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Examiners' report

BIOLOGY A

H420

For first teaching in 2015

H420/02 Summer 2022 series

Version 1

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Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 2 series overview

The Biological Diversity paper assesses Modules 1, 2, 4 and 6.

Although there were some challenging questions, most candidates coped well with the topics and skills being assessed. As candidates had been given advanced warning of the topics that made up the bulk of the paper, it was perhaps not surprising to find that there were few obvious 'gaps' in their knowledge of learning outcomes from Modules 2, 4 and 6. There was, however, evidence that practical skills had not been developed well in some candidates, be that in environmental sampling, using a colorimeter or presentation of results. There was some evidence that careful reading of the question, particularly in Questions 14, 17 (a) (ii) and 19 (b) (i) would have benefited some candidates.

There were a number of questions in which candidates were directed to refer to figures within their answer, including Questions 16 (b) (iv), 17 (c) (i), 17 (d), 18 (a) (ii) and 19 (a) (ii), yet many responses omitted to do this. When using figures to illustrate or support a point in an answer, it is usually better to include two sets of figures for the purpose of comparison and always better to include units, where appropriate.

Candidates who took note of the command words in Questions 18 (a) (ii) and 21 (d) (i) often saved themselves time and, in Question 18 (a) (ii) often gained a mark.

The proportion of questions requiring mathematical skills remained at around 10%, as in all A Level Biology papers. Most candidates coped well with most of the maths skills questions, although many struggled to translate numbers on a log scale into non-logarithmic numbers.

Candidates wrote more concise answers to the first Level of Response (LoR) question, than they did for the second LoR question on this paper. Centres are reminded that the answer to a question worth 6 marks should, on average be only twice as long as the answer to a question worth 3 marks. Responses that continue at length often struggle to retain coherence which can mean the communication mark is lost. Although the answer spaces provided on the paper are meant to suggest an appropriate length of answer, many candidates find it necessary, perfectly reasonably, to continue their answer beyond the space provided. Examiners were pleased that candidates were indicating when an answer extended onto the additional pages. It was also pleasing to see fewer candidates being unnecessarily supplied with extra sheets or answer booklets before candidates had used the additional pages at the back of the exam paper.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• read the questions carefully before beginning their answer • paid attention to command words • used any extra information given when constructing their answer • recalled and used precise key terms correctly	• based their answer on the general idea of the question • ignored command words • used general rather than precise terms or confused precise terms that have a different meaning

Section A overview

Candidates found most of the MCQs accessible, although some were challenging. Most candidates achieved 8 or 9 marks and there was some correlation between achievement in Section A and that in the paper as a whole. It was noted that questions involving biochemistry (Questions 8, 10, 11 and 13) were not answered well. Examiners noticed fewer examples than usual of candidates' thought processes on the paper. Although this is not essential, it can help a candidate find their way to a correct answer. Many candidates are crossing out answers when they change their mind and writing their preferred answer next to the box. This is perfectly acceptable, and better than writing it on the extra pages, as long as the desired answer is unambiguous. A few candidates were overwriting previous letters and occasionally the resulting letter was open to interpretation. Such ambiguous responses were not given marks.

Question 2

2 Many industrial processes use immobilised enzymes.

Which of the options is **not** an advantage of using immobilised enzymes rather than free enzymes?

A Enzymes can be reused.

B Enzymes remain active over a wider range of temperatures.

C Set-up costs are low.

D The product is not contaminated by enzymes.

Your answer ☐ **[1]**

Approximately 2 out of 3 answers were correct. D and B were the most common incorrect responses.

Question 3

3 Which of the following changes of lifestyle is/are likely to reduce the spread of a disease that is transmitted by droplets of moisture?

1 Clean drinking water
2 Fewer people living together in the same house
3 Housing with improved ventilation

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

About half were correct responses. Many candidates chose A, perhaps not realising that droplets of moisture are carried through the air.

Question 4

4 Ash trees are an important part of the British landscape.

In 2012, a fungal disease known as ash dieback arrived in the UK from mainland Europe.

Which of the following could explain how ash dieback could have reached the UK from mainland Europe?

1 Spores carried on the wind
2 Young diseased trees imported from Europe and planted in the UK
3 Contaminated soil from a previously infected crop

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

Just under half of answers were correct. Many candidates chose A or C.

Question 6

6 Different types of microorganism can act as pathogens.

Which of the diseases is caused by a pathogen without mitochondria in its cells?

A Black sigatoka in bananas

B Late blight in potatoes

C Ring rot in potatoes

D Ringworm in cattle

Your answer ☐ **[1]**

This had not been well learnt by candidates and the proportion of correct answers was similar to that which would be expected by chance.

Question 8

8 Which statement about the secondary structure of a protein is correct?

A β-pleated sheets contain β-glucose.

B Disulfide bonds are not involved.

C Each single polypeptide is either an α-helix or a β-pleated sheet.

D Hydrogen bonds form between the R-groups of different amino acids.

Your answer ☐ **[1]**

Around half of responses were correct but many answered C or D.

Question 9

9 Cellulose is the main component of plant cell walls.

Which option is **not** a property of cellulose?

A High tensile strength

B Inflexible

C Insoluble in water

D Resistant to digestion by enzymes

Your answer ☐ **[1]**

Almost half of answers were correct. The most common incorrect response was B. It should be noted that, although most animals do not produce cellulases, enzymes that digest cellulase are common in microorganisms.

Question 10

10 Glycogen is a large polysaccharide.

Which option describes the structure and function of glycogen?

A 1–6 glycosidic bonds are more accessible to enzymes than 1–4 glycosidic bonds so energy can be released more quickly.

B Bonds between β-glucose residues are easily broken by enzymes.

C Exposed OH groups mean glycogen is soluble.

D Short branches allow more energy storage in a small space.

Your answer ☐ **[1]**

Only a third of candidates got this right. The most common incorrect response was A.

Question 12

12 Some students incubated plasmid DNA with a restriction enzyme.

After 24 h they used gel electrophoresis to analyse the products of the incubation.

Which option shows the correct procedure for gel electrophoresis?

A Load the sample onto agarose gel → apply voltage for a set time → photograph the gel

B Load the sample onto agarose gel → apply voltage for a set time → stain the gel → photograph the gel

C Photograph the agarose gel → load the sample onto gel → apply voltage for a set time → stain the gel

D Stain the agarose gel → apply voltage for a set time → load the sample onto agarose gel → photograph the gel

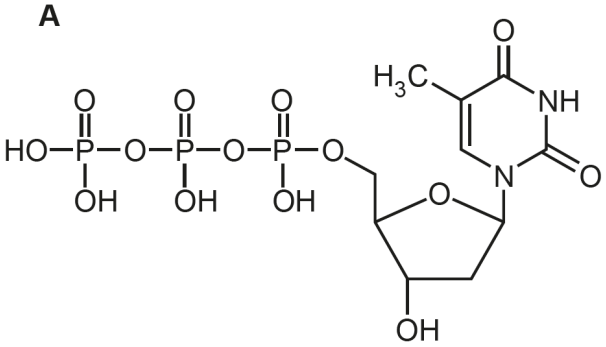
Your answer ☐ **[1]**

Most answers were correct.

