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GCE Biology 6BI04 01

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Introduction

This is the third paper on this A2 unit. The two specification topics that are included cover a wide range of biological concepts and principles. As the unit demands synoptic assessment, in addition to the new material which is introduced, knowledge and understanding from the AS units will be needed to answer questions fully. There is also a greater emphasis on AO2 than at AS. The recall of knowledge, expected for AO1, will often be set in the context of novel information. This means that questions often include a lot of information that needs to be read carefully.

On this paper, most questions provided an opportunity for candidates to demonstrate their knowledge and apply it to information and data. Within each question, some sections concentrate on fairly straightforward recall. This means that most candidates are able to gain some credit. Other sections are more testing and the responses to these proved to be wide-ranging. Only candidates with a sound knowledge and understanding across all sections of the unit specification were able to give consistently full answers throughout the paper.

There were some very good answers to most of the questions. These tended to be where candidates had read the information carefully and followed through the theme of the question. This ensured that they covered the subject fully and were able to score credit in all parts of their answer. Candidates who were able to focus clearly on the demands of questions tended to write full but concise answers. This meant that they were able to read and respond to questions throughout the paper without leaving themselves short of time overall.

Where candidates did not read questions carefully, irrelevant material was often included in their answers. This meant that they did not always cover all aspects demanded by the question could not be awarded full credit. It also meant that they did not complete all sections of the questions, leaving blank spaces. In some cases, answers included references that contradicted the given information. It was also apparent that some candidates attempted to use pre-learnt mark schemes from previous questions. This means that their answers are not always relevant to the context of the question being asked.

As the unit continues, there will be more past paper material available. This means that candidates will have more opportunity to familiarise themselves with the style and expectation of this A2 assessment.

Question 1(b)(i)

On this question most candidates were able to gain some credit for correct references to the process of carbon fixation. Relatively few candidates followed this up with acceptable comments about how changes in the rate of this process would affect the rate of production of subsequent products. Many candidates stated that an increase in rate of carbon fixation would mean that more glucose or starch would be produced. This is not necessarily true as the overall yield may be the same whether or not the rate of production is changed.

- (i) Suggest why the development of corn cobs, suitable for producing cereal products, depends on the rate of carbon fixation in maize plants.

(3)

~~The rate~~ The greater the rate of carbon fixation, the more starch that will be packed/stored into the Grains. The corn will be a ~~bad~~ poor source of starch if the rate of carbon fixation is very low because no starch will be stored in the grains and the corn cob will be discarded.

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Examiner Comments

This candidate has referred to the overall production of starch rather than the rate at which it is produced. There is no indication in this answer that the candidate has distinguished carbon fixation from the rest of the light independent reactions.

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Examiner Tip

Be careful about describing rates. Use words like 'faster' 'quicker' rather than vague terminology such as 'more'. When asked about a particular term or process, such as carbon fixation, indicate that you understand precisely what the term means or the process is.

Question 1(b)(ii)

Although some good answers were seen, most answers to this question lacked the detail expected at this level. The question asks for a suggested explanation. Many answers referred vaguely to increases in reaction rates as temperature increases or to enzymes being at their optimum temperature. Even where candidates referred to energy, many referred to the enzyme having more energy without reference to 'kinetic' or 'molecules'. Most candidates who attempted explanations referred to the increase in collisions or formation of enzyme-substrate complexes.

The rate of carbon fixation is higher at 25°C than at 14°C for each of the six varieties of maize. Suggest an explanation for this.

(2)

The rate of carbon fixation is higher at 25°C because the reactant molecules have greater kinetic energy and collide more often. This increases the rate of reaction and ultimately the rate of carbon fixation.



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Examiner Comments

A concise answer which can be awarded full credit.



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Examiner Tip

When asked to explain something, think about 'why' or 'how' in your answer.

Question 1(b)(iii)

Most candidates chose A as the most suitable variety for Central Europe and gained further credit by giving acceptable reasons related to the data given in the graph and the table. Full credit was gained by some candidates who explained why other varieties, such as F, would not be suitable in Central Europe. Candidates who did not choose A, could still gain some credit for some further points. The most common alternative choice was D. Some candidates put one variety in the space in the table and then described a different variety in their answer comments.

