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Examiners' Report
June 2011

GCE Biology 6BI02 01

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June 2011

Publications Code US027473

Introduction

This paper tested the knowledge and understanding of the two AS topics: 'The voice of the genome' and 'Biodiversity and natural resources'. The range of questions provided plenty of opportunity for candidates to demonstrate their grasp of these AS topics. There were some excellent responses to questions ranging from the role of zoos in conservation of endangered species to the processing of proteins within the cell. Those questions presenting information in tables or in graphs were generally interpreted well, although more care must be taken by some candidates when it comes to analysing this sort of data. As always, there are questions in this paper which draw upon candidates' practical experience gained through carrying out the recommended core practicals, and it cannot be emphasised enough that the only way candidates can tackle these questions with confidence is by having actually done the practical work and investigations described in the specification.

Despite the many opportunities made available for candidates to demonstrate their knowledge and understanding in this paper, marks were frequently lost because terminology was not used precisely. Poor expression of ideas can come across as lack of knowledge, especially when terms such as 'gene' and 'allele', 'species' and 'individual' are used interchangeably. In order to improve performance it is essential that students have a clear grasp of the vocabulary of the subject so that they can understand the questions and express their answers clearly.

Question 1(a)(iii)

Many candidates achieved the first marking point, for identifying D, but not always for the correct reason. The concept of endemism was either understood or not. Those whose grasp of the concept was weak made references to 'restriction to a habitat' or 'only found in certain conditions'. A few confused endemic with rare, or with biodiversity and species richness. The idea of endemic referring to a species being restricted to one geographical area was well expressed by those who did know what the term meant.

(iii) State which area contains an endemic species, giving reasons for your answer.
(3)

Area D

Reasons An endemic species is a species that is only situated in one area an no other areas. This may be due to separtion of islands many years ago. Area D has 1 particular species not found in any other area

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Examiner Comments

This is a good example of how a candidate could achieve a full 3 marks by simply stating what is meant by endemism and then going on to explain why they identified Area D as being the one with an endemic species.

(iii) State which area contains an endemic species, giving reasons for your answer.
(3)

Area ~~A~~ D

Reasons because the  species/shape ~~Shape~~ is only found in that area and no where else. It is unique to D therefore is endemic.

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Examiner Comments

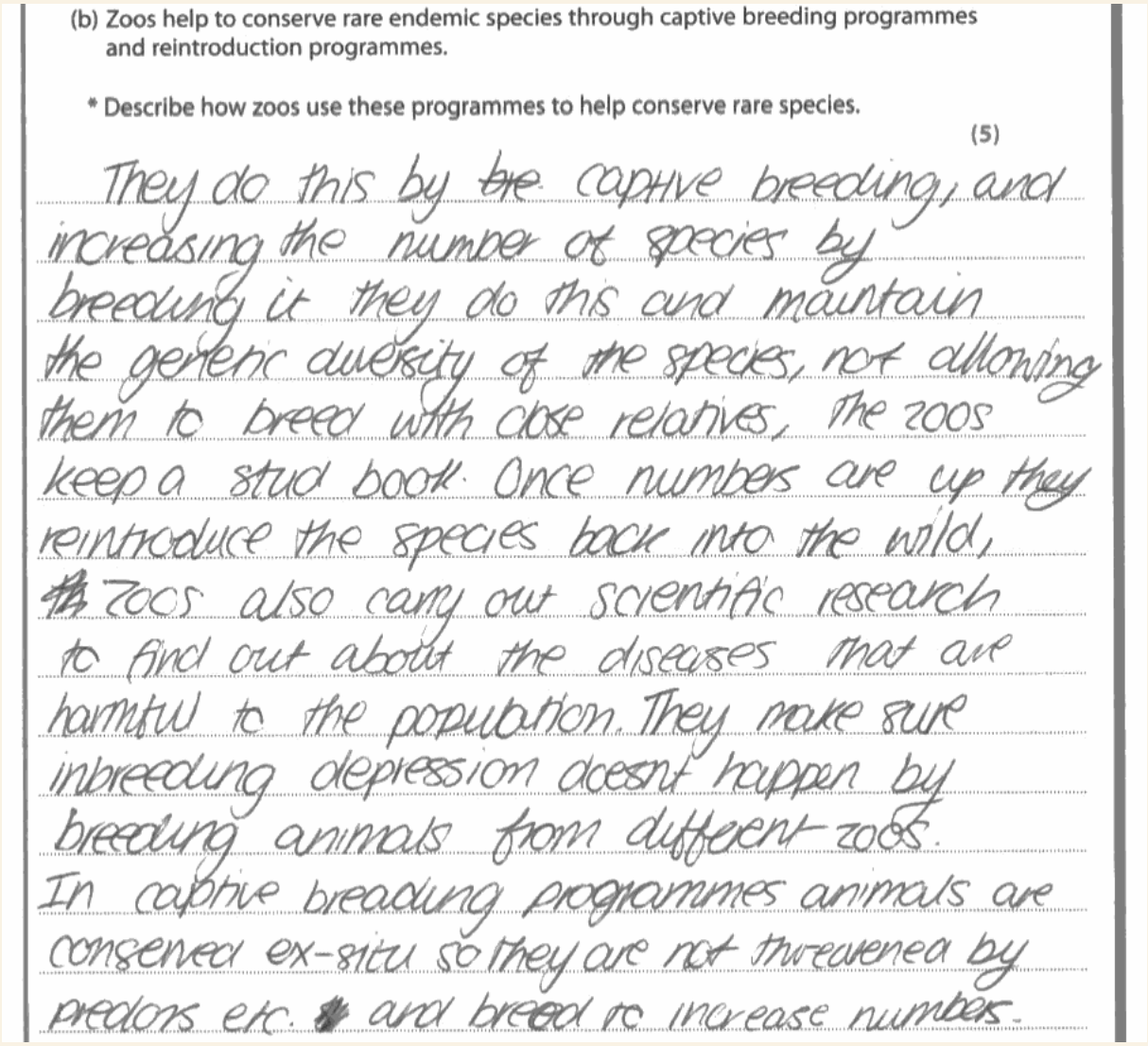
This example scored 2 out of a possible 3 marks. Many candidates chose to either draw the symbol that represented the endemic species, or describe it, e.g. 'flag-shaped symbol'. Marking point 2 could not be awarded here as there was not a clear explanation of what endemism is, although the reason for selecting D was fine for marking point 3.

Question 1(b)

The purpose of this question was to test understanding of how captive breeding and reintroduction to the wild help conserve species. There were some excellent responses indicating a thorough grasp of the biological processes involved, although many omitted the fundamental principle of increasing population size. Good responses worked through the role that zoos play specifically with regard to conservation, showing an appreciation of the use of stud books in breeding programmes.

As this was a question testing QWC it was important for candidates to present their responses in a logical sequence, which was only evident in those responses where candidates demonstrated a sound understanding of the processes involved.

Although this response does jump from one point to another, and does include much irrelevant material, it still manages to gain full marks.

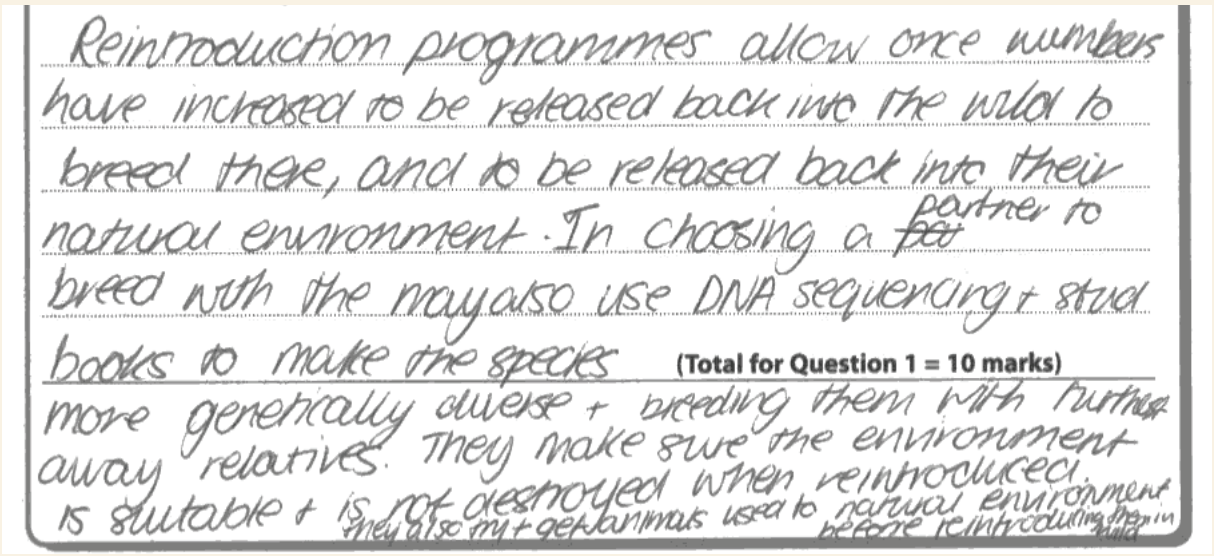


(b) Zoos help to conserve rare endemic species through captive breeding programmes and reintroduction programmes.

* Describe how zoos use these programmes to help conserve rare species.

(5)

They do this by ~~the~~ captive breeding, and increasing the number of species by breeding it they do this and maintain the genteric diversity of the species, not allowing them to breed with close relatives, the zoos keep a stud book. Once numbers are up they reintroduce the species back into the wild, ~~th~~ zoos also carry out scientific research to find out about the diseases that are harmful to the population. They make sure inbreeding depression doesnt happen by breeding animals from different zoos. In captive breading programmes animals are conserved ex-situ so they are not threatened by predors etc. ~~#~~ and breed to increase numbers.


