

# Advanced Subsidiary GCE Biology

## Unit F212 Molecules, Biodiversity, Food and Health - High 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 Some species of Acacia tree produce gum Arabic. Gum arabic is classed as a heteropolysaccharide. This means that it is made up of a number of different sugars.</b>	
<b>(a) Describe what happens during the hydrolysis of a polysaccharide molecule. [2]</b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>When a polysaccharide is hydrolysed, water is added to break the bonds between the monosaccharides..</i>	This is a response that indicates understanding of hydrolysis and addresses the question.

<b>(b) Complete the table below, comparing gum arabic with some other polysaccharides. [4]</b>				
<i>Candidate style answer</i>				
	gum arabic	amylose	cellulose	glycogen
branched structure	yes	no	no	yes
heteropoly saccharide	yes	no	no	no
found in animals / plants	plants	plants	plants	animal
function in organism	healing cuts	store of energy	cell wall	energy store
<i>Examiner's commentary</i>				
This is a well thought out answer that gives sufficient detail when required.				

<p><b>(c) <i>Acacia senegal</i> is a species of tree which is common in the drier parts of Africa. Cattle are allowed to graze on both its leaves and the fallen seed pods. The seed pods have relatively high protein content.</b></p> <p><b>(i) Describe how you would test an extract of the seed pods for protein. [2]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Add sodium hydroxide and then a few drops of copper (II) sulphate to the extract. If it changes from blue to purple then protein is present.</i></p>	<p>An answer that shows good understanding.</p>

<p><b>(ii) Describe how you could compare the <u>reducing sugar</u> content of the leaves with that of the seed pods.</b></p> <p><b>In your answer you should make clear how the steps in the process are sequenced. [8]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Take a sample of the leaves and grind them up. Add 3 cm<sup>3</sup> of water then filter. Add 5 cm<sup>3</sup> of Benedicts solution to the extract and boil in a water bath. If it contains reducing sugar, then it will go green, brown, orange and red. Then do exactly the same with the seed pods, making sure that you use the same volumes of water and Benedicts and that you boil the solution for exactly the same length of time. You can then compare the colours for the leaves and the seed pods and the one that changed colour more or more quickly is the one that has the most reducing sugar in it.</i></p>	<p>This is a comprehensive account that clearly establishes the need to treat each sample in exactly the same way and also to make a valid comparison between them.</p>

<p><b>(iii) The seeds of <i>Acacia</i> species are sometimes eaten by people.</b></p> <p><b>Suggest why it might be better for people living in areas where the tree grows to let their cattle feed on the trees and fallen seed pods and then obtain their nutrition from the cattle. [3]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Cattle can eat all different parts of the tree and can get more nutrients from the tree because they can digest cellulose better than humans because they have cellulase. As people only eat the seeds and cannot digest cellulose, they can get very little nutrition from the acacia tree. But by eating the acacia, the cattle will be able to produce more meat and milk and so can benefit the people who own them.</i></p>	<p>A good answer that states clearly the advantages with suitable reasons.</p>

**2 DNA and RNA are nucleic acids.**  
**(a)(i) Describe the structure of a DNA nucleotide.**  
**In your answer you should spell the names of the molecules correctly.**  
**You may use the space below to draw a diagram if it will help your description. [3]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>It's made up of deoxyribose (a pentose sugar), a phosphate group and a nitrogenous base (which may be adenine, cytosine, guanine or thymine).</i>	As the question has specified DNA, it was good that the sugar was described by name as deoxyribose rather than simply a pentose sugar. As the base was identified as nitrogenous, the inclusion of correctly named bases was unnecessary but was good practice.

**(ii) Describe how the two nucleotide chains in DNA are bonded together. [4]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>The bases in the chains are bonded to one another by hydrogen bonding in complementary base pairing. A pairs with T using 2 bonds and C with G using 3 hydrogen bonds. A purine always pairs with a pyrimidine.</i>	A sound and concise answer.

**(b) State three ways in which the structure of DNA differs from that of RNA. [3]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>1 The sugar in DNA is deoxyribose and in RNA it is ribose  2 DNA has thymine but in RNA it is replaced with uracil  3 DNA is made up of 2 strands but RNA is a single strand</i>	Once again, a sound answer that clearly states the difference between the two nucleic acids.