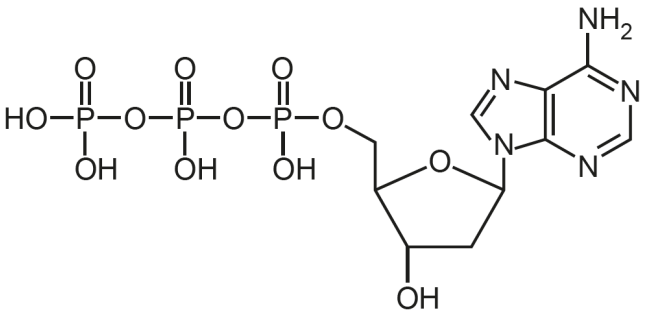
Question 13

13 Which structure shows ATP?

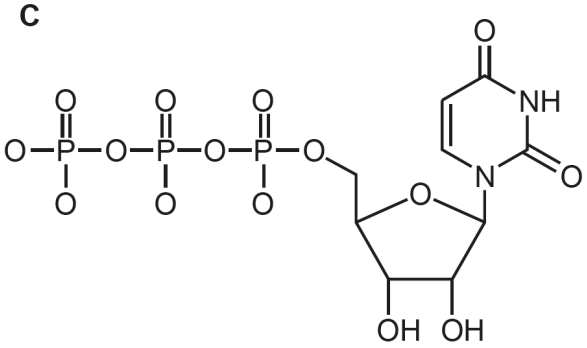
A



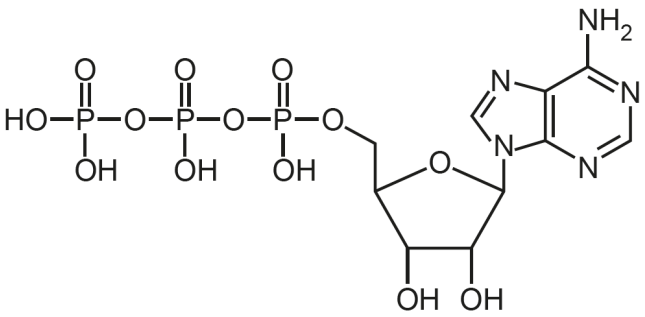
B



C



D



Your answer ☐ **[1]**

Only a minority got the right answer here. The most common incorrect answer was B, perhaps suggesting that candidates were aware that adenine is a purine but unaware that the sugar in ATP is ribose.

Question 14

14 Evolutionary relationships can be determined by comparing certain biological molecules between species.

Which option is commonly used to determine evolutionary relationships?

A The amino acid sequence of collagen

B The amino acid sequence of messenger RNA

C The base sequence of cytochrome c

D The base sequence of ribosomal RNA

Your answer ☐ **[1]**

Around a third of answers were correct; the most common response was C. It should be noted that, although cytochrome c is used for classification, cytochrome c is a protein and so it has an amino acid sequence, not a base sequence.

Section B overview

Most candidates were able to display a good understanding of genetic coding, protein structure, bacterial growth, sustainable fishing and Simpson's Index of Diversity. There were some clear gaps in practical knowledge shown by a lot of candidates: many could not draw a histogram in Question 19 (a) (i) and many struggled with environmental sampling in Question 20 or using a colorimeter in Question 21 (d) (i).

Question 16 (a) (i)

16 Haemoglobin is a globular protein.

Fig. 16.1 shows the structure of haemoglobin.

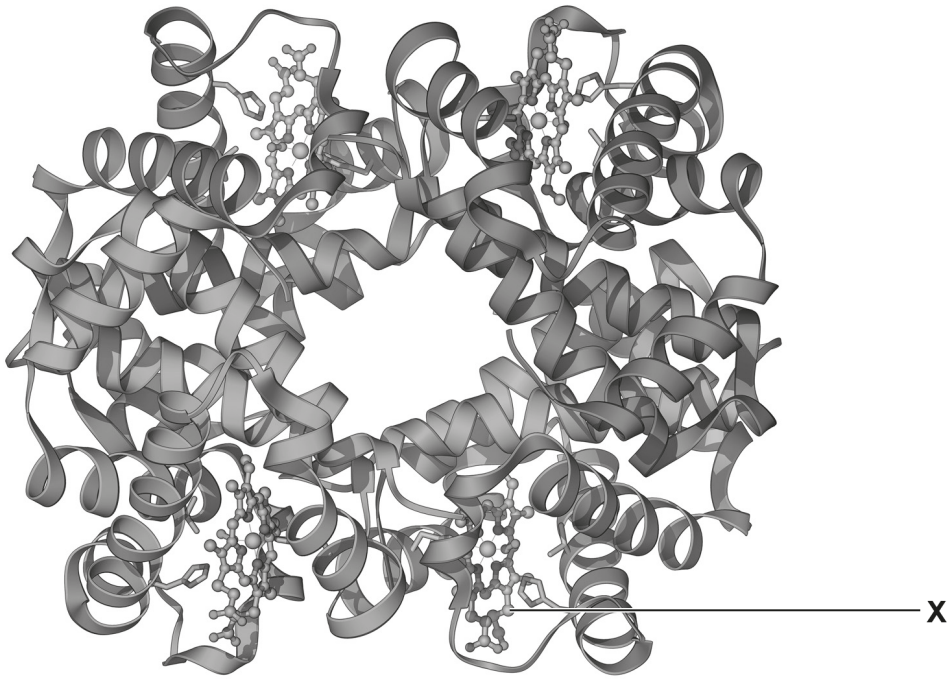


Fig. 16.1

(a) There are four levels of protein structure.

(i) Name the bond present in the primary structure of a protein.

..... **[1]**

Most candidates got the correct answer, the most common incorrect answers being 'hydrogen', 'glycosidic' and 'disulfide'.

Question 16 (a) (ii)

(ii) Name the structure labelled **X**.

..... **[1]**

Around half of candidates correctly identified 'haem'. Some candidates gave a less specific answer such as 'prosthetic group'. Candidates should be guided to give specific answers to questions with the command word 'Name', especially when they have been given some detail in the question – they knew it was haemoglobin so ought to have been able to name the prosthetic group. Common incorrect responses were 'iron', 'alpha helix' or 'beta sheet'.

Question 16 (a) (iii)

(iii) State **one** feature, visible in **Fig. 16.1**, that shows that haemoglobin is a globular protein.

..... **[1]**

Over half of candidates achieved this mark, usually for a description of the shape. The most common uncreditworthy response was 'coiled'.

Question 16 (b) (i)

(b) Sickle cell disease is a genetic disease that results from a substitution mutation in one of the genes that code for haemoglobin.

Fig. 16.2 below shows part of the mRNA sequence that codes for normal haemoglobin and the corresponding sequence of amino acids.

mRNA	ACU	CCU	GAG	GAG	AAG
Amino acids	1	2	glutamic acid	glutamic acid	lysine

Fig. 16.2

Fig. 16.3 is a representation of the genetic code.

