

# Advanced Subsidiary GCE Biology

## Unit F215 - Control, Genomes and Environment - Medium banded Candidate style answer

OCR has produced these candidate style answers to support teachers in interpreting the assessment criteria for the new GCE specifications and to bridge the gap between new specification release and availability of exemplar candidate work.

This content has been produced by senior OCR examiners, with the input of Chairs of Examiners, to illustrate how the sample assessment questions might be answered and provide some commentary on what factors contribute to an overall grading. The candidate style answers are not written in a way that is intended to replicate student work but to demonstrate what a “good” or “excellent” response might include, supported by examiner commentary and conclusions.

As these responses have not been through full moderation and do not replicate student work, they have not been graded and are instead, banded “medium” or “high” to give an indication of the level of each response.

Please note that this resource is provided for advice and guidance only and does not in any way constitute an indication of grade boundaries or endorsed answers.

<b>1(a)(i) A gene controlling coat colour in cats is sex linked. The two alleles of this gene are black and orange. When both are present the coat colour is called tortoiseshell. Define the following terms: [2]</b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>gene</i> <i>This is a length of DNA that codes for a particular protein.</i> <i>allele</i> <i>This is a type of a gene.</i>	The definition of gene is clear and accurate. That for allele, however, is ambiguous by the use of the word ‘type’. This could refer to a gene controlling fur colour or a gene controlling enzyme formation in a particular process rather than the alternative form of one particular gene. While this might be perfectly clear in the mind of the candidate, it was not expressed well.
<b>(ii) Explain why there are no male tortoiseshell cats. [2]</b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>Because the gene is sex-linked. Males will only have one allele and you need two (one black and one orange) to make tortoiseshell.</i>	This answer shows clear reasoning, using the information supplied.



The  $\chi^2$  statistic is calculated in the following way:

$$\chi^2 = \Sigma \frac{(\text{observed} - \text{expected})^2}{\text{expected}} \quad \Sigma = \text{"sum of ..."}$$

(ii) Calculate the value of  $\chi^2$  for the above data. Show your working. [2]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
$62 - 60 = 2 \quad 2^2 = 4 \quad 4 \div 60 = 0.067$ $131 - 130 = 1 \quad 1^2 = 1 \quad 1 \div 130 = 0.008$ $67 - 65 = 2 \quad 2^2 = 4 \quad 4 \div 65 = 0.062$ $0.067 + 0.008 + 0.062 = 0.137$ $\chi^2 \text{ value} = \dots\dots\dots 0.137 \dots\dots\dots$	Using the values provided in Table 1, the candidate has correctly calculated the value and has done so to a suitable number of decimal places. Even though the expected number for red was incorrect in (i), this number has been used correctly and so an error carried forward would be applied. It is obviously preferable if the candidate is working from the correct initial figures.

(iii) The critical value of  $\chi^2$  for this type of investigation with two degrees of freedom is 5.991. Explain whether your answer to (b) (ii) supports the hypothesis. [1]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>This supports the hypothesis.</i>	This answer is incomplete. Although it is a correct statement, the question asked for an explanation. Without an explanation, the answer is either 'supports' or 'does not support'; i.e. a 50/50 choice. This could be improved by explaining that the value that has been calculated for $\chi^2$ is below the critical value.

(d) Phenotype is influenced by genetic and environmental factors. Describe one example of how the environment influences phenotype. [2]

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>Fur colour in the snowshoe hare. In the winter, the fur grows white but in the summer it grows darker.</i>	A good basic answer. It could be improved by referring to the effect of day length on the enzymes and reactions producing pigments.