- (iii) The table below shows the range of temperatures for the main crop-growing season for maize, in four regions of the World. The main maize variety grown in three of the regions is also shown.

Region	Temperature range / °C		Main maize variety
	Minimum	Maximum	
Central Africa	24.8	27.3	F
Central USA	20.2	28.3	F
Northern Africa	24.7	27.9	F
Central Europe	11.2	19.3	D A

Using the data shown in the graph, complete the table by selecting the most suitable maize variety for Central Europe. Explain the reasons for your choice.

(5)

'A' has the largest carbon fixation value of $14 \mu\text{mol m}^{-2} \text{s}^{-1}$ at 14°C . This is suitable for Europe as the minimum temperature is 11.2°C and maximum is 19.3°C . This falls in between the temperatures so it will be ideal for Europe to grow maize A as it can be grown all year around to supply the demand of it.

**ResultsPlus****Examiner Comments**

Mp1 is awarded. Since the graph data given is given as a rate, the reference to 'largest carbon fixation value' can be accepted for mp4. Mp2 is awarded for the reference to 14°C being within the range for Central Europe. The reference in the last sentence to 'grown all year around' is not quite enough for mp5 as the stem of the question refers to this temperature range being for the 'main growing season'.

**ResultsPlus****Examiner Tip**

Be careful about making statements that do not take account of information in the stem of the question e.g. all year around. If you are asked to select from several options, include reasons for not selecting the alternative options.

Question 2(b)(i)

This was answered well by the majority of candidates who took account of the fact that severe cases of BRD involve virus infection. Some candidates confused 'antibodies' with 'antibiotics'. Some candidates tried to give explanations that involved the possibility of antibiotic resistance developing.

Question 2(b)(ii)

The majority of candidates recognised that enrofloxacin and florfenicol were the two antibiotics that should be considered. However, many candidates restricted their choice to one of these even though the question asks for antibiotics. However, in these cases, candidates usually gained some credit for further points. Relatively few candidates used the data to support their choice.

A group of cattle has BRD but the bacteria pathogen has not been identified.
Suggest which antibiotics would be the most suitable to use to treat these cattle.
Give reasons for your answer.

(3)

Enrofloxacin and florfenicol would be the most suitable to use to treat the cattle because both are over 80% effective against each ~~species~~ ^{species} of ~~the~~ pathogen therefore it is likely that ~~if~~ combined, the two antibiotics will be effective against whichever bacteria is infecting the cattle.

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Examiners' Comments

The candidate has identified the two most effective antibiotics. They have used the data, by stating 'over 80%' to emphasise the overall effectiveness rather than just quote the figures. Full credit can be awarded.

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Examiner Tip

Think carefully when referring to numerical data. Marks are not usually given if data is not used or manipulated.

Question 2(b)(iii)

This question proved to be more discriminating than expected. Many candidates realised that another antibiotic may be more effective against a particular pathogen. References to resistance of some bacteria leading to their survival and the development of resistant strains were often vague or incorrect. Many candidates use the term 'immune' rather than 'resistant'. Some candidates referred to the cattle becoming resistant to the antibiotic.

(iii) Suggest why it might be advisable to change the antibiotic being used, in the treatment of these cattle, once the pathogen has been identified.

(3)

AS the bacteria could mutate becoming immune to a specific antibiotic. If the pathogen is identified you could then use an antibiotic which is better suited to deal with a set pathogen i.e. Enrofloxacin is 40% more effective than oxytetracycline when dealing with *Histophilus somni*.



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Examiner Comments

The candidate has referred to 'immune', which would penalise mp3. However, mp1 can still be given for the idea that a more effective antibiotic can be selected. The use of enrofloxacin as a more suitable antibiotic can be ignored as the choice of a named antibiotic is not being assessed in this part of question 2.



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Examiner Tip

Be careful when using terminology. Immunity is not acceptable when referring to resistance in bacteria.

Question 3(a)

The information in the table was intended to guide candidates towards comments about the polymer structure of cellulose in relation to its constituent monomers and bonds. Most candidates were able to gain some credit by good descriptions of these. However, there were some noticeable confusions e.g. cellulose and starch, location of hydrogen and glycosidic bonding. Some candidates gave general descriptions of the functions of cell walls.

(a) Describe the chemical nature of cellulose.

