Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
January 2005
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY/HUMAN BIOLOGY (SPECIFICATION A) BYA5
Unit 5 Inheritance, Evolution and Ecosystems

Monday 24 January 2005 Morning Session

In addition to this paper you will require:
- a ruler with millimetre measurements.

You may use a calculator.

Time allowed: 1 hour 30 minutes

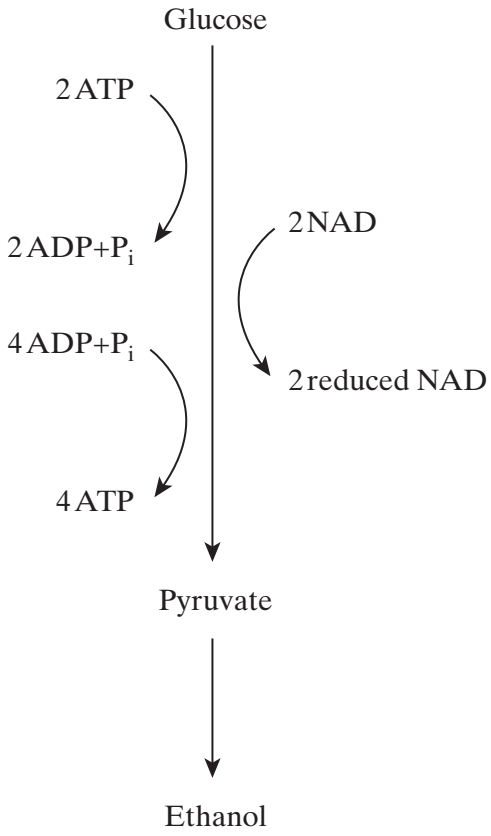
Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 75.
- Mark allocations are shown in brackets.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.
- The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 The diagram summarises the process of anaerobic respiration in yeast cells.



(a) (i) In anaerobic respiration, what is the net yield of ATP molecules per molecule of glucose?

.....

(1 mark)

(ii) Give **two** advantages of ATP as an energy-storage molecule within a cell.

1 .....

.....

2 .....

.....

(2 marks)

(b) Describe how NAD is regenerated in anaerobic respiration in yeast cells.

.....

.....

(1 mark)

(c) The respiratory quotient (RQ) for yeast respiring aerobically and using glucose as a substrate is 1.0. However, some students found the RQ of yeast respiring glucose to be 1.6. Assuming that their technique was correct, explain how this is possible.

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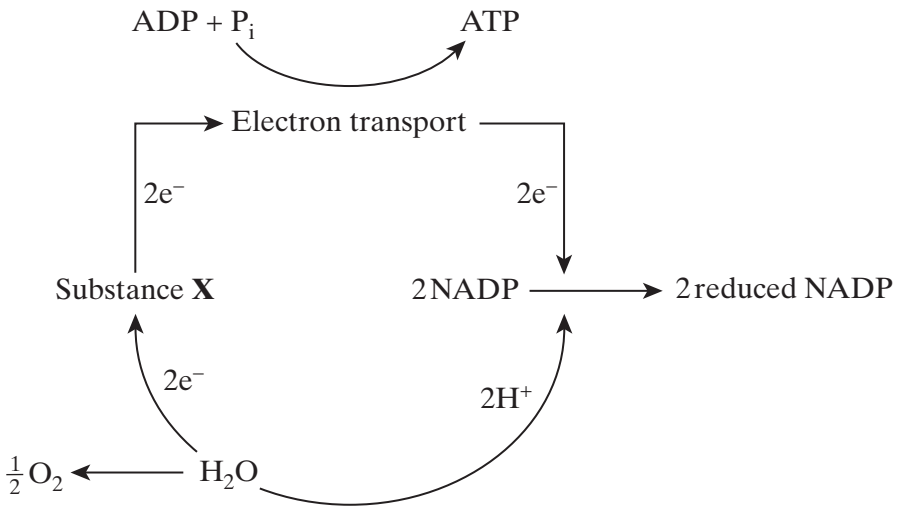
(2 marks)

