changed, then they wouldn't even want to mate with one another.

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Examiner Comments

This is an example of a generic speciation answer which gained level one.

ResultsPlus
Examiner Tip

It is important to relate knowledge to the given context correctly in order to score higher marks.

*(b) It is suggested that both of these Hawaiian honeycreeper species evolved from the same common ancestor.

Explain how these two species of honeycreeper could have evolved from the same common ancestor.

Use the information in the table, and your own knowledge, to support your answer.

(6)

- Speciation occured
- ancestors got isolated in different geographical locations therfore each group had different selection pressure and different mutations
- in Hawaii amakihi honeycreeper, their food source become pressure selection so birds with longer and thinner beaks to pick insects and nectar from flowers survived more and passed on this favourable alleles to their offsprings so allele, coding for long and thin beaks, frequency increased this is natural selection
- both birds, ancestors could have been in mountainous forest but some might have immigrated to other places like the low land and shrubland and they evolved to Hawaii amakihi honeycreeper.

Population in amakihi is more than palila

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Examiner Comments

This candidate only explained how one of the two species of honeycreeper could have evolved, so was limited to level two.

*(b) It is suggested that both of these Hawaiian honeycreeper species evolved from the same common ancestor.

Explain how these two species of honeycreeper could have evolved from the same common ancestor.

Use the information in the table, and your own knowledge, to support your answer.

(6)

The common ancestor population had a small part/number that migrated to/lived in lowland, shrubland, and mountainous forests, and another which lived in mountainous forests only, possibly on different islands. They experienced different selection pressures - type of food. There was genetic variation due to mutation in each part of the population, so some had alleles that gave them beneficial characteristics. Only these survived as they could obtain more food. They reproduced and passed on the advantageous alleles to the offspring over time, the process repeated, and by natural selection and evolution, the allele frequency of the advantageous allele increased. Speciation occured. This happened as the 2 groups became reproductively isolated to give ecological isolation - they had different niches. The Hawaii amakihi honeycreeper fed on nectar, tree sap, spiders and insects, so needed a long beak (for nectar and tree sap deep in flowers) ~~and other plants~~ which was strong (to crunch spiders and insects). This beak type evolved by natural selection. The Hawaii palila honeycreeper ate seeds and beetles so needed a short powerful beak to open up/break the seeds. Also due to natural selection. Common ancestor → the 2 species will have similar characteristics. This is true as they have a similar size,

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This is an example of a level three response. The candidate has explained how both of these species of honeycreeper could have evolved from the same common ancestor, including multiple aspects of indicative content from all three sections of the mark scheme.

Question 5 (c)

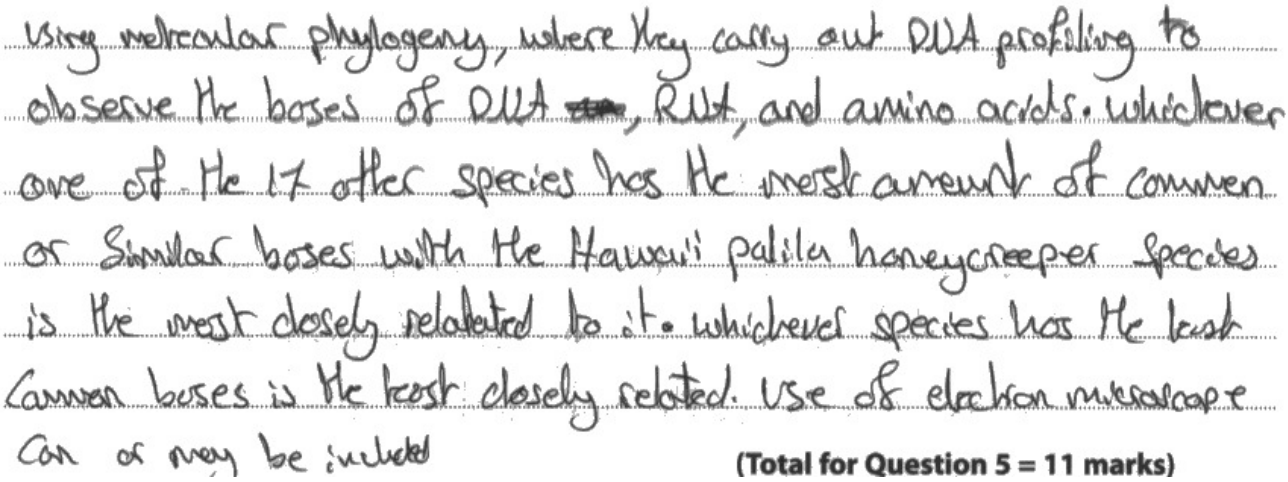
This question asked candidates to explain how scientists could determine which of the other species of honeycreeper is the most closely related to the Hawaii palila honeycreeper species.