(3)

Cellulose is a polysaccharide made of glucose that is joined together by glycosidic bonds. The cellulose is arranged in chains that then bond together via Hydrogen bonds which are very strong so ~~etto~~ cellulose is very rigid and tough.



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Examiner Comments

A clear, concise answer that can be given full credit. Mp1 is awarded. Mp3 cannot be awarded as there is no specific reference to β -glucose. As this candidate has not given a reference to an incorrect linkage e.g. 1-6, mp4 can be awarded. Mp5 is awarded.



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Examiner Tip

Use information in the question to guide you towards the type of answer required. Remember that AS knowledge can be expected in the context of A2 questions.

Question 3(b)

Most candidates gave acceptable responses. The most common error was to give a vague reference to stems or roots rather than to a 'tissue' as expected by the question.

Question 3(c)

Most candidates gained some credit on this question. However, many candidates described the decomposition by micro-organisms releasing carbon dioxide by respiration but did not refer to the recycling by photosynthesis. It was also noticeable that many candidates did not specify that it was carbon dioxide that is released. The noticeable number of candidates who either left this section blank or gave completely incorrect information, such as 'carbon dioxide would be used for respiration in plants', was disappointing on what should have been a straightforward recall of specification requirement.

(c) All of the components shown in the table are organic carbon compounds.
Describe the role of microorganisms in the recycling of the carbon from these compounds.

(3)

~~Organisms~~ Micro-organisms feeds on the plants, transferring the carbon. They then decompose after they die, releasing the carbon into the Earth's atmosphere which is later re-absorbed by photosynthesis into the



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Examiner Comments

The candidate has not given a reference to decomposition as an action of the micro-organisms. Mp1 cannot be awarded. There is no reference to respiration. Mp2 cannot be awarded. Carbon dioxide is not given as the raw material for photosynthesis. Mp3 cannot be awarded.

An example of how near an answer can be to several mark points without being able to be awarded any.

Compare this with the previous example.

(c) All of the components shown in the table are organic carbon compounds.
Describe the role of microorganisms in the recycling of the carbon from these compounds.

(3)

Microorganisms decompose dead plants and so therefore digest the carbon. They ~~are~~ then respire, and re-release the carbon in the form of CO_2 as a waste product. As this ~~carbon is~~ CO_2 is replacing the CO_2 ~~take~~ taken



Mp1, mp2 and mp3 can be awarded. The last statement indicates that the candidate has read and understood the question.

Question 3(d)(i)

Where candidates made a specific response, they usually gave an acceptable reason. References such as 'better for the economy', 'to sell them' and 'stop carbon pollution' were considered to be too vague.

Question 3(d)(ii)

A wide range of marks was given for this question. Candidates who followed the theme of the question right through tended to score the higher marks. This involved explaining why more carbon dioxide would be released by the clearance, following it up with details about how this would enhance the greenhouse effect and contrasting it with the assumed carbon neutrality of biofuels. Although most candidates attempted to make relevant points, these were often very vague or contained some common confusions. These included references to carbon rather than carbon dioxide, UV rather than IR and vague references to the Earth warming up.

A good answer that qualifies for maximum credit even though some mark points are not quite satisfied.

(5)

Peatlands act as a Carbon sink. These means that they take carbon dioxide out of the atmosphere and store it. Whilst draining and clearing of peatlands is carbon neutral, so they release as much CO_2 ~~and~~ as they took in while they were living, by removing carbon sinks this will have an impact on the atmospheric concentration of Carbon. Once these sinks have been cleared and destroyed they will loose their ability to take CO_2 out of the atmosphere and store it. This will mean that the amount of CO_2 in the atmosphere will now have increased (as theres no carbon sink to store it in). If more and more peatlands are destroyed it means less of the CO_2 will be stored away from the atmosphere. CO_2 is a greenhouse gas, so ~~it~~ contributes to the greenhouse effect. This means as theres more CO_2 in the atmosphere more of the heat energy from the Sun will be trapped, meaning less will escape out to space thus causing the temperatures on earth to rise, this will contribute to the global warming effect.

(Total for Question 3 = 13 marks)


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Examiner Comments

Mp2 awarded in lines 3 and 4. Mp8 and mp9 awarded in lines 6 to 10. mp3 awarded in line 11. Mp4 cannot be awarded in lines 13 and 14 as the 'heat energy from the Sun' is ambiguous. Mp5 can be awarded in line 14. The last sentence is too vague for mp6.


