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Examiners' Report
June 2010

GCE Biology 6BI04

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Introduction

This was the second paper in this unit and the first for a summer cohort. It was pleasing to see that many candidates were able to answer most of the questions with reasonable length responses. There were very few sections with no attempt at an answer. Almost all of the items produced the full range of available marks. Items which tended to score high marks and those which tended to have lower marks are highlighted in the individual question comments.

The paper required answers to eight questions for a total of 90 marks. There was no evidence that candidates were unable to complete the paper in the time allowed.

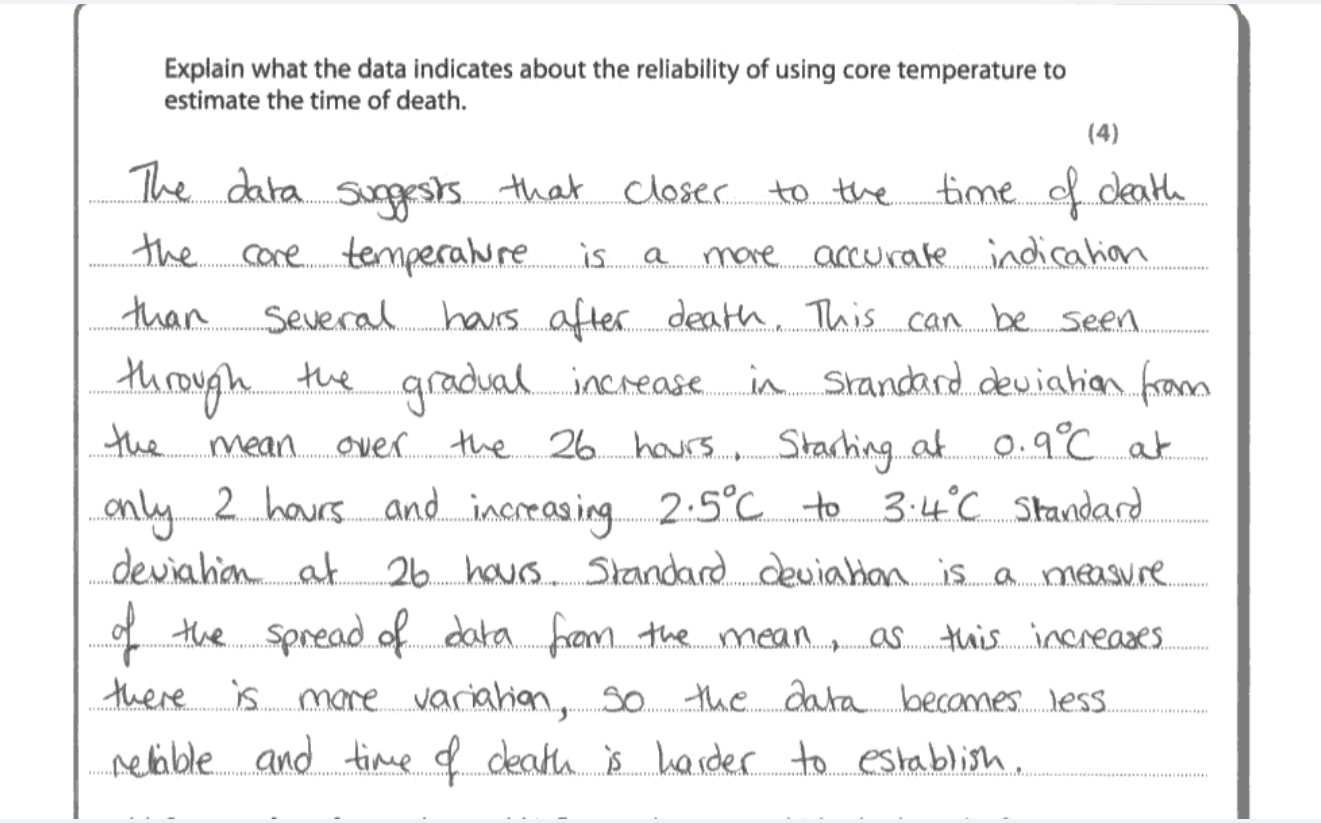
As on past papers, many candidates included irrelevance or repetition in their responses. The space provided for an answer is sufficient to give a concise and full answer. Candidates should not feel that they have to fill every available line. There are occasions where the correct response is then negated by a contradictory statement. If a candidate wishes to change an answer, they are advised to make the alteration clear by crossing out the unwanted section neatly and making a clear start to the required material.

Question 1(a)

Both of the correct responses were selected by almost all candidates.

Question 1(b)

This question produced a wide range of marks. It was pleasing to see many candidates who understood standard deviation and were able to gain high marks. Some candidates realised that the standard deviation would give an indication of reliability but suggested that it was the mean core temperature that was unreliable rather than the estimate of the time of death. Low marks tended to be attained by candidates who made no reference to standard deviation.



Explain what the data indicates about the reliability of using core temperature to estimate the time of death.

(4)

The data suggests that closer to the time of death the core temperature is a more accurate indication than several hours after death. This can be seen through the gradual increase in standard deviation from the mean over the 26 hours. Starting at 0.9°C at only 2 hours and increasing 2.5°C to 3.4°C standard deviation at 26 hours. Standard deviation is a measure of the spread of data from the mean, as this increases there is more variation, so the data becomes less reliable and time of death is harder to establish.

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Examiner Comments

This candidate has shown good understanding of standard deviation and its significance. The introductory statement is not really necessary but it does not detract from the quality of the answer.

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Examiner Tip

When commenting on data, include a manipulation to show the magnitude of any changes.

