

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Education
Advanced Level Examination
June 2011

Human Biology

HBIO5

Unit 5 The air we breathe, the water we drink, the food we eat

Wednesday 22 June 2011 9.00 am to 11.00 am

For this paper you must have:

- a ruler with millimetre measurements
- a calculator.

Time allowed

- 2 hours

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You will be marked on your ability to:
 - use good English
 - organise information clearly
 - use accurate scientific terminology.

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
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9	
10	
TOTAL	



J U N 1 1 H B I O 5 0 1

WMP/Jun11/HBIO5

HBIO5

Answer **all** questions in the spaces provided.

1 (a) During respiration where, exactly, in a cell does each of the following occur?

1 (a) (i) Glycolysis

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(1 mark)

1 (a) (ii) Electron transfer chain

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(1 mark)

1 (b) Without oxygen, less ATP is produced by respiration. Explain why.

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(2 marks)

4



2 (a) What is a brown-field site?

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(1 mark)

2 (b) Ecologists investigated invertebrate animals on a brown-field site, a *green roof* and a *brown roof*. A *green roof* is produced by covering a roof with low-growing *Sedum* plants. A *brown roof* is produced by covering a roof with gravel.

At each site, the ecologists calculated an index that measures the species diversity. The larger the diversity index, the greater the species diversity.

The table shows features of these sites.

Feature	Brown-field	Green roof	Brown roof
Age / years	3	6	3
Area / m ²	2000	300	200
Diversity index	2.30	1.98	1.82

What do these data suggest about the factors that affect biodiversity at these sites?

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(3 marks)

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ANSWER IN THE SPACES PROVIDED**



3 (a) What is the *polluter pays principle*?

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(2 marks)

A local council introduced new methods of dealing with household waste.
These new methods included

1. separate collection of paper, plastic, metal and glass items,
2. approval for a power station burning some types of household waste.

3 (b) These new methods should help the council to meet the requirements of the *waste hierarchy*.

Explain how.

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(2 marks)

3 (c) The council's new methods were part of their attempt to reach the *Best Practical Environmental Option* for waste disposal.
What is meant by the *Best Practical Environmental Option* (BPEO)?

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(2 marks)



4 (a) What is someone's carbon footprint?

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(2 marks)

Scientists calculated the energy required to keep a pet dog for one year.
The scientists also calculated the energy required to produce a four-by-four car
and run it for 10 000 km in one year.

The table shows their results.

	Energy requirement / GJ per year	Area of farmland required to supply this energy / hectares
Dog (German shepherd)	148.5	
Car	55.1	

The scientists then calculated the area of farmland needed to supply these amounts
of energy. They assumed that one hectare of farmland yields 135 GJ per year.

4 (b) Complete the table to show the areas of farmland required.

(1 mark)

4 (c) Other than food, suggest **two** other factors involved in keeping a dog which add to its
carbon footprint.

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(2 marks)



- 4 (d)** A journalist concluded that owning a four-by-four car has less impact on the environment than owning a dog.

Evaluate this conclusion.

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Turn over for the next question

