Advanced Subsidiary GCE Biology

Unit F212 Molecules, Biodiversity, Food and Health - 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.

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.

(a) Describe what happens during the hydrolysis of a polysaccharide molecule. [2]

Candidate style answer	*Examiner's commentary*
When a polysaccharide is hydrolysed, it releases monosaccharides. Water is added in the reaction.	This is a response that indicates understanding of hydrolysis but mention of the use of water in the breaking of bonds would have improved the answer. The first sentence simply restates the information given in the question.

(b) Complete the table below, comparing gum arabic with some other polysaccharides. [4]

Candidate style answer

	gum arabic	amylose	cellulose	glycogen
branched structure	yes	*yes*	no	*no*
heteropoly saccharide	yes	*no*	no	*no*
found in animals / plants	plants	*plants*	plants	*animal*
function in organism	healing cuts	*energy*	*cell wall*	energy store

Examiner's commentary

The structures of starch, cellulose and glycogen are frequently confused by candidates, so it is not surprising that the row relating to structure is incorrect. As amylose is an energy *store*, candidates will not gain credit for simply stating 'energy'.

(c) ***Acacia senegal*** **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.**

(i) Describe how you would test an extract of the seed pods for protein. [2]

Candidate style answer	*Examiner's commentary*
Add biuret and heat. If it goes purple it is positive.	An answer that shows limited knowledge. The reagent is correct but does not require heat. The expected colour is correct.

(ii) Describe how you could compare the <u>reducing sugar</u> content of the leaves with that of the seed pods.

In your answer you should make clear how the steps in the process are sequenced. [8]

Candidate style answer	*Examiner's commentary*
First you need to get a sample of the leaves and the seed pods. Take the leaves and grind them up. Add a little water then filter and add Benedicts solution to the extract and boil. If it contains reducing sugar, then it will go green, brown, orange and red. Then do the same with the seed pods. If they contain reducing sugar then they will go the same colours as the leaves.	An adequate account but lacking in some detail. It is not made clear that *exactly* the same procedure should be followed for the leaves and for the seed pods. Reference should have been made to the same mass of material, same volume of water and addition of the same volume (or excess) of Benedict's reagent to the filtrate. Good practice is to use a water bath to boil the samples and this should be mentioned. In a question of this type, the idea of comparison should be emphasised and this could be achieved by referring to the possible difference in colour change between the samples.

(iii) The seeds of *Acacia* species are sometimes eaten by people.

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]

Candidate style answer	*Examiner's commentary*
People only use the seeds as food. But there is goodness in other parts of the tree, like the leaves and pods, that the people do not get to eat. They can let their cattle wander and eat the leaves etc. Cows are able to digest cellulose so they can get more goodness from the plant. It means that the people don't have to grow food for the cows to eat.	The answer recognises that cattle can derive more nutrition from plant material than humans can. Some improvement to expression by a slightly more logical order would improve the answer.

2 DNA and RNA are nucleic acids.

(a)(i) Describe the structure of a DNA <u>nucleotide</u>.
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]

Candidate style answer	*Examiner's commentary*
It's made up of a pentose sugar, a phosphate and a base. The bases in DNA are adenine, cytosine, guanine and thymine.	As the question has specified DNA, the sugar should really be described by name as deoxyribose rather than simply a pentose sugar. Although the base was not identified as nitrogenous, the inclusion of correctly named bases would be credited.

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

Candidate style answer	*Examiner's commentary*
This is done by complementary base pairing. The bases are bonded to one another by hydrogen bonding. A always pairs with T and C with G.	A sound answer but a little lightweight for high marks. Additional information, such as the number of bonds involved in each pair or correct reference to purines and pyrimidines would improve this answer.

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

Candidate style answer	*Examiner's commentary*
1 The sugar is different *2 RNA has uracil instead of thymine* *3 DNA is a double helix, RNA is a single strand*	Once again, a sound answer but the different sugars (i.e. ribose and deoxyribose) need to be stated rather than the broad statement that the sugars are different.

(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.