Question 1(c)

Most candidates were able suggest at least two acceptable factors. Many suggestions were too vague or needed further qualification e.g. references to size or position.

(c) Suggest **three** factors that could influence the rate at which a body cools after death.

(3)

1 temperature of the surroundings

2 size of the body

3 exposure to air

(Total for Question 1 = 9 marks)

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Examiner Comments

Only the first suggestion is acceptable. Size could be referring to many different factors such as mass or surface area. Exposure to air could be linked to temperature or movement but it should be qualified.

Question 2(a)

Most candidates were able to suggest two acceptable reasons.

(a) Suggest **two** reasons why 95% of the light hitting the surface of a leaf is not used by the chloroplasts.

(2)

~~Most of the light energy is used for other reactions that occur in the plant.~~

Not all of the light energy is absorbed by the ~~plant~~ plant, some goes straight through the plant or is deflected from the surface of the leaf. Some of the light is ~~are~~ of the wrong wavelength and so can not be absorbed by the ~~other~~ chloroplasts

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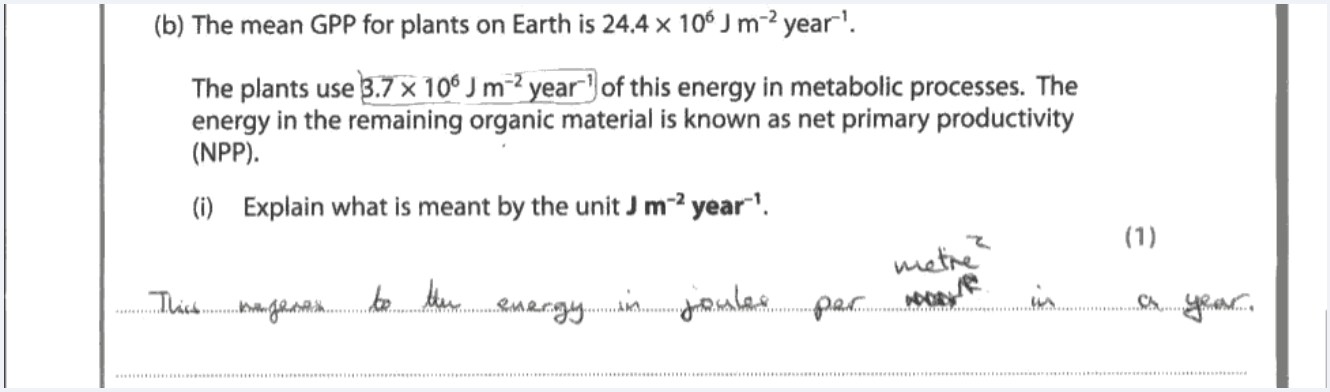
Examiner Comments

The response has correctly identified the need for the correct wavelength. The reference to deflection would not quite be creditworthy. However, transmission through the leaf can be awarded.

Question 2(b)(i)

It was expected that at this level candidates would be able to expand the unit symbols fully. Many candidates either did not refer to the 'square metre' or gave 'metre' with a superscripted 2. A noticeable number of candidates gave incorrect interpretations of 'm' e.g. molecule or minutes.



(b) The mean GPP for plants on Earth is 24.4×10^6 J m^{-2} year^{-1}.

The plants use 3.7×10^6 J m^{-2} year^{-1} of this energy in metabolic processes. The energy in the remaining organic material is known as net primary productivity (NPP).

(i) Explain what is meant by the unit **J m^{-2} year^{-1}**.

(1)

This refers to the energy in joules per metre^2 in a year.

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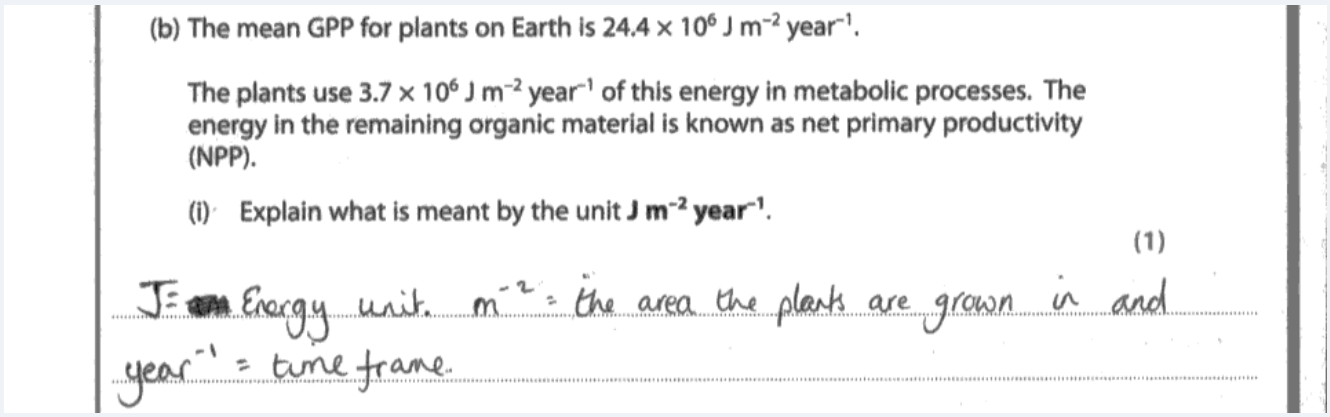
Examiner Comments

The candidate has not expanded the square metre fully.



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The plants use 3.7×10^6 J m^{-2} year^{-1} of this energy in metabolic processes. The energy in the remaining organic material is known as net primary productivity (NPP).

(i) Explain what is meant by the unit **J m^{-2} year^{-1}**.