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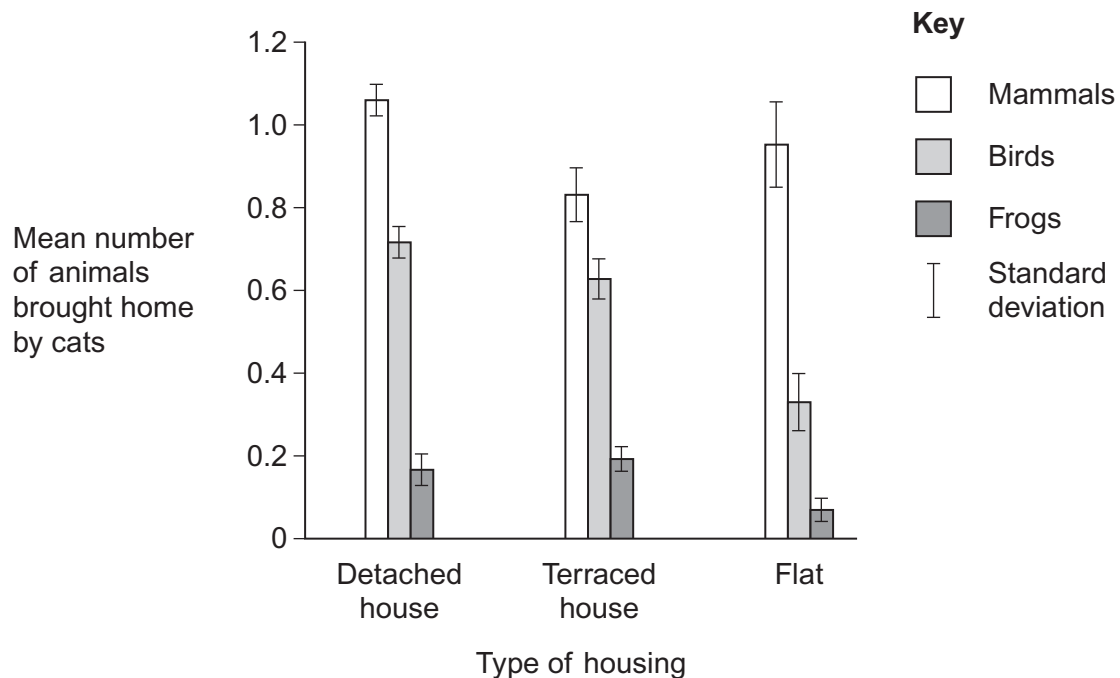
- 5 (a)** An ecosystem supports a certain size of population of a species.
Predation is one biotic factor that can cause the size of this population to change.

Give **one** other biotic factor that can cause the size of a population to change.

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(1 mark)

- 5 (b)** Ecologists investigated predation by 555 domestic cats whose owners lived in different types of housing. They asked cat owners to record the number of mammals, birds and frogs that their cats brought home over a five-month period.

The graph shows their results.



5 (b) (i) What do these data suggest about predation by domestic cats?

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(2 marks)

5 (b) (ii) Some scientists thought that the results of this investigation were **not** very reliable.
Suggest **one** reason why they might have thought that the results were **not** reliable.

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(2 marks)

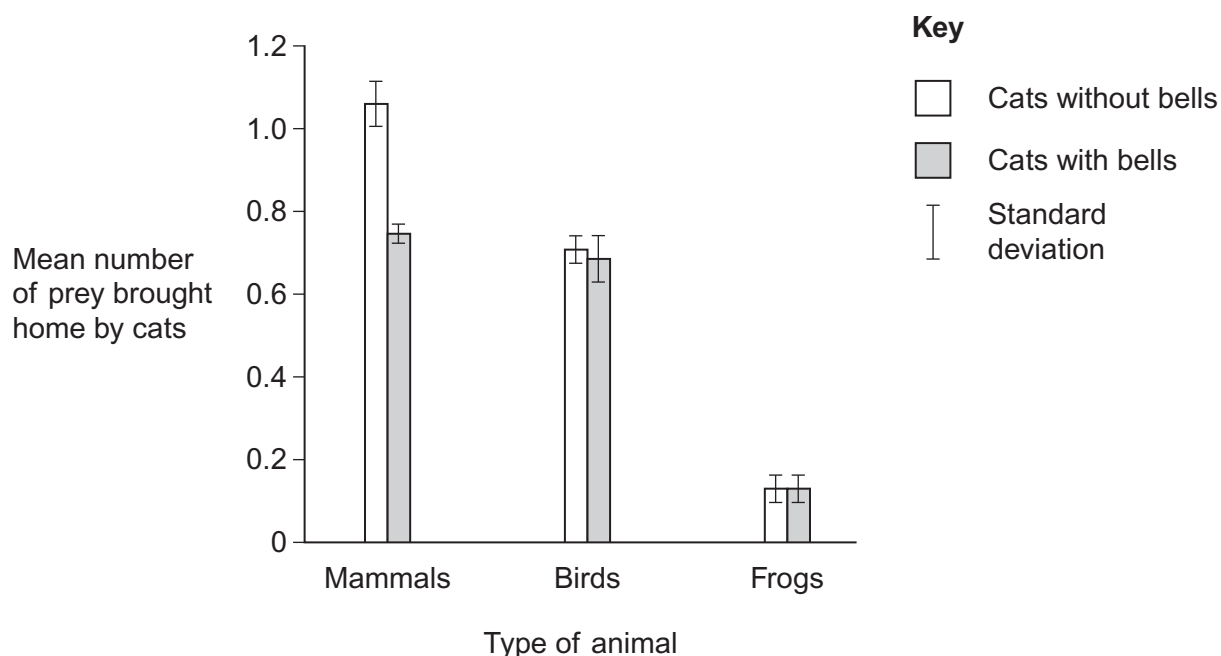
Question 5 continues on the next page

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- 5 (c)** The ecologists investigated the effect of putting a bell on a cat's collar on its probability of catching prey. As in the first investigation, they asked cat owners to record the prey brought home by their cats. Half of the cats in this study had bells on their collars.