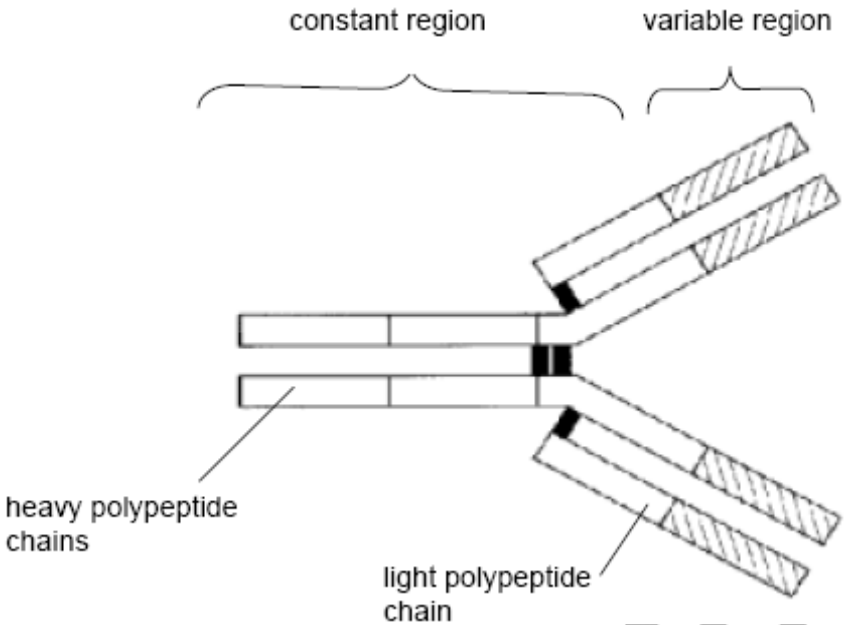

Fig. 2.1

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

Candidate style answer	*Examiner's commentary*
The constant region is the part that is the same in all antibodies. As each antibody is specific to a particular antigen, then the variable region will be different in each kind of antibody. It will exactly fit the antigen as it has a complementary shape. The centre of the 'Y' shape is hinged so that the antibody can exactly fit the antigen and this makes binding easier.	An adequate response. The first sentence seems to indicate that the candidate was trying to gain some thinking time, as it is an obvious statement that does not really address the question. The statements about antigen specificity and binding are a little disorganised but relevant. A clearer explanation would have improved this answer, as well as more detail on the role of the constant region.

(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*
Because we are more closely related to chimps than to mice.	A sound but basic answer. Further elaboration, such as referring to a more recent common ancestor, would be required for a higher mark.

3 **The fungus, yeast, contains the enzyme catalase.**

Catalase speeds up the decomposition of hydrogen peroxide, a toxic metabolic product, to oxygen and water.

$$2\ H_2O_2 \longrightarrow 2\ H_2O + O_2$$

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.

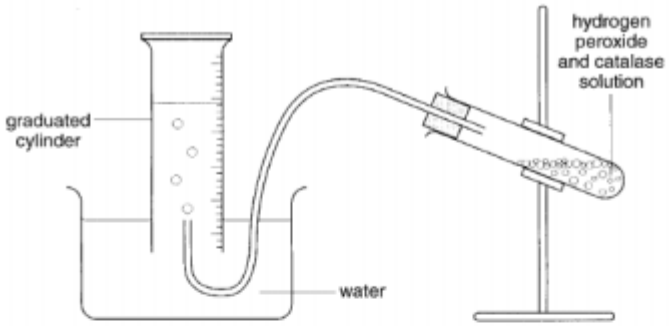

Fig. 3.1

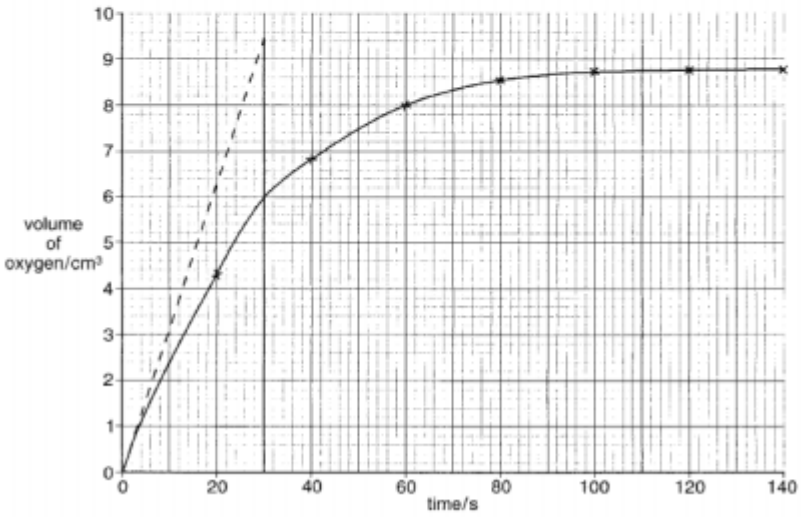

Fig. 3.2

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 $cm^3\ min^{-1}$. **[2]**

Candidate style answer	*Examiner's commentary*
6 in 30 sec so 12 in 1 min *Answer: = ...12.....cm3 min-1 [2]*	Correct answer following logical working. With such a calculation, however, examiners would be looking for evidence of 6 divided by 0.5 to award marks if the answer was missing or incorrect.

(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^3 min^{-1}.