Most candidates were awarded marking point 1 for either molecular phylogeny or a description of what biological molecule could be analysed.

However, it was disappointing that few candidates could explain how this evidence could be used to determine which of the 17 other species was the most closely related.

(c) Explain how scientists could determine which of the 17 other species of honeycreeper on these islands is the most closely related to the Hawaii palila honeycreeper species.

(2)



(Total for Question 5 = 11 marks)

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Examiner Comments

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

(c) Explain how scientists could determine which of the 17 other species of honeycreeper on these islands is the most closely related to the Hawaii palila honeycreeper species.

(2)

using molecular phylogeny & comparing DNA & RNA as ~~whe~~ well as looking at similarities & differences in phenotypes & allowing peer reviews for information gathered.

ResultsPlus
Examiner Comments

This response scored 1 mark for the first marking point. The candidate did not explain how they could use the identified similarities and differences to determine which of the 17 other species of honeycreeper is the most closely related to the Palila species.

Question 6 (b)(i)

Candidates were provided with some information about the enzyme acrosin.

They were then asked to describe the role of one organelle involved in the production of this enzyme.

The most common mistake made by candidates was that they did not notice the word 'production' in the question. A considerable number of answers giving acrosome were seen which were not creditworthy. Some candidates gave the answer mitochondria which gained one mark but did not describe the role of the mitochondria in the production of the enzyme acrosin.

A significant majority of responses correctly gave both a suitable organelle and could correctly describe the role of the organelle in the production of acrosin enzyme.

(i) Describe the role of **one** organelle involved in the production of this enzyme.

(2)

Organelle

nucleus

Role

responsible for the transcription of gene responsible for making acrosin to mRNA (then go to ribosome to be translated, folded + packaged to vesicles)

ResultsPlus
Examiner Comments

This response gave a correct organelle and gained marking point 1. The candidate correctly described the role of the nucleus in the production of acrosin and therefore gained the second marking point.

(i) Describe the role of **one** organelle involved in the production of this enzyme.

(2)

Organelle

golgi apparatus

Role

modify, package and transport enzyme in ~~vesicle~~ secretory vesicle.

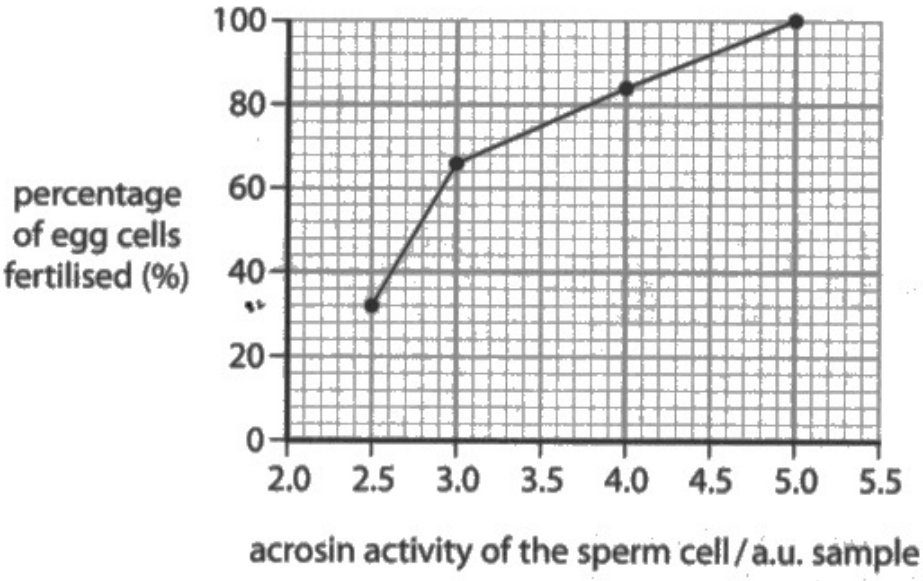
ResultsPlus
Examiner Comments

This response scored two marks.

(b) Sperm cells contain a digestive enzyme called acrosin.