Reintroduction programmes allow once numbers have increased to be released back into the wild to breed there, and to be released back into their natural environment. In choosing a ~~pet~~ partner to breed with the may also use DNA sequencing + stud books to make the species more genetically diverse + breeding them with further away relatives. They make sure the environment is suitable + is not destroyed when reintroduced. they also try + get animals used to natural environment before reintroducing them in wild

(Total for Question 1 = 10 marks)

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Examiner Comments

Although poorly worded initially, marking point 3 is awarded for noting that this will 'maintain the genetic diversity'.
This candidate also gets marks for referring to 'stud books' and the fact that captive breeding will bring about an increase in number. They also mention that captive breeding involves breeding animals from different zoos and that some of the animals are eventually returned to their natural environment.
This candidate also wrote that 'animals are conserved ex-situ so they are not threatened by predors etc', which would not have been sufficient for 'protected from predators', especially in a question assessing QWC.

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Examiner Tip

This example clearly shows that it would have been advisable for the candidate to request an additional answer sheet for completing their response. Writing that is crammed into a small space is not always easy to read. It is also helpful if candidates then add a note to the effect that their answer is continued on the additional answer sheet.

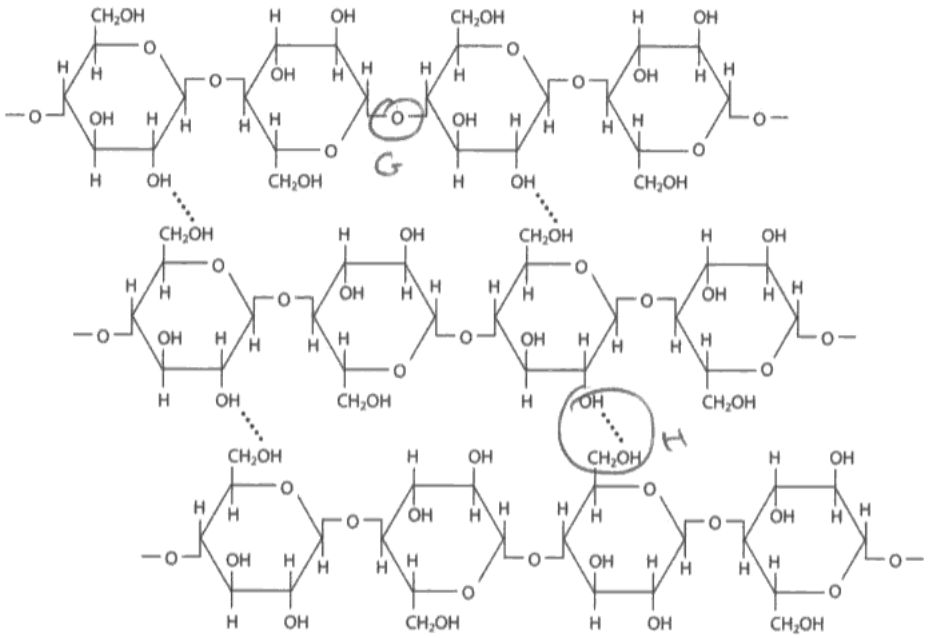
Question 2(a)

This was a well answered question, with most candidates demonstrating a good recall of the position of the key bonds within cellulose.

Questions that ask for candidates to annotate or draw onto a diagram are sometimes missed by those focusing on questions that ask for written responses.

2 Cellulose and mineral ions are important components of a plant.

(a) The diagram below shows part of a cellulose microfibril.



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Examiner Comments

The circle around the oxygen atom in the centre of the glycosidic bond is the minimum required here, whilst the circle around the hydrogen bond encompasses the groups either side of the bond itself, the maximum allowed for (a)(ii).

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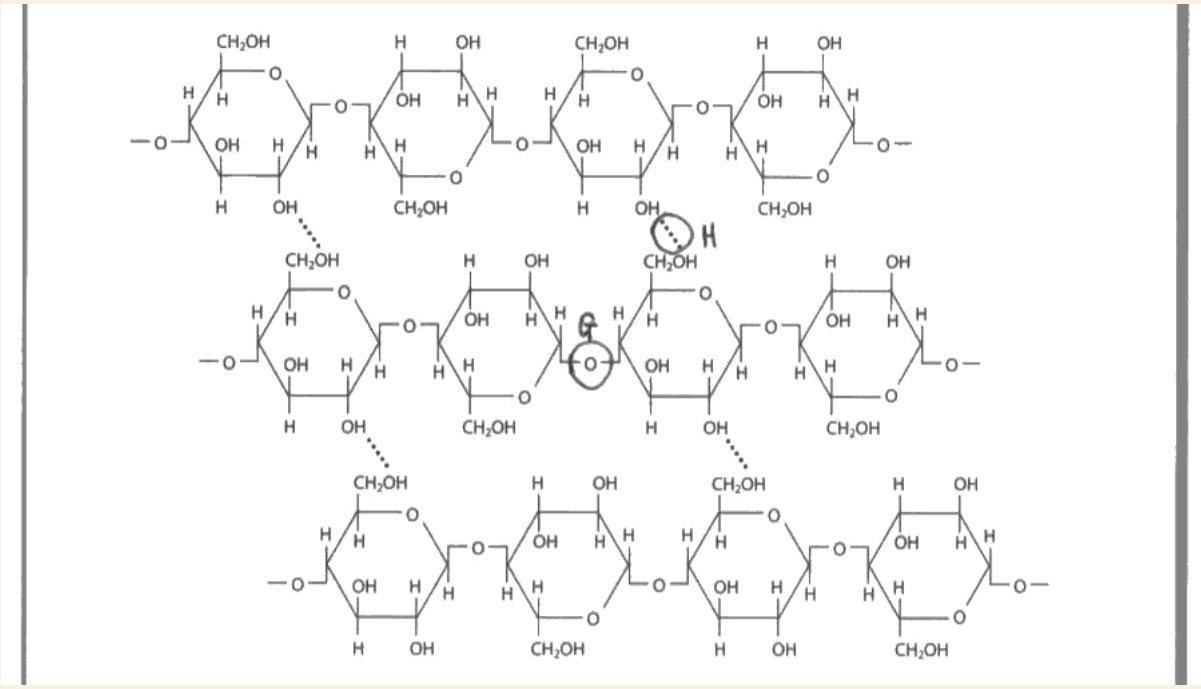
Examiner Tip

Note - when asked to label part of a diagram with a letter, that letter is often the first one of the word it is representing - e.g. G for glycosidic and H for hydrogen. There were a significant number of candidates who circled the correct bonds, but scored no marks as they got the labels the wrong way around.



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Examiner Comments

This response shows the hydrogen bond circled just around the dotted line - the minimum acceptable. This candidate achieved 2 marks for Question 2(a).

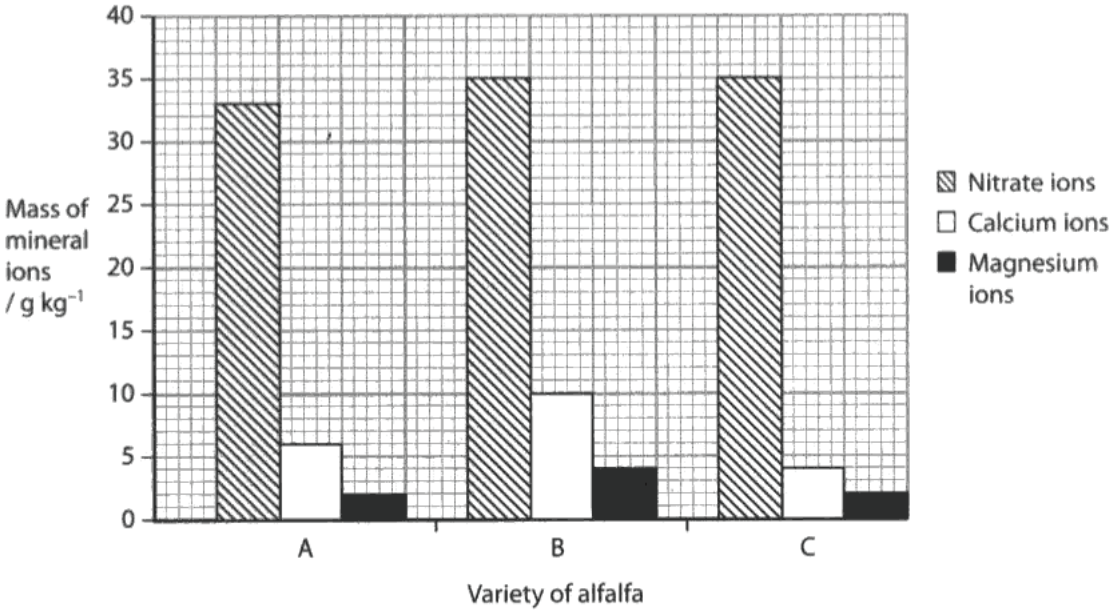
Question 2(b)(i)

This question tested the candidates' knowledge of the functions of mineral ions in plants alongside their ability to interpret information presented graphically.

This was very well answered, with a vast majority of candidates recalling the role of magnesium ions in chlorophyll molecules and noting that variety B had the highest levels of magnesium. Marks were lost by candidates who listed all three mineral ions, failing to identify magnesium as the key ion. It is also important to differentiate between the terms high, higher and highest - for this question the response should state that B had the **highest** levels of magnesium.

(b) An investigation was carried out to find the mass of mineral ions in three varieties (A, B and C) of the alfalfa plant.

The results of this investigation are shown in the graph below.



(i) Using the information in the graph, suggest which variety of alfalfa could have the highest concentration of chlorophyll. Give a reason for your answer.

(2)

Variety B

Reason Because magnesium is used in the production of chlorophyll in plants.

