OCR
Oxford Cambridge and RSA

Friday 17 June 2022 – Morning

A Level Biology A

H420/02 Biological diversity

Time allowed: 2 hours 15 minutes

You can use:
- a ruler (cm/mm)
- a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **32** pages.

ADVICE
- Read each question carefully before you start your answer.

SECTION A

You should spend a maximum of 20 minutes on this section.

Write your answer to each question in the box provided.

Answer **all** the questions.

1 Many processes in the body are controlled by enzymes.

Which of the options is an extracellular process controlled by enzymes?

A Conversion of fibrinogen to fibrin during blood clotting

B Digestion of a pathogen inside a lysosome

C DNA replication

D Movement of vesicles from the Golgi apparatus to the cell membrane

Your answer ☐ **[1]**

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]**

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]**

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]**

5 What chemical is produced by plants in response to attack by pathogens?

A Amylopectin

B Amylose

C Callose

D Cellulose

Your answer ☐ **[1]**

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]**

7 On a biology field trip, a student calculated that an area of ancient woodland had a Simpson's Index of Diversity of 0.85.

Which interpretation of a Simpson's Index of Diversity of 0.85 is correct?

A Biodiversity is high.

B Biodiversity is low.

C Interspecific variation is high.

D Intraspecific variation is low.

Your answer ☐ **[1]**

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]**

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]**

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]**

11 *Nitrobacter* is a bacterium that is involved in recycling nitrogen in an ecosystem.

Which nitrogen cycle reaction is carried out by *Nitrobacter*?

A $2NO_2^- + O_2 \rightarrow 2NO_3^-$

B $N_2 + 8H^+ + 8e^- \rightarrow 2NH_3 + H_2$

C $NH_2CONH_2 + H_2O \rightarrow 2NH_3 + CO_2$

D $NO_3^- \rightarrow NO_2^- \rightarrow N_2O \rightarrow N_2$

Your answer ☐ **[1]**

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

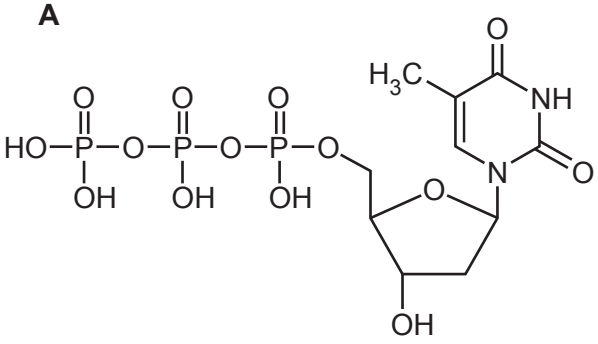
C Photograph the agarose gel → load the sample onto gel → apply voltage for a set time → stain the gel

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

Your answer ☐ **[1]**

13 Which structure shows ATP?

A



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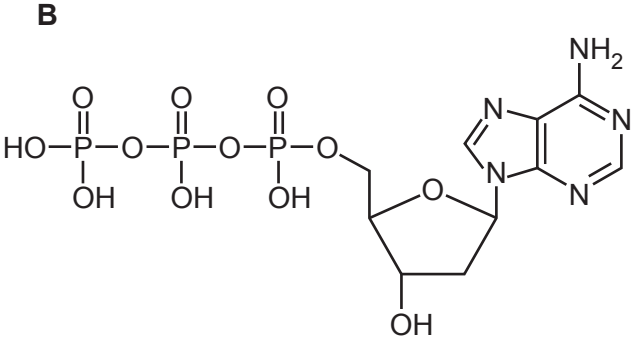

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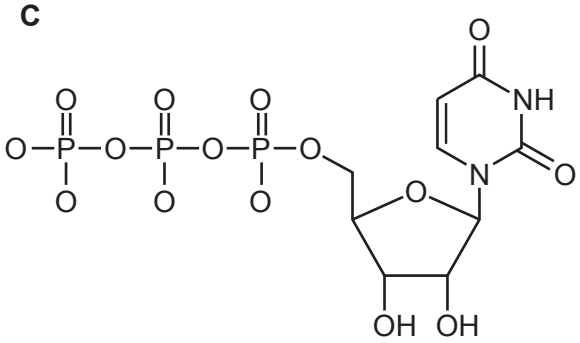

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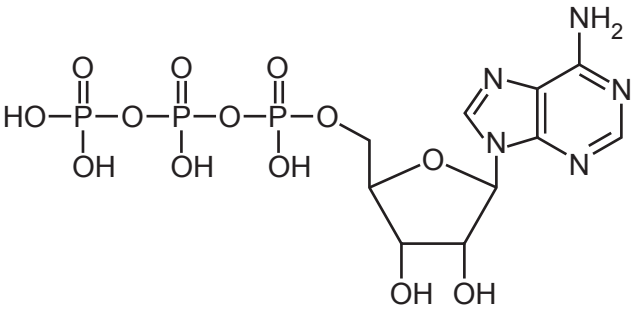

Your answer ☐ **[1]**

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]**

15 Competition is an important factor in determining population size.

Which statement about competition is **not** correct?

