

Examiners' Report  
June 2014

GCE Biology 6BI02 01

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## Introduction

Overall, many candidate's failure to read questions carefully and actually use information presented on the question paper cost many candidates vital marks.

There was evidence of a good understanding of the ultrastructure of the cell, with knowledge of the roles of the different organelles, especially in the process of cell differentiation. The roles of mitosis and meiosis were well understood by many candidates, although some struggled to explain how meiosis brings about genetic variation in gametes. The processes involved in the double fertilisation of flowering plants were understood well by most, although confusion between nucleus and nuclei is still evident. Natural selection was grasped by many, although not all were able to correctly describe the process.

The recollection of core practicals and the application of skills that should have been learnt through carrying out these procedures was variable, yet again suggesting that not all students have had the opportunity to fulfil this aspect of the specification.

Many candidates interpreted data from tables and graphs effectively, remembering to use appropriate units and realising that manipulation of data to support statements will gain extra marks. However, there were examples where candidates had misread graphs, or failed to select appropriate data to support their answers.

There were also many occasions when candidates were unable to articulate their answer in a way that correctly answered the question. This is something that can be addressed by centres, especially through encouraging correct use of key vocabulary and practising exam technique.

## Question 1 (a)

Although many candidates correctly described the action of digestive enzymes on the style, many incorrectly attributed the origin of the enzyme. A common misconception appears to be that the tube nucleus itself secretes the enzymes, or that it digests the style, which it obviously does not, although its genes for the digestive enzyme are activated.

(a) Explain how the pollen tubes grow through the style of the flower.

(2)

The tip of the pollen tube contains digestive enzymes which break down the style and create a pathway for the pollen tube to grow. The enzymes may also have chemicals that promote growth



**ResultsPlus**

**Examiner Comments**

This answer gains marks for 'digestive enzymes that break down the style' and 'create a pathway'.

(a) Explain how the pollen tubes grow through the style of the flower.

(2)

Tube nucleus enters first + releases enzymes that (digest) create a pathway to the micropyle. The male nucleus splits into 2 and follows afterwards.



**ResultsPlus**

**Examiner Comments**

This is a common example of the misconception that the pollen tube nucleus releases enzymes.

It should be obvious that the role of any nucleus is not to release enzymes. Students should be aware of how enzymes are produced inside cells.

## Question 1 (c)

Many candidates correctly identified the flagellum and acrosome as structures present on the sperm yet absent in the pollen. However, many also mentioned mitochondria as structures that only the sperm possess, inferring the absence of mitochondria as they had not been told that they did possess them. Good answers also referred to the difference in number of nuclei, credit was given to any answer recognising the fact that there were more nuclei in the pollen than in the sperm cell.

(c) Describe how the structure of a pollen grain differs from that of a sperm cell.

(2)

Pollen grains are spherical in shape whereas a sperm cell has a head and a flagellum to allow movement. ~~The~~ A sperm cell contains digestive enzymes in an acrosome to digest through the follicle cells and the zona pellucida whereas a pollen grain does not. Sperm cells contain many mitochondria but a pollen cell does not.

(Total for Question 1 = 7 marks)



**ResultsPlus**  
Examiner Comments

This answer gains marks for the presence of a flagellum and an acrosome in the sperm cell, clearly explaining that these are not in the pollen.

It does also contain the incorrect suggestion that pollen grains do not contain mitochondria.

(c) Describe how the structure of a pollen grain differs from that of a sperm cell.

(2)

Pollen grains don't have flagellum like sperm cells ~~and~~ acrosomes. <sup>pollen grains</sup> They have a cell wall unlike sperm and contain 2 nuclei instead of 1.



**ResultsPlus**  
Examiner Comments

This answer manages to list a number of marking points: 1. no flagellum, 2. no acrosome, 3. cell wall in pollen grains, 4. different number of nuclei.



**ResultsPlus**  
Examiner Tip

Remember to make comparisons when asked to - don't just describe one cell and then the other.

## Question 2 (a)

There were many candidates who guessed the answer to this by trying to work out what 'polygenic' could mean. Many lost marks by referring to the phenotype generally, rather than a specific characteristic or trait. There were also answers referring to alleles instead of genes – in this instance, we are looking for reference to multiple genes. Good answers came from those who understood that some characteristics are controlled by several genes at different loci that interact to give rise to a characteristic that often showed continuous variation. Rather too many simply described the inheriting of genes from both mother and father. Some candidates confused the terms 'characteristic' and 'phenotype', as well as 'continuous variation' with 'continuous variable'.

- 2 In 1886, Sir Francis Galton claimed that the height of a child could be predicted by working out the mean height of its parents.

Scientists have since discovered that the inheritance of height is an example of polygenic inheritance.

(a) Explain what is meant by the term **polygenic inheritance**.

(2)

A characteristic that is determined by more than one gene. Another example of a characteristic that is inherited by polygenic inheritance is eye and hair colour.



**ResultsPlus**  
Examiner Comments

This response gains the first mark for reference to one characteristic determined by more than one gene.

- 2 In 1886, Sir Francis Galton claimed that the height of a child could be predicted by working out the mean height of its parents.

Scientists have since discovered that the inheritance of height is an example of polygenic inheritance.

- (a) Explain what is meant by the term **polygenic inheritance**.

(2)

It is when the phenotype, the characteristics of an organism, are determined by ~~many~~<sup>multiple</sup> different genes, not just one.



**ResultsPlus**

**Examiner Comments**

If this response had referred to just one characteristic, instead of characteristics, plural, they would have gained the mark.

Generally, the phenotype of an organism is determined by many genes - this is not the meaning of polygenic.



**ResultsPlus**

**Examiner Tip**

Learn the definitions of key biological terms - read the glossaries in your text books, or make your own.

- 2 In 1886, Sir Francis Galton claimed that the height of a child could be predicted by working out the mean height of its parents.

Scientists have since discovered that the inheritance of height is an example of polygenic inheritance.

- (a) Explain what is meant by the term **polygenic inheritance**.

(2)

A trait which is expressed as the result of the presence of multiple genes that all code for this trait.



**ResultsPlus**

**Examiner Comments**

This example gains the mark for reference to more than one gene determining a single trait.

## Question 2 (b)

Many attempted a generic answer to this question, quoting information learnt from their text books instead of taking on board the context of the question. However, the majority of candidates realised that a poor diet could contribute to a person not reaching their potential height. Many found the question difficult to answer. Candidates who had read forward in the question used the increase in height in the graph and improved nutrition in answers.

(b) Some scientists have suggested that diet may affect the growth of a child.

Explain how the height of an adult human demonstrates how environmental factors interact with genotype.

(3)

- A person may have tall parents, and therefore be tall themselves, but may be short
- However, environmental factors, such as the amount of carbohydrates a person receives, could impact on the growth of the person.



**ResultsPlus**  
Examiner Comments

This answer is on the right lines, but is too vague to gain credit.

If they had referred to an individual not reaching their genetic potential and if they had referred to protein instead of carbohydrate they would have scored 2 marks.

(b) Some scientists have suggested that diet may affect the growth of a child.

Explain how the height of an adult human demonstrates how environmental factors interact with genotype.

(3)

As the height depends on the growth of bones, if an individual consumes large amounts of proteins during their growth period, then they are more likely to reach their genetic height potential as opposed to a malnourished child whose bones will not grow to fulfil their genetic potential. Therefore the height of an adult mainly depends on their diet when they were children and whether or not they can reach their genetic potential.



**ResultsPlus**  
Examiner Comments

This answer gained full marks (3) for describing the fact that a malnourished individual will not fulfil their genetic potential to grow tall and that protein, specifically, is required for growth of bones. It clearly recognises the role of specific environmental factors on the phenotype of the individual with reference to height.



## Question 2 (c) (i)

Good answers took into account the wording of the question that asked for a description of the 'changes in mean height', rather than just a description of the graph. There were many careless errors in the manipulation of data, with many incorrectly reading the starting height of the Northern Europeans. Care must be taken when reading points from graphs. There were a lot of responses that just compared the **differences** in height, rather than the **changes**. Some candidates also lost marks by not referring to the idea of 'increases' in the question, thus just comparing existing data.

- (i) Using the information in the graph, describe the changes in mean height for adult European males from 1955 to 1980.