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Examiner Comments

This response gets one mark for 'B', but nothing else. Even though the candidate realises that magnesium is needed to make chlorophyll they have not stated that variety B contains the **most** magnesium.

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Examiner Tip

Many candidates fail to provide enough details to demonstrate a clear understanding of their reasoning. This can be frustrating as examiners can see what the candidate means, but cannot award marks for something that has not been put in writing.

Variety B

Reason magnesium ions are responsible for the production of chlorophyll and B has the highest magnesium ion mass.

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Examiner Comments

This example gained 2 marks - variety B was correctly identified and a clear reason given, stating that 'B has the **highest** magnesium ion mass'.

Question 2(b)(ii)

This question tested the candidates' understanding of the function of mineral ions in plants. In order to gain full marks it was necessary to state variety B and then go on to explain that it had the highest mass of calcium ions and describe the role of these ions in cell walls.

(ii) Using the information in the graph, suggest which variety of alfalfa could have the strongest cell walls. Give an explanation for your answer.

(3)

Variety B

Explanation Calcium helps build cell walls and helps with the permeability of cell membrane.

ResultsPlus
Examiner Comments

This response only scores 1 mark for identifying variety B. Even though calcium is mentioned in the reason, the candidate does not state that there are more calcium ions in this variety than in the others and does not explain their precise function in cell walls.

(ii) Using the information in the graph, suggest which variety of alfalfa could have the strongest cell walls. Give an explanation for your answer.

(3)

Variety B

Explanation Because it has the highest mass of calcium and nitrate ions.

ResultsPlus
Examiner Comments

This example only gains 1 mark. Although the candidate describes B as having the highest mass of calcium, they have also included nitrate, which negates that marking point, as calcium has not been isolated.

(ii) Using the information in the graph, suggest which variety of alfalfa could have the strongest cell walls. Give an explanation for your answer.

(3)

Variety B

Explanation The strength of the cell walls require calcium ions, to form calcium pectate (pectin) used to hold cellulose microfibrils together, and a component of middle lamella. B has highest mass of calcium ions.

ResultsPlus
Examiner Comments

This excellent example scored full marks. Variety B was identified, calcium was linked to strength in cell walls due to its requirement for calcium pectate, as well as reference to the middle lamella. Variety B has finally been identified as having the **highest** mass of calcium ions.

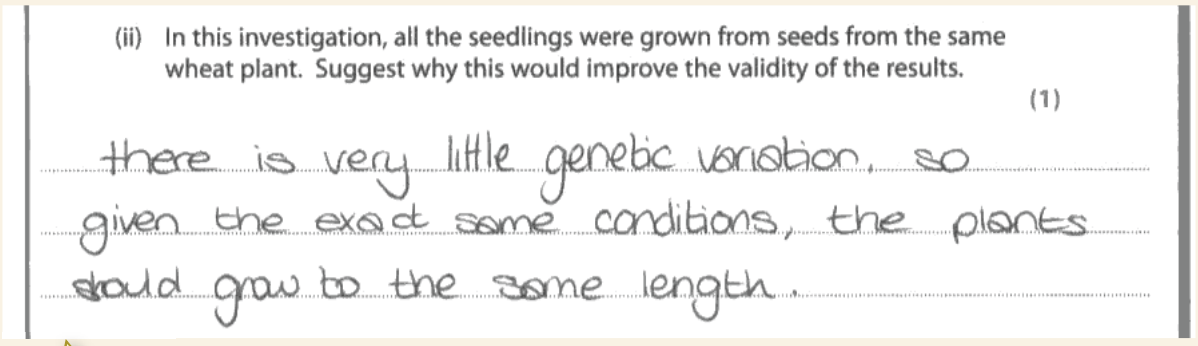
Question 2(c)(i)

The vast majority of candidates worked out the correct answer from the graph. As long as candidates check the labelling of the axes on a line graph, there should be no problem in ascertaining information from a line graph.

Question 2(c)(ii)

This was not well answered, with only a minority of candidates grasping the fact that using seed from the same plant would reduce genetic variation between the seedlings. A lot of candidates appeared to believe that seeds would be genetically identical if coming from the same plant, as if they had been cloned. This was more likely to have been a consequence of failing to read the question carefully, rather than not understanding that seeds are a result of sexual reproduction and hence have varying genotypes.

This is an excellent answer - not only stating that there would be little genetic variation, but also explaining how this would increase the validity of the results.



(ii) In this investigation, all the seedlings were grown from seeds from the same wheat plant. Suggest why this would improve the validity of the results.

(1)

there is very little genetic variation, so given the exact same conditions, the plants should grow to the same length.

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Examiner Comments
A well considered response states each point separately and clearly.

ResultsPlus
Examiner Tip
Keeping answers simple and to the point makes it clear that the candidate has understood the question and knows the biology.

(ii) In this investigation, all the seedlings were grown from seeds from the same wheat plant. Suggest why this would improve the validity of the results.

(1)

the seeds from the same wheat plant would be genetically identical therefore the validity will increase.

ResultsPlus
Examiner Comments

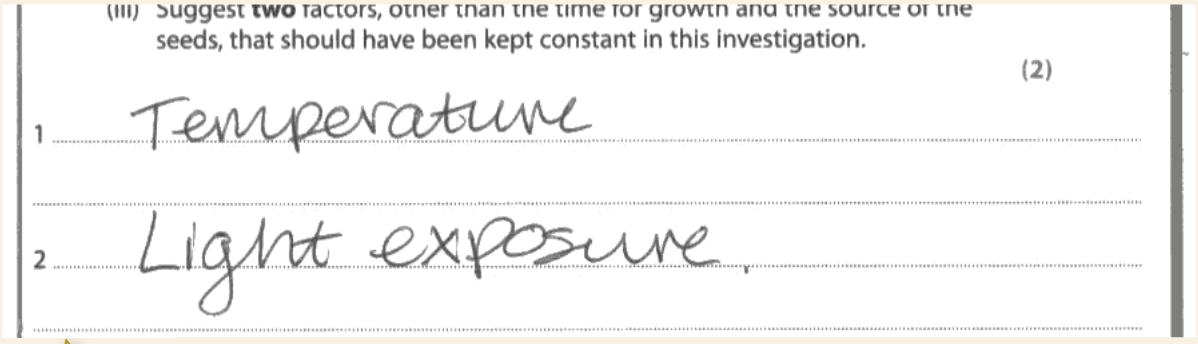
This is an example of a very common error made on this question - assuming that seeds from the same plant will be genetically identical.

ResultsPlus
Examiner Tip

Although having individuals that are genetically identical does increase validity when it comes to investigations, it is important that candidates check the context of the question first.

Question 2(c)(iii)

This question was answered well by those who understood that it referred to the conditions that needed to be kept the same for plants grown in culture solution. Responses concerning water were therefore ignored. It is also to be expected, at AS level, that candidates refer to volume rather than amount with respect to quantities of liquids, hence 'amount of solution' was not accepted as a correct response. The control of variables for this type of investigation should have been covered in the corresponding recommended core practical.


(iii) Suggest **two** factors, other than the time for growth and the source of the seeds, that should have been kept constant in this investigation.

(2)

1 Temperature

2 Light exposure

ResultsPlus

Examiner Comments

This example shows how full marks can be achieved by simply stating two separate factors that should be kept the same. Light and temperature were the commonest factors provided, which is to be expected as they are the principle factors that affect plant growth.

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Examiner Tip

Keep it simple - if asked to provide two factors, it is quite acceptable to just list them as this candidate has. Do not write more than one different example next to each number on the exam paper.

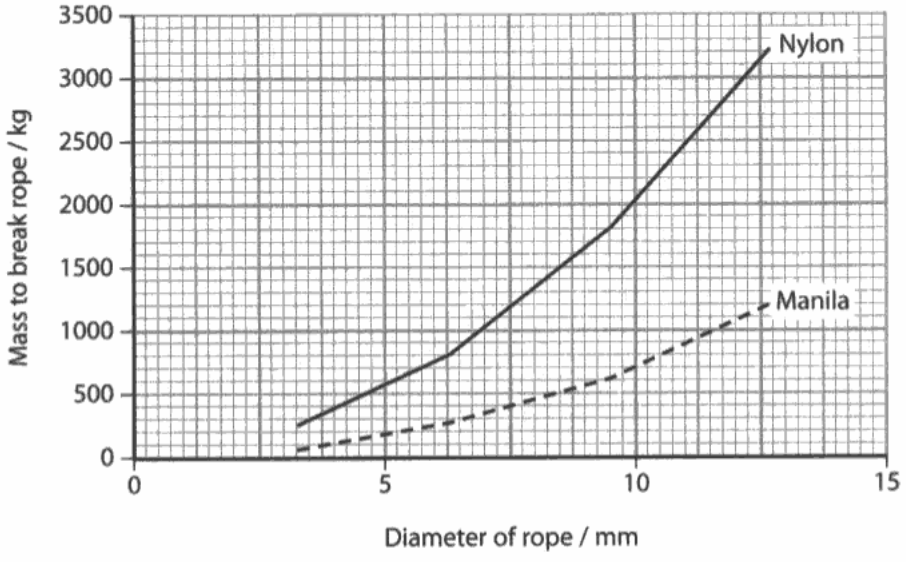
Question 3(a)

This question was relatively straightforward, yet there were relatively few candidates gaining full marks. Many responses discussed the relative strengths of the two types of rope, whereas the question just asked for a comparison of the effect of **increasing diameter** on the **mass** needed to break the two types of rope. References to speed or rate were irrelevant as there was no time factor involved. Many candidates only referred to nylon rope, failing to compare the two types of rope and not gaining any marks at all. Responses to this question were generally poorly expressed. As always, it is never enough to merely quote figures from graphs, credit can only be given for manipulation of the data. In this question it is relevant to work out the difference in mass required to break the two types of rope at any particular diameter.