A Competition between two species can result in the extinction of the less well-adapted species.

B Competition occurs between individuals of the same species.

C Predators only compete within their own species.

D Species with overlapping niches will compete with one another.

Your answer ☐ **[1]**

SECTION B

Answer **all** the questions.

16 Haemoglobin is a globular protein.

Fig. 16.1 shows the structure of haemoglobin.

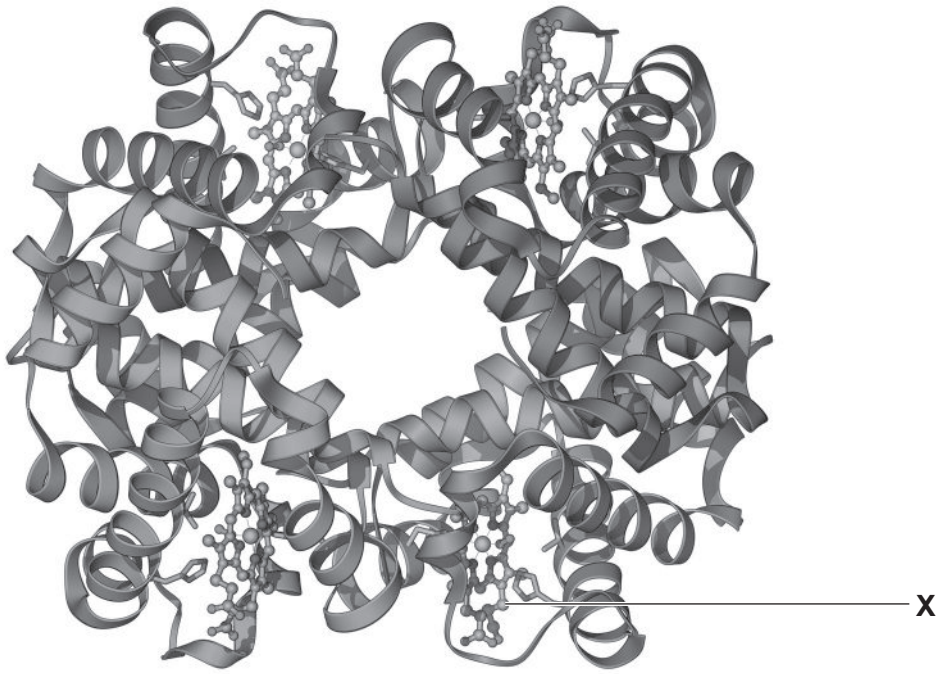

Fig. 16.1

(a) There are four levels of protein structure.

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

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

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

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

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

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

(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.

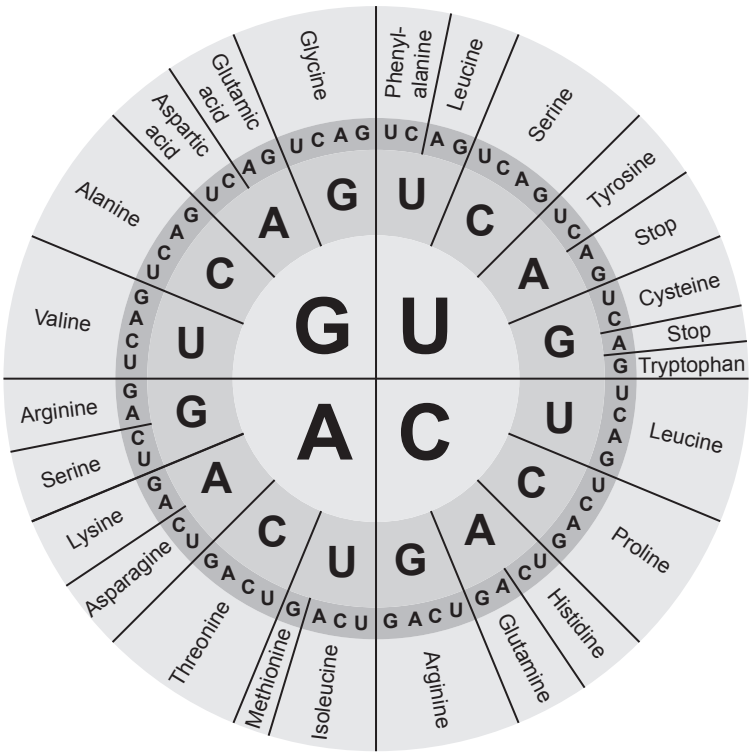

Fig. 16.3

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

1 .....