(3)

The ~~heights~~ mean heights of ~~Souther~~ Southern European males increased between 1955 and 1980, the ~~increase slows~~ ~~was~~ ~~less~~ there was a smaller increase between 1965 and 1970 and the largest increase was recorded between 1970 and 1975. The mean heights of Northern European men increased between 1955 and ~~in 70~~ 1980, however the increase was smaller and ~~the~~ the increase stopped at 1970 then started again. Overall there was an increase in the mean height for adult European males from 1955 to 1980.



### ResultsPlus Examiner Comments

This response gained marks for increase in height for both sets of European males and for describing the largest increase for Southern Europeans between 1970 and 1975. The mark for comparing the increase between Northern and Southern Europeans could not be given as the statement was incomplete.



### ResultsPlus Examiner Tip

Make sure it is clear what you are comparing when using words like 'smaller'. If this answer stated 'the increase was smaller than the increase in Southern Europeans' it would have scored full marks.

- (i) Using the information in the graph, describe the changes in mean height for adult European males from 1955 to 1980.

between 1955 and 1980 (3)

Generally, as time went on, mean height of adult European males increased.

Northern European adult male mean height increased by 2.3cm (1/277 (approx 1.3%)) and Southern European adult male mean height increased by 4.4cm (approx 2.5%), showing that Southern European mean adult male height has increased more in the 25 years, showing that ~~they~~ <sup>it</sup> increased at a faster rate than Northern European adult male mean height.



### ResultsPlus Examiner Comments

This was a good response that gained full marks (3). Marks were gained for reference to an increase in height for European males between 1955 and 1980, as well as describing a greater increase in height for Southern European males, with an accurate calculation comparing an increase of 2.3cm with 4.4cm. The percentages are also correct - either set of figures would have gained the mark for manipulation of data.



### ResultsPlus Examiner Tip

Check the units - some students lost marks by referring to changes in height of 2.3 and 4.4m!!

## Question 2 (c) (ii)

Many seemed to gain the first two marking points, however some missed the opportunity to say what the difference in diet would be. Standard answers discussed differences in diets and mentioned more protein or calcium. Good answers also mentioned changes in health care as well as the impact of migration in introducing alleles for tallness into the populations.

There were many who did not appreciate the time scale (1955 – 1980), and talked about evolution and natural selection. There were some who appeared to believe that the height changed in response to selection pressures, that varied from fruit produced on tall trees to cold weather in the mountains, whilst others claimed that exercise, such as basketball would make people taller. Meanwhile, there were those who seemed convinced that the reason for increased height lay in the fact that tall men are more attractive!

(ii) Suggest an explanation for the changes in mean height of these two groups of adult males.

(2)

As the years have gone by, the nutrition of food has been shown as more important. This means we eat more nutritious foods, growing more. It also suggests that the southern European males have been eating more nutritiously as they have a higher rise in height. It also shows that Northern European started more nutritious.



**ResultsPlus**

**Examiner Comments**

This is an example of the type of vague response that is not really specific enough to score well. This was given one mark for implying that there were differences in diet that affected the changes in height. 'More nutritious foods' is vague whereas 'foods containing more protein' is a far better answer.



**ResultsPlus**

**Examiner Tip**

Use appropriate, precise terminology that is of the right level for an AS answer - think of what is required at GCSE and then add more detail.

(ii) Suggest an explanation for the changes in mean height of these two groups of adult males.

(2)

Northern European adult males mean height increased by 2.4 cm whilst Southern European adult males increased by 4.2 cm (double the amount) <sup>during</sup> at the same period of time (25 years). This could be genetic variation <sup>as many cultures mix.</sup> ~~as the men could~~. Another reason could be due to environmental factors such as better nutrition or variety of food in southern Europe and exercise than in Northern Europe.



**ResultsPlus**  
Examiner Comments

Another example of a vague answer that starts off by describing the changes and then mentions 'genetic variation as many cultures mix' - not quite precise enough for the mark. A mark was given for 'better nutrition or variety of food in southern Europe'.

(ii) Suggest an explanation for the changes in mean height of these two groups of adult males.

(2)

One of the reasons for changes in mean heights could be that transport has become more widely available and people are migrating more. This could increase the gene pool size and there could be a greater proportion of people in Europe with the gene for being taller. Also people could be eating a better diet and having more protein so they're growing more.



**ResultsPlus**  
Examiner Comments

This answer refers to increased migration bringing about a change in the gene pool with more genes for tallness - this alone would have gained 2 marks. Marks could also have been given for describing a better diet with more protein.



**ResultsPlus**  
Examiner Tip

If you can think of a few relevant points, write them all down - that way you increase your chance of scoring full marks.

### Question 3 (a)

There were many good answers to this question – most gained marks for mentioning features only in eukaryotic cells, principally membrane bound organelles. Better answers also made comparisons between ribosome sizes, types of cell wall if present and listed features present in prokaryotic cells only. Interestingly, some suggested that flagella are only found in prokaryote cells, despite having mentioned flagella in their answers to Q1(c).

In order to gain full marks, candidates had to do more than write a list of organelles found only in eukaryotic cells.

3 Prokaryotic and eukaryotic organisms can be classified depending on their cellular structure.

(a) Describe **three** structural differences between prokaryotic and eukaryotic cells.

Answers (3)

~~Eukaryotic cells have nucleus whereas~~

Eukaryotic have nuclear DNA whereas prokaryotic cells have linear.

Eukaryotic have ~~fat~~ mitochondria whereas prokaryotic cells don't.

Eukaryotic cells are have larger ribosomes than prokaryotic.



**ResultsPlus**  
Examiner Comments

The first sentence does not gain a mark - prokaryotic cells do not have linear DNA, it is circular.

The next part of the answer gains a mark for naming an organelle present in eukaryotic cells and not in prokaryotic cells. The last part of the response also gains a mark for noting the correct difference in ribosome size.

3 Prokaryotic and eukaryotic organisms can be classified depending on their cellular structure.

(a) Describe **three** structural differences between prokaryotic and eukaryotic cells.

(3)

- Prokaryotic cell have no nucleus where as Eukaryotic cell do.
- Eukaryotic cells have linear ~~di~~ DNA where as Prokaryotic cells have circular DNA.
- Eukaryotic cell have large ribosomes where as ~~sm~~ prokaryotic have small ribosomes.



**ResultsPlus**

**Examiner Comments**

This is a good answer, clearly comparing the types of cells. Although simply laid out, the points are clearly made using correct terminology.



**ResultsPlus**

**Examiner Tip**

Bullet points help organise answers, especially if a specific number of points are required for the answer. Sometimes, keeping it simple works best.

3 Prokaryotic and eukaryotic organisms can be classified depending on their cellular structure.

(a) Describe **three** structural differences between prokaryotic and eukaryotic cells.

(3)

Prokaryotic cells ~~have nucleoids~~ have nucleoids and nucleolus' whereas eukaryotic cells have a nucleus. Eukaryotic cells have double membrane and single membrane organelles whereas prokaryotic cells have only single membrane organelles. Prokaryotic cells can also have some prokaryote specific characteristics, such as a flagellum, mesosome or plasmids. Prokaryotes have a peptidoglycan cell wall.



**ResultsPlus**

**Examiner Comments**

This answer shows how over-complicating the response can lose marks.

No mark for 'prokaryotic cells have nucleoids and nucleolus whereas eukaryotic cells have a nucleus' is not correct, it would have been better to just state that nuclei are only found in eukaryotic cells and not in prokaryotic cells.

Stating that eukaryotic cells have 'double membrane and single membrane organelles' is fine, but the mark is then lost by stating that 'prokaryotic cells have only single membrane organelles'.

This candidate then lists features that only prokaryotic cells possess - including flagella. However, in this case the mark was allowed for reference to plasmids.

The last line describing the peptidoglycan cell wall in prokaryotes is not a difference - there had to be reference to the structure of cell walls in either plants or fungi to gain that mark.



**ResultsPlus**

**Examiner Tip**

Beware of losing marks by over-complicating your answers.

### Question 3 (b)

A range of incorrect answers were seen for this question, as this does tend to be an aspect of the specification poorly grasped by many candidates. Many did gain marks for mentioning DNA or proteins, yet failed to discuss the molecular differences and similarities in the structures of these biological molecules. Poor expression resulted in many not achieving full marks for this question. An ideal answer would discuss the analysis of DNA or proteins, to investigate similarities and differences and that species sharing similarities would be more closely related and therefore grouped together.