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Examiner Tip

In a longer answer, follow a theme indicated by the question and make sure that the whole idea is covered.

Question 4(a)(i)

Most candidates did not give a characteristic symptom, such as bloody sputum or tubercles. Vague references, such as weight loss, tiredness, high temperature or breathing difficulties, were not considered to be sufficiently characteristic of TB. However, fever or extreme weight loss were accepted.

Question 4(a)(iii)

Most candidates scored reasonably well on this question. A straightforward account of phagocytosis usually gained full credit. A common error was the use of the term 'vesicle' rather than 'vacuole'. Although reference to the bacterium being recognised as 'non-self' was common, references to the labelling by B cells was not seen very often. A large number of candidates included irrelevant details about the digestion of the bacterium or the fact that it can remain inside the macrophage for some time.

(iii) Describe how the organisms that cause TB are taken up by macrophages.

(3)

The antigens on the TB bacterium are labeled by antibodies produced by B cells. These bind to CD4 receptors on macrophages identifying the bacterium as a pathogen which is then engulfed by the macrophage and enclosed in a vacuole.



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Examiner Comments

A clear answer that satisfies mp2, 4 and 5. The reference to 'identifying of the pathogen' is not quite enough for mp1.

(iii) Describe how the organisms that cause TB are taken up by macrophages.

(3)

antibodies with complementary receptors attach onto the TB's antigens. Macrophages antigen receptor binds to the antibody / (TB itself) and engulfs it. Macrophage has created a vacuole and lysosome fuse with the vacuole. Digestive enzymes are released but the TB has a thick waxy outside which inhibits digestive enzymes from working.



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Examiner Comments

This satisfies mp4 and mp5. Mp2 cannot be given as there is no reference to B cells. The last three lines are irrelevant to this question.



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Examiner Tip

Concentrate on the details required by the question.

Question 4(a)(iv)

This question was answered well by most candidates.

Question 4(b)

Most candidates were able to gain some credit on this question. Many candidates compared the data in the two graphs without referring to the hypothesis. It was accepted that, where this occurred, points about the data were made in support of the hypothesis. Where a candidate also indicated clearly where the data seemed to contradict or did not support the hypothesis, further points could be credited. Very few candidates made the general points about the lack of data on other factors or statistical evidence. Some candidates penalised themselves by careless reading of the years shown in the graphs.

Discuss how far the data in the graphs support the following hypothesis.

The increase in HIV infection in central Africa has led to an increase in TB infection.

(4)

In 1990, HIV infected 50 people, and TB infected 1% of the population. Both increased gradually, ~~suggests~~ supporting the hypothesis. However, after 2000, the percentage of the population infected by TB began to decrease, and continued to decrease until 2008. However, after 2000, the number of ^{HIV} ~~increased~~ cases increased, until 2004. Therefore, this does not support the hypothesis. Between 1990 and 2008, the percentage of population infected by TB increased from 1% to 3.3%. In the same period, the number of HIV cases increased from 50 to 410, a much larger increase than TB, therefore not supporting the hypothesis.



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Examiner Comments

Mp2 and mp3 are satisfied by the statements in the first seven lines. The point made in the final statement could have been used towards mp4 if the candidate had referred to the difficulty of comparing two different parameters. As it stands, a comparison is not possible unless the HIV cases are converted to a percentage.

Question 5(a)(i)

Most candidates gave acceptable responses.

Question 5(b)(ii)

This question proved to be more discriminating than expected. Many candidates made vague references such as 'so that the distribution can be measured', 'so that the organisms can be counted'. Where candidates realised that it would enable an easier measurement to be taken, they did not always realise that it was also a more precise measurement. Precision was often confused with accuracy or reliability. Relatively few candidates gave a numerical value (4%) to each of the divisions.

Question 5(b)(iii)

Most candidates were able to complete the table with acceptable responses.

Question 5(b)(iv)

This question proved to be more discriminating than expected. Most candidates were able to state that water depth is not a measure of soil saturation. Where candidates realised that only one factor was being measured with no other factors controlled or taken into account, they scored well. Candidates who noticed the use of 'valid' in the question, usually commented about the lack of repeats. A noticeable number of candidates made no attempt at this question.