(c) An antibody is an example of a protein molecule, which has a specific 3-dimensional shape.

Fig. 2.1 shows the structure of an antibody molecule.

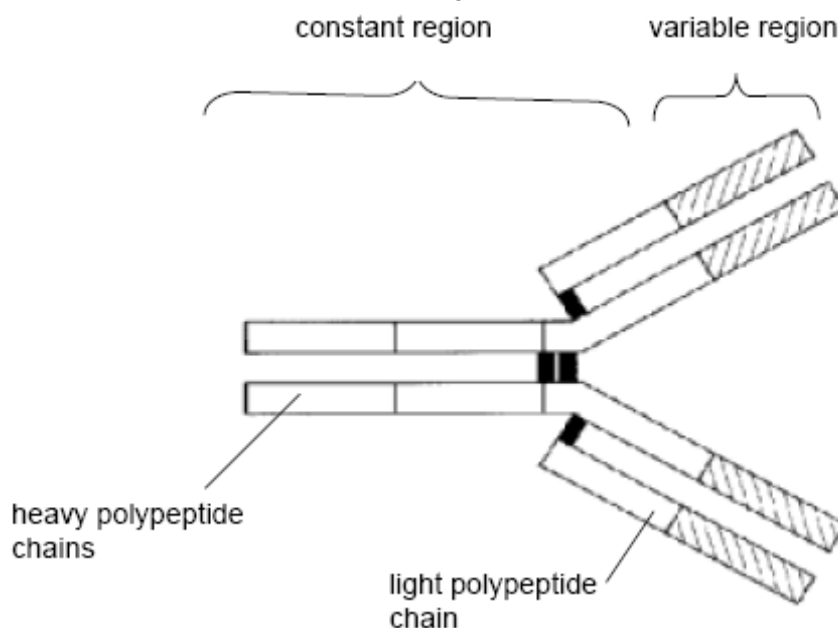


Fig. 2.1

(i) Outline how the structure of an antibody molecule is related to its function. [3]

Candidate style answer	Examiner's commentary
<p><i>The constant region is the part that attaches to the cell surface membrane and is the same in all antibodies. The variable region is the part that identifies the antibody as it is unique to each antibody and each antibody is specific to an antigen. It will have a complementary shape to the antigen so that they fit together exactly. The hinged part helps the two fit together.</i></p>	<p>A good and clear response, outlining functions of both the constant and variable regions.</p>

(ii) Suggest why the base sequence in the genes for human antibodies is more similar to that found in a chimp than to that found in a mouse. [2]

Candidate style answer	Examiner's commentary
<p><i>Because chimps are more closely related to us than mice are. We all had common ancestors in the past, but we split from mice longer ago than we split from chimps and that has given less time for our DNA to become too different from that of the chimps.</i></p>	<p>A sound answer that has established our closer relationship to chimps, commented on common ancestors and given some explanation for the similarities/differences in base sequence.</p>

- 3 The fungus, yeast, contains the enzyme catalase.  
Catalase speeds up the decomposition of hydrogen peroxide, a toxic metabolic product, to oxygen and water.



A student decided to investigate the activity of catalase using the apparatus shown in Fig. 3.1.

The total volume of gas collected was recorded every 20 seconds.

The results are shown in Fig. 3.2.