(b) In 1977, Carl Woese suggested that there are three domains of living organisms: the Archaea, the Bacteria and the Eukaryota.

He used molecular phylogeny to classify organisms into different domains.

Explain what is meant by the term **molecular phylogeny**.

(3)

Molecular phylogeny is looking at the DNA and RNA of different organisms and looking for similarities and differences between them to then place them into one of the three domains.



**ResultsPlus**

**Examiner Comments**

A nice response clearly describing the process of comparing the structures of DNA and RNA for similarities and differences and using those to assign organisms  
2 marks awarded here

(b) In 1977, Carl Woese suggested that there are three domains of living organisms: the Archaea, the Bacteria and the Eukaryota.

He used molecular phylogeny to classify organisms into different domains.

Explain what is meant by the term **molecular phylogeny**.

(3)

Its the study of RNA sequencing the more similar in organisms RNA the more closely related they are. It also studies other molecular structures such as proteins present in different organisms.



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**Examiner Comments**

A good answer, gaining full marks (3).

Marks given for describing similarities in molecular structures of RNA and protein being used to determine how closely related organisms are to each other.



### Question 3 (c) (i)

Although directed to evidence from the table other cellular details were often provided, which were not creditworthy. It is essential that candidates follow the instructions provided in the question, i.e. 'Using the information from this table' - this is a clear instruction and must be followed.

Some candidates gave differences between Archaea and Bacteria/Eukaryotes in turn, rather than both together as the question instructed, or only compared the Archaea with one other domain. Many just gave a long description of cell membrane differences, ignoring the differences in RNA polymerase.

- (i) Using information from this table, give evidence that supports Woese's conclusion that the Archaea are distinct from **both** the Bacteria and the Eukaryota.

(2)

The cell membrane contains branched hydrocarbon chains attached to glycerol by ether bonds. Neither bacteria nor Eukaryota have this in their cell membrane. They also have a different number of protein molecules in their RNA polymerase, 10, compared to Bacteria, 5, and Eukaryota, 12.



**ResultsPlus**

**Examiner Comments**

This is a nice, clear answer clearly comparing the Archaea with the two other domains, just using information from the table to gain full marks.

- (i) Using information from this table, give evidence that supports Woese's conclusion that the Archaea are distinct from **both** the Bacteria and the Eukaryota.

(2)

The Archaea's cell membrane is made of branched hydrocarbon chains attached to glycerol by ether bonds, whereas both Bacteria and Eukaryota's cell walls are made of unbranched fatty acid chains attached to glycerol by ester bonds.

It also has different sized ribosomes to Eukaryota and no peptidoglycan in the cell walls when Bacteria does.



**ResultsPlus**  
Examiner Comments

This response starts well, with a thorough description of the differences in cell membrane structure. However, it then refers to differences in ribosome size compared with just the Eukaryota and then the absence of peptidoglycan compared with just the Bacteria.

It scored just 1/2



**ResultsPlus**  
Examiner Tip

If a word in the question is in **bold** print - then take that word into account in your answer!

The question asked for evidence that the Archaea are distinct from **both** the other 2 domains.

### Question 3 (c) (ii)

Most candidates were able to select the lack of peptidoglycan and the similar number of protein molecules in RNA polymerase – and were able to phrase it successfully. However, an unfortunate number mistakenly stated that both Archaea and the eukaryotes **have** peptidoglycan – or that no cell wall is present.

(ii) Using information from the table, explain why the Archaea are thought to be more closely related to Eukaryota than to Bacteria.

(2)

Both Archaea and Eukaryota have a similar amount of protein molecules within the cell. Additionally, neither of the two cells have peptidoglycan in the cell wall, whereas, bacteria does.



**ResultsPlus**  
Examiner Comments

A nicely phrased answer that gained both marks easily.

## Question 4 (a)

Although the majority of candidates grasped the question, they were not always able to provide AS level detail in their answers, often simply stating 'cell division for growth and repair'. Surprisingly few discussed the idea of increasing cell number. Only a small proportion of candidates gained the mark for replacing dead cells or repairing damaged tissue – a common error being to refer to the repairing of damaged 'cells' instead of damaged 'tissues'. Some referred to the 'formation of identical cells' without describing these cells as **genetically identical**. There were also many references to asexual reproduction, probably as a consequence of describing the role of mitosis generally instead of in the context of root growth, as directed in the question. Some candidates focussed on the role of roots, showing that they had not understood the question.

Candidates need to be aware of the fact that answers learnt from prior mark schemes usually lose marks if the context of the current question is not taken into account.

4 The root tip squash procedure can be used to observe cells undergoing mitosis.

(a) Explain the role of mitosis in the development of roots.

(2)

Mitosis is used in the growth of new roots  
and the repair of others.



**ResultsPlus**  
Examiner Comments

This is typical of the type of response that is too vague and imprecise to gain marks. If the student had referred to new root 'cells' they would have gained one mark.

4 The root tip squash procedure can be used to observe cells undergoing mitosis.

(a) Explain the role of mitosis in the development of roots.

(2)

mitosis allows the root cells to divide  
and produce more of themselves so  
that they can ~~grow~~ <sup>and be</sup> grow longer ~~and~~  
and develop, extending further into  
the soil.



**ResultsPlus**  
Examiner Comments

This example gained one mark for explaining that mitosis allows cell division and the production of more cells.

4 The root tip squash procedure can be used to observe cells undergoing mitosis.

(a) Explain the role of mitosis in the development of roots.

(2)

Mitosis is the method of cell division resulting in genetically identical cells being produced. ~~The roots~~ The roots ~~undergo~~ cells undergo mitosis to grow as an organ, as the <sup>root</sup> cells divide and replicate.



**ResultsPlus**

**Examiner Comments**

This response gained 2 marks for reference to cell division and the production of genetically identical cells.

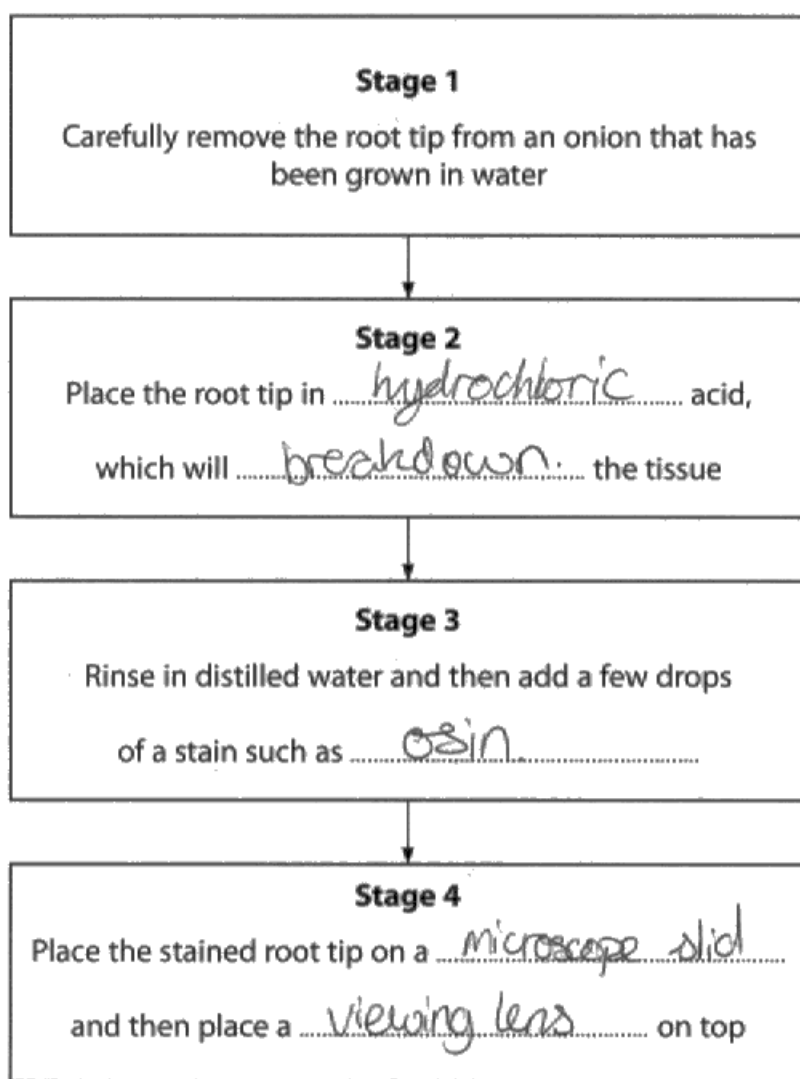
### Question 4 (b) (i)

Considering that the 'root tip squash' is a core practical, there were many very disappointing responses to this question. Many candidates were unable to name a microscope slide and a coverslip, and/or confused a microscope slide with a watch glass or Petri dish. Correct spelling of a suitable stain, or even a reasonable suggestion of one, was surprisingly rare. Overall this question was poorly answered, it not only challenged spelling, it also demonstrated that common equipment could not be identified. It also appears to indicate that there are candidates who had not carried out this core practical, a requirement of the course.