The effect of acrosin activity of samples of sperm cells on the percentage of egg cells fertilised was investigated.

The graph shows the results of this investigation.



(i) Describe the role of **one** organelle involved in the production of this enzyme.

(2)

Organelle

Mitochondria

Role

Provides site for aerobic respiration to occur.

ResultsPlus
Examiner Comments

This candidate did not relate the role of the mitochondria to the production of acrosin. Therefore the response was limited to one mark.

Question 6 (b)(ii)

Candidates were informed that the investigation used 2500 egg cells for each sample of sperm cells. Candidates were required to read the correct value off from the graph for the 2.5 a.u. acrosin activity in order to calculate the number of egg cells that would have been fertilised.

Most candidates were able to give the correct answer. The most common mistake was using an incorrect value from the graph, for example 26.

(ii) The investigation used 2500 egg cells for each sample of sperm cells.

Calculate the number of egg cells that would have been fertilised by sperm cells with 2.5 a.u. acrosin activity.

(1)

$32\% \text{ of } 2500 = \frac{32 \times 2500}{100} = 800$

Answer 800

ResultsPlus
Examiner Comments

This response scored one mark for the correct calculated answer.

Question 6 (b)(iii)

Candidates were asked to explain why a higher activity of acrosin resulted in a higher percentage of egg cells being fertilised.

This question was a very good differentiator, and the full range of marks were awarded.

Most candidates could correctly explain that a higher percentage of acrosin would result in a faster rate of digestion of the zona pellucida. Unfortunately, many candidates just repeated the stem of the question and stated that more egg cells would therefore be fertilised which was not creditworthy.

More detailed responses to the question considered that if a sperm digested through the zona pellucida it could fuse with the cell surface membrane and the two nuclei could therefore fuse together, resulting in the fertilisation of the egg cell.

Some candidates also considered that low acrosin activity could result in death of sperm cells before fertilisation could occur.

(iii) Explain why a higher activity of the digestive enzyme acrosin resulted in a higher percentage of egg cells being fertilised.

(4)

A higher activity resulted in a higher percentage because more acrosin enzymes means ~~for~~ more digestion of the zona pellucida surrounding the egg, as there are more sperm cells which secrete even more of this digestive enzyme. This means that the zona pellucida is digested faster and more efficiently meaning that more sperm cells can penetrate through it and reach the oocyte membrane. If more sperm reach the oocyte membranes, more sperm head membranes fuse with the oocyte membrane, thus releasing their haploid nucleus in the ovum. The haploid nuclei of both gametes fuse together ~~to~~ via fertilisation to form diploid zygotes, thus increasing the percentage of egg cell being fertilised.

ResultsPlus
Examiner Comments

This response scored three marks. Marking points 2, 3 and 4 were awarded.

(iii) Explain why a higher activity of the digestive enzyme acrosin resulted in a higher percentage of egg cells being fertilised.

(4)

As acrosin increases, percentage of fertilised eggs increases. It increases, from 2.5 a.u. sample to 5.0 a.u. sample by 68%. When acrosin activity increases, faster digestion of pathway in zona pellucida (acrosome reaction), so cortical granules form and secrete digestive enzymes hardening zona pellucida faster, preventing polyspermy, faster fusion of sperm head with the egg cell (secondary oocyte) cell membrane, so faster entering of male haploid nucleus into egg cell cytoplasm, so faster fusion and fertilisation of egg cells, so more egg cells fertilised.

ResultsPlus
Examiner Comments

This is an example of a response which scored four marks. It gained marking points 1, 2, 3 and 4.

Question 6 (c)(i)

This question asked candidates to state how to calculate the actual size of this egg cell. It was a different way of assessing this mathematical skill.

Most candidates could correctly state how the actual size would be calculated. Some detailed answers were seen, which also included reference to unit conversion.

Some candidates measured the width of the cell and placed it into an equation which was also creditworthy.

The most common mistake was to give an equation where actual size was not the subject of the equation.

(i) State how to calculate the actual size of this egg cell.

(1)

Divide size of image by the magnification

ResultsPlus
Examiner Comments

This response scored one mark for a correct answer.

magnification = Image size / Actual size

magnification ×200

(i) State how to calculate the actual size of this egg cell.

(1)

Actual size = Magnification x Image size.

ResultsPlus
Examiner Comments

This is an example of another common mistake where the candidate has rearranged the equation incorrectly.