The graph shows the results.



- 5 (c) (i)** What was the hypothesis that the ecologists were investigating?

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(1 mark)

- 5 (c) (ii)** What do these data suggest about the effect of putting a bell on a cat's collar?

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(2 marks)



- 6 (a)** People with allergic asthma have an asthma attack when exposed to a specific allergen.

Explain how the allergen leads to difficulty in breathing.

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(4 marks)

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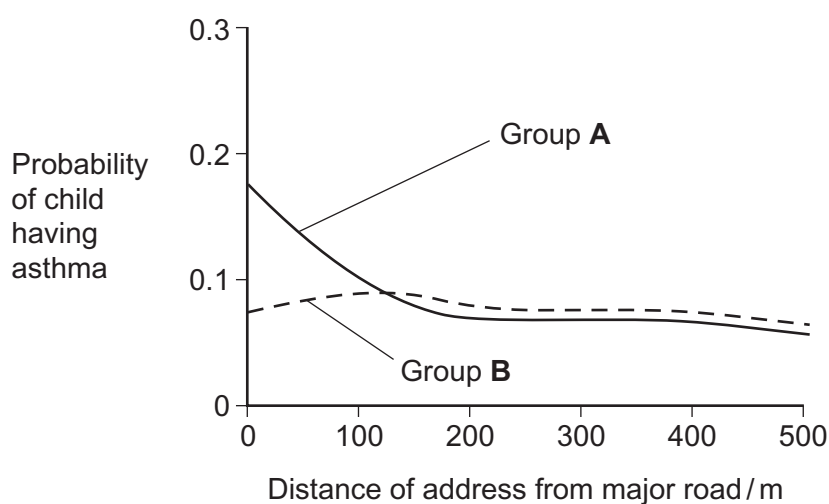
- 6 (b)** Doctors investigated the probability of having asthma amongst children living at different distances from major roads.

The doctors looked at the medical records of 5000 six-year-olds. The children were divided into two groups, **A** and **B**.

- Group **A** had lived at the same address since birth.
- Group **B** had moved to their present address after the age of two.

For each child, the doctors recorded whether they had asthma and how far they lived from a main road.

The graph shows the results for each group.



6 (b) (i) Describe the results.

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(2 marks)

6 (b) (ii) The doctors concluded that traffic pollution increases the risk of children having asthma.

Do these data show that living near to a main road increases the probability of a child developing asthma? Give reasons for your answer.

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(4 marks)

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7 (a) What is sympatric speciation?

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(2 marks)

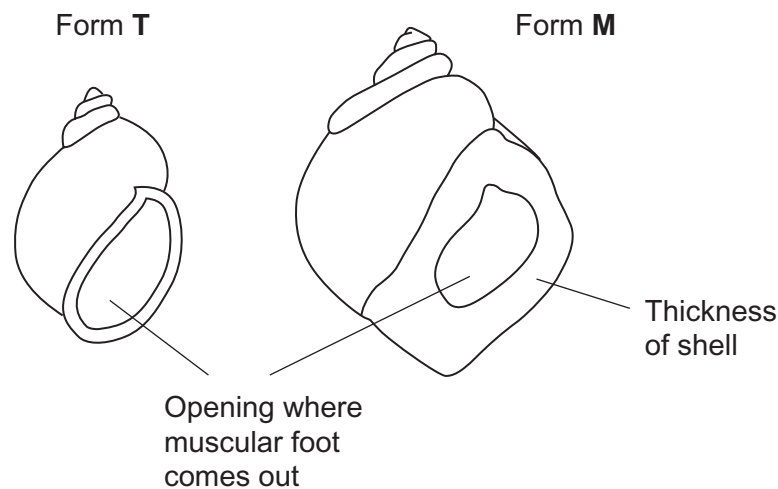
Littorina saxatilis is a snail found on rocky seashores. It has a shell and a muscular foot that it uses to move and to attach to rocks. Crabs are predators of this snail. The crabs use their claws to break open the snails' shells, or pull the snails from their shells.