(b) (i) The flow chart below describes the stages involved in staining a root tip squash to show mitosis.

Complete the flow chart by writing the most appropriate word or words on the dotted lines.

(3)



**ResultsPlus**  
Examiner Comments

This answer gained two marks - the first for identifying hydrochloric acid and correctly stating its function in the root tip squash practical, and the second mark for 'osin' accepted as a phonetically correct attempt to spell orcein.

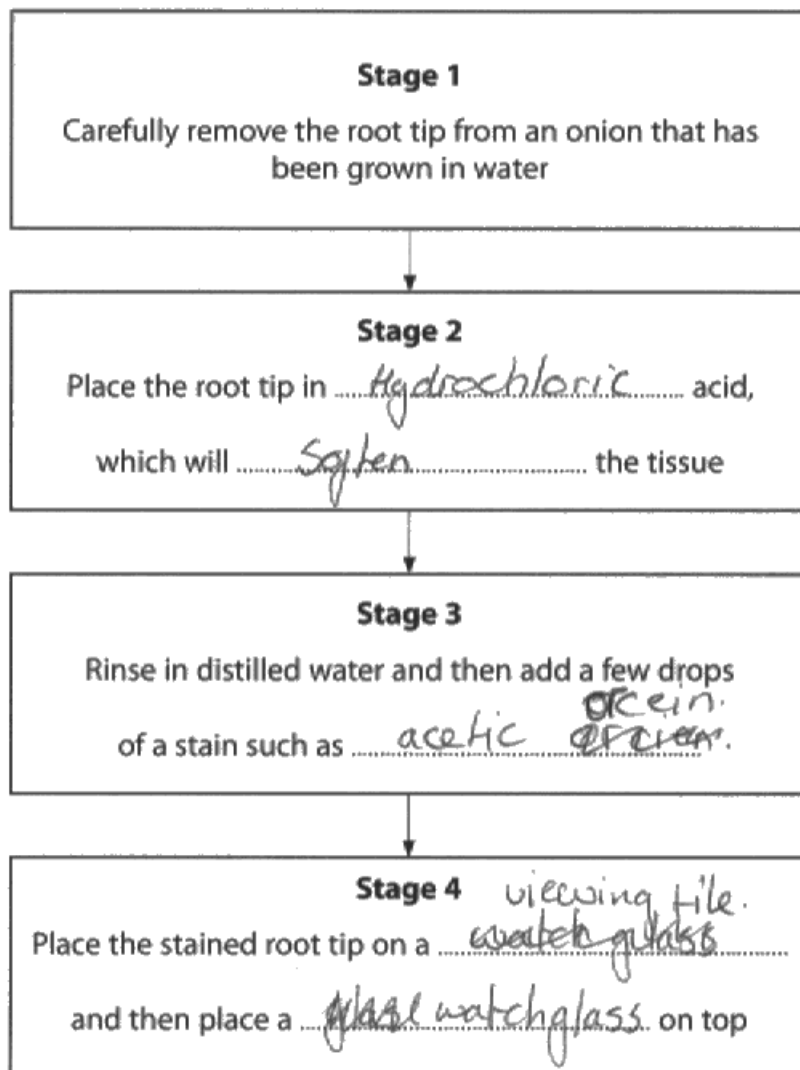
We were lenient on the spelling of stains in this question as it was not Quality of Written Communication(QWC) assessed and the focus was on learnt practical skills.

However, 'viewing lens' is not the equivalent of a 'cover slip'.

- (b) (i) The flow chart below describes the stages involved in staining a root tip squash to show mitosis.

Complete the flow chart by writing the most appropriate word or words on the dotted lines.

(3)



**ResultsPlus**  
Examiner Comments

There were many answers like this, where the candidate knew the theory - the fact that hydrochloric acid was used to soften the tissue and that an acceptable stain was acetic orcein, but had no idea of the names of basic laboratory equipment. This really does suggest that either the practical was not carried out, or that the student has not learnt the names of standard items such as a microscope slide.

### Question 4 (b) (ii)

Candidates cannot expect to score marks with generic answers such as “wear safety glasses” without some justification. Most answered correctly with reference to protecting the eyes from the acid or stain, although some inadvertently spelt ‘goggles’ as ‘googles’ that we allowed as a slip of the pen. It must be noted that the wearing of a lab coat to ‘protect clothing’ is not a safety precaution, it is a laundry consideration – however, if linked to keeping acid from spilling onto the skin, credit could be given.

A safety precaution is one that protects the individual carrying out the experiment from harm.

(ii) Describe **one** safety precaution that should be taken when carrying out this procedure.

(1)

To be carefull with the root tip as they are very fragile. If damaged we cannot see the stages of mitosis taken place under the microscope.



**ResultsPlus**  
Examiner Comments

There were a few who were concerned for the safety of the root tip rather than themselves.



**ResultsPlus**  
Examiner Tip

Remember - a safety precaution is one that protects you!

(ii) Describe **one** safety precaution that should be taken when carrying out this procedure.

(1)

Wear lab coat as stain will damage clothes by staining them.



**ResultsPlus**  
Examiner Comments

The wearing of lab coats cropped up frequently - although they do indeed keep your clothes clean and protected, this does not count as a safety precaution!



(ii) Describe **one** safety precaution that should be taken when carrying out this procedure.

(1)

Gloves should be worn when handling acid to prevent burns.



**ResultsPlus**  
Examiner Comments

This form of protective clothing does gain a mark for linking the wearing of gloves to preventing burns caused by the acid.

## Question 4 (c)

There were many good answers to this question, with answers to questions concerning differential gene expression clearly well 'rehearsed'. However, a few misconceptions still remain, mRNA is not transcribed (DNA is transcribed to produce mRNA) or DNA translated (the mRNA is translated at the ribosome), genes are activated or switched on (a standard phrase, linked to gene switching) they are not turned on. Although most candidates knew that cells are stimulated to become specialised, they were unspecific about the nature of said stimulus - only the better answers referred to a chemical stimulus. Poor expression cost marks here - and this was a question assessed for QWC.

\* (c) Following mitosis, some cells undergo differentiation to become specialised tissues, such as xylem.

Explain how cells differentiate to become specialised tissues.

(4)

- Only some genes are switched on.
- mRNA is only transcribed from the genes that are switched on.
- The mRNA is then translated into proteins.
- These proteins modify the cell structure and function.
- The changes the proteins produce are difficult to reverse.
- The cells become specialised tissues.



**ResultsPlus**

**Examiner Comments**

Yet again, a bullet pointed response clearly sets out the answer to the question.

Note that the student does refer to mRNA being transcribed, a common mistake that can be ignored if the context is correct - in this case the fact that transcription is described in relation only to the genes that are switched on.



**ResultsPlus**

**Examiner Tip**

Bullet points are a good way to arrange your answers to questions that ask you to describe a sequence of events.

\* (c) Following mitosis, some cells undergo differentiation to become specialised tissues, such as xylem.

Explain how cells differentiate to become specialised tissues.

(4)

There is a chemical stimulus which activates some genes and deactivates others. mRNA is transcribed from the switched on genes and travels to the ribosomes which read this code in translation and synthesise the correct protein. This protein permanently modifies a cell's shape and function and specialises it. These same specialised cells come together and form a specialised tissue.