3 Ropes can be made from many substances including nylon and manila.
Nylon is a synthetic fibre. Manila is made of fibres from the *Musa textilis* plant, shown in the photograph below.

Malkolm Warrington / Science Photo Library

(a) The mass required to break ropes, of different diameters, made from nylon and manila was investigated.
The results of this investigation are shown in the graph below.



Compare the effect of increasing the diameter on the mass needed to break nylon rope rather than manila rope.

(3)

Mass needed to break rope increases for both as diameter increases. Mass needed to break rope Nylon is always higher. Difference in mass to break rope is lowest at the beginning.

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Examiner Comments

This response gains two marks. It gets the first marking point for stating that 'the mass needed to break the rope increases for **both** as the diameter increases'. It then gets a second mark for going on to say that the 'mass needed to break nylon is always higher' (marking point 3 on the mark scheme).
The third sentence is not precise enough to gain a third mark as, although the candidate writes that the 'difference is.... lowest at the beginning', they have not written that the difference increases as the diameter increases.

ResultsPlus
Examiner Tip

Make sure that the answer given refers to the question itself - in this case the candidate has stuck to discussing the effect of diameter on mass needed to break the rope.

- The wider the rope (larger the diameter) the greater the mass needed to break the rope. This is true of both nylon + manila rope
- Nylon is able to hold greater weights than manila rope when they have the same diameter. e.g:
- It took 1300 kg of mass more to break nylon than manila rope when both had a diameter of 10mm.

ResultsPlus
Examiner Comments

This response gained full marks. The first point covers the idea that an increase in diameter requires more mass to break both types of rope. The second mark is given for writing that nylon is able to hold greater weights than manila rope at the same diameter which is equivalent to stating that nylon always requires more mass to break it. In the last bullet point the candidate has accurately calculated that it takes 1300kg more mass to break nylon when the ropes are both 10mm in diameter.

ResultsPlus
Examiner Tip

This is a good example of where a candidate has written their answer as a series of bullet points. This keeps each point separate and allows the candidate to express their ideas clearly.

Question 3(b)(i)

The key to this question was reading the information above the diagram which clearly stated that it was a prokaryotic cell. The stem of the question also provided the information that bacteria are prokaryotic cells. There were quite a few responses to all parts of question 3(b) on the premise that the diagram was of a sperm cell. It cannot be emphasised too much how important it is to read all of the information provided in the question.

However, most candidates correctly identified this as a flagellum, spelled in a variety of ways.

The structure of a prokaryotic cell is something that has to be learnt. Those who worked outwards from the cell membrane correctly identified B as the cell wall, many even going as far as to describe it as being made of murein or peptidoglycan, which was not necessary to gain the mark. The commonest incorrect answer was 'slime capsule' as it appeared to be the outermost layer.

Despite the fact that the cell membrane was actually labelled on the diagram, there were still a few that wrote cell membrane as the answer.

ResultsPlus

Examiner Comments

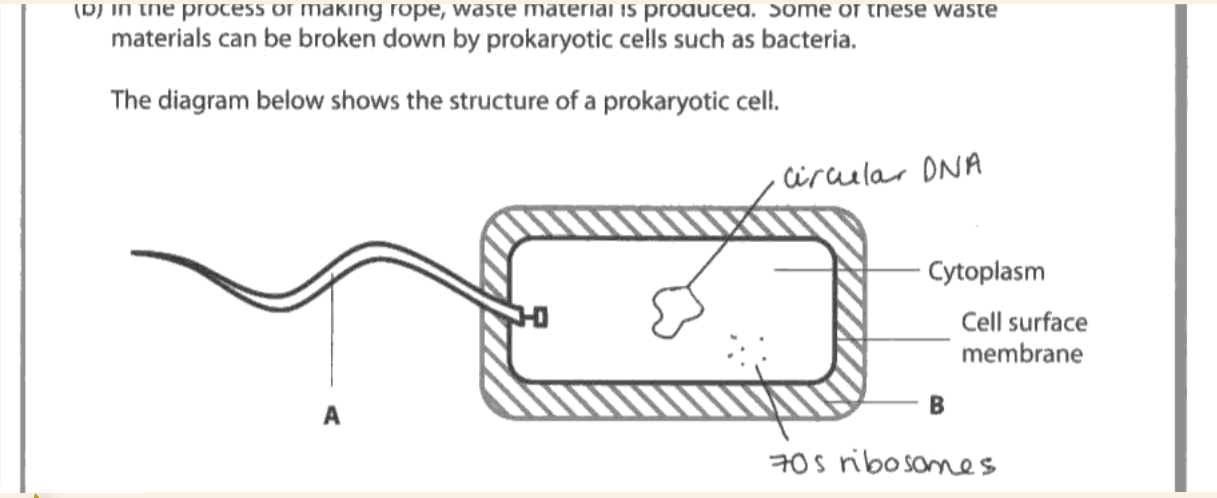
A good answer clearly stating bacterial cell wall, even though cell wall on its own would have achieved the mark.

Question 3(b)(ii)

An apparently straightforward question requiring a couple of structures found in prokaryotic cells to be drawn and labelled. The commonest correct answers were ribosomes, drawn as small dots rather than as large 'cottage loaves' and plasmids, drawn as small loops. There were some excellent answers which included circular DNA loops labelled as nucleoids, plasmids and small 70s ribosomes.

Mesosomes were not accepted for two reasons, firstly they are not found within the cytoplasm and secondly they are now believed to be artefacts of preparation techniques for electron microscopy.

Some of the responses seen equipped the bacterial cell with a wide range of membrane bound organelles, such as nuclei and mitochondria - found only in eukaryotic cells. A few also drew in an acrosome, under the impression that the diagram was that of a sperm cell.



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Examiner Comments

Two marks were awarded here for 'circular DNA' drawn as a complete loop with no loose ends, and ribosomes - it was not necessary to state that their size was 70s.

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Examiner Tip

Make sure that drawings do not contradict the label - many candidates drew a squiggle with two stray ends and labelled it as 'circular DNA' which could not be awarded a mark.

Question 4(b)

This question tested knowledge of what is happening within cells during telophase. There were many very good responses to this question. However, it should be noted that plant cells do not have centrioles. There are slight differences between mitosis in plant and animal cells and these need to be noted.

(b) Describe the appearance of a cell in telophase of mitosis as seen in a root tip squash.
(3)

~~In telo~~ * In telophase the chromosomes decondense and the chromosomes become invisible.
* The Nuclear envelope reforms.
* The nucleolus reapears
* The spindle disapears
As seen in a root tip squash; ~~the~~ two cells are seen divided. ~~in a cell~~

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Examiner Comments

This is a nice clear response covering four out of six marking points. The candidate uses relevant terminology accurately making it evident that they have a sound grasp of the process of mitosis.

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Examiner Tip

Unless a question is designated as one testing QWC, bullet points can be very helpful - both for the candidate and the examiner. Answers written out like this allow candidates to ensure they have covered enough separate points to gain maximum marks.

(b) Describe the appearance of a cell in telophase of mitosis as seen in a root tip squash.
(3)

During telophase the chromosomes unravel becoming less dense and lighter in appearance. In the cell there are two separate nuclei forming a nuclear envelope individually. The spindle would not be present. The nuclei would be at opposite ends.

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Examiner Comments

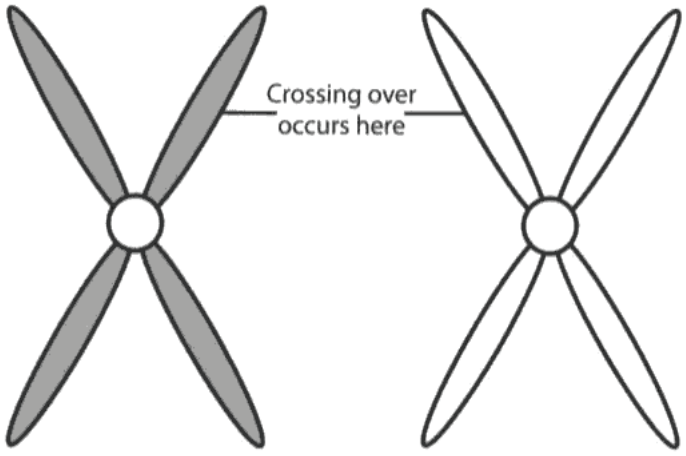
Although this example is less precise, it still achieved full marks. Credit was given to 'chromosomes unravel', 'two separate nuclei' and 'spindle would not be present'. This candidate shows a clear grasp of what would be visible at telophase.

Question 4(c)(i)

This question was well answered on the whole, with most candidates able to identify which portion of the chromatid would be swapped over.

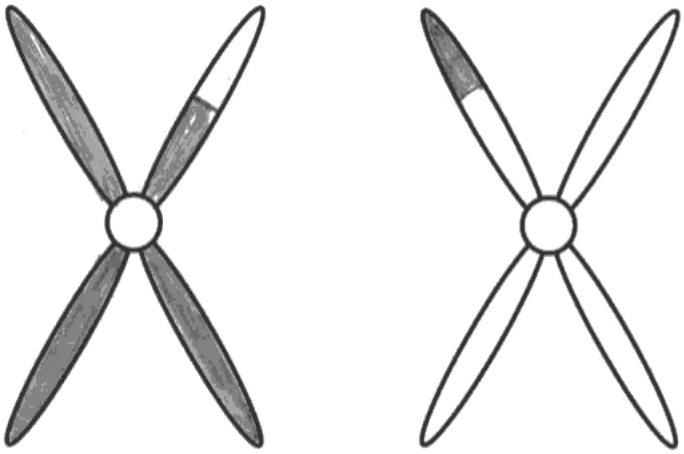
(c) One way in which meiosis increases genetic variation is through crossing over.