Two forms of this snail are common in the UK.

Form **T** lives near the top of the shore. It lives in cracks in rock. Wave action is greatest near the top of the shore and there are very few crabs.

Form **M** lives on the middle shore. On the middle shore there are many crabs. Unlike form **T**, the snails of form **M** live on the open rock and not in cracks.

Forms **T** and **M** were produced by natural selection. The drawings show both forms of the snail.



The table shows features of these forms.

Feature	Form of <i>Littorina saxatilis</i>	
	T	M
Size of shell	Small	Large
Thickness of shell	Thin	Thick
Size of opening of shell	Large	Small

- 7 (b)** Use this information to answer the following question.
Give **two** differences between forms **T** and **M**.
For each difference suggest how **one** environmental factor may have caused differential survival in the snail populations leading to this difference.

Difference 1

Suggestion

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Difference 2

Suggestion

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(4 marks)

- 7 (c)** Scientists placed male and female snails of forms **T** and **M** into an aquarium. They recorded how many form **T** males mated with form **T** females and how many mated with form **M** females.

The scientists found that the probability of a form **T** male mating with a form **T** female was greater than 90 %. They interpreted this result as evidence that speciation was taking place.

Explain why.

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(2 marks)



8 (a) Communities of bacteria live in the human gut.

What is a community of bacteria?

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(2 marks)

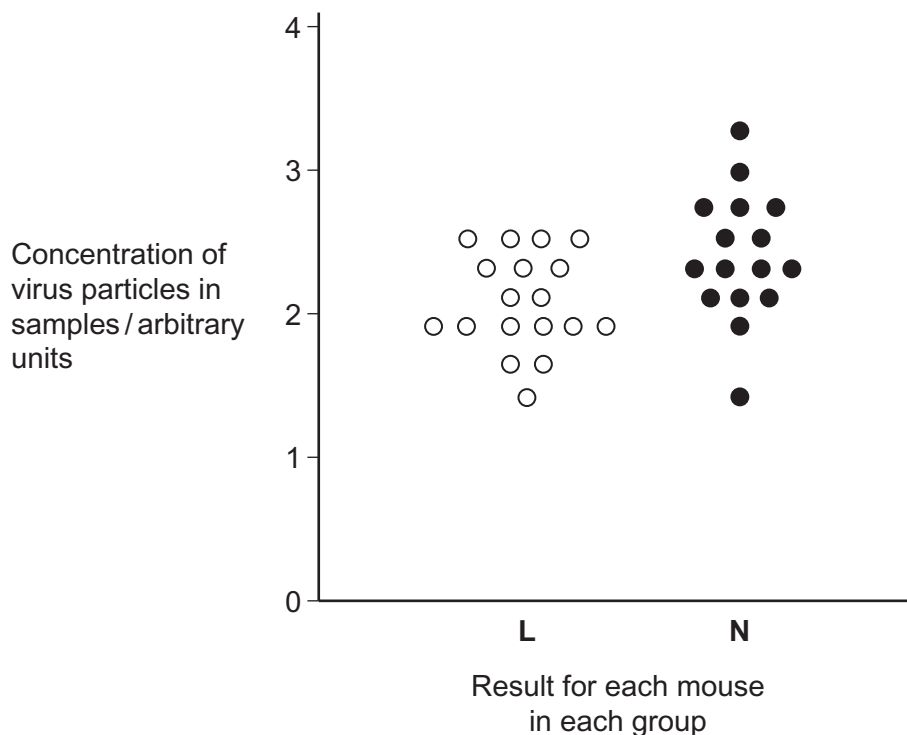
8 (b) *Lactobacillus casei* is a bacterium used in many probiotic foods.

Scientists obtained two groups of young mice.

- Group **L** was fed a diet containing *Lactobacillus casei*.
- Group **N** was fed the same diet without the bacterium.

After three weeks, they infected both groups of young mice with influenza virus. Three days after infection, the scientists measured the concentration of influenza virus particles in samples taken from the noses of the mice.

The graph shows their results, in the form they were presented by the scientists.



- 8 (b) (i)** The scientists used a statistical test to compare the mean concentrations of virus in each group. They obtained a value of p of < 0.05 . What does this value show?

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 (1 mark)

- 8 (b) (ii)** Do these results show that *Lactobacillus casei* increased the resistance of mice to the influenza virus?