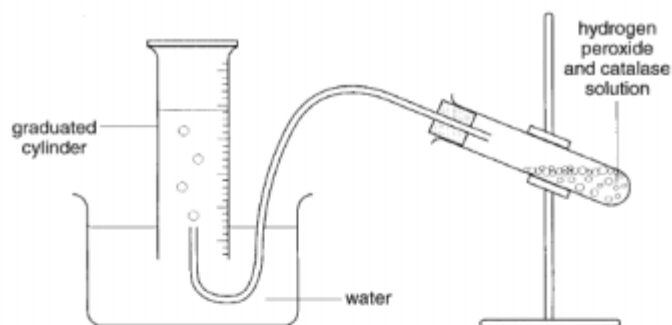


Fig. 3.1

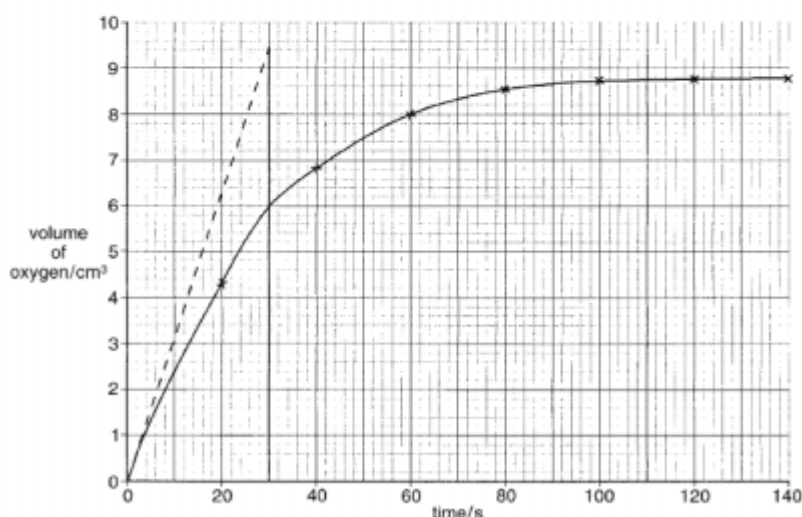


Fig. 3.2

The rate of decomposition can be calculated using the formula:

$$\text{rate of decomposition} = \frac{\text{volume of oxygen collected}}{\text{time taken for collection}}$$

- (a) Calculate the rate of decomposition over the first 30 seconds.  
Show your working and give your answer in  $\text{cm}^3 \text{min}^{-1}$ .

[2]

*Candidate style answer*

*Answer: = ..... 12.....cm<sup>3</sup> min<sup>-1</sup>*

*Examiner's commentary*

Correct answer but no evidence of working. Although a straightforward calculation, examiners would be looking for evidence of 6 divided by 0.5 to award a working mark if the answer was missing or incorrect. Candidates should always provide evidence of working in order to maximise marks.

<p><b>(b) The initial rate of decomposition is the rate measured within the first few seconds. Using the dashed line in Fig. 3.2, the initial rate of decomposition is calculated to be 19 cm<sup>3</sup> min<sup>-1</sup>.</b></p> <p><b>Explain why the initial rate of reaction is greater than the rate you calculated in (a). [3]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>At the start, none of the substrate has been used up and so it is at its highest level. This means that there is the greatest chance of enzyme-substrate complexes being formed and therefore a fast rate of reaction. All of the enzyme's active sites will be occupied and the reaction cannot go any faster because of this.</i></p>	<p>This is a difficult question on which to gain high marks. The candidate has broken down the information into small and discrete parcels and expressed them separately as distinct statements.</p>

<p><b>(c) Fungi such as <i>Fusarium venenatum</i> are grown in huge batch cultures to manufacture protein for food products. Explain why these cultures are often maintained at the optimum temperature for protein production and not at a temperature above the optimum. In your answer you should make clear how the structure and activity of enzymes relates to the effects described. [8]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>At the optimum temperature there is plenty of kinetic energy and the enzyme and substrate molecules can move and have a good chance of colliding and the substrate entering the active site. So the rate of reaction is good. At temperatures above the optimum, the molecules have more kinetic energy and move about more quickly and have a greater chance of colliding. But the bonds holding the enzyme's shape begin to vibrate more violently and will break. The enzyme will be denatured. Its 3D shape will change and so the substrate will not be able to fit into the active site. So even though you would think that the reaction should be quicker, it will be slow and might even stop.</i></p>	<p>This answer shows good understanding. The situation at the optimum temperature has been explained. Not only has the situation at a higher temperature been explained but it has been associated with the rate of reaction, thus linking it to the question.</p>

4 A group of students carried out some fieldwork to investigate the diversity of insects in three habitats:

- a field of barley
- a field of wheat
- the vegetation under a hedge.