Question 6 (c)(ii)

Candidates were given a drawing of a fertilised egg cell with three nuclei. They were asked to suggest why this fertilised egg cell has three nuclei.

Some candidates confused this rhino egg cell with a plant ovule. As a result, a number of responses referring to triploid endosperm were seen, which were not creditworthy.

Most candidates correctly recognised that polyspermy had occurred, but unfortunately a significant minority of candidates suggested that three sperm had entered the egg cell, which negated the mark.

It was clear that many students had a good understanding of the cortical reaction and could successfully apply this knowledge to this question. As a result, a large number of candidates were able to correctly link the information in the question regarding the damaged zona pellucida with their knowledge about the cortical reaction to gain marking points 1 and 2. Some candidates referred to a toughened outer layer which was not creditworthy at this level.

(ii) **Suggest why this fertilised egg cell has three nuclei.**

(3)

The zona pellucida was damaged, which means that polyspermy may occur. This is when more than one sperm cell fertilizes an egg cell, resulting in the formation of multiple nuclei in the fertilized egg. This egg cell ~~was~~ may have been fertilized by three sperm cells, resulting in three nuclei forming upon fertilization.

ResultsPlus
Examiner Comments

This candidate has incorrectly suggested that three sperm have entered the nuclei, which meant that marking point 3 could not be awarded. This candidate did not relate their knowledge of the cortical reaction to this novel context.

(ii) Suggest why this fertilised egg cell has three nuclei.

(3)

The first two are polar nuclei anel which results in double fertilization resulting in an ~~endospem~~ endosperm. The other nuclei is fertilizael to produce a zygote.

ResultsPlus
Examiner Comments

This candidate confused the fertilised rhino egg cell with the fertilisation of a ovule in a flowering plant.

(ii) Suggest why this fertilised egg cell has three nuclei.

(3)

As the zona pellucida was damaged, the sperm cells could enter from the damaged areas even after the cortical granules induce the hardening of zona pellucida. This is called polyspermy where one egg is fertilised by more than one sperm cell. That is the reason 3 nuclei were observed.

ResultsPlus
Examiner Comments

This response scored all three marks.

Question 7 (a)(ii)

This question required candidates to calculate the surface area of a long pollen grain. They then needed to calculate the difference in surface area between round and long pollen grains. Most students were able to calculate the difference in surface area correctly.

However, few candidates gave their answer in standard form with appropriate units and they were therefore limited to one mark.

(ii) The table gives information about the surface area and volume of round and long pollen grains.

Pollen grain shape	Surface area	Volume / μm^3	Surface area to volume ratio
round	5.03	33.5	0.150
long	4.13	25.8	0.160

Calculate the difference in surface area between round and long pollen grains.

Give your answer in standard form with appropriate units.

(2)

$\frac{x}{25.8} = 0.160$

$x = 4.128$

0.902

9.02×10^{-1}

9.02×10^{-1}

Answer ~~0.902~~

ResultsPlus Examiner Comments

This candidate has correctly calculated the difference in surface area and given their answer in standard form. However they do not gain full marks as they did not give a correct unit.

ResultsPlus Examiner Tip

Check if there are units on the answer line. If there are no units then candidates will be required to state them.

(ii) The table gives information about the surface area and volume of round and long pollen grains.

Pollen grain shape	Surface area	Volume / μm^3	Surface area to volume ratio
round	5.03	33.5	0.150
long	4·13	25.8	0.160

Calculate the difference in surface area between round and long pollen grains.

Give your answer in standard form with appropriate units.

(2)

$\frac{S.A}{25.8} = 0.160$

$S.A \approx 4.128$

≈ 4.13

$5.03 - 4.13 = 0.9\ \mu m^2$

Answer $9 \times 10^{-1}\ \mu m^2$

ResultsPlus
Examiner Comments

This is an example of a correct answer for 2 marks.

Question 7 (b)

This question asked candidates to describe how a stem cell in a plant can become a sclerenchyma cell.

Many candidates wasted time by defining the difference between a totipotent and pluripotent stem cell.

Most students knew that differentiation occurs because genes were switched off. Many candidates were able to describe production of a protein (from an activated gene) which would modify the structure/function of a cell in order to become specialised.

A significant number of responses gained marks for a description of epigenetic modification. Higher-level responses extended this to explain how these proteins would cause the cell specialisation.

Few candidates were able to apply their knowledge to the given context and describe modifications needed to become a sclerenchyma cell.