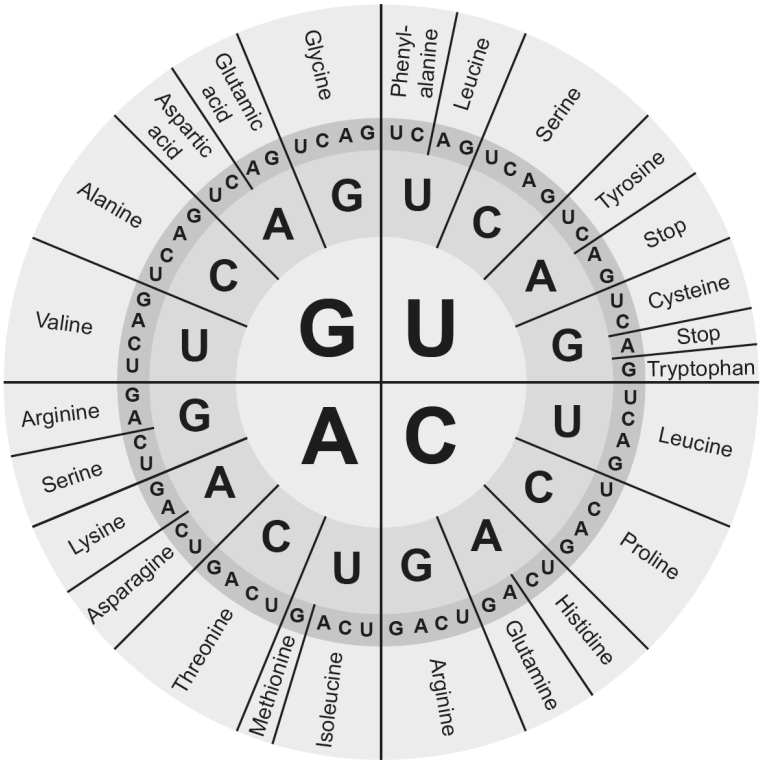


Fig. 16.3

(i) Use **Fig. 16.3** to identify the missing amino acids 1 and 2 in **Fig. 16.2**.

1 .....

2 .....

[2]

Almost all candidates got both marks here.

Question 16 (b) (ii)

(ii) Outline the role of RNA polymerase in the production of the mRNA sequence in **Fig. 16.2**.

.....

.....

.....

..... **[2]**

This question differentiated well between candidates of differing abilities but only a minority of candidates gained both marks. Many candidates thought RNA polymerase formed hydrogen bonds between the mRNA and the template strand and a few confused it with DNA polymerase or even helicase.

Question 16 (b) (iii)

(iii) In sickle cell disease, the haemoglobin contains the amino acid valine in one of the positions normally occupied by glutamic acid.

State the base sequence on the anticodon of a tRNA molecule that brings valine to the ribosome.

..... **[1]**

Not many candidates gave the correct answer to this stretch and challenge question. Some used Fig. 16.3 to identify an anticodon for valine but did not appreciate that GUG was the only substitution mutation of GAG that would result in valine. Many candidates suggested codons, rather than anticodons.

Question 16 (b) (iv)*

(iv)* In sickle cell disease, the mutated haemoglobin has a reduced ability to carry oxygen.

Some gene mutations do not affect protein function.

Use **Fig. 16.3 and** levels of protein structure to explain why some gene mutations do **not** affect the function of a protein.

.....

.....

.....

.....

.....

..... **[6]**

The question asked candidates to refer to three things in their answers: Figure 16.3, mutations and levels of protein structure. Responses that did not do all three were limited to Level 1. However, the question provided a good spread of marks and differentiated well between candidates.

Most candidates appreciated the degenerate nature of the genetic code and most illustrated this with reference to Fig. 16.3. Many could also explain the implications of this degeneracy in terms of silent mutations. Some of these candidates could also clearly explain why a silent mutation would have little impact on protein structure. Some even discussed the effect of substituting an amino acid for another with an R-group with similar properties. Many responses showed poor understanding within both sections, which was often illustrated by inaccurate use of technical terms. Confusion between bases and amino acids was evident, as were frequent references to amino acids, bases or DNA being degenerate. Candidates seemed more confident discussing mutations than they were protein structure, but a few candidates appeared to think that the amino acids were *produced*, as opposed to *selected*, on the basis of the generic code.

Some responses were not given the communication mark because of confusing use of technical terms. Many other responses were presented as either an explanation of the three types of mutation and their effects or as a description of protein structure which did not answer the question that had been asked.

Exemplar 1

Some gene mutations such a a silent substitution mutation may [redacted] form a different codon, however codons are degenerate, so more than one codon codes for the same amino acid, so although base sequence is different, the primary protein structure, which is the basic sequence of amino acids remains the same, so there's no change in tertiary protein structure, so the shape and function of the protein can remain the same. Fig 16.3 supports this because for example, for Threonine, there are 4 different codons which code for Threonine, so even if [redacted] ACA has a mutation and changes to ACC, Threonine is also produced. Alternatively, a conservative [redacted] mis-sense mutation can occur, which codes for a different amino acid so this changes the primary protein structure, which can change the secondary [6]

Additional answer space if required.

protein structure, which is hydrogen bonding, and may even have a small impact on tertiary protein structure (disulfide bonds, ionic bonds hydrogen bonds and hydrophilic/hydrophobic interactions) however with conservative mis-sense mutations, the new amino acid is very similar to the one which should be coded for so changes in structure are minimal, and these change might not be great enough to have any effect on protein function, e.g. active site might not be affected in enzyme.

Turn over

Level 3 was achieved in the first 13 lines of this response. The rest of the response was irrelevant to the question that was asked and so was a waste of the candidate's time.

Question 17 (a) (i)

17 Some students investigated the effect of time on the growth of bacterial populations.

The students prepared a large flask of bacterial culture.

They divided this large culture into a number of smaller flasks each containing 50 cm^3 of bacterial culture.

They then incubated the smaller flasks at 20 °C for up to 48 h.

Every 4 h the students removed one of the flasks and counted the bacteria.

The students recorded the total number of bacteria and the number of viable bacteria in each flask.

(a) When growing bacteria in culture, it is important that aseptic techniques are used.

(i) State why it is important that the technique used for culturing microorganisms be aseptic.

.....

..... **[1]**

The vast majority of candidates achieved this mark. Most understood the need to prevent contamination and for those who did not use the term contamination, they accessed the mark by stating that the entry or growth of microbes would be prevented.

Question 17 (a) (ii)

(ii) The students prepared the culture by adding a suspension of bacteria to a flask containing nutrient broth.

List **two** precautions that should be taken when preparing a bacterial culture in order to ensure that the procedure is aseptic.

1 .....

2 .....

[2]

Almost half of candidates achieved both marks here. In the information given in the question, they were told that there was a large flask of bacterial culture, which was divided into a number of smaller flasks. Candidates who took on board this information recognised that the flasks and broth would need to be sterilised (by autoclaving) and that the flasks should have a stopper or that the neck of the flask would need to be flamed before the culture was transferred. The most likely piece of equipment to transfer the culture would be a pipette so that would need to be sterilised too. Versions of the 2nd and 4th marking points were also frequently seen.