Give reasons for your answer.

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 (3 marks)

(Extra space)

6

Turn over for the next question

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- 9 Biofuels include biodiesel and bioethanol. Biodiesel is made from plant lipids and bioethanol by fermentation of plant sugars.

One source of biodiesel is marine algae. These are single-celled photosynthetic organisms that live in the sea. They can be grown in large ponds full of seawater and then harvested.

Scientists compared features of a species of marine alga with maize and oilseed rape. Maize and oilseed rape are also used as sources of biofuel.

The table shows their results.

Feature of organism	Maize	Oilseed rape	Marine alga
Lipid content / percentage of mass	6	42	23
Fermentable sugars / percentage of mass	70	9	30
Energy content of organisms per hectare of land used for plants or ponds / Gigajoules	120	73	1150
Volume of freshwater or seawater required per unit of energy content / dm ³	33 (freshwater)	200 (freshwater)	440 (seawater)

The scientists concluded that it would be better to use the marine alga as a source of biofuel than maize or oilseed rape.



- 9 (a)** Using the information provided, explain **two** features that led the scientists to this conclusion.

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(4 marks)

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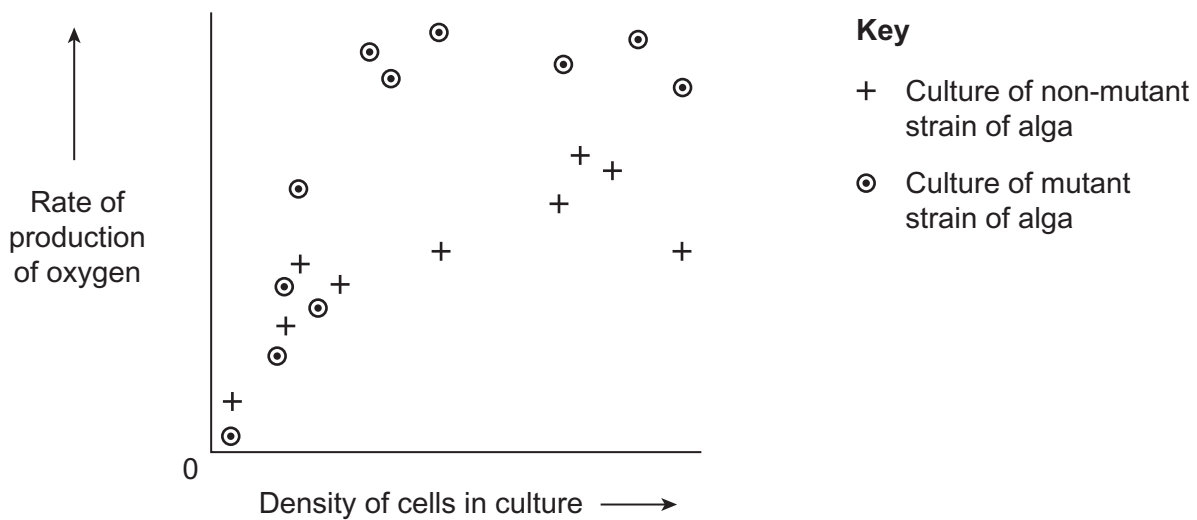
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Another group of scientists investigated whether a mutant strain of a species of alga would be a better source of biofuel than a non-mutant strain.

They grew non-mutant and mutant strains of the alga in cultures. They measured the rate of production of oxygen in each culture to decide which strain would be the best source of biofuel.

Their results are shown in the graph.



- 9 (b)** Suggest why the scientists chose the rate of oxygen production as the dependent variable in this investigation.

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(2 marks)



- 9 (c)** One scientist concluded that the mutant strain would produce more biofuel than the non-mutant strain. Evaluate this conclusion.

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(4 marks)

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ESSAY

You should write your essay in continuous prose.

Your essay will be marked not only for its scientific accuracy. It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is:

Scientific content	16
Breadth of knowledge	3
Relevance	3
Quality of Written Communication	3

10 Write an essay on **one** of the topics below.

EITHER

10 (a) The environment affects all aspects of human life. (25 marks)

OR

10 (b) The importance of movement of substances and cells. (25 marks)

END OF QUESTIONS

If you want to make a plan write it here.

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This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.

Handwriting practice area with 20 horizontal dotted lines.