**(e) The bacterium *Escherichia coli* (*E. coli*) uses glucose as a respiratory substrate. In the absence of glucose, *E. coli* can use lactose. Explain how the use of a different substrate is determined by the interaction between genes and the environment. [5]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>There must be a gene that is responsible for the production of an enzyme that will convert lactose into a compound that can enter the respiratory pathway. When glucose is present, this gene is not expressed but when it is not present the enzyme is made. This is because a gene isn't just on its own. Each gene also has two lengths of DNA, known as the promoter and the operator, which determine where transcription begins and when it is to be transcribed. The unit of gene, promoter and operator is known as an operon. The operator only activates the gene when there is no glucose present.</i></p>	<p>This answer is factually correct but doesn't really address the question. An idea of how the gene relating to lactose is activated needs to be included, such as the presence of a repressor that will prevent the attachment of RNA polymerase under normal conditions, which is changed in the presence of lactose and the absence of glucose.</p>

**2(a) Cystic fibrosis (CF) in humans is caused by mutations of a gene coding for transmembrane protein (CFTR) which acts as an ion pump. A large number of different mutations of the gene have been found. Explain what is meant by a gene mutation. [2]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>It is a spontaneous change in the DNA.</i></p>	<p>A basic answer that could be improved by giving an example of such a change e.g. substitution.</p>

(b) CFTR regulates the transport of chloride ions (Cl<sup>-</sup>) across the plasma (cell surface) membrane. Tissues that express the normal CFTR allele secrete alkaline fluids, whereas the secretions of tissues expressing some mutant alleles are acidic. The transport of Cl<sup>-</sup> by epithelial cells expressing the normal CFTR allele was compared with that by epithelial cells expressing one of 10 different mutant CFTR alleles. The results are shown in Table 2.1.

In the table, normal digestive functioning of the pancreas associated with a particular allele is indicated with a tick (✓) and the absence of normal functioning by a cross (×).

Table 2.1

CFTR allele	percentage of Cl <sup>-</sup> transported in comparison with normal allele	normal digestive functioning in pancreas
normal	100	✓
mutation 1	6	×
mutation 2	4	×
mutation 3	0	×
mutation 4	3	×
mutation 5	1	×
mutation 6	33	✓
mutation 7	41	✓
mutation 8	46	✓
mutation 9	37	✓
mutation 10	44	✓

With reference to the information given in the table, explain why some mutant CFTR alleles allow normal digestive functioning of the pancreas and others do not. [3]

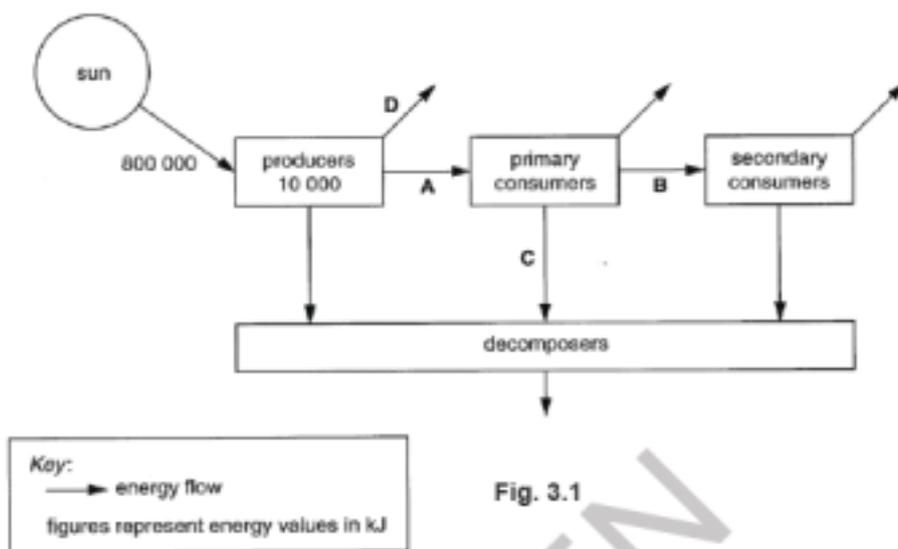
*Candidate style answer*

*It seems to depend on how much percentage of Cl<sup>-</sup> the allele will let through. The ones that let very little Cl<sup>-</sup> through will stop the pancreas functioning but if they let 33% or more through compared with the normal allele then the pancreas will work.*

*Examiner's commentary*

Although this answer is fundamentally correct, it has not answered the question. The question asked for an explanation rather than a simple analysis of the data. Details of the possible effect of the mutation on the structure of the transport protein and the impact of this change on its function would have addressed the question.