A significant minority of candidates did not relate their answer to the question and discussed streaking an agar plate with a wire loop—responses that were clearly in this incorrect context were not given marks. There was also the misconception that the Bunsen burner flame was used to kill all microbes rather than to create the upward air movement directing them away from the work area.

Question 17 (b) (i)

(b) When counting the number of bacteria, the students performed serial dilutions on samples removed from each small flask. In each serial dilution, the students removed 0.1 cm^3 and added it to 9.9 cm^3 of water.

To estimate the total number of bacteria, the students used a light microscope to count the number of bacterial cells in a 0.01 cm^3 sample of the final serial dilution.

To estimate the number of viable bacteria, the students spread 0.1 cm^3 of the final serial dilution on an agar plate and counted the number of colonies that had grown after 24 h.

(i) The students shook each flask before they removed the samples for counting.

Suggest why the students shook the flasks.

.....

..... **[1]**

About half of the responses achieved this mark. It was often stated the sample was needed to be mixed, or because bacteria will have settled to the bottom, but many responses omitted the explanation that an even distribution of bacteria was required. As in part (i), responses that discussed colonies or spreading bacteria on agar were not given marks.

Question 17 (b) (ii)

(ii) It can be more difficult to count bacterial cells using a light microscope than it is to count human cells.

Suggest **one** reason why bacterial cells are difficult to count using a light microscope.

.....

..... **[1]**

This synoptic question tested candidates' knowledge about relative cell size of eukaryotic (human) and prokaryotic (bacterial) cells in the context of using a light microscope to count them. Most responses gained this mark. A significant minority discussed microscope resolution without mentioning size and received no marks while others cited the absence of a nucleus to take up stain. A few candidates mistakenly thought that the bacterial cells would be moving due to flagella, or that they would be dividing rapidly, so would be difficult to count.

Question 17 (b) (iii)

(iii) In one 0.01 cm^3 sample the students counted 52 bacterial cells under the microscope.

Describe the calculation steps the students would then need to make to estimate the total number of bacteria in the small flask.

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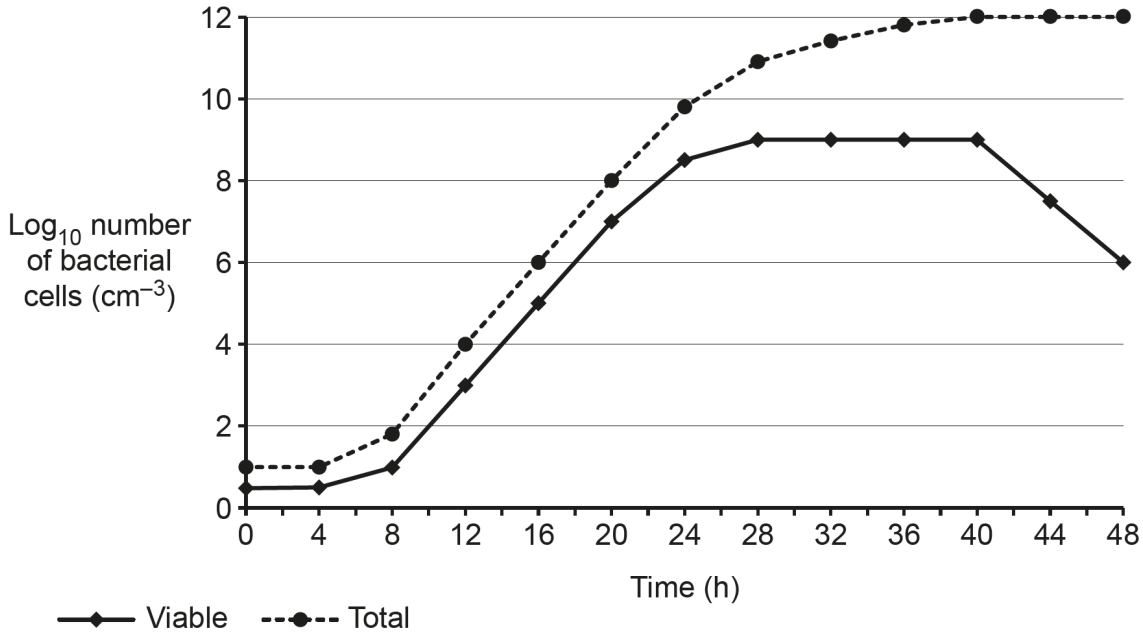
.....

..... **[3]**

Candidates found this unfamiliar style of question challenging. Although most gained at least 1 mark, it was rare to award all 3 marks. The most common mark given was for multiplying by a correct number to get the number of bacteria in 10 cm^3 or 1 cm^3. Some then went on to multiply this by the appropriate number, 5 or 50, to get the number in 50 cm^3. Very few candidates were able to clearly demonstrate how to deal with the number of serial dilutions, hence, the 2nd marking point was achieved only by the strongest candidates and this was normally written out rather than expressed as a formula. Some candidates did not attempt to describe the steps as the question asked but treated it as a calculation with a correct answer. This approach meant they could not access the 2nd marking point, as the number of serial dilutions was not stated in the question.

Question 17 (c) (i)

(c) The graph shows the students' results.



(i) Explain, with reference to the graph, why the students used a logarithmic scale on the *y*-axis.

.....

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..... **[2]**

The concept of logarithms proved difficult and many candidates could not explain why a log scale would be used. Many candidates were able to identify that the numbers would be large but large numbers can be plotted easily; the key idea that the numbers change quickly from very small to very large was missed by most candidates. The majority of candidates did not include any data in their answer despite the question asking to refer to the graph. Many offered the circular explanation that logarithms are necessary because growth is exponential. Some candidates thought that a number with fewer zeroes would make the *y*-axis labels easier to read.

Question 17 (c) (ii)

(ii) Calculate the percentage decrease in the viable population between 40 h and 48 h.

Give your answer to **3** significant figures.

Percentage decrease = ... % **[3]**

This question differentiated well between candidates with a little under a fifth of answers scoring full marks. However, many candidates struggled to interpret the logarithmic numbers and could not translate, e.g. $\log_{10}6$ into 1 000 000. Around half of responses scored 1 mark for knowing know to calculate a percentage change despite beginning with the wrong numbers, as long as working was shown.

OCR support

Help with logarithms and other mathematical skills can be found in the OCR Biology Maths Skills Handbook: AS and A Level Biology A Biology B (Advancing Biology) Mathematical Skills Handbook (ocr.org.uk)

There is also a useful blog about serial dilutions and logarithms: https://www.ocr.org.uk/blog/challenging-maths-skills-alevel-biology/

The Maths for Biology website is a further resource: https://www.ocr.org.uk/subjects/science/maths-for-biology/index.aspx?id=biology-a-h020-h420-from-2015

Question 17 (d)

(d) Explain, with reference to the graph, the decrease in the population of viable bacteria between 40 h and 48 h.

.....

.....

.....

.....

.....

..... **[4]**

This question differentiated well between candidates. This question directed the candidates to a specific part of the graph and asked for an explanation. Many correctly identified the stage as the death, or decline, phase. Often, responses described this phase in terms of reproduction rate being lower than death rate; however, references to bacteria having a 'birth rate' were not given marks. Many candidates explained that there would be a lack of nutrients and a build-up of waste products. Where competition was mentioned, it was only given marks when couched in terms of an increase. Few candidates appreciated the significance of the high total count indicating that the culture was full of dead cells and hence rarely offered a creditworthy figures quote. Many quoted figures for the viable population but these were not given marks because describing a decrease does not really offer any support to an explanation for that decrease.