(b) Plants that grow from a sweet pea seed contain stem cells.

Describe how a stem cell in a plant can become a sclerenchyma cell.

(4)

Stem cells are pluripotent, so they can give rise to almost any type of cell. If the plant needs more sclerenchyma or if the sclerenchyma is damaged, this could begin the speciation of the stem cells. Genes in the stem cells will be activated or deactivated to become a sclerenchyma cell. Then these cells will be sent to where they are needed.

ResultsPlus
Examiner Comments

This response only scored the first marking point. The candidate has not described the events after genes are activated/deactivated.

(b) Plants that grow from a sweet pea seed contain stem cells.

Describe how a stem cell in a plant can become a sclerenchyma cell.

(4)

Stem cells become specialised through differential ~~gene~~ epigenetic modifications. Genes are silenced or activated in the stem cells by histone modification (histone methylation and histone acetylation), DNA methylation, RNA splicing and non-coding RNA. These changes cause a change in the structure of chromatin, which make it more or less open to RNA polymerase, which would form mRNA translated to form a protein. This would cause a permanent modification to the cell which would result in a differentiated sclerenchyma cell. This cell would now have thick lignified walls and no living contents.

ResultsPlus
Examiner Comments

This is an example of a response that scored full marks. The candidate has demonstrated that they understand how a stem cell can become specialised and then related it to the given context.

(b) Plants that grow from a sweet pea seed contain stem cells.

Describe how a stem cell in a plant can become a sclerenchyma cell.

(4)

Because of cell specialisation, or differential gene expression; due to a chemical stimulus, some genes are activated (e.g. gene for sclerenchyma cell) and mRNA is transcribed only for this gene and then translated into a protein. The protein will then permanently modify the cell's function and properties, making it a sclerenchyma cell.
The other genes can be inactivated by using DNA methylation.

ResultsPlus
Examiner Comments

This response shows the most common error made by candidates. The candidate has not described any of the modifications that would be needed to become a sclerenchyma cell. Therefore, this response is limited to 3 marks

Question 7 (c)

This question assessed candidates understanding of linkage.

The candidates were expected to analyse the given information regarding three sweet pea genes located on two different chromosomes. They were then asked to comment on the role of meiosis in the inheritance of these traits.

Many candidates found this a particularly challenging question due to the inclusion of the command word 'comment on', the word 'role' and the concept of linkage.

Most candidates understood that meiosis led to genetic variation or that crossing over and independent assortment occurred in meiosis. As a result, marking point 1 was the most awarded mark.

A number of responses described crossing over and random assortment in detail, failing to connect to the question in terms of inheritance of sweet pea traits.

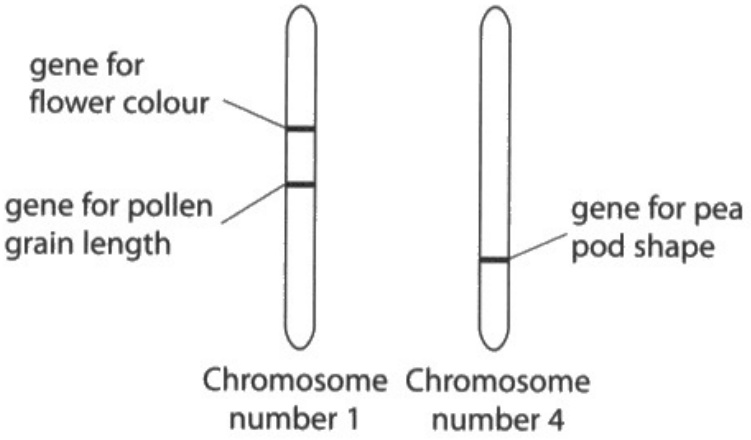
A significant number of candidates were able to state that the genes for flower colour and pollen grain length were close together on the same chromosome to gain the additional guidance for marking point two. It was pleasing to see that many could use the term 'linkage' correctly. Some of these candidates could then relate linkage to the likelihood of the two traits being separated during crossing over.

Few candidates accessed marking points 4 and 5, with a significant number of candidates incorrectly referring to crossing over occurring between chromosome number 1 and chromosome number 4.

(c) Sweet pea plants were used in an investigation into the inheritance of flower colour, pollen grain length and pea pod shape.

Each of these traits is controlled by a single gene. Sweet peas have seven pairs of chromosomes.