**ResultsPlus**

**Examiner Comments**

This is a good answer which refers to a chemical stimulus activating some genes, transcription at the active genes and then describes translation correctly. This answer also takes into account the context of the question in the description of specialised cells forming a specialised tissue.

### Question 4 (d) (i)

The key to this question was the word 'observed'- there were many answers concerning events that happened during meiosis but not mitosis, however, not all can be observed using a microscope. There were also a number of incorrect responses, concerning events that occur in both mitosis and meiosis, such as interphase or cytokinesis. 'Crossing over' was by far the most common correct answer seen.

(d) Similar staining techniques can be used to observe cells undergoing meiosis.

(i) Name a process that may be observed in cells undergoing meiosis but **not** mitosis.

(1)

Independent assortment.



**ResultsPlus**

**Examiner Comments**

Although independent assortment does occur in meiosis but not in mitosis, it is not readily observable under the microscope.

(d) Similar staining techniques can be used to observe cells undergoing meiosis.

(i) Name a process that may be observed in cells undergoing meiosis but **not** mitosis.

(1)

Crossing over of chromosomes



**ResultsPlus**

**Examiner Comments**

Although it is the chromatids rather than the chromosomes which cross over, the mark was given for the process of crossing over being visible.

### Question 4 (d) (ii)

Naming the two processes of 'crossing over' and 'independent assortment' was common, and although it seems that candidates tend to have the right sort of idea about what they are, clear descriptions were less frequently seen, especially for independent assortment. Many responses did not explain how the random assortment would produce variation in the gametes. Vague details concerning the exchange of 'genetic material' do not gain credit, whereas exchange of pieces of chromatid, or DNA, or indeed alleles between chromatids is far preferable. There were also, as usual, many incorrect discussions of fertilisation as one of the features of meiosis. Random fertilisation does give rise to genetic variation, but it is not a consequence of meiosis.

(ii) Explain how meiosis can give rise to genetic variation in the gametes produced.

(2)

When the chromosomes line up they will cross over some of their genetic information many combinations will be created. This leads to independent assortment and this will cause genetic variation in the gametes produced.



**ResultsPlus**  
Examiner Comments

Although this response initially appears to contain enough relevant details to gain at least one mark, the context is incorrect and the details too vague to gain credit. Exchange of some of 'their genetic information' is not enough - DNA would be better.

Also this response implies that it is crossing over that leads to independent assortment which is incorrect.

Descriptions of 'many combinations' needs to be qualified - e.g. different combinations of alleles are created.

(ii) Explain how meiosis can give rise to genetic variation in the gametes produced.

(2)

Crossing over leads to two chromatids twisting around each other, pulling sections off and rejoining. This means different parts of chromatids will combine together, giving genetic variation.

Independent assortment means that random alleles can be taken from either parent and combined in cells, giving genetic variation.



**ResultsPlus**  
Examiner Comments

This answer gains 2 marks - one for mentioning both crossing over and independent assortment and another for correctly describing crossing over, with reference to chromatids.

(ii) Explain how meiosis can give rise to genetic variation in the gametes produced.

(2)

During meiosis, the ~~the~~ crossing over of ~~the~~ chromatids gives rise to different alleles being produced from the same gene. Also the different assortment of chromosomes from the maternal chromosomes and the paternal chromosomes gives rise to genetic variation.



**ResultsPlus**  
Examiner Comments

One mark for mentioning both crossing over and independent assortment and a second mark for correctly describing how independent assortment generates genetic variation.

The incorrect details of crossing over were ignored.

## Question 5 (a)

Overall good responses were provided to this question, with most candidates gaining marks for the idea of renewable resources that will not run out and are therefore available for future generations. Common mistakes included 'more seeds can be grown or seeds can be regrown' – instead of more plants. Extra, superfluous, information on 'carbon neutrality' and 'biodegradability' was given, which although are advantages of using biofuels, are not descriptions of sustainability.

Candidates re-sitting this paper often try to use facts encountered in the A2 topics - sometimes this is correct and will be given credit, but carbon neutrality is not directly linked to the sustainable nature of biofuels.

(a) Suggest why the production of oil from Canola seeds can be described as **sustainable**.

(again and again) (2)

As these seeds can be regrown, and is a biodegradable substance and so classified as sustainable. Compared to fossil fuel where these resources will eventually run out.



**ResultsPlus**  
Examiner Comments

No marks for saying that the seeds can be re-grown, because once the oil has been extracted, the seeds cannot be regrown!

One mark allowed for implying that these resources will not run out - compared with fossil fuels.

(a) Suggest why the production of oil from Canola seeds can be described as **sustainable**.

(2)

Plants can be regrown. This enables them to be used indefinitely and not run out.



**ResultsPlus**  
Examiner Comments

One mark for the plants being able to be regrown and one for stating that this resource will not run out.

(a) Suggest why the production of oil from Canola seeds can be described as **sustainable**.

(2)

Because the canola seed is a renewable resource  
As it can be regrown and will therefore not  
run out if used at a reasonable rate.  
(Can produce more in a reasonable time frame)



**ResultsPlus**  
Examiner Comments

A good answer, covering all the marking points, using the phrases 'renewable', 'regrown' and 'not run out'.



## Question 5 (b)

This was surprisingly poorly answered, there appeared to be a lot of guesswork or vague, imprecise ideas provided. Guesses linked nitrates to carbohydrate production, or implied that nitrates were needed for active transport in plants. Many candidates quote 'growth and repair' without being specific. Some linked nitrates being used for making amino acids and therefore protein, without clearly stating that protein synthesis requires amino acids that are produced using nitrates. Better responses mentioned nucleic acids and other molecules such as ATP. Chlorophyll was accepted as a correct response, as the molecule does include nitrogen, even though some that provided that as an answer had possibly confused the roles of nitrate and magnesium.

(b) Farmers provide the plants with fertiliser containing nitrate ions.

Explain the importance of nitrate ions for the growth of plants.

(2)

Nitrate ions are important as they help to produce amino acids which are used to create proteins and thus the growth of plants.



**ResultsPlus**  
Examiner Comments

This response clearly links nitrates with production of amino acids and then amino acids with the production of proteins.

(b) Farmers provide the plants with fertiliser containing nitrate ions.

Explain the importance of nitrate ions for the growth of plants.

(2)

Nitrate ions are important because they provide the plant with a source of protein. Protein is a necessary ~~activity~~ for growth, therefore nitrate ions are needed for growth.

Calcium cell wall  
Magnesium Chlorophyll  
Nitrate Protein



**ResultsPlus**  
Examiner Comments

This is just enough for one mark - it does seem to suggest that nitrates provide proteins. However, the notes underneath make it clear that the student does know what nitrate is needed for in relation to other mineral ions.



**ResultsPlus**  
Examiner Tip

Watch out for poor phrasing that results in your answers not saying what you intended.

equal to the  $\text{CO}_2$  taken in by the plant to  
(b) Farmers provide the plants with fertiliser containing nitrate ions. photosynthesis.

Explain the importance of nitrate ions for the growth of plants.

(2)

- Nitrate ions provide nitrogen that is a component of amino acids, these amino acids are important as they're the components of polypeptide chains to produce proteins for growth.
- Nitrate ions are also important for ATP production.



**ResultsPlus**

**Examiner Comments**

This is a very good answer, clearly indicating an understanding of the role of nitrates in protein production by plants.

The last line is also creditworthy - linking nitrate to ATP production.

(b) Farmers provide the plants with fertiliser containing nitrate ions.

Explain the importance of nitrate ions for the growth of plants.

(2)

Nitrate ions prevent the plant from becoming deficient and turning brown on the edges of the leaves eventually making the whole plant wilt.



**ResultsPlus**

**Examiner Comments**

Responses describing symptoms of nitrate deficiency were not answering the question - they were not explaining the importance of nitrate ions to the growth of plants.



**ResultsPlus**

**Examiner Tip**

Remember to read the question - make sure you are actually answering it!

### Question 5 (c) (ii)

A surprising number did not gain full marks here. Many either selected the wrong values from the graph, or divided the difference by the final value rather than the original value before multiplying by 100 to give a percentage. However, most candidates did read the correct values from the graph, although not all were able to complete the calculation. The working out of percentage changes is a commonly requested calculation at AS and is not too demanding – practice will help candidates improve this fairly basic mathematical skill.