Explain why the initial rate of reaction is greater than the rate you calculated in (a). [3]

Candidate style answer	*Examiner's commentary*
Because none of the substrate has been used up and so it can go as fast as possible. The reaction is limited by the enzyme as the substrate molecules will be queuing up for the enzyme's active site.	This is a difficult question on which to gain full marks. The candidate has to try and break down the information into small and discrete parcels and express them separately so that they can be seen as being distinct statements. While the answer shows that the candidate has a sound understanding of the principles, the way in which it is expressed could be improved.

(c) Fungi such as Fusarium venenatum 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]**

Candidate style answer	*Examiner's commentary*
At the optimum temperature the reaction is going at the fastest rate. But at high temperatures the enzymes have too much energy and their bonds begin to vibrate and will vibrate so much that they break. This will change the shape of the enzyme and will denature it. The substance will not be able to fit into the active site and so no ESC will be formed and the reaction will stop. Once you have denatured an enzyme it is useless. If you are trying to make a protein, this will also change its shape at a high temperature and so will be useless as well.	This answer shows basic understanding but will not be very high scoring. The main reason for this is a lack of detail of enzyme activity at the optimum temperature. Suitable elaboration would have been to indicate that the enzyme (and substrate) had kinetic energy and that this leads to the formation of enzyme-substrate complexes. The detail supplied at higher temperatures could also benefit from some clarification.

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.

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

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

	number of individuals of each species in each habitat		
species	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	*Examiner's commentary*
The number of different species in a sample or area.	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	*Examiner's commentary*
32 + 78 + 86 = 196 *32 ÷ 196 = 0.1632653 = 0.0266555* *78 ÷ 196 = 0.3979592 = 0.1583715* *86 ÷ 196 = 0.4387755 = 0.1925394* *0.3775664* *1 – 0.3775664 = 0.6224336*	The correct answer has been written in the shaded box, so a failure to round to 2 decimal places in the working is not a problem. As far as the working is concerned, it would have been better if the candidate had clearly stated that $0.1632653^2 = 0.0266555$ (as 0.1632653 does not equal 0.0266555).

(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]

Candidate style answer	*Examiner's commentary*
Because even though there are far less total numbers of insects, there are far more different species found in the hedge.	This answer has grasped the essential concept but has not really applied it to this particular situation. In order to access more marks, the candidate should have suggested possible reasons for the difference.

(c) Describe how the students may have determined the numbers of individuals of each species in each habitat. [5]

Candidate style answer	*Examiner's commentary*
They could have used a quadrat. They would put it in different places, at random, and then counted the organisms that they found there. But these are insects and not plants. And insects move around a lot. So they could use a big net and sort of sweep it over the area. Then they could identify the insects that they caught and count how many of them there were. They would have to make sure that they did this exactly the same in each of the three habitats.	This answer indicates that the candidate is not really too sure of the facts or concepts involved, possibly only having carried out limited ecological studies. The first part of the answer is irrelevant and the candidate has not been applying knowledge to this particular situation. The rest of the answer is lacking in specific detail and has not given enough to gain the full marks allocated to this part of the question.

(d) Studies of biodiversity are an integral part of an environmental impact assessment (EIA).

(i) Discuss the role of an EIA as part of a local planning decision. [3]

Candidate style answer	*Examiner's commentary*
It will tell you whether there are rare or endangered species in the area and whether there is a good variety of wildlife. If the area looking for planning permission is considered to be special, then they will not let building or development take place. Sometimes they will let it happen, but they have to move animals, such as rare toads, to a new place. Or they could make the builders provide a new habitat close to the place that it being built on – like they did in Cardiff Bay when they did work on the mudflats near Newport so that the birds would have somewhere to go.	This answer is really too longwinded for full marks. It needs to be more concise and, although it was a good idea to give some examples, any examples should clearly indicate the points that are being made.

(ii) Suggest why some conservationists might object to these studies. [2]

Candidate style answer	*Examiner's commentary*
I can't really think why they would object as it is trying to save wildlife. The only thing that I can think of is that it might advertise where a rare animal or plant can be found and then lots of people will know and could steal or damage them.	This answer, again, shows the candidate thinking on his/her feet. The point made is good but further clear statements are required to improve the answer.

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]

Candidate style answer

Kingdom	…….*Animal*……
……*Phylum*……	Chordata
Class	Mammalia
……*Order*……	Carnivora
Family	Felidae
Genus	……*Panther*……
……*Species*……	*pardus*

Examiner's commentary

This answer indicates that the candidate has knowledge of the hierarchy of classification groups. The answer for genus would not be credited as the information given in the question is that the specific name for the leopard is *Panthera pardus*.

(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]

Candidate style answer	*Examiner's commentary*
1 Fungi *2 Proctotista*	Although the spelling of Protoctista is incorrect, it is clear to which kingdom the candidate is referring. In this case there is no obvious confusion with Prokaryote, but had the spelling revealed such an ambiguity then the mark would not be awarded. Correct spelling would obviously improve the answer.