(i) The diagram below shows a pair of homologous chromosomes during meiosis. They are positioned next to each other but crossing over has not yet occurred.



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

(1)



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Examiner Comments

A good example, clearly shading in the correct portions of the chromatids.

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Examiner Tip

When asked to draw on a diagram, use pencil so that changes can be made if mistakes are made. As long as the shading is dark enough it will show up perfectly well when the scripts are scanned.

Question 4(c)(ii)

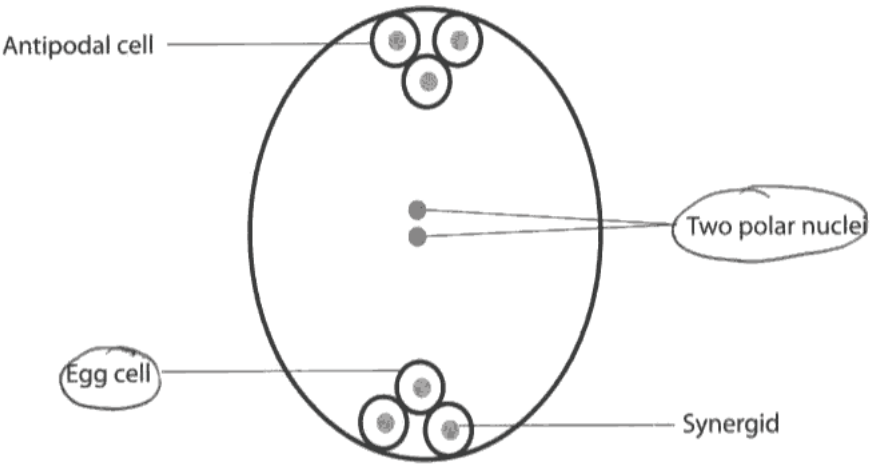
This question tested knowledge of the process of fertilisation in flowering plants following pollination. This question was left blank in a significant proportion of papers. Whether this was because of unfamiliarity with the embryo sac diagram or as a consequence of not reading the instructions carefully is hard to tell. However, it does reinforce the necessity of reading every sentence in every question.

Candidates who drew circles around the actual structures were credited on this occasion, but it is important to follow instructions precisely.

(ii) Meiosis produces haploid structures in the plant.

The diagram below shows an embryosac.
Draw a circle round each of the labels of **two** haploid structures that are fertilised in the embryosac.

(2)



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Examiner Comments
This response does exactly as the question instructs - the **labels** of the haploid structures that are fertilised are both circled.

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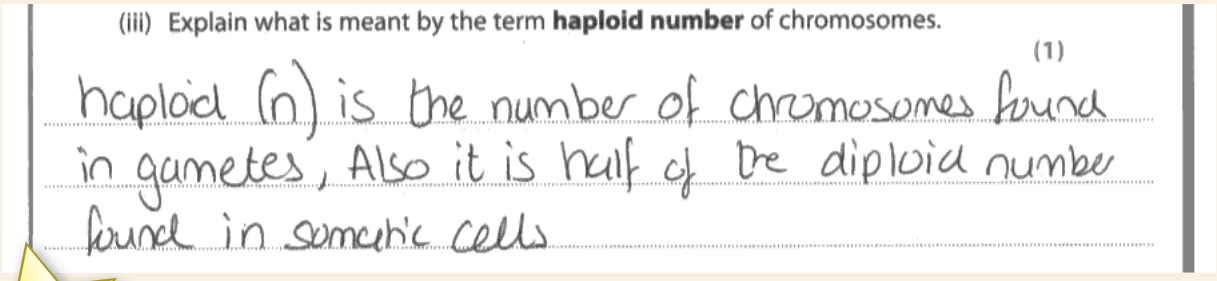
Examiner Tip
Read every part of the question otherwise marks could be lost unnecessarily.

Question 4(c)(iii)

This question asked for an explanation of the term 'haploid number' of chromosomes. It was not enough to just state 'half the number of chromosomes', there had to be further explanation of what that means. Stating that it is 'half the diploid number' may seem logical, but it does not explain what the terms mean. This question was not answered with sufficient detail by the majority of candidates. Examiners were looking for responses referring to the number of chromosomes in relation to that in normal **body** cells (somatic cells) or the number of chromosomes to be found in gamete cells, or following meiosis; there were some excellent responses that covered the full range of possible marking points.


(iii) Explain what is meant by the term **haploid number** of chromosomes.

(1)

haploid (n) is the number of chromosomes found in gametes, Also it is half of the diploid numbe found in somatic cells

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Examiner Comments

This response clearly demonstrates a clear grasp of the meaning of haploid, covering two different marking points - the fact that it is the number of chromosomes to be found in gametes and half the number to be found in somatic cells. An excellent answer.

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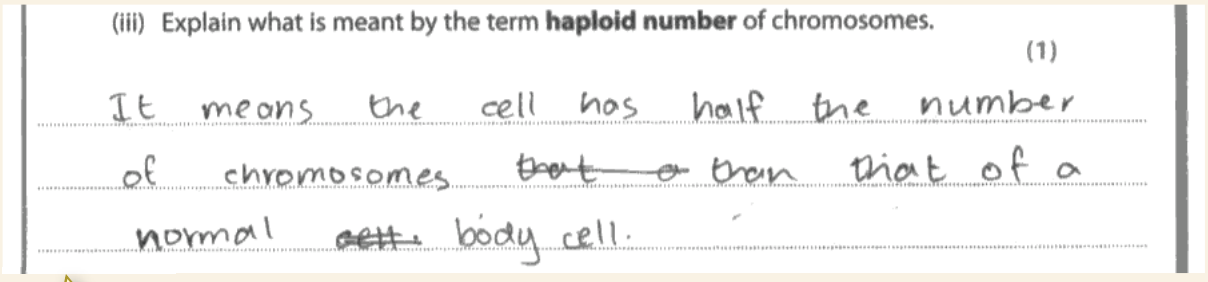
Examiner Tip

In questions like this, where an explanation is required, if more than one reason is known, it is always a good idea to write more, just in case one point is not made clearly enough to be awarded the mark.


(iii) Explain what is meant by the term **haploid number** of chromosomes.

(1)

It means the cell has half the number of chromosomes ~~that a~~ than that of a normal ~~cell.~~ body cell.

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Examiner Comments

This response gained one mark for stating that haploid refers to half the number of chromosomes that are found in a normal **body** cell.
Note - no mark would have been given for 'normal cell'.

Question 5(a)

This question tested whether or not the term gene locus was understood. Generally speaking there were many candidates who knew exactly what it was and could express this clearly. There were some who were unfamiliar with the term, yet inferred that it had something to do with the position of a gene and were credited with one mark. This question is also one of the rare examples when either gene or allele would have been correct, and either chromatid or chromosome could be accepted, due to the context of gene locus.

5 Genetic diversity is important for the long term survival, adaptation and evolution of organisms. Genetic diversity can be considered as the number of different alleles found at each gene locus in a population of organisms.

(a) Explain what is meant by the term **gene locus**.

(2)

a gene locus is the position of the allele on the chromatid.

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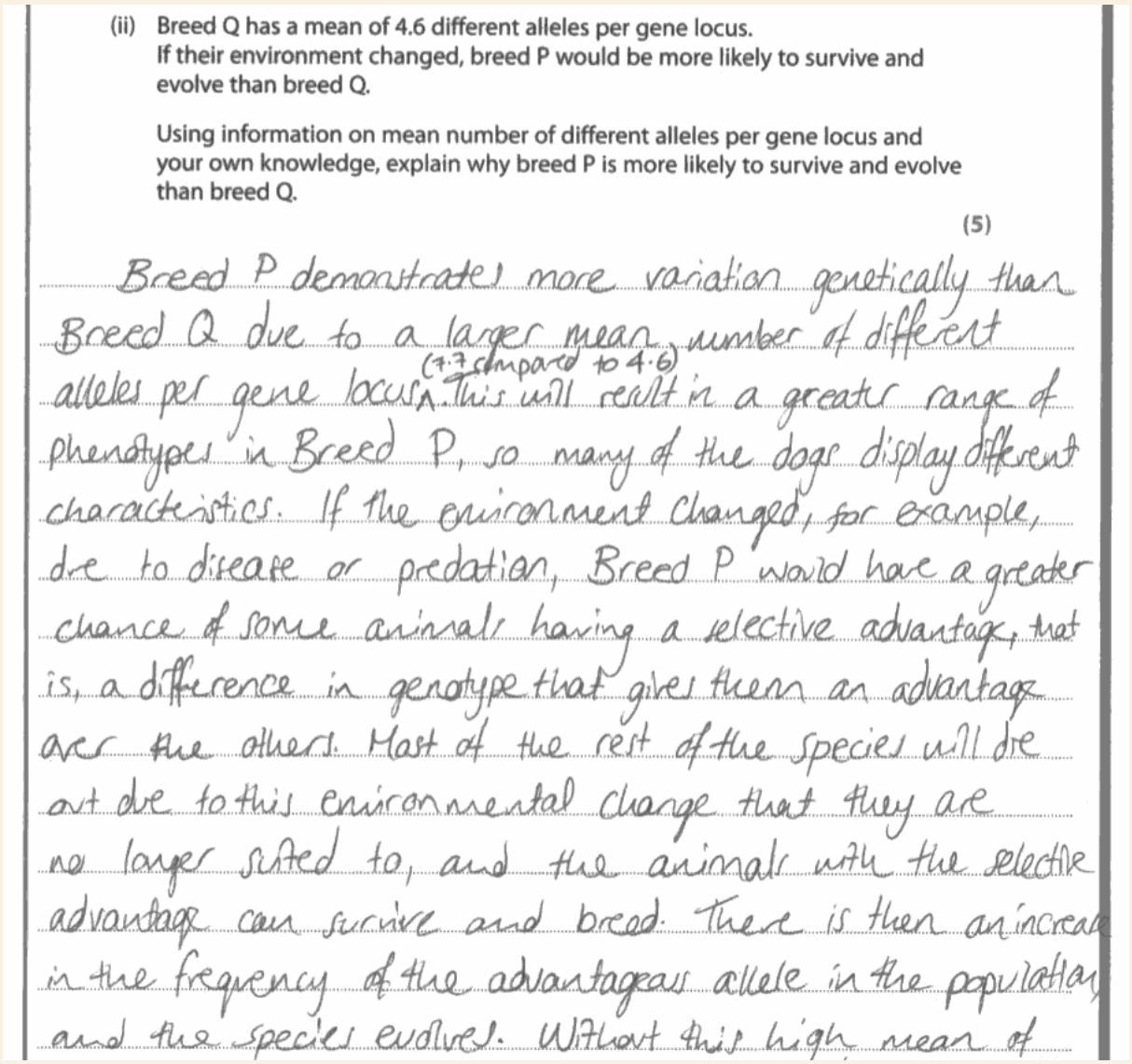
Examiner Comments

This response gains 2 marks for clearly stating position of **allele** on the **chromatid**.