Their results are shown in Table 4.1. Table 4.1 also shows how they used their data to calculate Simpson's Index of Diversity (D) for each habitat.

$$D = 1 - (\sum(n/N)^2)$$

where N = the total number of insects found, and n is the number of individuals of a particular species.

species	number of individuals of each species in each habitat		
	barley field	wheat field	under hedge
a	32	4	0
b	78	0	1
c	0	126	2
d	0	5	12
e	0	0	8
f	0	0	9
g	0	25	3
h	0	10	3
i	0	0	2
j	0	0	5
k	86	56	0
l	0	0	7
species richness	3	6	10
total number of insects (N)	196	226	52
Simpson's Index of Diversity (D)	0.62	0.61	0.86

Table 4.1

(a) State what is meant by the term *species richness*.

[1]

*Candidate style answer*

The number of different species in a sample or area.

*Examiner's commentary*

A sound answer, the phrasing possibly indicating a deductive guess rather than relying on recall of knowledge.

(b)(i) Calculate the value for Simpson's Index of Diversity (D) for the barley field.

Show your working and write your answer in the shaded box in Table 4.1.

[2]

*Candidate style answer*

$$\begin{aligned} \frac{32}{196} &= 0.1632653 & 0.1632653^2 &= 0.0266555 \\ \frac{78}{196} &= 0.3979592 & 0.3979592^2 &= 0.1583715 \\ \frac{86}{196} &= 0.4387755 & 0.4387755^2 &= 0.1925394 + \\ & & & 0.3775664 \\ 1 - 0.38 &= 0.62 \end{aligned}$$

*Examiner's commentary*

The correct answer has been given, together with clear and logical working.

<b>(ii) Using the data in Table 4.1, suggest why the value of Simpson's Index of Diversity (D) for the vegetation under the hedge is so much higher than that for the wheat field. [3]</b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>More different species are found under the hedge than in the wheat field so under the hedge has greater species richness than the wheat field. This could be because there are more different habitats and variety of food under the hedge because there will be more plant species growing there. A wheat field will contain mainly wheat, with only a small number of a few other species to provide food for the insects.</i>	This answer has grasped the essential concept and has sensibly applied it to this particular situation by suggesting possible reasons for the difference.

<b>(c) Describe how the students may have determined the numbers of individuals of each species in each habitat. [5]</b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>You can use a sweep net to catch the insects in the vegetation, but you have to do this randomly and use the same way of sweeping each time so that you will be sampling in exactly the same way to make a fair comparison. You have to use the same technique to sweep through the air and do it the same number of times in each habitat. Any insects that you catch need to be identified and counted and recorded for each habitat.</i>	This answer emphasises well both the techniques used and the importance of a standard or uniform procedure.



<b>(d) Studies of biodiversity are an integral part of an environmental impact assessment (EIA).</b>	
<b>(i) Discuss the role of an EIA as part of a local planning decision.</b>	<b>[3]</b>

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>In any planning development, you have to look at the impact on wildlife. There could be the danger of destroying environmentally sensitive habitats that are rich in biodiversity or where there are rare species. It could be that the area has animals or plants that are protected by law and so these need to be protected. If the assessment shows that there is a need for conservation or protection then it gives an opportunity to consider whether the development should be stopped or whether other measures could be taken to protect the species, such as providing other suitable habitats close to the site that they can be encouraged to use. In some cases, it isn't possible to move the plants or animals that are at risk but in other cases you can provide very similar habitats e.g. the mudflats on the shores of the Bristol Channel near Newport were extended and work done on them to make them more suitable for the wading and migrating birds that used to use the mudflats in Cardiff Bay that were lost when a big damn was built to keep the bay full of water all the time. This has been successful as more species of birds now visit the Newport mudflats and the numbers keep on increasing each year.</i></p>	<p>This answer is concise and deals well with the issues of protection and conservation. Consideration is given to the possible ways of dealing with potential problems and the example given clearly illustrated the point that was being made.</p>

<b>(ii) Suggest why some conservationists might object to these studies. [2]</b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>In order to carry out the study, you would need to go into the habitat, possibly destroying it and certainly disturbing the wildlife. This could cause even more disruption than the development would, depending on how close to it it is. And if people knew that there was, for e.g., a rare flower or bird in a particular place, then there could be problems with people disturbing or even stealing them (as some collectors will pay a lot for rare birds eggs).</i></p>	<p>A well thought out and presented answer that deals with a number of different aspects and gives relevant examples.</p>