(1)

J = Energy unit. m^{-2} = the area the plants are grown in and year^{-1} = time frame.

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Examiner Comments

Here the reference to each unit is explained. Area was acceptable instead of square metre.

Question 2(b)(ii)

Most candidates were able to complete some of the calculation. Of these, a small majority were able to complete it fully to give the final percentage.

Question 2(c)

On this question, it was pleasing to see a large number of high-scoring answers. Candidates showed good understanding of the process and were able to give straightforward, accurate accounts. It is pleasing that so many candidates can tackle the details of biochemical processes at this level. It was noticeable that many candidates included details of the light-independent stages. The question required that an account would be given up to the point at which the energy was available in ATP rather than how it was used. The spelling of the required technical terms did not need penalising on many occasions.

*(c) With reference to the structures in a chloroplast, explain how the energy from light is made available in ATP molecules for the synthesis of organic materials.

(6)

The light-dependent stage produces ATP. This stage includes cyclic and non-cyclic phosphorylation. In cyclic phosphorylation, light is used to excite electrons in PSI found in the membranes of intergranal lamellae in chloroplasts. The excited electrons are passed along an electron transport chain (ETC) to drive the synthesis of ATP, before the electrons are returned to PSI. In non-cyclic phosphorylation, electrons are excited in PSI ~~again~~ and electrons are excited in PSII as well. PSII is found on the thylakoid membranes in chloroplasts. A stack of thylakoids makes up a granum. The excited electrons of PSII are passed along an ETC, driving the synthesis of ATP, before being passed onto PSI to replace ~~the~~ its electrons that had been excited.

(Total for Question 2 = 12 marks)

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Examiner Comments

This is a mid-level answer. Mps 1, 2, 3 and 5 can be awarded. The references to phosphorylation do not explain what is being used. There is some repetition towards the end.

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Examiner Tip

When explaining a synthesis, give the full process from starting point e.g. ADP + inorganic phosphate, to product e.g. ATP.

Question 3(b)(i)

Most candidates were able to name the independent variable correctly.

Question 3(b)(ii)

Most candidates were able to score some credit for the description of the changes in the rate of growth as shown in the graph. The question also required suggested explanations for these changes. Although many candidates were aware that temperature would affect enzymes, relatively few could give details of this. A large number of candidates seem to believe that enzymes suddenly denature at a certain temperature or that the denaturation does not start to occur until a certain critical point.

(ii) Using the information in the graph, describe and suggest explanations for the effect of temperature on the rate of growth of the filamentous alga.

(4)

The graph shows us that the growth rate of filamentous alga is at a peak at 22°c. At 13°c the alga ~~grew~~ grew very slowly and only a gradual increase accured to 18°c. It increase became steeper, on the graph, between 18°c and 20°c. It carried increasing until it reached 22°c. After, which, it began to drop.

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Examiner Comments

Only description of the changes given without any explanation.

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Examiner Tip

Make sure that all command words in questions are noted so that relevant points can be made fully.

(ii) Using the information in the graph, describe and suggest explanations for the effect of temperature on the rate of growth of the filamentous alga.

(4)

There is a steady increase in rate of growth between 13 and 18 degrees. from 18 to 22 degrees the rate in growth increases more dramatically, before falling between 22 and 25 degrees C. However the steepest increase in rate of growth is between 20 and 22°C which would suggest that the peak of this (22°C) is the optimum temperature for reactions in the cell. The graph also suggests that enzymes start to denatures after 22°C.

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Examiner Comments

There is a clear description of the increase and decrease in rate of growth with correct readings of the temperatures. The reference to enzymes is not specific enough and could refer to all the enzymes rather than those involved in growth. There is also a statement that the denaturation does not start until 22 C is reached.

Question 3(b)(iii)

In this question, the link between light availability and photosynthesis was indicated by most candidates. However, relatively few of them followed this up by reference to the photosynthetic products being needed for growth. It was pleasing that many candidates understood the concept of limiting factors and its relevance to this investigation. Very few candidates referred to the need to keep the light intensity constant at all temperatures. Almost no answers were seen which referred to threshold value.

(iii) Suggest why it was important that this investigation was carried out at a high light intensity.

(3)

The high light intensity means that the alga can photosynthesise rapidly, and this means that the limiting factors of growth were restricted to temperature as the organic materials needed for growth can all be provided for by photosynthesis.

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Examiner Comments

This is a clear, concise answer that links photosynthetic products to growth and shows understanding of limiting factors.

Question 3(b)(iv)