2 .....

[2]

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

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(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]**

(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.

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Additional answer space if required.

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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.

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

(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]

(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.

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

(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.

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

(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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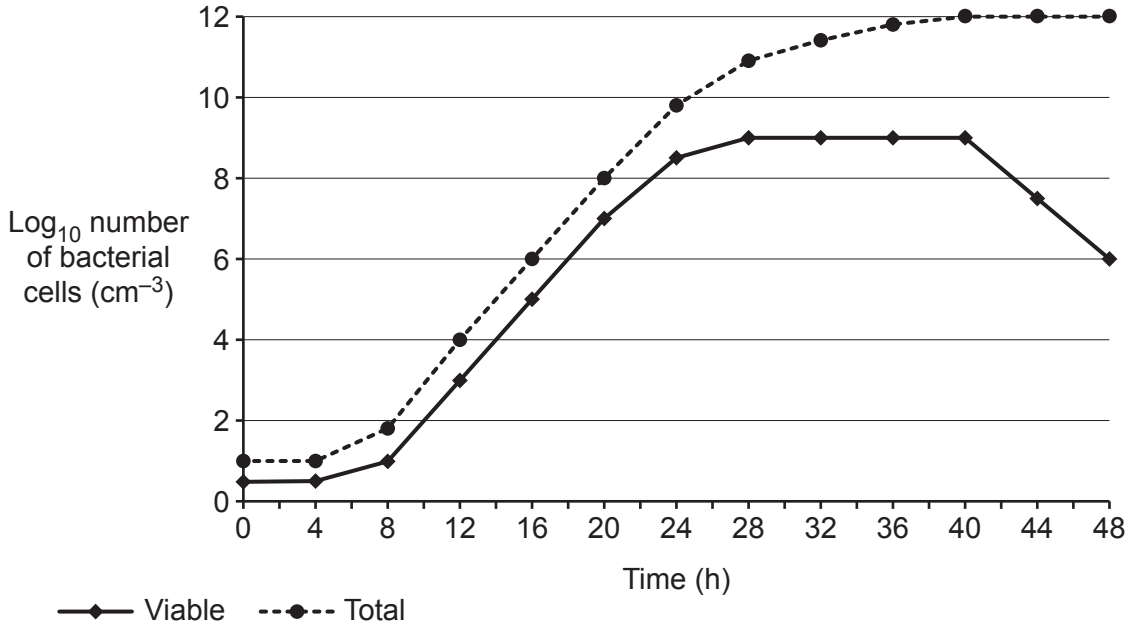
(c) The graph shows the students' results.