**5** The leopard, *Panthera pardus*, is a large member of the cat family.

**(a)** Complete the following table to show the full classification of the leopard. **[5]**

<i>Candidate style answer</i>		<i>Examiner's commentary</i>
<b>Kingdom</b>	..... <i>Animalia</i> .....	This answer indicates that the candidate has knowledge of the hierarchy of classification groups and can relate this to a particular example.
..... <i>Phylum</i> .....	Chordata	
<b>Class</b>	Mammalia	
..... <i>Order</i> .....	Carnivora	
<b>Family</b>	Felidae	
<b>Genus</b>	..... <i>Panthera</i> .....	
..... <i>Species</i> .....	<i>pardus</i>	

**(b)** The leopard belongs to a kingdom in which all members are eukaryotic. Plants are also eukaryotic.  
Name two other kingdoms that contain eukaryotic organisms. **[2]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
1 <i>Protocista</i> 2 <i>Fungi</i>	A clear and correct answer.

<p><b>(c) Historically, all organisms were classified into just two kingdoms. In 1988 a five-kingdom system of classification was accepted. In 1990 a three domain system was proposed.</b></p> <p><b>Discuss, with reference to the <u>Prokaryotes</u>, the reasons why classification systems are not universally accepted and why they change over time. [4]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>The Prokaryotes are a large group of organisms that do not have their genetic material contained within a nucleus. But, apart from viruses, all the other large groups (kingdoms) do have a nucleus but they are separated because of other features. So it doesn't necessarily make sense to put all the organisms without a nucleus into one kingdom. Some scientists think that the Prokaryotes should be split into two separate kingdoms. One group of Prokaryotes called the Archaea are very different chemically from all the other Prokaryotes as their RNA and enzymes are different. We wouldn't know about this if it wasn't for the advances in science and each time we have advances in technology we can learn more about the organisms and can see whether they are being grouped in a sensible or logical way.</i></p>	<p>This answer has made some good points and has attempted to show organisation and logical argument rather than a rambling account that includes facts in a haphazard manner.</p>

<p><b>(d) <i>Staphylococcus aureus</i> is a species of bacterium that is found on the skin.</b></p> <p><b>(i) Describe how variation may arise within a species of bacterium such as <i>S. aureus</i>. [1]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Spontaneous mutation will alter the DNA.</i></p>	<p>A comprehensive answer that possibly goes beyond the requirements but ensures that more than enough information is given.</p>

<p><b>(ii) Suggest why such variation alters the characteristics of the individual organism. [2]</b></p>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<p><i>Because the DNA and genes control what the characteristics are. DNA codes for proteins and if the DNA sequence changes the protein that is made is changed or may not even be produced at all. Many proteins are enzymes so a change could affect the course or product of a reaction. So this could mean that a different coloured compound is produced and a change could be seen.</i></p>	<p>This answer recognises that a change in the DNA can result in a corresponding change in protein structure and function. This has also been linked to biochemical processes and phenotype.</p>

<b>(e) Discuss the difficulties that variations arising in <i>S. aureus</i> may cause to the medical profession. [4]</b>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>The two main ways that the medical profession fights disease are by using antibiotics and vaccines. If the bacterium changes, then the immune system will no longer recognise it, even if the person had had that disease before. Vaccinations rely on the body's immune system reacting to a form of the disease that won't harm the person but if the pathogen keeps on changing then the vaccine will be useless. Then if a change means that the bacteria is resistant to an antibiotic, like MRSA, then it gets difficult to treat the disease and new antibiotics have to be found that will deal with the pathogen.</i>	This answer shows that the candidate has appreciated a range of problems and not simply concentrated on MRSA. This indicates a high level response and the ability to think around the problem.