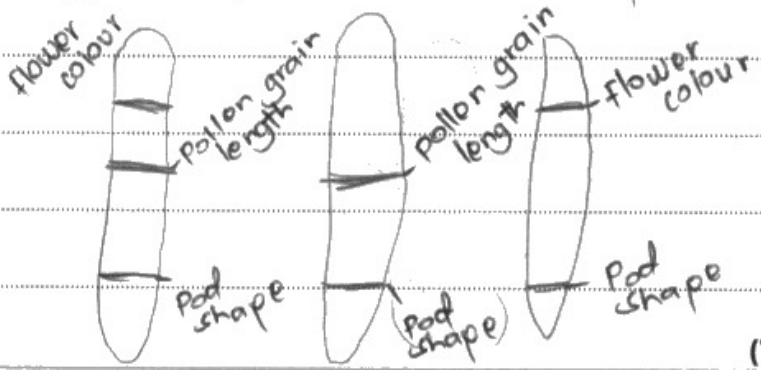
The arrangement of these three genes on sweet pea chromosomes is shown in the diagram.



Comment on the role of meiosis in the inheritance of these traits.

(4)

Meiosis enables crossing over of genetic information. Chromosome 1 and 4 will cross over and the chromosome 1 may get the gene for pea pod shape while chromosome 1 may give chromosome 4 the gene for flower colour and or gene for pollen grain (length)^. This will result in the product I produce having traits from both parents thus providing a higher quality sweet pea.



(Total for Question 7 = 11 marks)

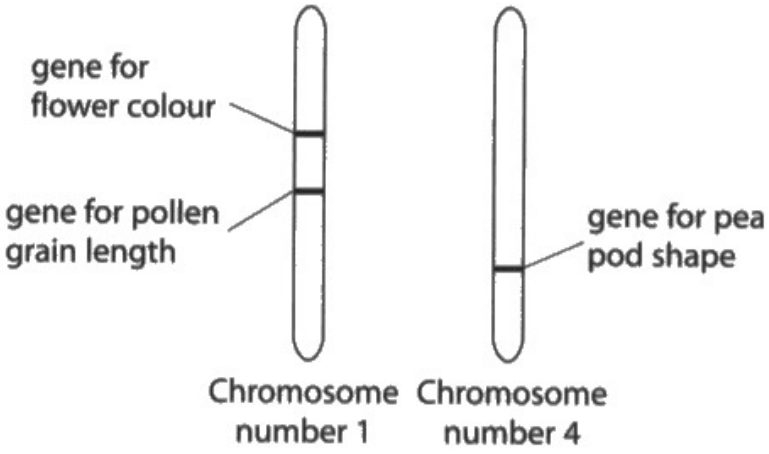
ResultsPlus
Examiner Comments

This response incorrectly describes crossing over between chromosome 1 and 4.

(c) Sweet pea plants were used in an investigation into the inheritance of flower colour, pollen grain length and pea pod shape.

Each of these traits is controlled by a single gene. Sweet peas have seven pairs of chromosomes.

The arrangement of these three genes on sweet pea chromosomes is shown in the diagram.



Comment on the role of meiosis in the inheritance of these traits.

(4)

Meiosis is reduction division i.e it halves the original number of chromosomes in the diploid cell. Genes for flower colour and pollen grain length are closely located on the same chromosome (linked genes) so are unlikely to be separated during crossing over and ~~won't be sep~~ independent assortment. Gene for pea pod shape is located on a different chromosome than the other 2 genes, so it may be separated from them by independent assortment (while the other 2 genes are inherited as a single unit). Each of these genes have a multiple alleles which are randomly distributed into the gametes formed by meiosis due to the crossing over of these alleles and the independent assortment of the sister chromatids of these chromosomes.

(Total for Question 7 = 11 marks)

This candidate understood the concept of linkage and could relate their knowledge to the given context to gain full marks.

Question 8 (a)

Candidates were provided with a table of data and some information about the introduction of wolves to Yellowstone National Park.

This question asked candidates to explain why the percentage of young shoots eaten by the elk changed after the introduction of wolves.

Most candidates could recognise that the introduction of the wolves would decrease the elk population and, as a result, marking point two was the most awarded mark.

However, candidates did not always follow through with the extended outcome of the reduction in elk population. Many candidates referred to fewer elk eating shoots with no outcome of reduced numbers of shoots being eaten.

A few candidates simply quoted data from the table without describing a decrease.