- (ii) Using information in the graph, calculate the percentage change in seed yield when the level of nitrate fertiliser is increased from 0 to 160 kg ha<sup>-1</sup>.

Show your working.

(3)

$$\frac{3.30 - 2.40}{2.40} \times 100$$

$$\therefore \frac{0.9}{2.40} \times 100 = 37.5$$



**ResultsPlus**  
Examiner Comments

A correct answer provided with clear working out shown.

37.5 (%)

- (ii) Using information in the graph, calculate the percentage change in seed yield when the level of nitrate fertiliser is increased from 0 to 160 kg ha<sup>-1</sup>.

Show your working.

(3)

$$2.4 - 0$$

$$3.3 - 160$$

$$\frac{0.7}{2.4}$$

$$\frac{0.7}{2.4} \times 100 = 29.16\%$$

$$3.3 - 2.4 = 0.7$$

29.16% increase (%)



**ResultsPlus**  
Examiner Comments

This answer was given one mark for correctly identifying the data from the graph - 2.4 and 3.3. Although this student appears to understand that the percentage change involves dividing a figure by the original value and then multiplying by 100, they have incorrectly calculated the difference between 2.4 and 3.3 as 0.7 instead of 0.9. This could have been done without a calculator and the final answer indicates that a calculator was used.

(ii) Using information in the graph, calculate the percentage change in seed yield when the level of nitrate fertiliser is increased from 0 to 160 kg ha<sup>-1</sup>.

Show your working.

(3)

2.4      3.3

$$3.3 - 2.4 = 0.9$$

$$\frac{0.9}{2.4} \times 100 = 37.5\%$$

38 (%)



**ResultsPlus**

**Examiner Comments**

Correct calculation carried out and an answer derived of 37.5% - all worth full marks. The fact that the final answer was rounded up to 38% was ignored as the calculation was present with '=37.5%' showing that the correct answer was provided.



**ResultsPlus**

**Examiner Tip**

Do not round up to fewer decimal places than given in the original data!

Always show your working! If it was not here, this student may not have gained any marks.

### Question 5 (c) (iii)

Candidates struggled to adapt their rote-learned core practical knowledge to the actual question being asked here. The word 'valid' prompted many to refer to peer review and having other scientists repeat the investigation. Most did not seem to have a clear idea of what is meant by the validity of an investigation and very few candidates seemed to gain full marks. Many just listed lots of variables to control assuming to pick up marks for at least one of them, and many did, almost by accident, by referring to a sensible environmental variable as well as one concerning either the source of the plants, or the soil conditions. The age of the plants is irrelevant as the 'seeds harvested' is the dependent variable, not the growth of the plant. Time was also incorrectly given, which is not relevant to this investigation.

Many stated 'do repeats' without explaining the purpose of the repeats or what was being repeated. Very few mentioned a control experiment, without nitrate, although this was seen in better answers.

It is important that students understand that skills developed carrying out the core practicals often have to be applied to a variety of unfamiliar contexts.

(iii) Suggest how the scientist could have ensured that this investigation was valid.

(4)

By controlling the variables such as; keeping the yield at a constant temperature, by keeping yield in a constant amount of sunlight, By watering the yield at a constant amount. Also By using the same instruments to measure the seed yield and percentage oil each time. Also by controlling the pH of the Nitrate fertilizer and the yield.



#### ResultsPlus Examiner Comments

This is typical of the type of response where a range of variables were listed - constant temperature, light and water all came under the same marking point, so only one mark was given.

The word 'yield' is often a cause of confusion to students - however, when investigating the effect of mineral ion deficiencies on plants, yield is a dependent variable that is frequently encountered.



#### ResultsPlus Examiner Tip

When controlling variables, make sure you are not controlling the one you are meant to be measuring - i.e. the yield. Learn what **yield** means.

(iii) Suggest how the scientist could have ensured that this investigation was valid.

(4)

Its valid if control variables are kept constant, hence they could ensure the plants are spread evenly apart to reduce competition, they could ensure amount of sunlight available and temperature was constant, ~~time~~ time for growth etc. Also, they could ensure methods were kept constant, e.g. the same way to extract seeds and oil each time. They could also repeat the experiment to check for anomalies, other scientists could carry it out to see if results were reproducible etc.

They could also try to use plants or seeds from same plant to try to minimise genetic variation and ensure ~~results~~ results were due to nitrate mass, nothing else.



**ResultsPlus**  
Examiner Comments

This is a very good answer - describing the controlling of environmental variables such as temperature and light; the extraction method used to measure yield of oil; repeats used to check for anomalous results; and using seeds from the same plant to reduce genetic variation in the plants grown.

## Question 6 (a)

Most candidates scored at least one mark by mentioning what stem cells can do, though they found it trickier to explain how this helped the dog recover from paralysis. Several candidates stated stem cells 'turn into' or 'become' other cells, instead of referring to them giving rise to specialised cells. Yet again, marks were lost as a consequence of failing to address the context of the question. Good answers referred to stem cells giving rise to specialised cells that could replace the damaged cells in the spinal cord.

(a) Suggest why stem cells can be used to reverse this paralysis.

(2)

Old damaged cells in the spine get replaced with new healthy ones so that affects the rest of the body.



**ResultsPlus**  
Examiner Comments

One mark given for the idea that the damaged cells in the spine are replaced with new cells. However, there's no indication of how stem cells can bring this about!

(a) Suggest why stem cells can be used to reverse this paralysis.

(2)

Stem cells are totipotent, which means they can become any type of cell. Stem cells could make healthy spinal cells in order to reverse the paralysis.



**ResultsPlus**  
Examiner Comments

This example gains a mark for describing the stem cells as totipotent. No mark can be given for simply saying that the stem cells can make 'healthy ... cells ... to reverse the paralysis'.

(a) Suggest why stem cells can be used to reverse this paralysis.

(2)

because stem cells are totipotent, meaning they can differentiate into any type of cell, including spinal cord.



**ResultsPlus**  
Examiner Comments

This answer gained 2 marks for referring to the stem cells as totipotent and then explaining that they can differentiate, (which is enough for 2 marks) - with the implication that they can give rise to spinal cord tissue.

## Question 6 (b)

Generally, candidates realised that this was to avoid rejection, although many said that it was to reduce the risk of rejection rather than to prevent rejection. Realising that this was because the stem cells would be genetically identical was rarer. Many attempted to explain why the stem cells should not be taken from another dog – which was not the question being asked.

Suggest why stem cells were taken from this dog and not from another dog.

(2)

As stem cells from this dog will already contain the correct genetic information, and there is a much reduced chance of the body rejecting it, as well as increasing its chance of success.



**ResultsPlus**  
Examiner Comments

Many answers like this one, referred to a reduced chance of rejection - the point is that if the stem cells are derived from the patient there will be no rejection.

If this response had described the cells as 'genetically identical' to the dog, instead of containing 'the correct genetic information', one mark could have been given.



**ResultsPlus**  
Examiner Tip

Use correct terminology - e.g. 'genetically identical'.

Suggest why stem cells were taken from this dog and not from another dog.

(2)

Because it would have the same genetic material. If it was from another dog, the cells may be rejected by the dog's body.



**ResultsPlus**  
Examiner Comments

No marks can be given for 'same genetic material' - it's too vague, it could mean that they both contain DNA!

However, the converse argument gains the mark for stating that if the stem cells were from another dog they would be rejected.



Suggest why stem cells were taken from this dog and not from another dog.

(2)

So the cells are genetically identical to the cells the dog needs, which stops the need for immunosuppressants as the dog's body won't reject cells with the same DNA as the dog itself.



**ResultsPlus**  
Examiner Comments

A good answer here gaining 2 marks. Note the correct use of terminology and decisive statements - 'the dog's body won't reject cells'.

## Question 6 (c) (i)

This question concerned the use of a placebo as a control, however, many forgot the context and discussed the 'placebo effect' and the fact that the dogs may think they were getting better. Again, context is everything – this was not a question about humans, but about dogs.

Overall most responses were good, with references to controls being used to compare with the stem cell treatment given, although some lost that mark due to discussing the 'drug' and not the stem cells.

(i) Explain the reason for giving some of the dogs a neutral fluid instead of stem cells.

(2)

This is called a placebo. The point of this is to determine whether it is merely a psychological or it is the stem cells actually being an effect.