(iv) Suggest why the students were **not** able to draw valid conclusions about the effect of saturation of the soil by water on the distribution of the five plant species.

(3)

other factors not just saturation of the soil by water ~~would~~
 could be affecting the distribution of the 5 plant species
 such as climate ^{or CO₂} ~~availability~~ availability.
 repeat investigations would need to be done using
 control variables.



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Examiner Comments

Even though the candidate has not satisfied mp1, mp3, mp4 and mp5 can be awarded for maximum credit.

Question 6(b)

Although most candidates were able to gain some marks, very few gained full credit. Many descriptions of transcription showed some evidence of knowledge of the process but these often included incorrect terminology or insufficient detail. Most candidates made some reference to complementary base pairing. The significance of the original DNA sequence was usually too vague or omitted altogether. Very few candidates did not follow the lead of the question and did not make any reference to the bonding of the nucleotides. When mentioned, bonds were often given incorrectly as peptide or hydrogen bonds. References to involvement of RNA-polymerase were fairly common. Incorrect references to other enzymes were also seen in many answers.

(b) Describe how free nucleotides are bonded together in the correct sequence in pre-mRNA, at stage A.

(3)

Free nucleobides join to the template strand of DNA via the complementary base pairing rule. They form phosphodiester bonds with adjoining nucleobides. This is controlled by RNA polymerase, and this enzyme will move along the template strand creating pre-mRNA.



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Examiner Comments

A clear, concise description with mp2, mp4 and mp5 awarded.



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Examiner Tip

In a description, use terminology carefully and accurately.

(b) Describe how free nucleotides are bonded together in the correct sequence in pre-mRNA, at stage A.

(3)

- DNA double helix unwinds
- Free nucleotides with the correct complementary base pairing match up / bond to one half of the DNA



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Examiner Comments

Here the reference to complementary base pairing is not absolutely clear. There is some implication that it exists within the free nucleotide. However, mp2 is awarded as the reference to 'match up / bond to one half of the DNA' just about allows a judgement of benefit of doubt.

Question 6(c)(i)

Most candidates gained some credit for a reference to a start or stop codon. However, many candidates did not use any description of the process of translation for the second mark point.

They are start & stop codons. Telling the tRNA when to begin translation and when to stop translation.



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Examiner Comments

Mp1 awarded. Mp2 cannot be awarded as the question uses the term 'translation'.



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Examiner Tip

Try to explain terms that are given in the question rather than just repeating them.

There are one start and stop codons that indicate to the ribosome the beginning or an end to an amino acid sequence. (2)



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Examiner Comments

An answer which satisfies mp1 and mp2 clearly.

Question 6(c)(ii)

Relatively few candidates were able to gain any credit on this question. Most candidates realised that it was possible to form variations in the exons in mRNA. However, despite the information in the question, many candidates stated that the exons could be in a different sequence or order. Very few candidates attempted to give a full answer to the question with details of how the final structure of a protein depends on the initial amino acid sequence.

(ii) Suggest why a variety of different protein structures could be formed from the polypeptides synthesised using the mRNA molecules from a single gene. (3)

- The exons from the pre-mRNA can be rearranged in many different ways, including removing some of the exons.
- This means that a variety of different amino acid sequences will be coded for, making a variety of different polypeptide chains.
- These polypeptide chains will all have different primary structures, therefore different secondary and tertiary structures.
- This is how a variety of different protein structures can be formed from a single gene.

(Total for Question 6 = 11 marks)



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Examiner Comments

A concise answer that can have mp1 and mp2 awarded.

- The exons from the pre-mRNA can be rearranged in many different ways, including removing some of the exons.
- This means that a variety of different amino acid sequences will be coded for, making a variety of different polypeptide chains.
- These polypeptide chains will all have different primary structures, therefore different secondary and tertiary structures.
- This is how a variety of different protein structures can be formed from a single gene.

(Total for Question 6 = 11 marks)



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Examiner Comments

A clear answer that follows the question through completely to gain mp1, 2 and 3.



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Examiner Tip

Make sure that you complete the demands of a question completely.

Question 7(a)(i)

Very few candidates were able to give acceptable definitions of this term. Many answers showed confusion with allele frequency. Some candidates referred to 'in an organism' or 'in a species'.