3 Fig 3.1 represents the transfer of energy through a woodland ecosystem.



- (a) Of the 800 000 kJ of energy which reaches the producers, only 10 000 kJ of energy is converted to growth in the producers.
- (i) Calculate the percentage of the energy reaching the producers that is converted to growth in the producers. Show your working. [2]

Candidate style answer	Examiner's commentary
Answer = ..... 1.25..... %	Correct answer but no working shown. In this case, as the answer is correct, this isn't a problem. But had the final answer been incorrect, no marks could have been available for any correct working shown.

- (ii) Explain what happens to the energy reaching the producers that is not converted to growth. [2]

Candidate style answer	Examiner's commentary
It is used to keep the producer alive. But some of it may reach the producer but not be used because it is reflected off the leaves or it is the wrong wavelength.	An adequate response but the candidate was obviously initially struggling to think of reasons to give. Having started to answer along the correct lines, further examples (such as passing through the leaf and missing the chloroplasts or hitting non-photosynthetic parts of the plant) would have improved the answer.

<b>(iii) Name <u>one</u> decomposer.</b>		<b>[1]</b>
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>Fungus</i>	The candidate should really have been thinking in terms of bacteria as candidates are only expected to be able to <i>name</i> bacteria.	

<b>(iv) State two ways in which energy is transferred from primary consumers to decomposers at C.</b>		
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>1 Death</i> <i>2 Faeces</i>	An adequate response that might have been improved by giving a process (egestion) rather than the product (faeces).	

<b>(b) Suggest why the percentage energy transfer between producers and primary consumers at A is less than that between the primary consumers and secondary consumers at B.</b>		<b>[3]</b>
<i>Candidate style answer</i>	<i>Examiner's commentary</i>	
<i>The primary consumer will find it difficult to digest a lot of the producer. They don't have enzymes to be able to digest cellulose and there are lots of bits of the plant that can't be reached. But animals are easier to digest than plants so more energy will be transferred from the primary to the secondary consumers.</i>	An example of an answer that has made the point about the difficulties of digestion of plant material. It could have been improved by reference to gut organisms.	

<p><b>4 One product manufactured using microorganisms is insulin. The process involves genetically engineering bacteria to synthesise human insulin.</b></p> <p><b>(a)(i) Describe how the isolated human insulin gene is inserted into a bacteria plasmid. [4]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>First of all the plasmid is cut using a restriction enzyme. Then the gene is put into the plasmid using the sticky ends. The joins are sealed using ligase.</i></p>	<p>An adequate response that lacks some detail. The idea of using the same enzyme to cut both the DNA and the plasmid should have been stated and further detail of the complementary sticky ends should have been given to improve the answer.</p>

<p><b>(ii) Suggest <u>two</u> ways in which the bacteria which take up the modified plasmids can be identified. [2]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>If you also put in a gene for antibiotic resistance then you could expose the bacteria to the antibiotic and the ones that survive will have taken up the plasmid.</i></p>	<p>An adequate response. Even though the candidate might have thought that enough information had been given for full marks, only one method has been given.</p>

<p><b>(b) Suggest <u>one</u> reason why it is considered preferable to use genetically engineered sources of human insulin rather than insulin obtained from pigs. [1]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Because it will be exactly the same compound and there will be no side effects.</i></p>	<p>Another basic response that could have been improved by giving a clearer indication that the candidate was answering the question in terms of the human insulin. The point would not be correct if referring to the pig insulin.</p>