(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.

Discuss, with reference to the Prokaryotes, the reasons why classification systems are not universally accepted and why they change over time. [4]

Candidate style answer	*Examiner's commentary*
As science progresses, we find out a lot more about the structure of organisms and how they work. We discover that organisms that we didn't think were related might be and those that seemed to be closely related weren't really. The Prokaryotes are made up of the bacteria, but not all bacteria are alike and there's one group that seem to be totally different and some people that they should have a kingdom of their own. They say that it's a bit like having plants and animals in the same kingdom because the differences are so great. They have different chemicals inside their cell, for example.	This answer is a bit rambling and seems to follow the candidate's train of thought. It is essentially correct but is lacking in scientific approach and terminology.

(d) *Staphylococcus aureus* is a species of bacterium that is found on the skin.

(i) Describe how variation may arise within a species of bacterium such as *S. aureus.* [1]

Candidate style answer	*Examiner's commentary*
By mutation	A basic answer that would be better if qualified with reference to a change in DNA and spontaneous or random mutation.

(ii) Suggest why such variation alters the characteristics of the individual organism. [2]

Candidate style answer	*Examiner's commentary*
Because the DNA and genes control what the characteristics are. If the genes change then the characteristics change, but not necessarily because sometimes a change in the genes will not change the characteristics because it didn't take place at an important place.	This answer does not indicate an understanding that DNA codes for protein formation and that a change in the DNA can result in a corresponding change in protein structure and function.

(e) Discuss the difficulties that variations arising in *S. aureus* may cause to the medical profession. [4]

Candidate style answer	*Examiner's commentary*
There are some strains of the bacteria that are resistant to antibiotics. This is called MRSA. It means that you need to find different antibiotics to treat some diseases and it can cause infections in hospitals and amongst old people.	This answer shows that the candidate has an appreciation of MRSA and drug resistance. There is insufficient detail for four marks and the answer could be improved by considering wider issues such as the inability of the body to recognise and produce antibodies against *S. aureus*, the need to develop antibiotics for an increasing range of bacteria and the idea that vaccines developed against these bacteria will be ineffective once they change.

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	*Examiner's commentary*
There aren't as many condoms available, there is a big drugs problem and the medical services are poor.	This is a superficial answer. The comment relating to condoms is good, as is the reference to medical services (although this is not expressed as well). The statement about drugs, presumably referring to intravenous drug use, is not really relevant as the levels of intravenous drug use in Sub-Saharan Africa is no greater than in some of the other regions identified on the map. Reference to late diagnosis, sexual practices and general poverty would have improved the answer.

(ii) Explain why it is useful to collect information, such as that shown in Fig. 6.1. [4]

Candidate style answer	*Examiner's commentary*
So that you can see where there is a lot of the disease, to know where to concentrate the education campaigns, the treatment and which areas to avoid going to.	To score well in a question of this type, candidates need to make clear and distinct statements. It also helps to use as much scientific terminology as possible. The way in which they are expressed could be improved.

(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]

Candidate style answer	*Examiner's commentary*
Find people who are immune to HIV and run tests on their DNA to see if you can find the gene that gives them immunity. Then do gene therapy so that people can get the gene and become immune.	The idea of identifying the gene is good but gene therapy is unlikely to be a practical alternative to reduce the spread. Reference to the subsequent identification of the protein coded for by the gene and its use as a vaccine or the blocking of the CD4 receptor would have improved this answer.

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.

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

Candidate style answer	*Examiner's commentary*
It is a species with very low numbers and they are in danger of becoming extinct.	This answer identifies the key points but the candidate would have been better advised not to use the word 'danger' as it is too close to the term 'endangered'. The idea of the population number having reached a critical level would have been a good point to make.

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

Candidate style answer	*Examiner's commentary*
1 Hunting (for ivory) *2 Killed because they damage crops*	Two suitable reasons given.

(b) State two ways in which the CITES agreement is helping to save endangered species, such as the black rhinoceros. [2]	
Candidate style answer	*Examiner's commentary*
1 Prevent international trade in animal products from endangered species. *2 The countries that sign up to it ban the killing of those animals*	A clear and comprehensive answer with two good points made.

(c) Outline the potential benefits to agriculture of maintaining the biodiversity of wild animals and plants. [4]	
Candidate style answer	*Examiner's commentary*
It keeps a reservoir of plants and animals so that you can use them for breeding. They might have better yield or disease resistance or less fat or more milk. You can then selectively breed these with the crops or farm animals to make them better for agriculture. Or you could even start to use them for food as well as the plants or animals that are already being used.	This is a reasonably good answer that emphasises the potential of wild animals and plants.

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 and some marks have been lost because of imprecision in expressing ideas.