Question 7(a)(ii)

This definition was better than that for part 7ai. However, many candidates repeated the term 'frequency' rather than explain it. As in part 7ai, many candidates use the term 'species' rather than 'population / gene pool'.

Question 7(b)(i)

Most candidates gave acceptable responses to this question. Some candidates stated that they were separate species and could not interbreed. The terms 'viable' and 'fertile' are used by many candidates as meaning the same thing.

Question 7(b)(ii)

This question produced the full range of marks. Many candidates tried to give general descriptions of speciation without relating their answer to these populations. Many candidates referred to the populations being separated by a river or mountain range. Answers often started with statements about allopatric speciation as if the separation into two species was already complete. However, it was still possible to gain full credit as long as terminology was used carefully in a logical sequence.

An example of how a concise answer can gain maximum credit.

The ancestral population became reproductively isolated (geographically).

They experienced a change in environment, leading to different selection pressures.

This resulted in mutations occurring happening. (changes in DNA coding for genes). Those with mutations were able to survive and reproduce, passing on the most advantageous mutation.

This led to an increase in the allele frequency within the population.



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Examiner Comments

Reproductive isolation can be accepted as equivalent to mp3. Mp2 can also be given in the first sentence. The second sentence qualifies for mp8. Mp7 and mp9 are awarded in the last five lines.

Question 7(b)(iii)

In this question, many candidates gave descriptions of the process that produces the DNA profile rather than concentrate on how it could be used. Relatively few candidates stated much more than it could be used to show the relationship or that there was a common ancestor. The significance of the number of matching bands being an indicator of the closeness of a relationship was not given in the majority of answers. DNA hybridisation was described by a noticeable number of candidates.

(iii) Explain how the results of DNA profiling of tissue samples from the two sub-species could be used to provide evidence that they share common ancestry.

(3)

~~Then~~ If they are related, bands of their DNA will match, and so the more they match, the more closely related they are. The species that recently diverged will have more similar bands of DNA than those who diverged a long time ago.



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Examiner Comments

Mp1 and mp4 are clear in the first 4 lines. There is not quite enough in the last 3 lines to satisfy mp5.

Question 8(a)

Most candidates gave acceptable answers to this question.

Question 8(b)

Many candidates did not give answers where any credit could be given. Candidates who realised that the antigens on the MRSA would stimulate the immune system to produce a variety of antibodies tended to pick up some credit. In these answers, B cells were usually given as the cells that will give rise to the clones of plasma cells. There was some confusion shown as to how the initial stimulation by antigens is received. However, most candidates gave some reference to the stimulation of B cell division by T helper cells. There were very few references to 'mitosis'. There were hardly any references to the clones of plasma cells being genetically identical.

An example of an answer gaining full credit.

(4)

MRSA will have antigens on its surface which will stimulate T cells the immune response. T cells will attach to APC cells from the non specific response which create T helper cells, which activate B cells, which then divide and differentiate into B memory and B effector cells. plasma cells then secrete many antibodies specific to the bacteria and its antigens.

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Examiner Comments

Mp2 can be awarded in the first sentence. Mp5 and mp3 can be awarded in line 5. There is just about sufficient detail to justify awarding mp4 in the final sentence.

Question 8(c)

Very few candidates gained any credit on this question. Where candidates used the lead given by the question and realised that a monoclonal antibody will only respond to one specific antigen, some credit was gained. However, few candidates indicated that the treatment could be more specific or is likely to be more effective once the pathogen is identified.

Monoclonal antibodies are able to target a particular antigen, the advantage of it being for just one antigen means that if the antigen evolves and becomes immune to the antibody then it means that only that antigen is immune ^{and not every} ~~leaving the other~~ antigen out _{becomes} immune to the antibody.



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Examiner Comments

Here there is enough to satisfy mp1. Mp2 cannot be given as there is no reference to the antibody and antigen binding to each other. The rest of the answer is confused.

In order to improve their performance, candidates should:

- - read the information and data in questions carefully,
- - adapt their answer to the context of any novel information,
- - avoid general answers that do not focus on the theme of the question,
- - ensure that their knowledge of both AS and A2 topics is sound,
- - time their responses carefully to make sure that they attempt every section of every question.

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