Question 5(b)(ii)

This question proved problematic for many candidates and scored low overall. There was a tendency for candidates to refer to genes instead of alleles, which prevented them from achieving marks, and to discuss probability of mutations, which was irrelevant in this context. Very few managed to make the link between greater number of alleles per gene locus with greater genetic diversity and therefore greater chance of having favourable **allele combinations**. However, it was still possible for candidates to achieve some marks if they recognised that more different alleles would increase survival chances and that those that survived reproduced and passed on the favourable alleles. Few candidates seemed to understand that the frequency of favourable alleles in a population increases over several generations, that is over time, and not immediately. Some candidates also failed to note that the two breeds were of the same species.

It really is essential that candidates are able to distinguish between genes and alleles, especially in this context, otherwise they are not scoring marks despite understanding the basic principles of natural selection.



(ii) Breed Q has a mean of 4.6 different alleles per gene locus.
If their environment changed, breed P would be more likely to survive and evolve than breed Q.

Using information on mean number of different alleles per gene locus and your own knowledge, explain why breed P is more likely to survive and evolve than breed Q.

(5)

Breed P demonstrates more variation genetically than Breed Q due to a larger mean number of different alleles per gene locus (7.7 compared to 4.6). This will result in a greater range of phenotypes in Breed P, so many of the dogs display different characteristics. If the environment changed, for example, due to disease or predation, Breed P would have a greater chance of some animals having a selective advantage, that is, a difference in genotype that gives them an advantage over the others. Most of the rest of the species will die out due to this environmental change that they are no longer suited to, and the animals with the selective advantage can survive and breed. There is then an increase in the frequency of the advantageous allele in the population and the species evolves. Without this high mean of

different alleles per gene locus, there would be less variation within the species, therefore less chance of an ~~animal~~ organism having the 'selective advantage', so more chance of all of the species dying off, rather than surviving and evolving.

ResultsPlus
Examiner Comments

This response was awarded 4 marks. In the first sentence there are 2 marks - one for greater genetic variation and one for larger number of alleles per gene locus. Then on lines 6-8 marking point 4 from the mark scheme is gained for stating that, if the environment changed, there would be a greater chance of breed P having a genotype that would give them a selective advantage. Then on the 12th line there is reference to these individuals surviving and breeding for marking point 5.
Although the candidate states that there would be an increase in frequency of the advantageous allele in the population, there is no reference to this taking place over several generations or time.

Question 5(c)

This question tested the appreciation of how sample size can influence the type of data that can be gathered. A reasonable number of candidates noted that there were more dogs in group 1 than in 2 and therefore a greater chance of recording a higher number of different alleles at 31 gene loci. However, there were many who failed to observe that **both** groups of dogs were from breed P and wrote answers that assumed the two sets of results represented different breeds, for example stating that there were 'more dogs of breed P'. Yet again, there were examples of incorrect responses that seemed to result from not having read the whole question first.

(c) Two groups of dogs, of breed P, were taken from the same population.
The total number of different alleles at the same 31 gene loci was recorded for each of these two groups.

The results are shown in the table below.

Group	Number of dogs of breed P	Total number of different alleles at 31 gene loci
1	40	239
2	20	215

Suggest why the total number of different alleles in group 1 was greater than in group 2.

(2)

Because there are more dogs in group 1 and so a greater chance of genetic diversity.

ResultsPlus
Examiner Comments

This is a good example of a simply stated response that achieves full marks.

Question 6(a)(i)

Most candidates accurately identified group C as the Eukaryota and many went on to give the presence of mitochondria as the reason for their choice. However, there were many responses which indicated that many of the candidates believed that only animals possessed mitochondria, rather than all eukaryotic organisms. Many responses also failed to note that the cell walls referred to in the table were those composed of peptidoglycan and then erroneously stated that Eukaryota do not possess cell walls, suggesting that they did not understand that fungi and plants can be eukaryotic and possess cell walls.

6 Woese was the scientist who proposed a classification of organisms into three domains called the Archaea, Bacteria and Eukaryota (Eucarya).

(a) The table below shows some of the characteristics of the three domains.

Characteristic	Domain		
	A	B	C
Mitochondria	Absent	Absent	Present
Cell wall containing peptidoglycan	Yes	No	No
Amino acid carried on tRNA that starts protein synthesis	Formylmethionine	Methionine	Methionine
Sensitive to antibiotics	Yes	No	No
May contain chlorophyll	Yes	No	Yes

(i) Using the information in the table, suggest which of A, B and C represents the Eukaryota domain. Give a reason for your answer.

(2)

Domain C

Reason Eukaryotic cells contain mitochondria whilst Prokaryotic and archaea do not.

ResultsPlus

Examiner Comments

A typical example of a correct response scoring full marks, clearly identifying eukaryotic cells as being the only ones to possess mitochondria.

Question 6(a)(ii)

This question asked for information from the table to be used to suggest which group represented the Archaea domain. Whilst the majority of candidates correctly identified B as the Archaea, fewer provided sufficiently detailed reasons to achieve the second marking point. It was not enough to state just one characteristic that domain B shared with domain C, as it also shared one characteristic with domain A. Therefore, to achieve full marks it was necessary to state clearly that there were more characteristics in common, or to name at least two of them. An alternative approach to this would be to refer to the characteristic of sensitivity to antibiotics and state that domain A must be Bacteria and therefore B was Archaea; this was described by many candidates, showing good deductive reasoning.

(ii) Many scientists believe that the Eukaryota domain is more closely related to the Archaea domain than to the Bacteria domain.

Using the information in the table, suggest which of A, B and C represents the Archaea domain. Give a reason for your answer.

(2)

Domain B

Reason Out of the 5 named characteristics domain C and B share 3 of them. C and A only share one characteristic and so C is more similar to B than it is to A.

ResultsPlus
Examiner Comments

This example scored full marks for identifying B as the Archaea domain, referring to the greater number of shared characteristics with C as the reason for selecting B.

Domain A B

Reason Domain B is not sensitive to antibiotics, whereas Domain A is. As antibiotics kill bacteria and Domain A is the only one sensitive to them, Domain A must be bacteria meaning Domain B are Archaea. Domain B also has more characteristics in common with Domain C.

ResultsPlus
Examiner Comments

This is an example of the alternative reasoning regarding sensitivity to antibiotics, as well as referring to the number of shared characteristics. This also achieved full marks.

Question 6(b)(i)

This question tested knowledge of the structure of cell organelles, specifically the Golgi apparatus. Candidates could score high marks, even if they did not recall the term 'cisternae', as long as their descriptions were sufficiently clear. There were some very good answers indicating a sound appreciation of cell ultrastructure.

(b) Cells of the Eukaryota domain contain rough endoplasmic reticulum and Golgi apparatus.
Both the rough endoplasmic reticulum and the Golgi apparatus are made up of membrane-bound sacs.

(i) Describe how you would recognise the Golgi apparatus as seen using an electron microscope.

(3)

Golgi apparatus is made up of ~~eee~~ 3 curved cisternae each smaller than the last. it will have vesicles next to the end of the cisternae. Some of the ends of the cisternae will be bulging to release vesicles.

ResultsPlus

Examiner Comments

This response gained full marks. **Cisternae** are correctly referred to and they are described as being curved and of different sizes. There is also mention of vesicles associated with the Golgi apparatus. As full marks had already been awarded the diagram was not considered, but if there were only two marks awarded for the written part of the answer, the third mark could have been awarded if the diagram was labelled.