A lot of candidates spent unnecessary time explaining all the events leading up to 40h (i.e., lag, log and stationary phases) instead of discussing the specific timeframe that was the focus of the question. Some candidates did not seem to understand the distinction between 'viable' and 'total' with many writing responses implying that they thought there were two different species of bacteria competing with one another.

Exemplar 2

Explain, with reference to the graph, the decrease in the population of viable bacteria between 40 h and 48 h.

= stationary phase. at 10^9 bacterial cells.

The graph plateaus from 28 to 40 hrs. This indicates ~~that~~ that 10^9 is the vital capacity of bacterial cells in the environment that the student has kept them in. However, after the 40 hours, the number of viable bacteria falls. This could be due to a buildup of waste product or lack of nutrients for the bacteria. The B phase. Most of the viable bacteria will die as the maximum capacity will fall.

This response gets 2 marks but the first part of this response discusses the time between 28 h and 40 h, which does not respond to the question. The response to the question begins on line 4, gaining the 4th marking point on line 6 and the 5th on line 7.

Question 18 (a) (i)

18 The Maasai Mara is a grassland ecosystem in east Africa with a large range of wildlife.

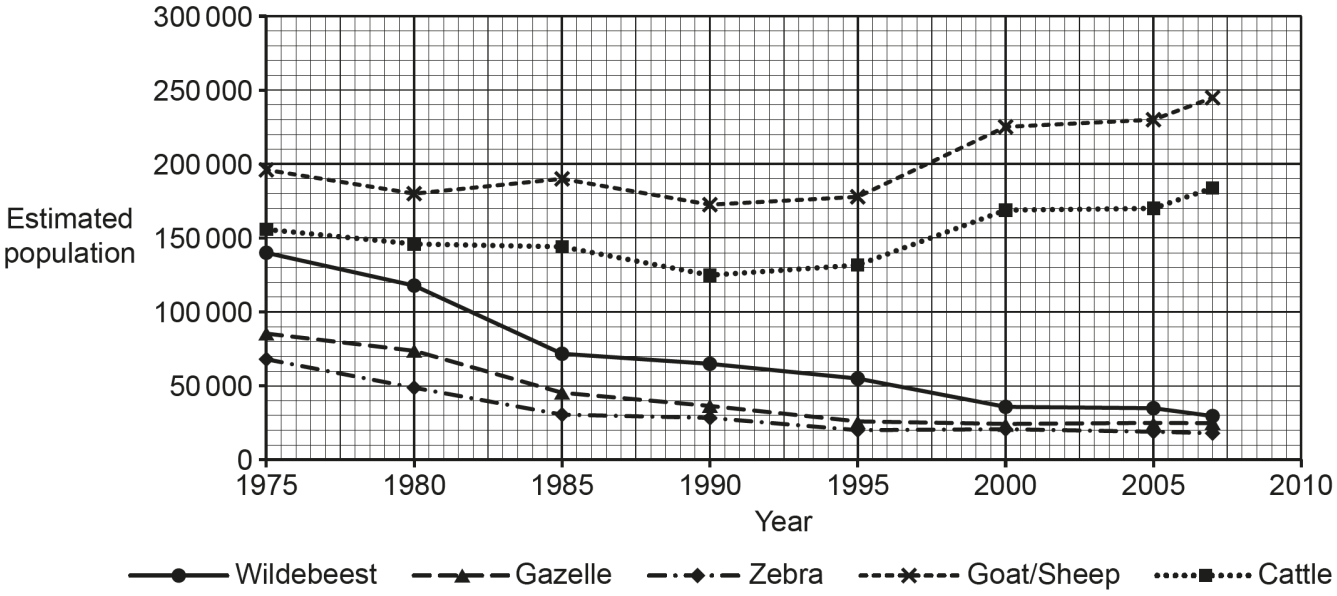
The human population in the area is increasing.

An increasing human population can affect the biodiversity of an area.

(a) The wildlife present in the Maasai Mara includes several large mammals, such as gazelle, zebra and wildebeest.

Domestic animals, such as cattle, sheep and goats, are farmed by humans to provide food.

The graph below shows the population of some large mammals in the Maasai Mara between 1975 and 2007.



(i) Calculate the rate of change in wildebeest population between 1975 and 2007.

Rate = ... animals per year **[2]**

Almost three quarters of candidates correctly read off the graph and performed the calculation. However, fewer than half of those included the correct sign and so only achieved one mark.

Question 18 (a) (ii)

(ii)* The graph has been used to support the claim that rising human population in the Maasai Mara has a negative impact on biodiversity in the area.

Use the evidence in the graph to evaluate this claim.

.....

.....

.....

.....

.....

..... **[6]**

Almost all candidates scored something in this question usually for citing a decrease in wild animal populations as support for the claim and usually supporting this with some reference to the graph. However, the key to scoring highly in this question was to appreciate that the command word was 'evaluate' and what candidates were being asked to evaluate was the evidence in the graph, insofar as it could be used to support the given claim. Only a minority made a valid comment about the limitations of the evidence in terms of supporting a claim about the effect of rising human population and so only around a third of candidates were given a level higher than Level 1. A still smaller number offered any convincing evidence against the claim along the lines of the points listed in the indicative content but without it a response could not achieve Level 3, as considering both sides is necessary for a full evaluation. Many candidates referenced the overall trend of decreased wild and increased domestic populations over time but most did not notice the distinct differences pre- and post-1995, some of which could be used as evidence against the claim.

Common themes in answers that were not given marks included reference to minor fluctuations from one data collection year to the next (a single data point is not enough from which to infer a trend) and the absence of any post-2007 data (as this does not invalidate the claim). Common misconceptions that were noted in candidates' answers were that domestic animals made a positive contribution to biodiversity and that some of the wild animals (usually the wildebeest) were predators of the other species.

A very large proportion of candidates spent a lot of time suggesting possible explanations for the trends seen in the graph. Such discussions may have been plausible but, in terms of evaluating the claim as the question asked, they were irrelevant.

Exemplar 3

17 655 – 495

The graph has been used to support the claim that rising human population in the Maasai Mara has a negative impact on biodiversity in the area.

Use the evidence in the graph to evaluate this claim.

On the one hand, as the human population has increased over time, the populations of all the wild species shown in the graph have decreased e.g. zebra had an estimated population of 70 000 in 1995 which fell to just under 20 000 in 2007. Meanwhile, overall domestic species have shown an increase in numbers e.g. 195000 goats/sheep in 1995 vs. 245000 sheep in 2007. It is possible that increasing numbers of humans has meant wild species have lost their [illegible] space to these domestic species as well as having to compete for the grasses which all the species present rely on for food [illegible] as more humans would likely mean farming more goats, sheep and cattle as food for their own population.