Some candidates were confused between a decrease in percentage of trees eaten and a decrease in the percentage of trees.

Higher level responses recognised the significance of the data for two different habitats.

Explain why the percentage of young tree shoots eaten by the elk changed after the introduction of wolves.

(3)

Because wolves are predators of elk, elk might be eaten by wolves due to they are food of wolves. ~~when~~ The population of elk decrease by the introduce of wolves, ~~at~~ when the number of elk decrease, ~~the~~ the ~~food~~ demund of their food also decrease, therefore young tree shoots eaten by the elk decrease since ~~these~~ this plant ~~is~~ is food for elk.

ResultsPlus
Examiner Comments

This response gained marking points 1 and 2 for 2 marks. The candidate did not compare the two columns of data.

Explain why the percentage of young tree shoots eaten by the elk changed after the introduction of wolves.

(3)

In the introduction of wolves the elk now has a predator. The elk is now being hunted and & this leads to the wolves eating the elk lowering the population and now that there are less of them less food will be eaten and this also allows other animals to eat young tree shoots as it was all being eaten by the elk. The decrease is much greater in the Riverside showing it may have more predators and the forest is safer for the elk

ResultsPlus
Examiner Comments

This response scored full marks for marking points 1, 2 and 3.

Question 8 (b)

Candidates were asked to describe the relationship shown in the provided graph.

It was disappointing that many candidates did not take careful note of the number of marks for the question. Most responses just gave a general trend with no further information. More detailed responses referred to a non-linear decrease and the plateau.

Describe the relationship shown in the graph.

(3)

as number of elk increases, mean beaver lifespan decreases throughout years, it decreases non-linearly showing negative correlation, and mean beaver lifespan was constant between 90 - 100 km^2 of number of elk.

ResultsPlus
Examiner Comments

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

Describe the relationship shown in the graph.

(3)

As the number of elk increases, the mean beaver lifespan decreases. This can be caused by elk feeding on beavers, or it can be due to competition over food. As they live at same area, less food resources and the beavers have shorter lifespa...

ResultsPlus
Examiner Comments

This is an example of a response which gave the overall trend for 1 mark.

Question 8 (c)(i)

This question asked candidates to suggest what information the scientists would need to collect to calculate species richness.

The vast majority of candidates knew that species richness referred to the number of different species in an area, but many also stated the need to know the number of each species.

The most common error which resulted in marking point 1 not being awarded was a lack of precision in the candidates' answers. Some candidates referred to obtaining numbers of animal species, instead of all species. Some candidates described methods to ensure that the organisms were different species.

Few candidates recognised that they would need to know the size of the habitat in Yellowstone National Park. Some candidates thought that the entire park was the habitat.

(c) Scientists investigated the effect of the introduction of wolves on the biodiversity of Yellowstone National Park.

(i) Suggest what information the scientists would need to collect in order to calculate species richness in a habitat in Yellowstone National Park.

(2)

They would need to calculate how many different species there are in the habitat and the size of the habitat.

ResultsPlus
Examiner Comments

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

Question 8 (c)(ii)

Candidates were asked to write a formula that could be used to determine the biodiversity of a habitat in Yellowstone National Park. This formula is listed in the specification, although other correct formulas were accepted.

Some correct responses were seen. Many candidates attempted to recall the equation but made errors when writing it out.

The most common incorrect answers were the Hardy-Weinberg or heterozygosity index equations.

(ii) Write a formula that could be used to determine the biodiversity of a habitat in Yellowstone National Park.

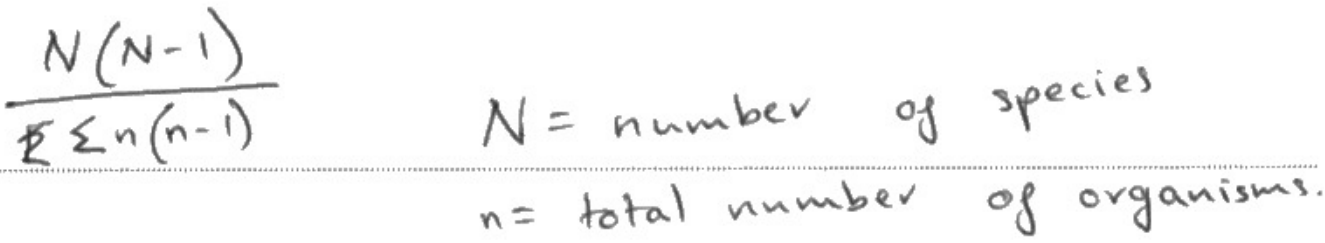
(1)

ResultsPlus
Examiner Comments

This is an example of a common incorrect answer.