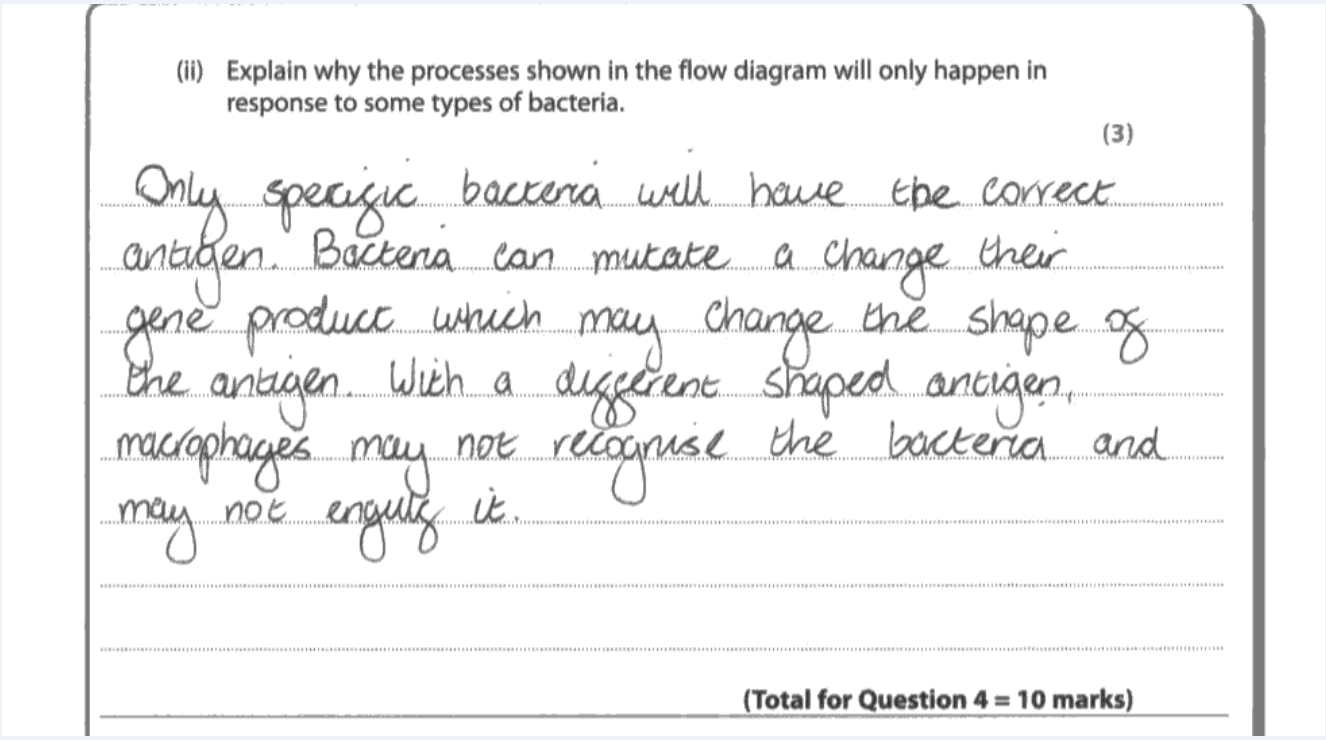
It was disappointing that many candidates did not relate their choice of abiotic factors to ones that would be relevant to this investigation. Although candidates are not expected to be familiar with filamentous algae, the question does state that the organism is being grown in a culture solution. Unqualified references to the concentration of the solutions were also common.

Question 4(b)(i)

This question was generally answered well and most candidates seemed to be familiar with the process. Antigens and antibodies were, as expected, confused on many occasions for D and F. Many candidates gave lysosome, the structure, rather than lysozyme, the enzyme, for H.

Question 4(b)(ii)

This question referred to all of the processes shown in the flow diagram and not just the resultant phagocytosis. Relatively few candidates gave responses which considered the specific nature of the antigens and available antibodies. There were many responses that included details of T-cell action which is inappropriate here. Some candidates gave details of the protective nature of the slime capsule or the ability of some bacteria to invade cells.



(ii) Explain why the processes shown in the flow diagram will only happen in response to some types of bacteria.

(3)

Only specific bacteria will have the correct antigen. Bacteria can mutate a change their gene product which may change the shape of the antigen. With a different shaped antigen, macrophages may not recognise the bacteria and may not engulf it.

(Total for Question 4 = 10 marks)

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Examiner Comments

The first two lines are a clear reference to the specific nature of an antigen to a bacterium. The statement about the change in gene product leading to a change in antigen which is not recognised by the macrophages is confused.

Question 5(a)

This question was answered reasonably well with most candidates gaining some credit. The most common error was to put a tick for RNA only in the second row.

Question 5(b)(i)

There was a very varied response to this question. There were some very clear, straightforward descriptions of transcription. However, many candidates did not express the points clearly or gave confused answers which included details of translation. References to the separation of the DNA strands were often vague. The terms 'nucleotide' and 'base' were frequently used to describe the same structure.

Using this information, explain how each of the following processes leads to the synthesis of this sequence of amino acids.

(i) The formation of mRNA during transcription in the nucleus

(3)

The double stranded DNA begins to unravel. The sense strand is attached to RNA polymerase which begins to read to strand. The RNA polymerase uses free nucleotide bases and attaches them together forming a strand of mRNA.

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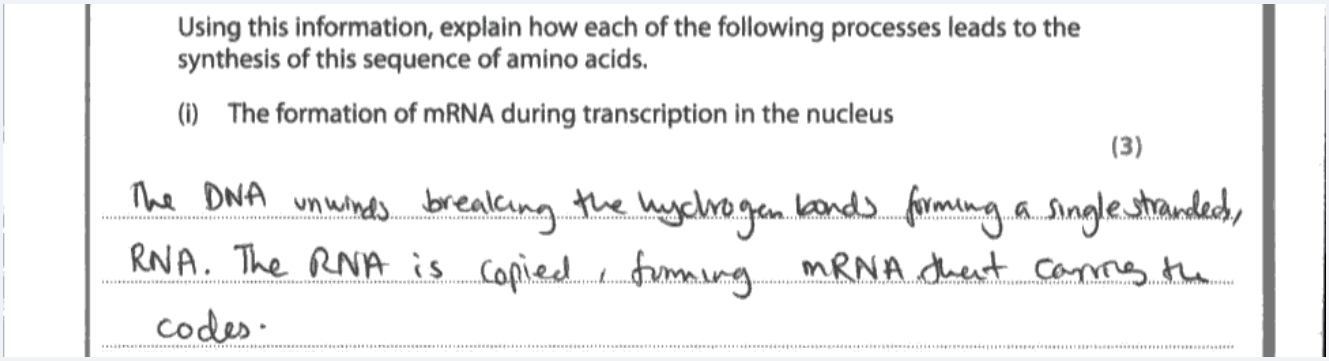
Examiner Comments

The candidate has used an ambiguous term 'unravel' which could mean separate or untwist. However, full credit can be given for the rest of the answer.