ResultsPlus

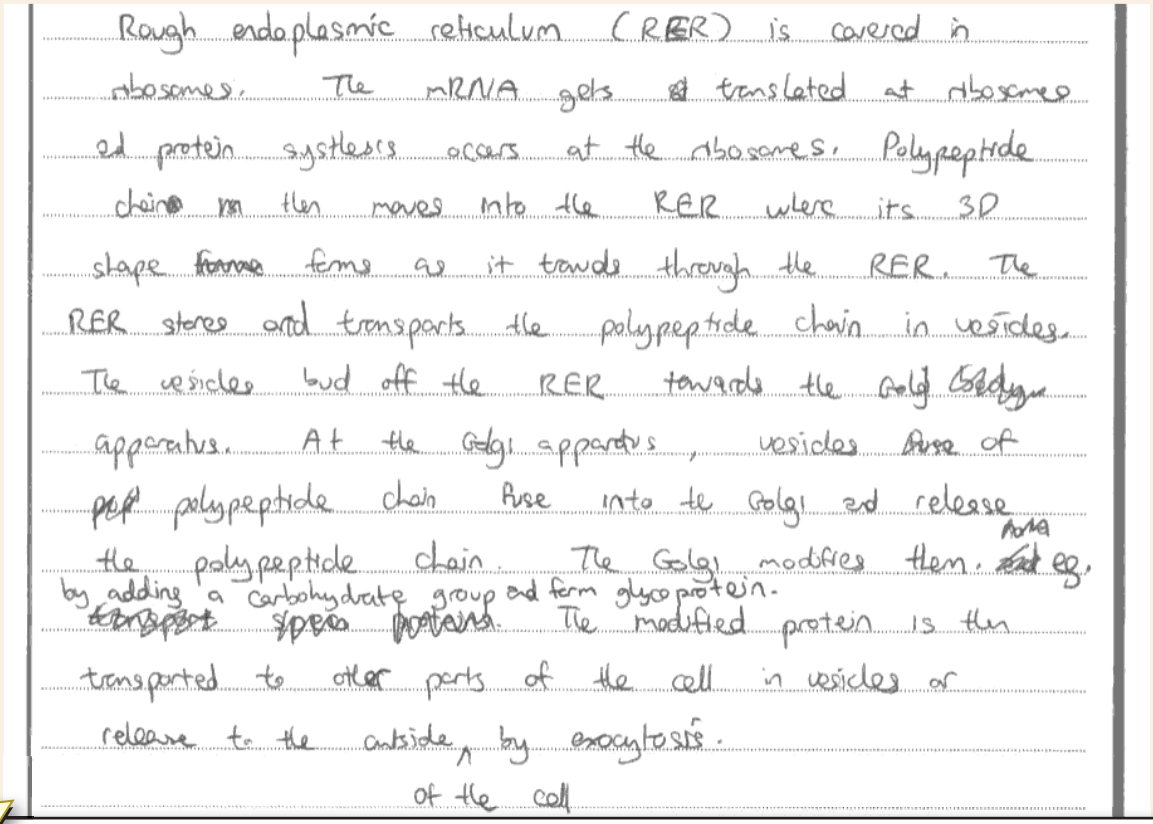
Examiner Tip

If adding a drawing to an answer, it is very important to label or annotate the diagram.

Question 6(b)(ii)

It was good to read many clear answers to this question, demonstrating a sound understanding of the roles of the rough endoplasmic reticulum and the Golgi apparatus. The best answers took into account the packaging of the proteins in vesicles by the rER for transport to the Golgi apparatus where the proteins were modified; many even providing details about the addition of carbohydrate groups to produce glycoproteins. This part of Q6 was also assessed for QWC and, on the whole, technical words were spelt correctly and answers were presented logically.

However, there were many examples of muddled answers, where it seemed as if candidates were under the impression that it was either the ribosomes or the vesicles that were being transported and modified. It is essential that these type of questions are tackled methodically and that the sequence of events are clearly set out.



Rough endoplasmic reticulum (RER) is covered in ribosomes. The mRNA gets translated at ribosomes ed protein systhesis occurs at the ribosomes. Polypeptide chains then moves into the RER where its 3D shape forms as it travels through the RER. The RER stores and transports the polypeptide chain in vesicles. The vesicles bud off the RER towards the Golgi apparatus. At the Golgi apparatus, vesicles fuse of polypeptide chain fuse into the Golgi and release the polypeptide chain. The Golgi modifies them. eg. by adding a carbohydrate group and form glycoprotein. transport spreads proteins. The modified protein is then transported to other parts of the cell in vesicles or release to the outside, by exocytosis. of the cell

ResultsPlus

Examiner Comments

Although this answer is not neatly presented and parts have been crossed out and extra parts added in, it does demonstrate how a plan could have helped this candidate produce a 'tidier' response. The first part of the answer is not clear and it does not state specifically that the ribosomes are **attached** to the rER. However, full marks were gained for the following points:- at the end of the 4th line reference is made to proteins gaining their 3-D shape in the rER (marking point 4 on the mark scheme), then the candidate states that proteins are stored and transported in the rER (marking point 3), then another mark is given for making it clear that the polypeptides are packaged in vesicles by the rER (marking point 5), followed by the fact that these vesicles fuse with the Golgi (marking point 6), and then the polypeptide is processed in the Golgi (marking point 7), for example by having carbohydrate adding to produce a glycoprotein (marking point 8)

ResultsPlus

Examiner Tip

It can help making a few notes before attempting this type of question. When there are marks depending on points being made in a logical sequence it pays to get that order sorted out before beginning to write, that way nothing gets left out and what is written is relevant.

Question 7(a)

This question tested understanding of totipotency and relied on candidates correctly interpreting information in a table listing the number of genes not switched off in three different cells. Good candidates correctly worked out that the cell with none of the genes switched off was the totipotent one. Those with a less thorough grasp of totipotency decided that if 23000 genes were not switched off they must all be switched on, which is obviously not the case. Better answers were provided by candidates who associated totipotency with the potential to differentiate into any cell in the body and therefore must be cells that have not had any genes switched off.

Terminology is important here and yet again there were responses that described stem cells as 'turning into' any other cell, which is not accurate. It is preferable to describe stem cells 'differentiating to give rise to all cell types'.

7 Stem cells can differentiate into specialised cells and tissues.

(a) There are about 23 000 genes in a human body cell. The table below shows the number of genes that have not been switched off, in three different cells, A, B and C.

Cell	Number of genes that have not been switched off
A	11 000
B	18 000
C	23 000

Suggest which of these cells is a totipotent stem cell.
Give reasons for your answer.

(3)

Cell C

Reasons As it has 23000 genes that have not been switched off, and there are 23000 genes in a human cell, this means cell C has the abilty to differentiate into any cell type and this is what totipotency is.

ResultsPlus
Examiner Comments

This response gained full marks. After correctly identifying cell C as the totipotent stem cell, this candidate then refers to 23000 genes not being switched off, notes that there are 23000 genes in a human cell and then clearly states that cell C can therefore differentiate into any cell type.

Question 7(b)(i)

The emphasis in this question was testing whether candidates understood that pluripotent cells could differentiate into fewer types of cell than totipotent cells and that they could provide a reason for this. Very few responses provided reasons for pluripotent cells giving rise to fewer cell types, however, many gave examples of the tissue types that pluripotent cells could not give rise to. It should be noted that many referred to **embryonic** tissues rather than **extra-embryonic** tissues, which did not gain the mark.

(b) A fertilised egg can be used as a source of human pluripotent stem cells.

(i) Explain what is meant by the term **pluripotent stem cell**.

(2)

A pluripotent stem cell is one which is undifferentiated and has the ability to become any of the specialised cells in the body, except extra-embryonic cells such as the placenta and umbilical cord.

ResultsPlus

Examiner Comments

This response gains full marks. One mark is given for stating that pluripotent cells are **undifferentiated** and another for going on to explain that they are able to become any specialised cell except **extra-embryonic cells**, giving the examples of placenta and umbilical cord.
A well learnt response using correct terminology, although it is better to describe stem cells as giving rise to other cells rather than 'becoming' other cells.

Question 7(b)(ii)

The question quite clearly asks how a 'fertilised egg' can be used as as a source of pluripotent stem cells, yet very few candidates addressed this issue. This question was very poorly answered and low scoring. Many incorrect responses seemed to focus on either the potential of human stem cells or on the process by which stem cells become differentiated. Weaker candidates confused IVF with cloning, whereas better answers noted that surplus fertilised eggs from IVF acted as a source of these eggs. The most common marking point awarded was for stating that pluripotent cells were to be found in the blastocyst. Good candidates were able to explain that the fertilised egg needed time to divide to become a blastocyst and that the pluripotent cells could be extracted from the inner cell mass. This is evidently an area that the vast majority of candidates found especially challenging.

(ii) Describe how a fertilised egg can be used as a source of human pluripotent stem cells.

(3)

After a few days the egg cell has divided by mitosis. It then forms a blastocyst, group of cells. The cells on the outside have been determined into placenta cells. So, the cells nearer the middle are pluripotent. They still have the ability to produce any other cell, apart from placenta.

ResultsPlus

Examiner Comments

This response was awarded 3 marks. The first was given for reference to the egg cell dividing by mitosis, the second for the fact that it then forms a blastocyst and the third for identifying the cells in the middle of the blastocyst as being pluripotent. Although some of the points are only just acceptable on the mark scheme, this candidate has understood the question and has a sound grasp of how pluripotent cells can be harvested from a fertilised egg. As fertilised egg was in the stem of the question, it can be taken that the candidate is referring to that in the first line and they have shown that they know there is a difference between the cells on the outside of the blastocyst and the ones in the middle, even though they did not refer to the inner cell mass specifically.

Question 8(a)(i)

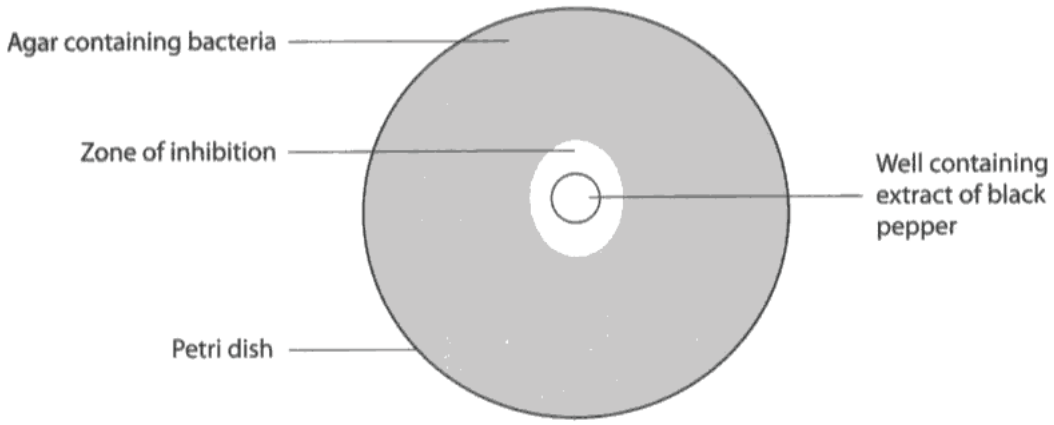
This question tested the candidates' knowledge of the procedures involved in preparing agar plates containing bacterial cultures. Although this stage may be performed in schools and colleges by laboratory technicians instead of the students, it is important that they are aware of the processes, especially the need for aseptic techniques to minimise contamination of the plate. There were many vague answers to this, including reference to sterile equipment that would not be called for in this particular experiment, such as forceps.