**6 The Human Immunodeficiency Virus (HIV) is spread by exchange of body fluids between an infected person and an uninfected person. This often occurs as a result of unprotected sexual intercourse.**

**Fig. 6.1 shows the percentage of people infected with HIV in different parts of the world at the end of 2002.**



Fig. 6.1

**(a)(i) The percentage of people infected with HIV is much higher in Sub-Saharan Africa than in much of Europe.**

**Suggest three reasons why the percentages are so much higher in Sub-Saharan Africa.**

**[3]**

*Candidate style answer*

*This is just about the poorest region in the world. Medical facilities are very poor and people do not have easy access to doctors and hospitals and this means that it is often very late when someone is diagnosed with HIV. Drugs to treat AIDS are very expensive and people cannot afford them. The lifestyle of some people means that they have lots of sexual partners and there is little use of condoms. All this helps with the spread of HIV/AIDS.*

*Examiner's commentary*

This answer deals with many of the reasons for the high incidence of HIV/AIDS in this region. A number of very good points are made.

**(ii) Explain why it is useful to collect information, such as that shown in Fig. 6.1.**

**[4]**

*Candidate style answer*

*If you know where there is a high incidence of the disease, then you will know where the efforts need to be made to treat the disease and where there might be serious outbreaks of the disease. It is also possible to target educational programmes in those areas and if you keep track of what is happening with the disease, it can help with research in how to tackle the disease with drugs and also how well preventative measures work. People who are likely to travel in those areas can be warned of the risks.*

*Examiner's commentary*

This answer shows the candidate's ability to deal with a slightly more unusual question. Information needs to be sifted so that only relevant points are made.

**(b) At present there is no cure for HIV / AIDS. Researchers have found that some people in Africa are not infected despite continual exposure to the disease. HIV uses a specific cell surface receptor known as the CD4 receptor to enter a human cell. Suggest how this information and knowledge of the Human Genome might be used to help reduce the spread of HIV. [2]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>There must be a reason why those people are immune. It is probably something to do with the CD4 receptor that is different in the immune people and stops HIV from entering the cell. If they can find out what the difference is, by looking at the difference in DNA sequence and perhaps identifying the gene responsible, they could develop a drug that could block the receptor of a person who is not immune and stop HIV from binding to it.</i>	The idea of identifying the gene is good but this answer centres on the different shapes of the receptors and therefore a way of blocking them. The candidate ensured that reference was made to the identification of the DNA sequence in order that all aspects of the question were covered.

**7 The black rhinoceros, *Diceros bicornis*, is an endangered species whose numbers have fallen to approximately 3000 in the past thirty years. For this reason, the species was placed on Appendix I of the Convention on International Trade in Endangered Species (CITES) agreement. Since the black rhinoceros has been placed on the appendix, numbers have stabilised, or even increased, in several countries. [2]**

**(a)(i) Explain the term endangered species. [2]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>They are at risk of becoming extinct because their population has fallen so low that the numbers are at a critical level for continued survival.</i>	This answer identifies the key points and expresses them well.

**(ii) Suggest two reasons why the black rhinoceros is endangered. [2]**

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
1 <i>Poaching</i> 2 <i>Their habitat is being destroyed</i>	Two suitable reasons given.

<i>Candidate style answer</i>	<i>Examiner's commentary</i>
1 <i>Permits to hunt are only issued to certain people.</i> 2 <i>Different countries cooperate to deal with poachers and illegal trade.</i>	A clear and comprehensive answer with two good points made.

<b>(c) Outline the potential benefits to agriculture of maintaining the biodiversity of wild animals and plants.</b> <span style="float: right;"><b>[4]</b></span>	
<i>Candidate style answer</i>	<i>Examiner's commentary</i>
<i>Plants and animals that are used for agriculture need to be suitable with features such as high yield, quick growth and development, low fat or all ripening at the same time. The way that these features end up in the farm animals and crops is by selective breeding. We could have an outbreak of disease in a crop but a wild relative could have resistance to it. So if the wild plant was bred with the crop plant, some of the offspring may have the good characteristics of both plants. These would then be selected and bred from again so that new stocks of plants can be built up.</i>	This is a good answer that emphasises the range of potential of wild animals and plants as well as outlining how this can be achieved.

## Overall banding: High

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The answers to these questions indicate a thorough understanding of the topics and a good appreciation of the requirements of the different types of questions.