<p><b>(c) Another product manufactured using microorganisms is single cell protein (SCP). Describe how a protein would be synthesised in the cell of a single-celled fungus. In your answer, you should make clear the sequence of the steps in the process.</b> [10]</p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Single cell protein is made in huge vats and the conditions need to be kept at the optimum so that the protein can be made by the fungus. It needs to be supplied with nutrients and the waste products need to be removed otherwise they will contaminate the product.</i></p> <p><i>The first stage in the production of protein by the cell is transcription. Here the DNA code is transferred to mRNA. This leaves the nucleus and moves to the ribosome where it attaches. In the cytoplasm are tRNA molecules that are attached to amino acids. On the bottom of the tRNA molecule is a triplet and this will match up with the bases on the mRNA. As the tRNA molecules line up, the amino acids join with a glycosidic bond. This carries on until there is a stop triplet.</i></p>	<p>This answer starts with a paragraph that is irrelevant to the question being asked. The candidate only starts to answer the question in the second paragraph. While it is essentially correct, the critical ideas of complementary base pairing, the attachment of two tRNA molecules at the ribosome at any one time, the concept of a triplet coding for a specific amino acid and the importance of the sequence of amino acids being determined by the sequence of DNA bases have been ignored or poorly expressed.</p>

5 Fig. 5.1 is a drawing of the brain that shows the origin of the cranial nerves.

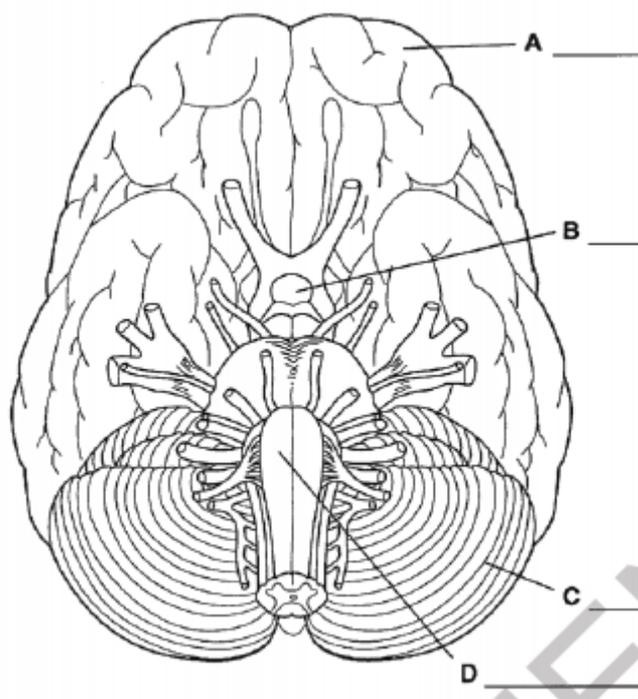


Fig. 5.1

(a) State the direction from which the brain has been drawn. [1]

Candidate style answer	Examiner's commentary
<i>The underside.</i>	This is not well expressed. Candidates should be encouraged to use ventral/dorsal or from below/from above in questions such as this.

(b)(i) Name the structures A, B, C and D shown on Fig. 5.1. [4]

Candidate style answer	Examiner's commentary
<p>A Cerebral hemisphere</p> <p>B Pons</p> <p>C Medulla oblongata</p> <p>D Cerebellum</p>	This answer shows inadequate knowledge of the structure of the brain as only one structure is named correctly.

(ii) State two roles of structure D. [2]

Candidate style answer	Examiner's commentary
<p>1 Coordination of movement like walking</p> <p>2 Control of heart rate</p>	This answer shows some confusion, that has extended from the incorrect labelling in (i). The candidate is only able to think of one function of the cerebellum so then resorts to another function of the hindbrain, which happens to be correct for structure D.