8 An investigation was carried out to extract antimicrobial substances from black pepper.

One extraction method used ethanol. The black pepper was crushed and soaked in the ethanol for 24 hours. The crushed pepper was then removed, leaving an ethanol extract.

A Petri dish containing agar and one species of bacterium (B1) had a cylinder of agar removed to produce a well.
The ethanol extract was then placed in the well.

The Petri dish was incubated at 37 °C for 24 hours. After incubation, the diameter of the zone of inhibition around the well was measured. This was repeated using Petri dishes with different species of bacteria (B2, B3, B4 and B5).



The investigation was repeated using an extract prepared with hot water in place of ethanol.

(a) (i) Describe how the bacteria should be added to the Petri dish.

(2)

The bacteria should be added with a sterile pipette and spread evenly on the petri dish into a lawn.

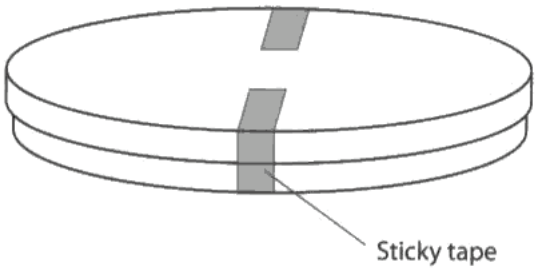
ResultsPlus
Examiner Comments

This response was awarded 2 marks. The candidate has correctly described the use of a sterile pipette to add the bacteria which qualifies as a reference to aseptic technique. There is also a clear statement about the bacteria being spread out evenly to form a lawn.

Question 8(a)(ii)

This question tested that candidates understood the reasons for not completely sealing the lid of the Petri dish. However, many candidates just gave reasons for securing the lid to the base, rather than explain the reason for securing it in a particular way. There were some very good answers describing how this prevents anaerobic conditions by allowing air/ oxygen to enter the Petri dish. Credit was also given for answers that explained that the lid prevented contamination by other micro-organisms.

(ii) Before incubation, the lid was secured to the base of the Petri dish as shown in the diagram below.



Explain why the lid was secured in this way.

(2)

To ensure air can go into the petri dish for the bacteria to respire, and to prevent entry of any other micro-organisms. Also to ensure that when the petridish is lifted the next time, not only the lid comes off, but the whole petri dish is lifted so that it does not open.

ResultsPlus

Examiner Comments

This response gained 2 marks in the first sentence for stating that air is allowed in, but not other micro-organisms. The second sentence is typical of many incorrect responses that were provided, however, in this example it can be ignored as the correct answers are also provided.

Question 8(a)(iii)

This question tested candidates' knowledge of the reasons for not incubating bacteria at temperatures of 37°C. Unfortunately some candidates seemed unaware that incubation does not take place in the open laboratory or classroom and expressed concern that temperatures of 37°C could lead to heat stroke. Others seemed to have little or no concept of relative temperatures, believing that 37°C was hot enough to melt Petri dishes, ignite ethanol or even cause explosions, all the while acknowledging it to be human body temperature!

(iii) Suggest why an incubation temperature of 37°C should not be used in a school or college laboratory.

(1)

It would encourage the growth of harmful human pathogens, as it is body temperature.

ResultsPlus

Examiner Comments

A good answer clearly recognising that it is human body temperature and that the hazard would be the growth of harmful human pathogens.

Question 8(b)

This question tested candidates' ability to extract relevant information from a table to support different hypotheses. The vast majority of candidates managed to select the correct data to support at least one of the hypotheses. However, there were a significant number who got it the wrong way around - using the correct data for (b)(i) to answer (b)(ii) and vice versa, suggesting that they had misunderstood the wording of the questions. Most candidates understood the idea that the larger the zone of inhibition, the more effective the extraction technique, indicating that they had carried out the recommended core practical and were aware of the type of results to be expected.

(b) The results of this investigation are shown in the table below.

Species of bacterium	Mean diameter of zone of inhibition / mm	
	Ethanol extract	Hot water extract
B1	27.4	18.2
B2	26.2	16.8
B3	15.0	29.6
B4	25.0	16.4
B5	15.0	29.8
Mean	21.7	22.2

(i) One student used the data in the table to form the hypothesis that using ethanol was more effective than hot water at extracting antimicrobial substances from crushed black pepper.

Give evidence from the table that supports this hypothesis.

(1)

For 3 of the species of bacteria, the zone of inhibition was greater using the ethanol extract.

(ii) A second student formed the hypothesis that using hot water to extract the antimicrobial substances was more effective than using ethanol.

Give evidence from the table that supports this hypothesis.

(1)

The mean value of the inhibition area is greater with the hot water extract.

ResultsPlus

Examiner Comments

(b)(i) - this response clearly states that for three of the species of bacteria the zone of inhibition was larger when ethanol was used.
(b)(ii) - mean value correctly referred to for hot water extract.

(i) One student used the data in the table to form the hypothesis that using ethanol was more effective than hot water at extracting antimicrobial substances from crushed black pepper.

Give evidence from the table that supports this hypothesis.

↳(3 out of 5 of the species) (1)

In B1, B2 and B4, the mean diameter zone of inhibition was greater in the ethanol extract than in the hot water extract.

(ii) A second student formed the hypothesis that using hot water to extract the antimicrobial substances was more effective than using ethanol.

Give evidence from the table that supports this hypothesis.

(1)

The overall mean shows a greater zone of inhibition with the hot water extract (22.2mm) than with the ethanol extract (21.7).

ResultsPlus

Examiner Comments

(b)(i) - a very precise response, covering all bases, not only stating that ethanol gave a larger zone of inhibition in three out of five species, but also identifying them as B1, B2 and B4.
(b)(ii) - reference to larger mean diameter with hot water, using the figures from the table to make it clear which mean values are being used to support the hypothesis.

ResultsPlus

Examiner Tip

Take care when transferring data from a table - many candidates lost marks on (b)(i) by referring to the wrong three species of bacteria, e.g. B1, B2 and B3. Drawing circles around the data to be referred to may help avoid making such careless mistakes.

Question 8(c)(i)

This question asked for candidates to analyse the information provided in the table critically. However, many candidates just repeated the information provided in the stem of the question, such as 'the results overlapped' which could not be awarded any marks. Many candidates did gain a mark for calculating the values for hot and cold water, correctly working out that the maximum for cold water would have been 17.0mm and the minimum for hot water would have been 16.8mm. However, there were few who actually went on to state, categorically, that these **ranges** overlap. There were very few who managed to describe the fact that the highest value for cold water was **greater** than the lowest value for hot water, despite having worked them out separately. It did appear that many candidates struggled to put into words the observations that they made regarding the data and this does seem to be an area that they need to work on.

(c) Another investigation was carried out using cold water to extract the antimicrobial substances. The same method was used but only bacterium species B1 was tested.
The table below shows the mean diameter of the zones of inhibition and the ranges of the data.

Mean diameter of zone of inhibition / mm	
Hot water extract	**Cold water extract**
18.2 ± 1.4	16.4 ± 0.6

(i) A third student stated that some of the results for the hot water extract overlapped with some of the results for the cold water extract.

Suggest what evidence from the table above the student could have used to support this statement.

(2)

The ~~% error for the relevant~~ Smallest Zone of inhibition for the hot water extract is 16.8mm which is smaller than the Largest Zone of inhibition for the Cold water extract which is 17.0mm

ResultsPlus
Examiner Comments
Although this candidate has started to write about 'error' in the results, they have crossed this out and gone on to score full marks, clearly grasping the idea that the smallest value for hot water extract was smaller than the largest zone for the cold water extract. They have also correctly calculated the two values.

Question 8(c)(ii)

This question was well answered by many candidates who had clearly read that the table of results showed mean values and the ranges of data. Many correctly described the fact that the cold water was more reliable as the range was smaller than that of the hot water. However, quite a few discussed percentage errors and standard deviation, as if they had not observed that the data in the table described ranges and not statistically calculated errors. There were also others who decided that neither set of water results was reliable and that ethanol was better, having failed to appreciate what was meant by reliability in terms of results obtained through experimentation.

(ii) Using the table above, suggest whether the data for the hot or cold water extract were more reliable. Give a reason for your answer.

(2)

The data for cold water is more reliable as it has a smaller range. This means more of the readings were closer together showing their reliability.

ResultsPlus

Examiner Comments

This answer gained full marks for correctly identifying the cold water data as the most reliable as it had the smaller range. The answer also goes on to make it clear that the candidate understands why this means it was more reliable, as the readings were closer together.

ResultsPlus

Examiner Tip

This question was (c)(ii) - therefore the table referred to in the question would be the one associated with (c) and not (b). This may seem obvious, but quite a few candidates incorrectly discussed the reliability of the hot and cold water data in comparison to the ethanol data.

Paper Summary

In order to improve their performance candidates should:- read all of the details in the questions carefully and address their responses to the examples provided in those questions; understand the terminology encountered at this level and learn how to define key phrases accurately; review all of the recommended core practicals with particular reference to laboratory procedures; gain practice at interpreting information presented graphically and in tables.

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