However, it is possible that another factor is responsible for the loss of biodiversity. There are overall fewer animals counted in 2007 compared to 1995 (655000 vs 495000), so it is possible another pressure has had an effect such as climate change creating more [6]

drought in the area. In addition, the numbers given are estimates and methods of measuring animal populations may have been less accurate in 1975 than 2004 as technology has evolved. ~~The data also only shows the numbers counted and does not necessarily reflect the trend of biodiversity~~ It may be easier to count the domestic species than the wild ones. Also biodiversity encompasses all life in an area ~~such~~ such as other species and types of animal and other kinds of life like plants. A negative impact on biodiversity for these specific species may not be reflected elsewhere such as among birds or plants, so this claim is incomplete without such information. We also don't know how much the human population has grown.

Lines 2 to 4 contain evidence to support the claim, backed up by figures, so this response achieved Level 1 easily; most of the extra response space, and below it, discusses some limitations in the validity of the data, which means the response achieves Level 2. Level 3 has not been achieved because no evidence against the claim has been offered. Lines 6 to 11 and 14 to 16 contain suggested explanations for the events on the graph. In the context of this question such explanations are not relevant.

Question 18 (b)

(b) Maintaining biodiversity in the Maasai Mara is important.

The following are some statements about biodiversity in the Maasai Mara:

A People visit the Maasai Mara to see animals such as lions, giraffes and rhinoceros.

B Wild animals are sometimes killed for food by local people.

C Large herbivores such as wildebeest are the main source of food for large predators such as lions.

D Part of the area is used by farmers for grazing livestock.

E Soil erosion has occurred where trees have been removed by humans for fuel or to clear land for grazing.

F In and around the Maasai Mara there is accommodation for over 7000 tourists.

The reasons for maintaining biodiversity can be grouped into three categories: ecological, economic and aesthetic.

Fill in the table to show which of the statements, A to F, could be used as an example of the importance of each of the three categories.

You may use each letter once, more than once, or not at all.

Reason for maintaining biodiversity	Letter or letters
Ecological	
Economic	
Aesthetic	

[3]

Around three quarters of candidates gained at least 2 marks here. Many answers omitted one of the required economic examples.

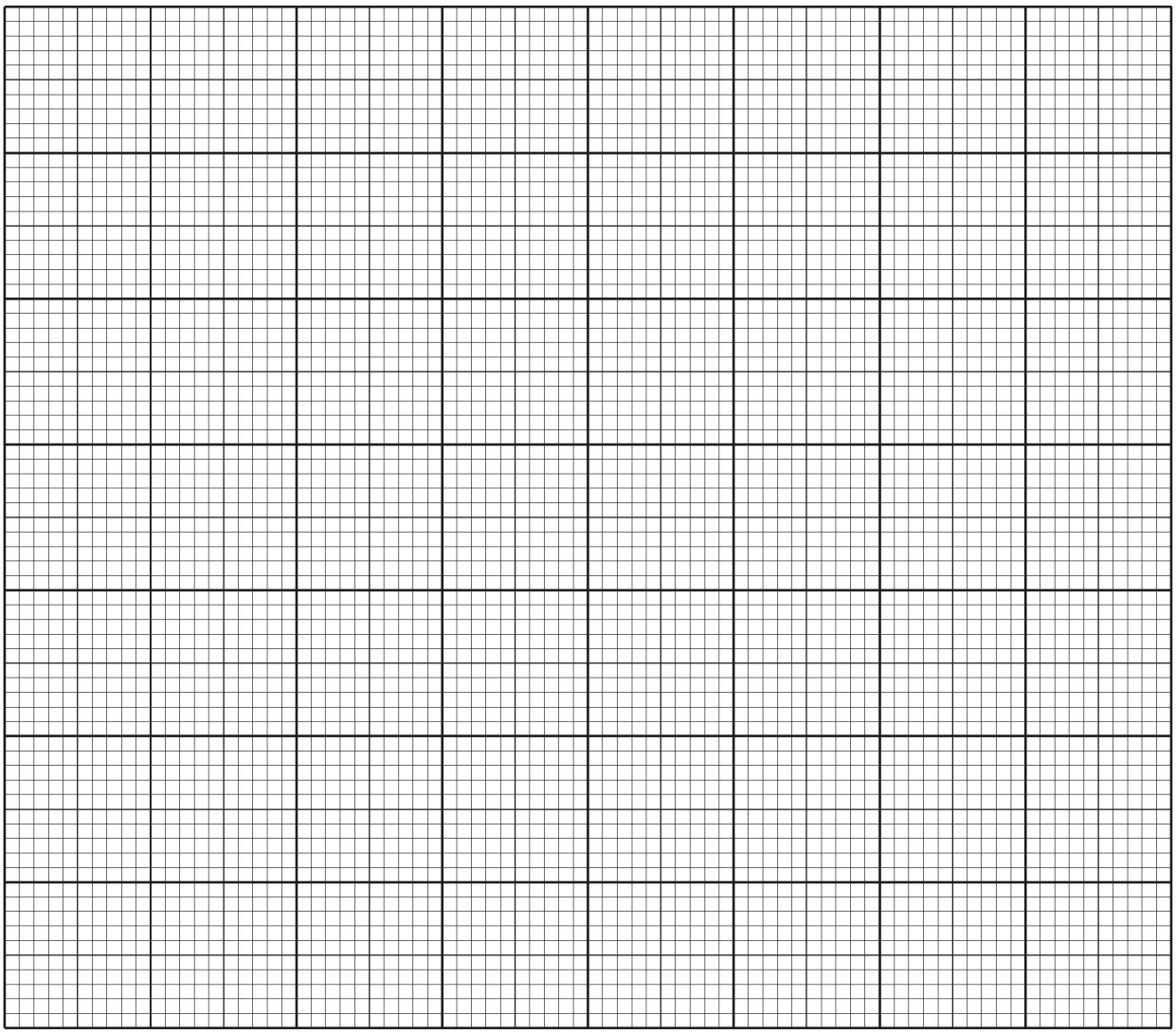
Question 19 (a) (i)

19 The Atlantic cod, *Gadus morhua*, is a large fish that is often eaten by humans.

(a) The body length of Atlantic cod varies between individuals.

The table below shows some data on the size of cod caught in one area of the Atlantic Ocean during one survey.

(i) In the space provided, plot the results from the table as a suitable graph.



[5]

The full range of marks was seen for this question in which candidates had to draw a histogram to represent the data they had been given. The vast majority achieved the first marking point with very few reversing the axes, neglecting to label the axes or omitting units for body length. The second marking point was given to most of the answers seen but often candidates used a categoric scale on the *x*-axis or, occasionally, used a *y*-axis scale that did not fill enough of the available space. Some candidates did not achieve the third marking point because they had drawn a bar chart (where the bars didn't touch) rather than a histogram but almost all knew to use a ruler. Of the candidates who drew bars, most drew them the correct height; however, a few, usually those who had chosen an unusual *y*-axis scale (e.g., going up in 15s), did not manage to find 121 or 119. Very few got the final marking point, suggesting not much practice of histograms in lessons. It was noted that those few candidates who achieved all 5 marks tended to plot frequency density.