**ResultsPlus**  
Examiner Comments

This did gain 2 marks for reference to placebo being used to assess the effectiveness of the stem cells - even though there was the suggestion of a 'psychological effect'.

(i) Explain the reason for giving some of the dogs a neutral fluid instead of stem cells.

(2)

This was to provide a control to determine whether it was in fact the stem cells that cured the dog, or whether it was another factor. It was known that the neutral fluid had no effect.



**ResultsPlus**  
Examiner Comments

This answer gained 2 marks for reference to a control being used to determine if the stem cells cured the dog.

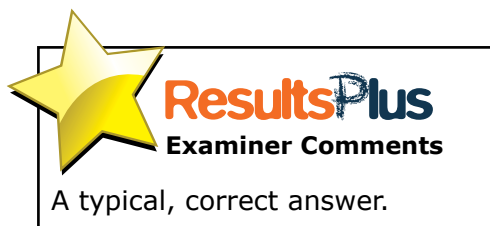
### Question 6 (c) (ii)

The vast majority of students successfully cited the avoidance of bias or a double-blind trial, frequently both.

(ii) Suggest why neither the scientists nor the owners knew which dogs had been given stem cells and which had been given the neutral fluid.

(1)

So it was a double-blind trial so there was no bias when the scientists were recording the results.



A typical, correct answer.

## Question 7 (a) (ii)

Candidates appeared to either grasp the question and achieved full marks, or waffled on aimlessly and gained nothing; there was not a lot in between.

The key here is reading the question - it refers to the validity of the statement that 'brown coir fibres are stronger than white coir fibres' - those who selected evidence that either supported or did not support this statement did well. Many candidates simply repeated the data and did not manipulate it or failed to make comparisons between the two types of fibre at each length. Repeating data from graphs or tables is never going to be enough to gain marks at this level. Some candidates thought that there were no repeats for the different sizes of fibres given and did not realise that the range represented the repeats. Those who took a systematic approach and considered that some parts could be valid and others not, generally fared better. Analysis of graphical and tabular data has to be practiced in order for candidates to develop the confidence to tackle these types of question.

(ii) The student concluded that brown coir fibres are stronger than white coir fibres.

Use the information in the table to comment on the validity of her conclusion.

(4)

Short brown coir fibres are 151 MPa more tensile strong than short white coir fibres. The range of error of both is such that they do not overlap & therefore the student's conclusion for short fibres is valid. However, the tensile strength of long brown coir fibres is only 24 MPa greater than white coir long white coir fibres on average. This figure comes within the overlap of both long & white & brown fibres. This significant overlap invalidates her remark for long fibres. Therefore, the student's conclusion is only valid for short fibres.



**ResultsPlus**  
Examiner Comments

This is an excellent example of a response that tackles the question logically.

It states that the short (5mm) brown fibres are stronger than the short white fibres by 151 MPa - 1 mark for manipulating data and another mark for going on to state that there is no overlap in the data. Then the student states that the conclusion is valid for short fibres - this gains a mark. The student then goes on to explain that the data is invalid for the long fibres.



**ResultsPlus**  
Examiner Tip

Read the question - then carefully select data from the graph or table when putting together your answer. Look for differences - are they significant? Is there an overlap in the results?

(ii) The student concluded that brown coir fibres are stronger than white coir fibres.

Use the information in the table to comment on the validity of her conclusion.

(4)

This is not a valid conclusion because although the short brown fibres are the strongest. The long brown fibres are one of the weakest. <sup>So the</sup> ~~However~~ conclusion is not valid because shorter white fibres are stronger than a longer brown fibre.



**ResultsPlus**  
Examiner Comments

This response gained one mark for the observation that the short white fibres were stronger than the long brown fibres.

## Question 7 (b) (i)

Those who knew their sclerenchyma structure and answered the question in a systematic way generally scored well here. A few candidates just said the coir fibres were dead, not qualifying that they were empty too, as dead cells are not necessarily light, it is that fact that they are hollow that makes them light. Some candidates discussed the cellulose structure, without mentioning the presence of lignin or secondary thickening. Most answers tackled the aspects of the fibres lightness and strength, with fewer correctly describing how they are waterproof. There were many references to lignin covering or coating the cells, or the cells being made of lignin - candidates need to be aware of the role of lignin in cell walls of both sclerenchyma and xylem.

(b) Fibre cells in coir have a similar structure to sclerenchyma fibres. → dead.

(i) Suggest how the structure of the coir fibres makes them light, waterproof and strong.

(3)

They are covered in lignin, which makes them very strong. Waxy cuticle makes coir fibres waterproof and also the secondary wall (thick wall) adds the strength. The arrangement of fibres are also makes it light and very strong.



### ResultsPlus Examiner Comments

This is the type of muddled response which indicates some knowledge of the structure of sclerenchyma, with some guesswork thrown in.

The one mark gained is for a feature that provides strength - this was awarded for reference to the secondary wall (thick wall) which was taken to refer to the cell wall, even though that is not stated.

Leaves have waxy cuticles, not cells.



### ResultsPlus Examiner Tip

Cells are not covered in lignin - it's in the cell walls of xylem and sclerenchyma.

(b) Fibre cells in coir have a similar structure to sclerenchyma fibres.

(i) Suggest how the structure of the coir fibres makes them light, waterproof and strong.

(3)

The cells contain lignin, which waterproofs the fibre and gives structural support, making ~~them~~ strong. Also the fibres cells in the fibres are dead and ~~hollow~~ and hollow (they form continuous hollow tubes due to no end walls) which makes them light.



**ResultsPlus**  
Examiner Comments

This response gained the mark for waterproofing for mentioning lignin, the strength mark for associating lignin with support and 'making them strong'. The lightness mark was given for describing the fibres as hollow.

### Question 7 (b) (ii)

There were many good attempts at this question, many correct and some quite imaginative. However, the majority did get the idea that the white coir fibres would contain either less lignin or have less secondary thickening, showing good application of knowledge. Many expressed the converse argument that the brown fibres would have more lignin, or thicker cell walls.

(ii) White coir fibres are more flexible than brown coir fibres. Suggest how their structure may account for this difference in flexibility.

They may contain less lignin, making them less rigid. The lack of lignin may also account for their seemingly lesser tensile strength compared to brown. (1)

(Total for Question 7 = 9 marks)



**ResultsPlus**

Examiner Comments

This shows a good example of the type of response that indicates application of knowledge to gain the mark.

(ii) White coir fibres are more flexible than brown coir fibres. Suggest how their structure may account for this difference in flexibility.

(1)

White coir fibres may have no lignin making them white and more flexible.



**ResultsPlus**

Examiner Comments

A common error was to state that the fibres contained no lignin instead of less lignin - this cannot be the case as the students have been informed that the coir fibres have a similar structure to sclerenchyma, which does have lignin.



## Question 8 (a)

The majority of candidates understand the term 'endemic', although some still confuse it with 'endangered', or discuss habitats and ecosystems, which may be found in many areas of the world, instead of locations. An endemic species cannot be described as being found in only one habitat or environment, as these could be found in numerous part of the world - e.g. rainforests are found across the globe, but certain species are only endemic to rainforests in one particular geographical location.

(a) Explain what is meant by the term **endemic species**.

(1)

A species only found in one location.



**ResultsPlus**  
Examiner Comments

A basic, yet correct, response - a species **only** found in one **location**.

(a) Explain what is meant by the term **endemic species**.

(1)

a species only found in one habitat or area.



**ResultsPlus**  
Examiner Comments

Hedging bets by giving both habitat and area in the answer results in no mark being given for this response.



**ResultsPlus**  
Examiner Tip

Learn the definitions of words such as 'habitat' and 'endemic'.

## Question 8 (b)

This question prompted some interesting responses. Many answers did refer to the fact that genetic diversity will become reduced, but failed to pick up on the issues concerning inbreeding. Many also focused on the small population from which to select mates, rather than the fact that the wolves would all be closely related. There were a lot of examples of confusion between the terms 'interbreeding' and 'inbreeding'. However, it was good to see candidates referring to genetic drift and the loss of alleles from these isolated populations.

(b) There are estimated to be only 500 Ethiopian wolves left in the wild, living in six separate populations. There are high levels of genetic diversity between these six populations.

The separate populations are geographically isolated. This prevents interbreeding between populations.

Suggest how this may affect the genetic diversity of each individual population.