This is an example of being almost correct on several points but not really making it for a mark.



Using this information, explain how each of the following processes leads to the synthesis of this sequence of amino acids.

(i) The formation of mRNA during transcription in the nucleus

(3)

The DNA unwinds breaking the hydrogen bonds forming a single stranded, RNA. The RNA is copied, forming mRNA that carries the codes.

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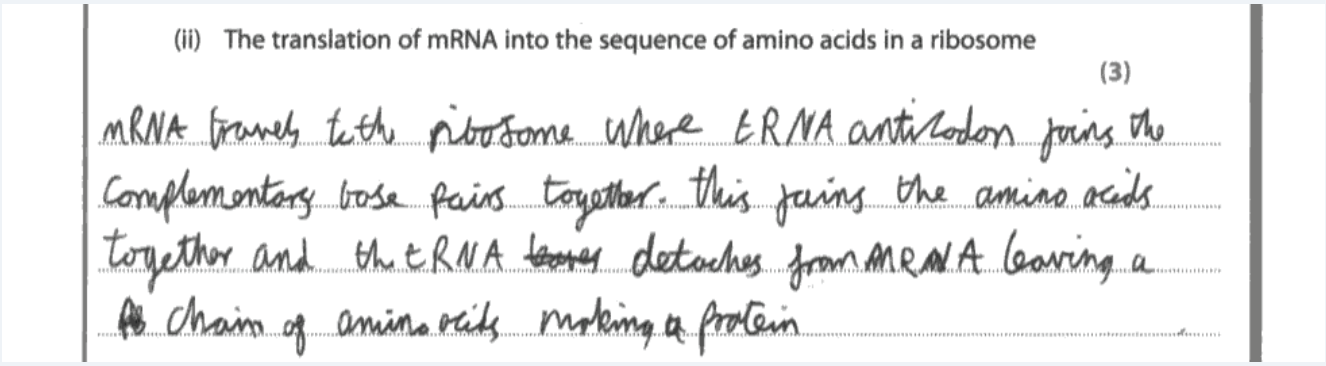
Examiner Comments

The first sentence confuses several processes. There is no clear idea of the strands separating. The answer also implies that RNA is formed as the hydrogen bonds break. The last sentence confuses RNA and mRNA.

Question 5(b)(ii)

The responses to this question generally lacked the required detail. There were also numerous examples of confused terminology and poor expression. Although a large number of candidates knew that the anticodon is complementary to the codon, there was a great deal of confusion as to where these structures are found. The anticodon was often attributed to the amino acid or the tRNA molecule was described as the anticodon. Many candidates stated that the amino acids were produced or formed rather than being bonded together. A common error was to name the bond as a phosphodiester bond.

This answer shows a general lack of detail.



(ii) The translation of mRNA into the sequence of amino acids in a ribosome

(3)

mRNA travels to the ribosome where tRNA anticodon joins the complementary base pairs together. this joins the amino acids together and the tRNA ~~leaves~~ detaches from mRNA leaving a chain of amino acids making a protein

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Examiner Comments

The reference to the tRNA anticodon and the base pairing does not explain how the mRNA is involved. There is no explanation of how the amino acids join together.

This answer shows more detail.

(ii) The translation of mRNA into the sequence of amino acids in a ribosome

(3)

mRNA travels to the ribosome where tRNA anticodon joins the complementary base pairs together. this joins the amino acids together and the tRNA ~~leaves~~ detaches from mRNA leaving a chain of amino acids making a protein

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Examiner Comments

The detail of the relationship between the anticodon and codon is clear. There is also a correct reference to the formation of peptide bonds.

Question 5(c)

This question proved to be more discriminating than was expected. A variety of terms was seen for the stop codon. At this level, it is expected that terms used in the specification are known. Many candidates repeated information about tRNA from the stem of the question without explaining its significance.

(c) Suggest why the final triplet of nucleotides, on the strand of mRNA involved in the synthesis of this sequence of amino acids, did not correspond with any anticodon on tRNA.

(2)

Because the last triplet of nucleotides is a stop codon which tells the ribosome the required sequence of amino acids to create the protein has been done. Therefore there is no require matching triplet the the tRNA is needing to get.

(Total for Question 5 = 10 marks)

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Examiner Comments

The explanation implies that the stop codon has the information for the sequence rather than the end of the sequence. The last sentence is really rewording part of the stem of the question.

Question 6(a)

Many candidates were able to gain some credit by giving a definition of a species. However, relatively few of these then related this to these actual examples being able to produce a hybrid that is able to produce viable seed. Some candidates gave lengthy descriptions about similar features without any reference to the possibility of interbreeding. The terms 'fertile' and 'viable' were used by many candidates to mean the same thing.

(a) Suggest why some scientists might prefer to classify *Rhododendron eriocarpum* and *Rhododendron indicum* as varieties within the same species rather than as two separate species.

(3)

They are classified as such because when they undergo cross-fertilisation they produce offspring which are fertile. This means they are still of the same species. They could n't be classified as seperate species because they reproduce to produce offspring which are fertile

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Examiner Comments

They have the correct idea of the definition of a species. However, the hybrids being fertile does not mean that the seed they produce would be viable.

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Examiner Tip

Pay careful attention to terms such as 'fertile' and 'viable' to make sure you understand exactly what they mean.