(ii) Write a formula that could be used to determine the biodiversity of a habitat in Yellowstone National Park.

(1)



ResultsPlus
Examiner Comments

This is an example of a correct response for one mark

Question 8 (d)

This was the second of the level-based questions on the paper.

Candidates were given pertinent quantitative and qualitative information. They were expected to use this information in their discussion of the effect of the introduction of wolves on the biodiversity of Yellowstone National Park.

Some candidates thought that biodiversity was simply an increase in the population size.

Candidates who just described information from the given graphs were limited to level one.

To access level two, candidates needed to discuss some linkages. For example, discussing reasons as to why there were changes in numbers of the organisms. The most common points made by candidates were linking to the decrease in elk population to the increase in tree shoots and consequently the increase in beaver populations.

Some good descriptions of wolf-elk predator-prey relationships were seen.

The most common way that candidates accessed level three was by extending their answer to discuss how the increased number of habitats created by the trees and the beavers would increase species richness and biodiversity.

Some candidates also recognised that the introduction of wolf species had already increased biodiversity. Comments regarding genetic diversity were often seen but were not relevant for this context.

Discuss the effect of the introduction of wolves on the biodiversity of Yellowstone National Park.

Use all the information in the question to support your answer.

(6)

after the introduction of wolves the number of elks kept on gradualy decreasing across the years then somehow stayed the same. Number of cottonwood shoots stayed the same for a few years then kept on increasing rapidly. Number of beaver colonies also stayed the same for a few years then it kept on increasing.

ResultsPlus
Examiner Comments

This is a level one response as the candidate has just described the graphs.

Discuss the effect of the introduction of wolves on the biodiversity of Yellowstone National Park.

Use all the information in the question to support your answer.

(6)

as the number of wolves increases ~~in~~ the number of elk decreases because wolves are predetor of elk so as a result there will be more beiver colonies because there is less compititon on young trees ~~as the~~ because the number of elk decrease the young trees are not eaten by them so those trees grow so the number of cotton wood shoots also increases ~~and the~~ but the number of cotton wood shoots was delaid until it increased from 2001 to 2003 they where growing so the number of cotton wood shoots did not increas until growth was completed and in 2005 the number of wolves decreased so the number of elk ~~later~~ also increased in the same year

ResultsPlus
Examiner Comments

This is an example of a level two response where the candidate has described the changes in population size of the different organisms and then extended their answer to discuss reasons as to why there were changes in the number of the organisms.

Discuss the effect of the introduction of wolves on the biodiversity of Yellowstone National Park.

Use all the information in the question to support your answer.

(6)

The introduction of wolves lead to a decrease in the number of elk and later a decrease in the number of wolves as many elk were gone so less food left for the wolves, which lead to a loss of biodiversity.

Since the number of elk were reduced it led to more cotton wood shoots growing which led to them growing into big trees forming a forest which led to creation of new habitats for the organisms increasing biodiversity.

And for the beaver colonies they also increased in number as there were less elk to eat the young tree shoots which allowed the trees to grow and get chopped down by beavers which reduces the biodiversity of the forest but increases it as the beavers use the trees to build dams creating ponds which created new habitats for species. increasing the biodiversity of the park.

ResultsPlus
Examiner Comments

This is an example of a level three response. The candidate discussed changes in numbers of the different organisms and then discussed a number of linkages which allowed them to access level two. The candidate then discussed the new habitats that would be formed and linked this to an increased biodiversity.

Paper Summary

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

- Read the whole question carefully to ensure you do not miss questions.
- You should take into account the command words as well as the context given. Answers which do not match the command words or do not relate to the given context will not gain high marks.
- Information provided in the introduction to questions is provided for a specific reason. Read it carefully and analyse what information will be needed to provide a high-level response to the question being asked.
- Do not try and make a mark scheme you have learnt from a previous paper fit a different question with different context and command words.
- Study all of the mathematical skills that are non emboldened in the specification.
- Make sure you include your workings with all calculations. If rounding is necessary, make sure that this is done correctly. Check to see what format you are expected to present your answer in, eg, standard form.
- If units are not given on the answer line, check to see if you have been asked to provide them.

Grade boundaries

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