<p><b>(c) The hypothalamus constantly monitors and regulates the concentration of hormones in the blood. Outline how the hypothalamus regulates the concentration of hormones in the blood. [2]</b></p>	
<p><i>Candidate style answer</i></p>	<p><i>Examiner's commentary</i></p>
<p><i>It does this by negative feedback. It detects an increase in the concentration of hormone in the blood and then sends messages that will stop hormone production and so they fall until they reach a level where they need to be increased again so a message will be sent to start producing the hormone again.</i></p>	<p>An answer that only gives the basic outline of the mechanism. It could be improved by referring to trophic hormone release from the pituitary.</p>

6 An investigation was carried out into the effects of two plant growth substances, gibberellins and auxins, on apical dominance. The terminal (apical) buds of a number of pea plants were removed and discarded. The tops of each of the remaining shoots were given one of the following treatments:

- Coated with a paste containing gibberellin.
- Coated with a paste containing auxin (IAA).
- Coated with a paste without any plant growth substance.

In addition, a control group of plants did not have their terminal buds removed and were not coated with paste.

The growth of the side shoots was measured at regular time intervals and a mean value calculated. The results are shown in Fig. 6.1.

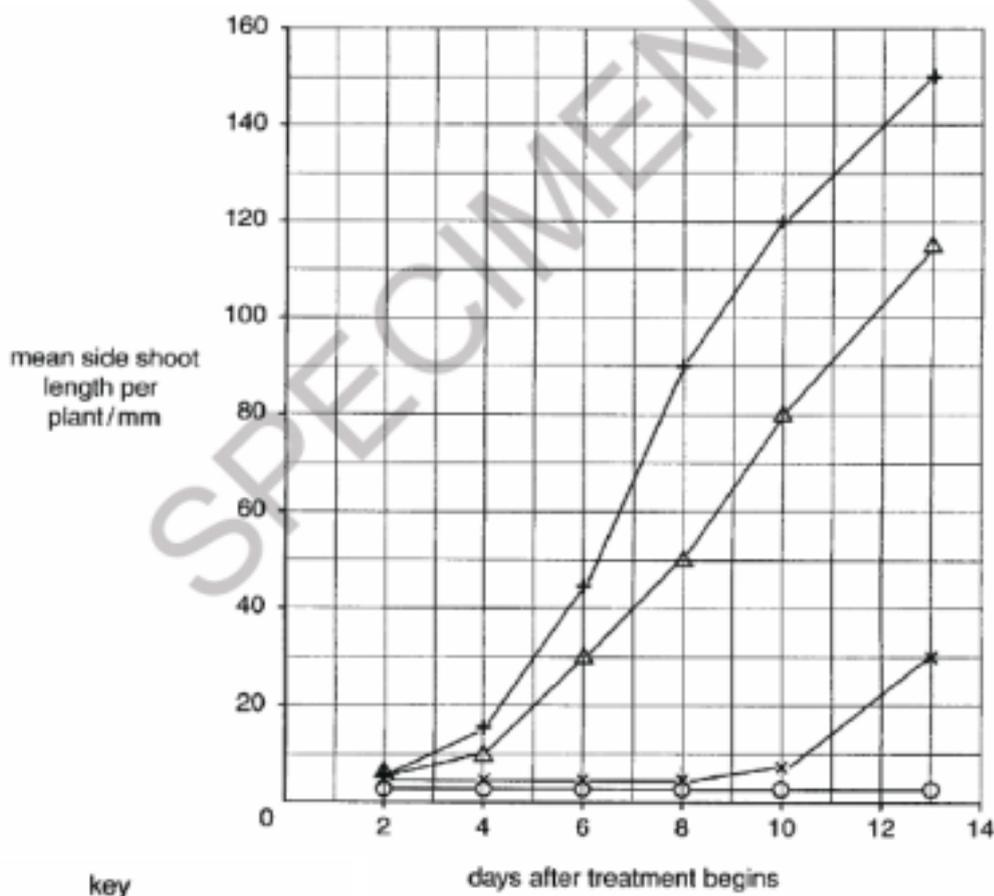


Fig. 6.1

(a) Explain why the side shoots grow when the terminal buds are removed. [3]

Candidate style answer

*This is because the apical dominance has been removed. When there is apical dominance, then the side shoots can't grow but when it has been taken away they can grow. This is because of auxin.*

Examiner's commentary

This answer is brief and repetitive. The term 'apical dominance' is known and the involvement of auxin is recognised. But there is no real explanation of the production of auxin by the terminal bud or the role of auxin in cell division and elongation.