Question 6(b)(i)

The responses to this question were disappointing. It was expected that at this level, this would be a straightforward definition. The terms 'allele' and 'gene' were often used as if they can be interposed. Many candidates described it as a variety in allele frequency. Relatively few candidates completed the definition with a reference to the gene pool.

(b) (i) Explain what is meant by the term **genetic diversity** in a species.

(2)

Genetic diversity is a term used to describe variation within the gene pool of a species. That is the species have a variety of alleles for certain genes.

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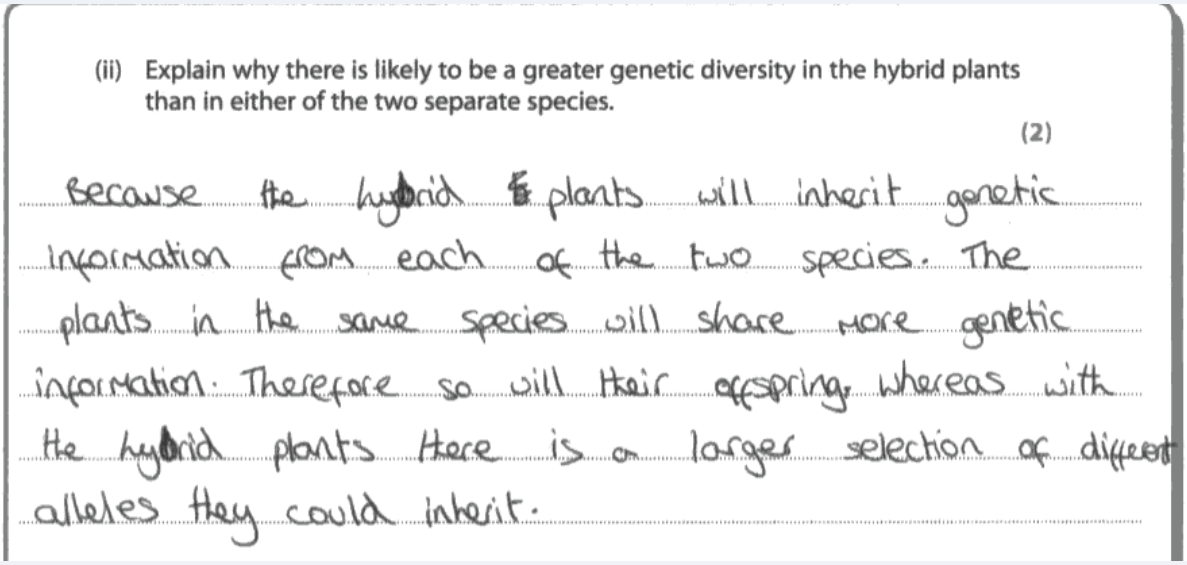
Examiner Comments

A good clear answer.

Question 6(b)(ii)

Most candidates realised that the hybrids would inherit from two types of parent but did not use terminology correctly or include sufficient detail. As in the previous question, the terms 'allele' and 'gene' were often confused. Many answers were too vague and did not explain why the two separate gene pools of the parents would have different alleles so that there was a greater variety available to the hybrids.



(ii) Explain why there is likely to be a greater genetic diversity in the hybrid plants than in either of the two separate species.

(2)

Because the hybrid & plants will inherit genetic information from each of the two species. The plants in the same species will share more genetic information. Therefore so will their offspring, whereas with the hybrid plants there is a larger selection of different alleles they could inherit.

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Examiner Comments

The reference to 'genetic information' is not sufficient to give the idea of different alleles from both parents. The last sentence justifies awarding a mark.

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Examiner Tip

When referring to genetic information, be specific and use 'allele' and 'gene' appropriately.

Question 6(c)

There were some very good answers seen to this question. However, although many of the required terms or concepts were included in most answers, they were often muddled and too generalised. Many answers assumed that there had been some geographical barrier that had separated the two populations. It was hoped that the information in the table would give some clue towards the idea of spreading into different habitats as the population expanded. The concept of reproductive isolation was often given as a consequence of speciation rather than an initial causative factor. The ideas of different selection pressures leading to adaptation and its effects on survival and breeding were understood well.

This answer touches on several points but does not really show clear understanding in the context of the different regions with different environmental conditions.

*(c) Explain how the two different species of Rhododendron on Yakushima Island may have evolved from a single population of an ancestral species. Isolation

(6)

The Rhodendron would have undergone speciation due to different selection pressures in the local environment. In different areas, different adaptations would be needed to survive. The Rhododendron that had different alleles and therefore different characteristics would have lead them to adapt to the surroundings. They would go onto reproduce successfully and pass on their genes. The successful plants would have different characteristics than the original Rhododendron leading to two different species.

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Examiner Comments

There is no clear reference to the different selection pressures being in different regions. It then suggests that the different characteristics caused the adaptation. There is a fairly clear reference to survival and breeding.

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Examiner Tip

Try to relate an answer to the information given in the question rather than attempt a general account.

Question 7(a)

Although this question was in the context of an organism which is unfamiliar to many candidates, it was expected that the reference to woodlice as decomposers would enable candidates to give some account of their part in the carbon cycle. Many candidates referred to 'carbon' all the way through their answer without any indication as to the form that it would take. This was especially noticeable when carbon, rather than carbon dioxide, was given as the product of respiration. Overall, the responses to this question were disappointing.

(a) Suggest how woodlice are involved in the recycling of carbon.

(3)

Living organisms, such as the woodlice, respire and breath out carbon dioxide. Since the woodlice are decomposers they will respire aerobically. They will also convert organic compounds into carbon dioxide. The ~~dead~~ organism would have respired and when they die, they'll have locked up carbon. This is released back into the air by the decomposers.