(2)

Their genetic diversity would be lowered as they would only breed within their population, so some alleles would not be passed onto offspring which may be ~~also~~ beneficial. This means they would be ~~more susceptible to a disease~~ more susceptible to a disease.



**ResultsPlus**  
Examiner Comments

Although this response picks up on the lowered genetic diversity (for one mark), the fact that the wolves will only breed within their population is not worth a mark - the wolves will breed within their population regardless of its size.

The mark for loss of alleles was not given as the context was incorrect.

(b) There are estimated to be only 500 Ethiopian wolves left in the wild, living in six separate populations. There are high levels of genetic diversity between these six populations.

The separate populations are geographically isolated. This prevents interbreeding between populations.

Suggest how this may affect the genetic diversity of each individual population.

(2)

As they are separate from other populations, they will interbreed with each other which will produce ~~many~~ offspring but as the genetic diversity decreases, the wolves will interbreed with close relatives, producing infertile offspring.



**ResultsPlus**

**Examiner Comments**

To begin with, the comment 'they will interbreed with each other' would not gain the mark, but the phrase 'the wolves will interbreed with close relatives' does gain the mark. Another mark is gained for reference to genetic diversity decreasing.



**ResultsPlus**

**Examiner Tip**

**Inbreeding** and **interbreeding** are not interchangeable - they have different meanings!

### Question 8 (c)

Many failed to see the link between the previous question and this one, therefore failed to pick up on the introduction of new alleles leading to a greater chance of adaptation and hence survival of the species. Many candidates simply stated that the wolves were more likely to survive, but not how.

(c) Ethiopian wolves are endangered in the wild.

Some scientists have suggested that moving male wolves from one population to another may help the species survive.

Suggest how this strategy of transferring individuals from one population to another could help the species survive.

(2)

Moving the males would decrease inbreeding, as there would be a 'new set of genetics' for the female wolves to breed with. This would increase the genetic diversity in that particular population, meaning there are more wolves in a population, overall increasing their numbers.



**ResultsPlus**  
Examiner Comments

'A new set of genetics' is not precise enough phrasing to gain a mark here - 'however, 'introduction of new alleles' would have gained the mark.

One mark was awarded for recognising that this would increase the genetic diversity of that population.

(c) Ethiopian wolves are endangered in the wild.

Some scientists have suggested that moving male wolves from one population to another may help the species survive.

Suggest how this strategy of transferring individuals from one population to another could help the species survive.

(2)

This would increase the gene pool and therefore beneficial alleles from the parents would appear in the offspring and the offspring may be able to survive against predators <sup>and harsh conditions</sup> due to a greater genetic variation. Also, the females will have a greater number of males to mate with and therefore a greater reproduction rate.



**ResultsPlus**  
Examiner Comments

One mark was given for increasing the (size of) gene pool.

Many students thought that increasing the number of males would increase the reproduction rate, whereas this can only happen if more females are introduced.

(c) Ethiopian wolves are endangered in the wild.

Some scientists have suggested that moving male wolves from one population to another may help the species survive.

Suggest how this strategy of transferring individuals from one population to another could help the species survive.

(2)

By moving males from one population to another, interbreeding between different populations will take place. This will result in a larger gene pool and thus ~~greater~~ greater genetic diversity among the species. Greater genetic diversity will lead to an increase in biodiversity which will help the species survive as new alleles may be introduced that make the species better adapted to the environment. If they have alleles which make them better adapted they are more likely to survive.



**ResultsPlus**  
Examiner Comments

This is well expressed answer - referring to a **larger** gene pool and **greater** genetic diversity. The second mark is gained for noting that the introduction of new alleles may help the species become better adapted leading to increased chance of survival.

### **Question 8 (d) (i) (1)**

Most candidates correctly identified the small sharp teeth as an anatomical adaptation - although some thought it was a physiological adaptation.

### **Question 8 (d) (i) (2)**

Most candidates correctly identified the narrow snout as an anatomical adaptation - although some thought it was a physiological adaptation.

### **Question 8 (d) (i) (3)**

Almost all candidates correctly identified the habit of hunting alone as a behavioural adaptation.

### Question 8 (d) (ii)

This question required candidates to apply their understanding of natural selection to the evolution of the Ethiopian wolves.

The question was in the context of the wolves being adapted for life in the mountains of Ethiopia and information in the previous question provided details of three specific adaptations.

As this was a QWC (Quality of Written Communication) question, candidates had to make their meaning clear and unambiguous to be awarded the marks, but there was unfortunately much rambling and repetition.

Many candidates again failed to give examples to gain specific points, e.g. not describing the selection pressure and the advantageous characteristic that some of the wolves would have possessed.

A lot of candidates also seemed to think that a change in the environment brings about mutations, or that mutations happen in order for species to adapt.

There was the usual confusion between 'gene' and 'allele', with marks lost due to references to advantageous genes being passed on, instead of alleles.

Unfortunately, poor use of relevant, precise, biological terminology meant that many candidates lost marks on this question. There were also answers learnt by rote to describe the process of natural selection that failed to gain full marks as they did not refer to the context required for this particular question.

**\*(ii) Suggest how natural selection has led to the evolution of this species of wolf, adapted for life in the mountains of Ethiopia.**

Individuals within the wolves all <sup>show</sup> ~~differing~~ <sup>(4)</sup> genetic variation in their genotype and hence their phenotype. Wolves that were better adapted ~~to~~ <sup>for</sup> life in the mountains e.g. <sup>stronger</sup> legs to allow climbing to reach food, were more likely to survive and reproduce to pass on their advantageous alleles <sup>of strong legs</sup> to their offspring. This ~~process~~ continues so that the advantageous allele is passed on from generation to generation, increasing the number of ~~that~~ alleles in the gene pool, which eventually results in a greater number of wolves with the better adapted allele. (Total for Question 8 = 12 marks)





**ResultsPlus**  
Examiner Comments

This is a good response to the question - it ties in an understanding of the process of natural selection with the context provided of the wolves in the Ethiopian mountains. It also uses the correct terminology, referring to **advantageous alleles** and **survival** and **reproduction**.

\*(ii) Suggest how natural selection has led to the evolution of this species of wolf, adapted for life in the mountains of Ethiopia.

(4)

A random mutation for an allele would have occurred in a wolf. This allele would have provided the wolf with an advantage over others such as a narrower snout. This wolf is therefore more likely to survive and outcompete other wolves. The wolf will then reproduce and pass on its advantageous alleles to its offspring. The genotype then becomes more common as wolves without the allele will be outcompeted and die.



**ResultsPlus**  
Examiner Comments

This is another good example of a response that uses knowledge of natural selection to explain the evolution of the Ethiopian wolf, referring to information provided in the rest of Q8. The terminology used is also precise, which is essential in a QWC question.

This response gained full marks.

\*(ii) Suggest how natural selection has led to the evolution of this species of wolf, adapted for life in the mountains of Ethiopia.

(4)

Due to natural selection only ~~few~~ certain off spring will be able to survive due to the adaptations they have. If an off spring with a ~~narrower~~ narrower snout is competing with another who has a wider snout the wolf with the better adaptation is more likely to survive. If the animals who have better adaptations survive have off spring the adaptations will be passed on and will develop as more off spring are produced



### ResultsPlus Examiner Comments

This response gained 2 marks.

One mark is gained for description of the narrow snout as a beneficial characteristic. The second mark is given for stating that these wolves survive and produce offspring.

There is no reference to genetic variation or advantageous alleles being passed on or becoming more frequent in the population, this limits the number of marks this answer can gain, even though it is on the right lines.



### ResultsPlus Examiner Tip

For QWC questions - the ones with a \* - you must use correct terminology and arrange your answer in a logical sequence. You must also express your answers as well as you possibly can.

## Paper Summary

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

- read all of the details in the questions carefully making sure that they consider the context before writing their answers;
- develop a familiarity with the subject specific vocabulary encountered at this level and learn how to use key words and phrases with precision;
- review all of the recommended core practicals with particular reference to laboratory procedures, ensuring that they are familiar with the processes involved and the equipment used;
- gain practice at interpreting information presented graphically and in tables;
- practice simple mathematical calculations – subtractions, and % differences;
- practice writing longer responses to develop skills in expressing ideas using appropriate scientific terminology.

## 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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