<p><b>(b) Side shoots show greater growth when paste containing gibberellin is applied than when paste without any plant growth substance is applied. Calculate the percentage increase in growth due to gibberellin in 8 day old seedlings compared to seedlings with paste only. Show your working. [2]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p>90 – 7 = 83                      83 ÷ 7 × 100 = 1185.71429</p> <p>Answer = .....1186.....% [2]</p>	<p>This answer shows the importance of reading the questions carefully. The candidate has correctly calculated the percentage increase in growth due to giberellin (from day 2 to day 8). The question required a comparison between the growth due to giberellin and growth with paste alone on the 8<sup>th</sup> day.</p>

<p><b>(c) Using data from Fig. 6.1 describe <u>and</u> explain the effect of auxin (IAA) on the growth of side shoots. [3]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Auxin inhibits the growth of side shoots. Up until day 8 there was no increase in the growth of the side shoots as they stayed at 5mm. After day 8 they grew a bit and reached 30mm by day 13. Perhaps this is because all the auxin has been used up by then.</i></p>	<p>This answer shows basic understanding and description and analysis of the data. The data quotes are accurate and the explanation adequate.</p>

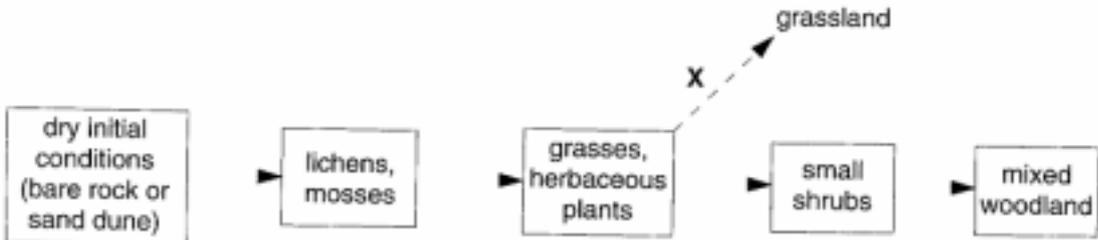
<p><b>7(a) Immobilised enzymes can be used in bioreactors that attach to space suits. The bioreactors recover water from the astronauts' urine. The bioreactors use immobilised urease enzyme which catalyses the hydrolysis of urea, forming carbon dioxide and ammonia. These products react to form ions, which are then removed by the bioreactor.</b></p> <p><b>(i) State the meaning of the term immobilised enzyme and describe how immobilisation can be achieved. [3]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>The term immobilised enzyme means an enzyme that has been trapped and cannot move. The enzyme can be trapped in beads.</i></p>	<p>This is a fairly basic response. The key idea of an insoluble material is missing and the means of immobilising lacks detail. The nature of the beads (alginate) could have been mentioned. As there is unlikely to be more than one mark for the term, further detail or examples of immobilising enzymes should have been given to achieve more marks.</p>

<b>(ii) Suggest <u>three</u> practical advantages of using an immobilised urease bioreactor in a spaceship.</b> [3]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p>1 The urine produced by the astronauts can be made harmless</p> <p>2 The enzymes can be reused more easily</p> <p>3 The treated urine will not be mixed with the enzyme and there will be no need to separate the enzyme from the product.</p>	This answer demonstrates some thought being applied to the particular situation.