OCR support

Presentation of practical results is regularly assessed in examinations. Help in development of these skills can be found in the OCR Biology Practical Skills Handbook: Biology Practical Skills Handbook (ocr.org.uk)

Question 19 (a) (ii)

(ii) Variation can be caused by genetic and environmental factors.

Explain why your graph shows that at least some of the variation in body length in Atlantic cod is caused by environmental factors.

.....

.....

.....

.....

..... **[2]**

Around half of responses achieved a mark here for stating either that the variation was continuous or describing the shape of the curve, but very few candidates did both and hence both marks were rarely given. The first marking point was often given for a description of a bell-shaped curve; however, some potentially creditworthy descriptions ended up as attempts to support hypotheses about selection pressures and so were not given marks.

Misconception

A number of responses stated that the graph did not show a normal distribution but the shape of the graph in this question is about as close to a normal distribution as is likely to be achieved with real data of this type.

Question 19 (b) (i)

(b) It is important that commercial fishing is done in a sustainable way.

Fish farms are one potential solution to declining fish stocks.

(i) List **three** other strategies that governments could use to increase the sustainability of commercial fishing.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

Most candidates answered this well and many achieved full marks. All marking points were seen, although the final one rarely so. Some candidates mentioned 'net size' rather than 'mesh size' and hence could not be given marking point 2. A number of responses discussed fish farms and was a clear example of the need for candidates to read the question carefully.

Question 19 (b) (ii)

(ii) International agreements are an important approach to sustainability.

Suggest why international agreements are particularly important in the case of sustainable fishing.

.....

..... **[1]**

Around half of candidates achieved a mark here – usually for a version of the 2nd alternative on the mark scheme. The most common style of non-creditworthy response discussed the general importance of preventing extinction, maintaining biodiversity or preserving global food supply, rather than focussing their answer on the 'case of sustainable fishing'.

Question 20 (a) (i)

20 The abundance and distribution of plants can be surveyed in different ways.

Some students wanted to survey abundance and distribution of plants on a small area of grass outside the school. The area was roughly 20 m × 20 m in size.

They used the following method:

1 Lay two 20 m tape measures at right angles starting in the south east corner of the grass area.
2 Use a random number generator to select *x* and *y* coordinates.
3 While facing north, place the left-hand corner of a quadrat on the point where the coordinates meet.
4 Identify the species present in the quadrat using a key.
5 Count the number of each species present.
6 Record the information in a table.
7 Generate a new set of coordinates and repeat steps 2 to 6 until 10 quadrats have been sampled.

(a) The teacher said that this method would not allow the students to measure the distribution of plant species.

(i) Suggest an improvement to the method that would allow the distribution of plants to be measured.

.....

..... **[1]**

Around half of candidates immediately spotted the need to reference distribution and promptly cited transects and/or systematic sampling. Many responses discussed doing more quadrats, using point quadrats, or measuring percentage cover within each quadrat, none of which were given marks.

Question 20 (a) (ii)

(ii) Identify a limitation with step 3 of the students' method and explain why this limitation might affect the data collected.

.....

.....

.....

.....

..... **[2]**

Few responses achieved both marks in this question but it did differentiate well. Many spotted the ambiguity about which left hand corner was needed. Fewer seemed aware of the routine limitation with this kind of investigation which is the difficulty in judging the position of the coordinate when you are standing some distance from a tape measure. There were a large number of regular incorrect responses. Many did not seem to appreciate that if a quadrat lay outside the 20 x 20 grid, this would not invalidate the results. Many seemed to think that there would be some difficulty in deciding in which direction north lay while others thought the centre of the quadrat should be placed over the coordinate. This all suggests that many students may have, understandably, had restricted access to fieldwork opportunities during their course. Some struggled to understand the method and were concerned that only those plants associated with 'the north' (either in terms of where they were growing or facing) were being included in the investigation. A few candidates thought north would move.

Question 20 (b) (i)

(b) The students' results are shown in the table.

Plant species	Mean number of individuals per quadrat
Creeping buttercup	3
Daisy	7
Dandelion	1
Grass	26
Red clover	4
Ribwort plantain	3
White clover	6

(i) Calculate the Simpson's Index of Diversity (D) for the students' data.

Use the formula: $D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$

D = ... **[3]**

This skill has evidently been well practised, with most candidates getting the correct answer, supported by a clear and well-organised calculation.

Question 20 (b) (ii)

(ii) The students found grass species difficult to distinguish from one another so they decided to record any grass species as 'grass'.

Explain how the students' decision might have affected the calculated value for *D*.

.....

.....

.....

.....

..... **[2]**

Most responses gained 1 mark for recognising that the students' approach would have lowered the value for D. However, only a minority went on the support this with reference to which of the earlier stages in the calculation would have been affected. Responses that did not reference the calculated figure for D, merely discussing the idea of biodiversity, were not given marks.

Assessment for learning

This question could be used, or modified, to consolidate or extend a class's understanding of Simpson's Index and the impact of species richness and evenness.

Question 20 (c) (i)

(c) On a biology field trip, the same students surveyed a large area of heather moorland.

On this occasion they did not use quadrats.

Pairs of students were each assigned a large area of moorland. They rated the abundance of plant species using the following scale:

A = Abundant

C = Common

F = Frequent

O = Occasional

R = Rare

One reason the use of quadrats was inappropriate was that many moorland plants are too large to fit in the quadrat.

(i) Suggest **one** other advantage of using an ACFOR rating scale for the students' survey.

.....

..... **[1]**

Around half of candidates appreciated that ACFOR would be quicker than using quadrats. Few mentioned its advantages for surveying a wide area. Some answers suggested that many candidates were unfamiliar a sampling technique that did not involve quadrats.

Question 20 (c) (ii)

(ii) Suggest **one** limitation of using an ACFOR rating scale, instead of quadrat sampling, to rate the abundance of plant species.

.....

..... **[1]**

Around half of candidates realised that a major issue with ACFOR was subjectivity. A minority of responses thought that not being able to calculate Simpson's Index was a disadvantage while others thought it would not be possible to perform any kind of statistical test on the resulting data. The fact that the second marking point was very rarely given suggests that very few responses had the opportunity to undertake fieldwork that did not involve quadrat sampling.

Question 21 (a)

21 Microorganisms can be used to produce a variety of food products.

(a) Microorganisms have simple nutrient requirements, which helps to reduce production costs.

List **two** other advantages of using microorganisms in food production.

1 .....

.....

2 .....

.....

[2]

Most responses achieved at least 1 mark in this question and correct versions of the first five marking points were common – the last marking point was rarer. The most common uncredited responses discussed being grown on waste materials, being readily available, or producing healthy protein. Responses that just said 'quick' or 'cheap' were not given marks without further qualification.

Question 21 (b) (i)

(b) Yoghurt is a food produced from milk using microorganisms.

Yoghurt production involves two bacteria: *Lactobacillus delbrueckii* and *Streptococcus thermophilus*.

(i) The bacteria convert the lactose present in milk into lactic acid.

Lactic acid is an important contributor to the flavour of yoghurt. Lactic acid also helps to give yoghurt a longer shelf life than milk.

Suggest how lactic acid helps to extend the shelf life of yoghurt.

.....

.....

.....

.....