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Examiner Comments

This is a fairly good answer with correct references to carbon dioxide as a product of respiration and the decomposition of the woodlice themselves. If the organic compounds had been linked to the plant material, further credit would have been possible.

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Examiner Tip

Be prepared for straightforward material being tested in a new context.

Question 7(b)(ii)

Most candidates were able to give acceptable responses. It is important to qualify a reference to light. Some candidates gave biotic factors.

Question 7(c)(i)

Most candidates were able to complete the table correctly. There were very few mathematical errors. Candidates should be reminded that data in tables should all be to the same number of significant figures.

Question 7(c)(ii)

Most candidates gave acceptable responses. Some described the reasons why it was difficult to count them without a photograph, others described the advantages of a photograph. A common error was to state that the count on a photograph is accurate rather than more accurate. A small number of candidates confused the terms validity and reliability.

(ii) Suggest why taking photographs is a suitable method to count the woodlice.

(2)

woodlice is well adapted. It has long legs and many of them, which allows it to run away. therefore it would be difficult conting them. Therefore a photo-graph will help to capture the abundance.

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Examiner Comments

A very straightforward answer which links the movement to the difficulty in counting.

Question 7(c)(iii)

Although most candidates realised that there would be a large number of variable factors in a garden, relatively few followed this up to make further points about the difficulty in conducting a valid scientific investigation.

(iii) Explain why it would be difficult to determine which abiotic factor is influencing the behaviour and distribution of the woodlice in a garden environment.

(3)

It would be hard to tell because the conditions themselves are hard to control for example you can't control your gardens temperature or Humidity. All you can try and do is pick days when everything is about the same with the exception of 1 variable.

(Total for Question 7 = 12 marks)

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Examiner Comments

A very straightforward answer which links the movement to the difficulty in counting.

This is a good answer that relates the nature of the factors in a garden to the difficulty of only having one variable test factor.

Question 8(a)

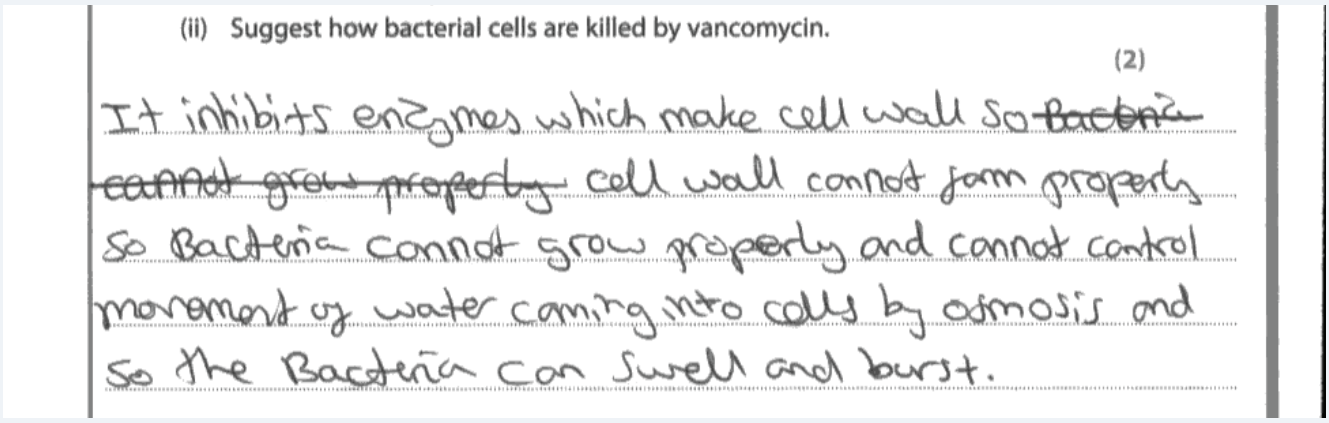
Most candidates could name the structures. For the type of cell, a large number of candidates did not realise that flagella can be in both eukaryotic or prokaryotic cells.

Question 8(b)(i)

Almost all candidates answered this correctly.

Question 8(b)(ii)

Many candidates stated that the wall would not form at all rather than it being weaker or not formed properly. However, most candidates gave the idea of this leading to lysis or bursting of the cell. A very small number of candidates made any reference to these effects being during division or mitosis.



(ii) Suggest how bacterial cells are killed by vancomycin.

(2)

It inhibits enzymes which make cell wall so ~~Bacteria cannot grow properly~~ cell wall cannot form properly so Bacteria cannot grow properly and cannot control movement of water coming into cells by osmosis and so the Bacteria can swell and burst.

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Examiner Comments

A clear and concise answer showing good knowledge.

Question 8(b)(iii)

Although most answers showed some indication of the development of resistance, there were some fairly common misunderstandings. As in previous similar questions, many candidates confused resistance with immunity. Other common misunderstandings are that the antibiotic becomes resistant or that the patient becomes resistant to the antibiotic. Many candidates gave general statements that antibiotics rather than the specific one would become ineffective. It was pleasing to see so many correct references to the idea of the antibiotic acting as a selective pressure and the consequence of this as the bacteria reproduce.

(iii) Explain why doctors have been advised to limit the prescription of antibiotics.

(2)

Some bacterias have begun to produce a mutation allowing it to become immune The more a drug is used the more likely the bacteria will become immune. Also meaning a new drug would need to be made

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Examiner Comments

The use of 'immune' is not acceptable. There is an implication that the bacteria are deliberately developing this immunity. The final sentence is not quite enough to give the idea of the antibiotic becoming ineffective.