<b>(b) An investigation was carried out to compare lipase in soluble and immobilised forms. Palm oil was hydrolysed to produce fatty acids and glycerol.</b>	
<ul style="list-style-type: none"> <li>• The two forms of lipase showed optimal activity at the same pH and temperature (pH 7.5 and 35°C).</li> <li>• At that pH and temperature, 100% of the oil was hydrolysed in two minutes.</li> <li>• If the temperature was increased to 45°C, the immobilised enzyme hydrolysed 100% of the oil but the soluble enzyme hydrolysed only 80% of the oil in two minutes.</li> </ul>	
<b>(i) Define the term <i>hydrolysis</i>.</b> [1]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>This is the breaking of a bond with the addition of water.</i>	A standard and accurate answer.

<b>(ii) Explain, <u>using the information in the passage</u>, the advantages of using an immobilised enzyme to hydrolyse palm oil.</b> [4]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>The enzyme can be reused. If the temperature is increased above the optimum, then the immobilised enzyme will hydrolyse more of the palm oil – 100% at 45°C with the immobilised as compared to 80% with the mobilised. This means that it can be used at a higher temperature and if you increase the temperature by more than that then the difference would be greater.</i></p>	<p>This answer has stated some of the advantages and has described the differences rather than explaining them. No mention has been made of the increased thermal stability of the immobilised enzyme because movements of the bonds is restricted. No reference has been made to pH, considering that the pH of the reaction mixture will decrease as the reaction proceeds because of the formation of fatty acids.</p>

<b>8(a) Explain the meaning of the term <i>primary succession</i>.</b> [2]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>This is the stages that happen as an area of ground changes over the years until it reaches the climax, like woodland.</i>	Sound basic information but not very well expressed. The sequence or series of clearly defined stages was not emphasised. The idea of starting with bare ground to be colonised by pioneer species was not mentioned.

<p><b>Fig. 8.1 shows a primary succession in a temperate climate. X represents an example of deflected succession.</b></p>  <p style="text-align: center;"><b>Fig. 8.1</b></p>	
<b>(b) Explain the role of pioneer plants in succession on a bare rock or sand dune.</b> [3]	

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>The pioneer plants are able to survive on very little. They grow, clinging on to the bare ground. When they die they decompose and form humus which starts to form soil and the roots of the plants will stabilise this organic matter and then other plants can take over and grow.</i>	This answer is a little superficial. While the importance of humus or soil formation and stabilising is noted, the release of nutrients into the soil is not mentioned.

<b>(c) Suggest <u>two</u> ways in which deflected succession at X could be caused.</b> [2]	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>1 The land is used for grazing e.g. sheep 2 Fire</i>	Two suitable suggestions were made.

<b>(d) Explain how biomass changes during a <u>primary</u> succession. [2]</b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>It starts off very low and gets bigger as you go through the succession. This is because the trees and shrubs are much bigger than the pioneer plants and grass.</i>	This answer has the key points required.

<b>(e) Using timber production in a temperate country as an example, explain how ecosystems can be managed in a sustainable way. [7]</b> <b><i>In your answer, you should make clear how the management is sustainable.</i></b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>The ecosystem can be managed by reducing the impact on the ecosystem of the planting and removal of timber. Many timber products are now made from sustainable sources and for every tree that is felled another one is planted to take its place. In temperate countries mostly softwood trees are grown, such as conifers. But you have to make sure that they're not planted too close together and plant other plants or allow other plants to grow in or around the plantations. This will provide a range of habitats for insects and birds. You also need to try and make sure that you only cut down the trees that are ready to be cut down and that they are planted so that they will be ready at different times.</i>	This answer shows an appreciation of some of the management policies that are in place in sustainable woodland. The meaning of the term 'sustainable' is not made clear and there is some indication that the candidate does not really appreciate what the term means, even though the answer has dealt with appropriate measures. Planting and felling strategies are not separated and the answer gives the impression of being disorganised, with points being added as they are thought of.

## Overall banding: Medium

The answers to these questions indicate good basic understanding of many of the principles being tested. There are some gaps in knowledge, some vagueness and some misconceptions. The importance of reading the questions carefully cannot be over-emphasised.