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

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

(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]**

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

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

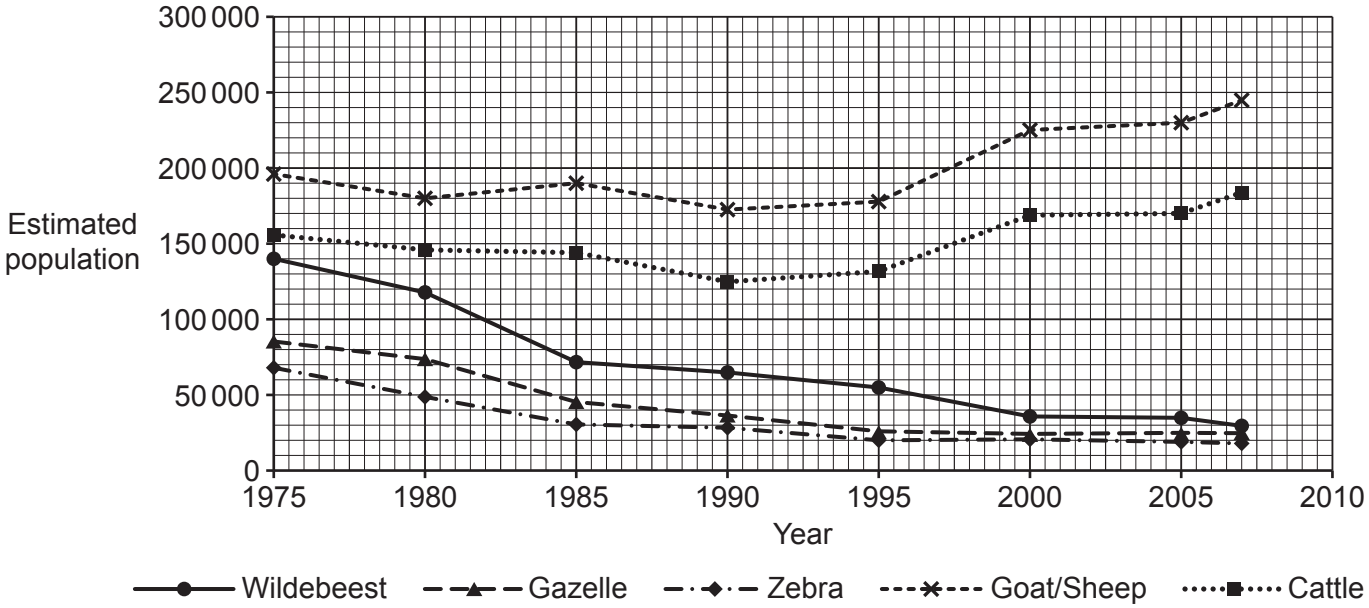
The human population in the area is increasing.

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]**

(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.

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Additional answer space if required.

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(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]

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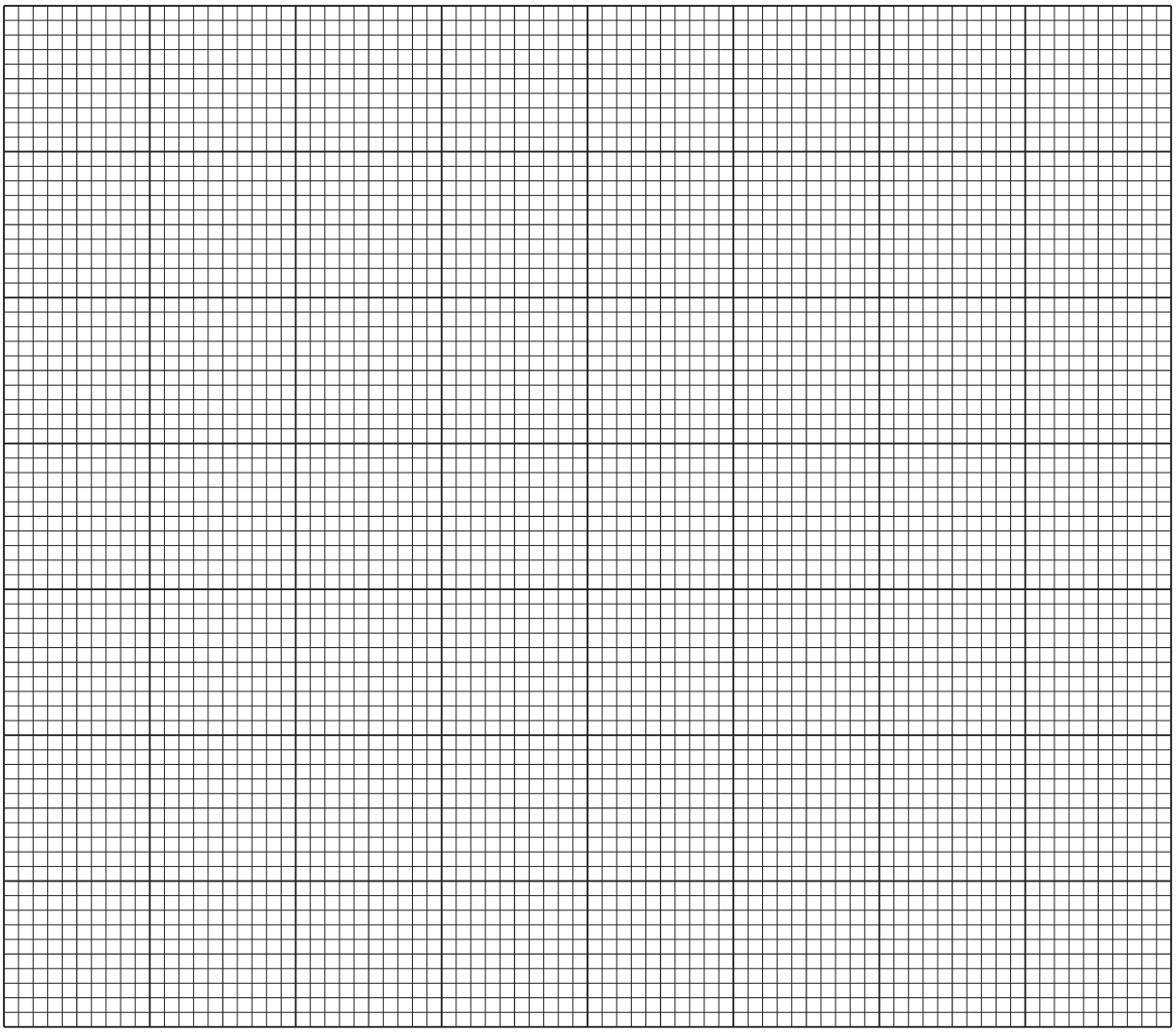
19 The Atlantic cod, *Gadus morhua*, is a large fish that is often eaten by humans.