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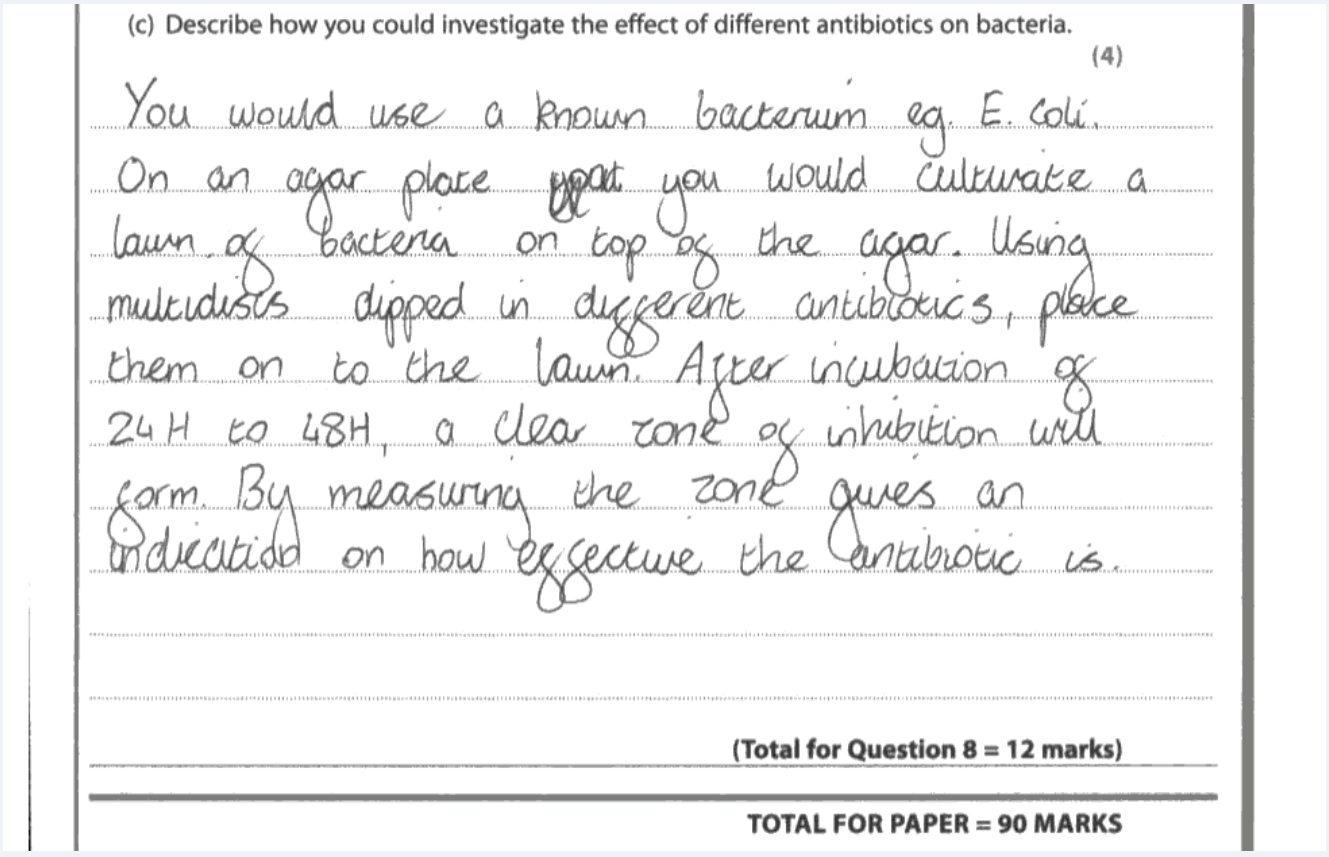
Examiner Tip

Be careful when using terminology. Immunity and bacterial resistance are not the same concept.

Question 8(c)

The answers given to this question indicated that experience of a core practical is essential to be able to describe the procedure well. The majority of the candidates were able to show that this procedure was understood well. Perhaps, due to this being the last question, many answers could have been improved by more attention to detail. Examples of this are the description of distributing the bacteria evenly, placing the antibiotics in separated positions, reference to a suitable incubation temperature and how the effect is assessed. Overall though, very few candidates were unable to give some suitable responses.



(c) Describe how you could investigate the effect of different antibiotics on bacteria.

(4)

You would use a known bacterium eg. E. coli. On an agar plate that you would culturate a lawn of bacteria on top of the agar. Using multidisks dipped in different antibiotics, place them on to the lawn. After incubation of 24H to 48H, a clear zone of inhibition will form. By measuring the zone gives an indication on how effective the antibiotic is.

(Total for Question 8 = 12 marks)

TOTAL FOR PAPER = 90 MARKS

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Examiner Comments

This is a clear, concise account of the procedure. The reference to multidisks can be accepted as suitable to space out the antibiotics. However, there is no reference to the need for sterile or aseptic technique or to a suitable temperature for incubation.

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Examiner Tip

Pay attention to detail when describing practical procedures. As a rule ask yourself 'Could someone else repeat my experiment with my instructions?'.

Overall the paper produced a wide range of responses. It was pleasing to see that most candidates were well-prepared and were able to show clear and accurate knowledge as expected by the specification. It was also pleasing to see that questions which tested assessment objectives, other than knowledge, were understood and answered well by most candidates.

Grade Boundaries

Grade	Max. Mark	A*	A	B	C	D	E	N
Raw boundary mark	90	63	58	53	49	45	41	37
Uniform boundary mark	120	108	96	84	72	60	48	36

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