..... **[2]**

Most candidates struggled to produce a creditworthy response to this with many answers merely stating that the lactic acid prevented microbial growth. Around a fifth of candidates gained at least 1 mark, most commonly for a version of the extra guidance for the first point; the second marking point was more rarely given marks and usually only in those responses that had already been given the first. A significant minority of responses suggested that the acidic conditions would promote the growth of bacteria and some suggested that the bacteria could metabolise the lactic acid in preference to lactose. A few responses discussed the *lac* operon.

Question 21 (b) (ii)

(ii) Both bacteria also break down some of the protein casein, which is present in milk.

Name the product of protein breakdown and describe the type of reaction that takes place.

Product .....

Reaction .....

.....

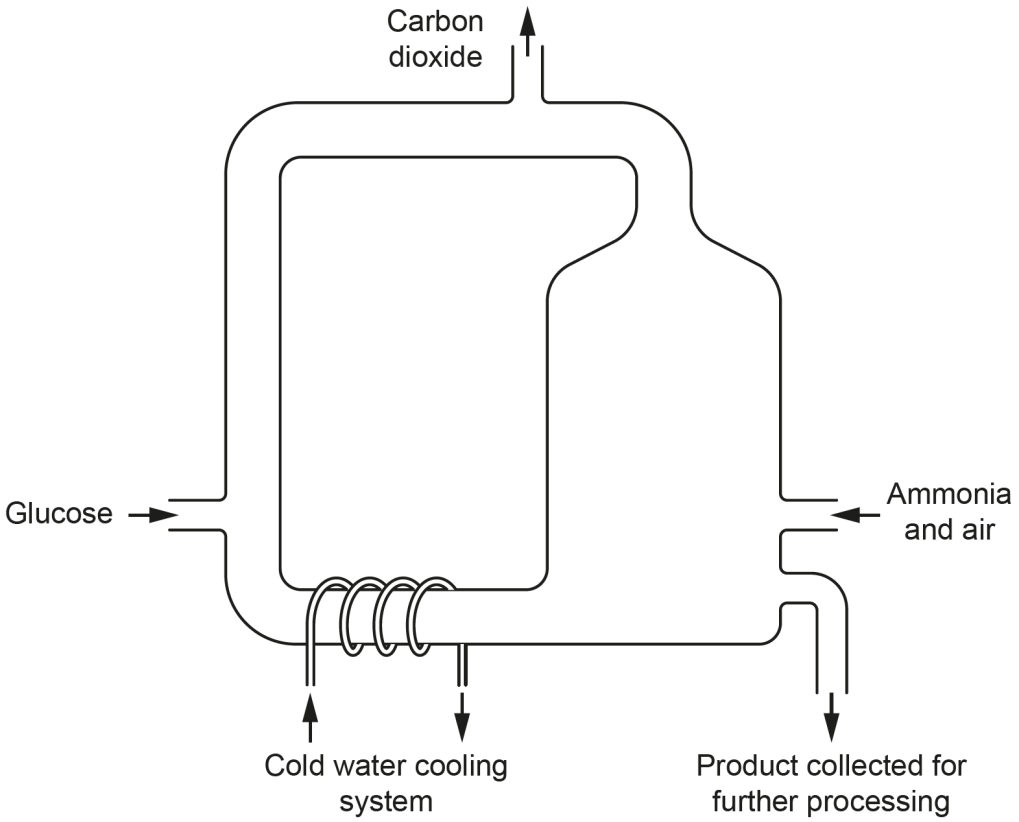
[2]

The vast majority of candidates gained both marks here. Of those that didn't, the reaction was more often correct than the product, for which 'whey' and even 'casein' itself were sometimes suggested.

Question 21 (c) (i)

(c) The microorganism that is used to produce mycoprotein is a fungus.

The diagram is of a fermenter used for mycoprotein production.



(i) Use the diagram to name the type of fermentation process used for mycoprotein production.

Justify your answer.

Name .....

Justification .....

.....

[1]

The vast majority correctly chose 'continuous' and all but a few of these supported this with a creditworthy explanation. Some chose batch but almost as many wrote 'aerobic' or 'alcohol' (fermentation).

Question 21 (c) (ii)

(ii) Suggest and explain why a cooling system is necessary.

.....

.....

.....

.....

..... **[2]**

Most candidates achieved 1 mark here, usually for a version of the extra guidance for the first marking point. All three marking points were seen but rarely more than one in a single answer. Often candidates stated that heat was being produced but many such responses were vague about the source of this extra heat.

Question 21 (c) (iii)

(iii) The air inlet provides the fungus with oxygen for respiration, and ammonia.

Suggest and explain why the fungus is provided with ammonia.

.....

.....

.....

.....

..... **[2]**

A little under half of candidates seemed to understand what was happening here but those who did usually achieved both marks. A significant minority of responses discussed the role of nitrates in the nitrogen cycle. Many responses vaguely suggested that ammonia might be used as a substrate for something, usually respiration. Some thought it killed unwanted microbes.

Question 21 (d) (i)

(d) Mycoprotein foods contain protein.

The presence of protein in a solution can be detected using biuret reagent.

In the presence of protein, biuret reagent turns from blue to violet.

(i) A colorimeter can be used, along with biuret reagent, to determine the concentration of protein in a solution.

Outline how to use a colorimeter to determine the concentration of protein in a solution.

.....

.....

.....

.....

.....

..... **[4]**

This question differentiated well between candidates, with many being given full marks, and each of the first five marking points was regularly seen. Where a filter was mentioned, it was usually red, which would have been appropriate for Benedict's reagent, but which was the wrong filter for the context of the question. Some candidates spent unnecessary time giving detailed step-by-step instructions, including serial dilutions and suggestions for a range of known concentrations. The command word in this question was 'outline' so this level of detail was not needed.

Question 21 (d) (ii)

(ii) State **one** alternative method for determining the concentration of protein in a solution.

.....

..... **[1]**

Less than a quarter of responses gained a mark here. The most common of the incorrect responses was 'Benedict's test' but 'universal indicator' and 'titration' were not uncommon answers. Candidates need to focus carefully on the stem and question – it was not looking for a different reagent, but what other method you could use other than a colorimeter. This was the most often-omitted question on the paper.

Question 22 (a)

22 Body plan is important in multicellular organisms.

(a) Complete the following sentences about control of body plan using the most appropriate terms.

Body plan is under genetic and ..... control. Internal and external..... can influence the expression of genes that regulate the cell cycle. Such genes can promote or inhibit programmed cell death, known as ..... . During programmed cell death ..... digest the cell contents and the products are removed by ..... so that they do not damage the surrounding tissues.

[5]

The majority of responses for the first three blank spaces were correct. Few responses were able to gain full marks. For each blank, the most common incorrect responses were 'hormonal' and 'conditions'.

Nearly all candidates got this right, although spellings that were not phonetically similar were not given marks. Examples of these are: phagocytes, lysosomes and lysozyme, exocytosis, enzymes and vesicles.

Question 22 (b)

(b) State the name of the type of gene responsible for controlling body plan in multicellular organisms.

..... **[1]**

The vast majority answered correctly. Occasional incorrect responses were 'regulatory' or '*lac* operon'.

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