(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.

Body length (mm)	Frequency
$100 \leqslant x < 200$	10
$200 \leqslant x < 300$	48
$300 \leqslant x < 400$	121
$400 \leqslant x < 500$	130
$500 \leqslant x < 600$	119
$600 \leqslant x < 800$	46

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



[5]

(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.

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

(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.

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2 .....

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3 .....

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[3]

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

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

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

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.

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

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

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

(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: $D = 1 - \left(\sum\left(\frac{n}{N}\right)^2\right)$

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

(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.

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

(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.

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

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

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

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 .....

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2 .....

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[2]

(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.

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

(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 .....

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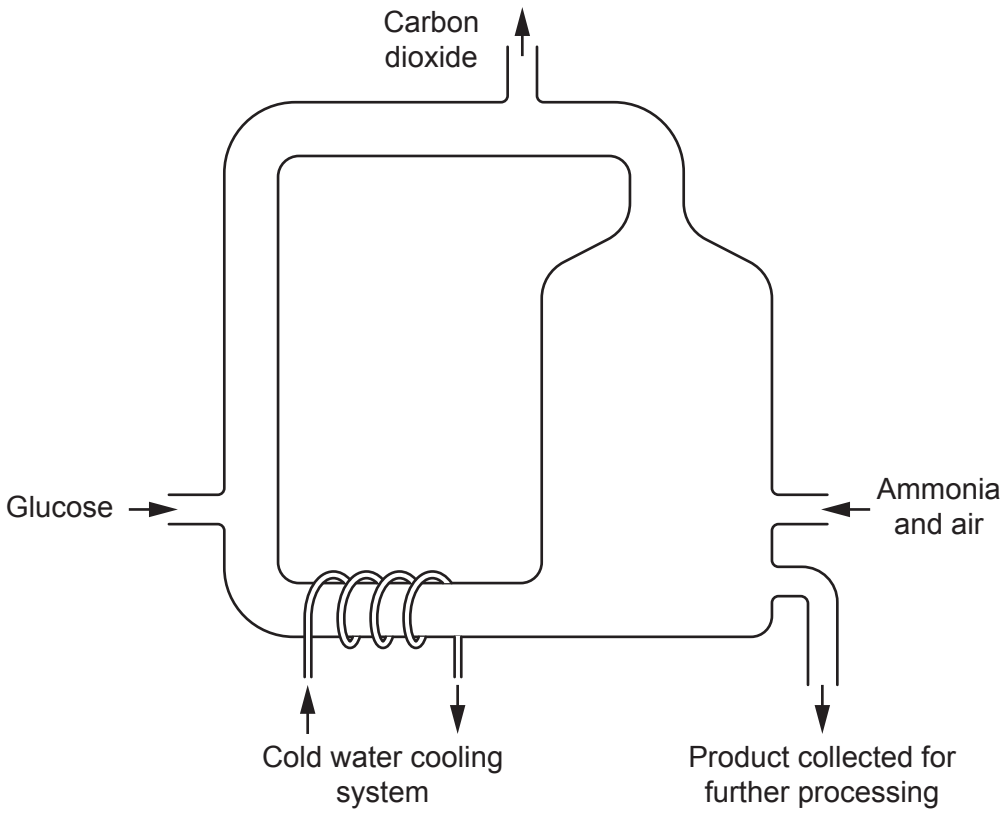
[2]

(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 .....

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[1]

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

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

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

Suggest and explain why the fungus is provided with ammonia.

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(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.

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

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

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

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]

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

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).