6

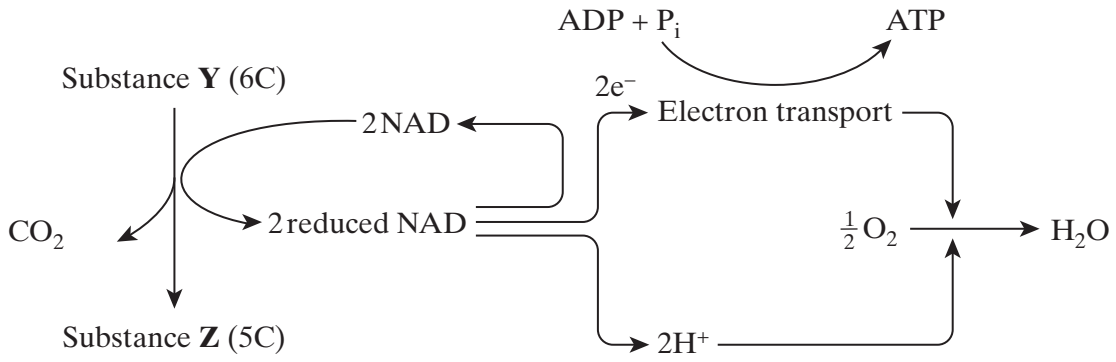
TURN OVER FOR THE NEXT QUESTION

2 The diagram shows some of the stages in two processes that produce ATP.

Process 1



Process 2



(a) In **Process 1**, what causes substance **X** to lose electrons (e^-)?

.....

.....

(1 mark)

(b) Where precisely, within a cell, does electron transport take place in **Process 2**?

.....

.....

(1 mark)

(c) Name **one** kingdom which contains organisms that can produce ATP using both processes. Explain your choice.

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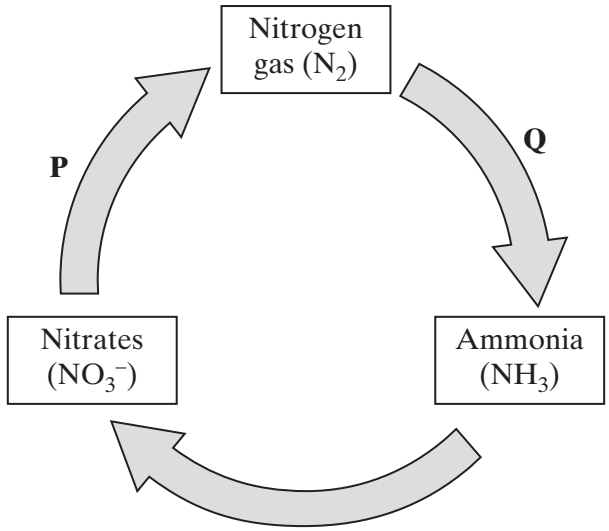
(2 marks)

4

TURN OVER FOR THE NEXT QUESTION

3 The diagram shows part of the nitrogen cycle.



(a) Name processes **P** and **Q**.

P .....

Q .....

(2 marks)

(b) It is estimated that, each year, a total of 3×10^9 tonnes of ammonia are converted to nitrate. Only 2×10^8 tonnes of ammonia are produced from nitrogen gas. Explain the difference in these figures.

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(2 marks)

(c) The conversion of ammonia to nitrate involves oxidation. What evidence in the diagram supports this?

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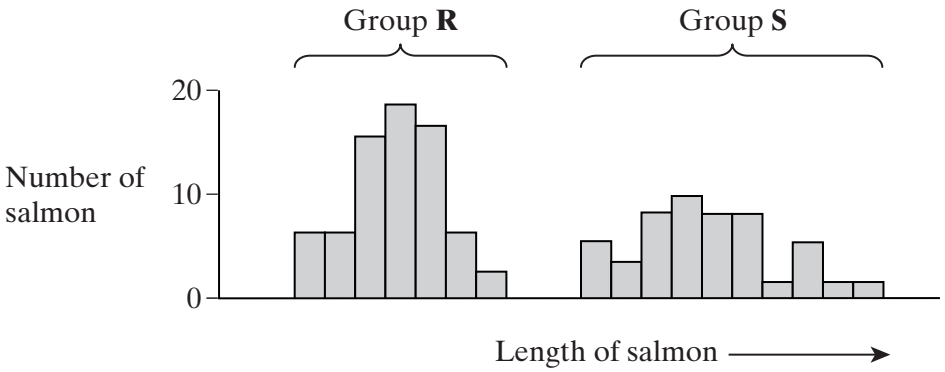
(1 mark)

5

4 The graph shows the variation in length of 86 Atlantic salmon.



(a) (i) What type of variation is shown by the lengths of the salmon in group **R**? Give the evidence to support your answer.

.....

.....

(1 mark)

(ii) Give **two** possible causes of this variation that result from meiosis during gamete formation.

1 .....

.....

2 .....

.....

(2 marks)

(b) When comparing variation in size between two groups of organisms, it is often considered more useful to compare standard deviations rather than ranges. Explain why.

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(2 marks)

5

5 The herring is a fish found in the North Sea. In the food chain below, the figures represent biomass. The units are $g\,m^{-3}$.

Phytoplankton	→	Zooplankton	→	Herring
4.0		21.0		1.7

(a) Sketch and label a pyramid of biomass to represent this food chain.

(1 mark)

(b) In this food chain, the phytoplankton reproduce very rapidly. Suggest why this rapid rate of reproduction is essential to sustain the food chain.

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(2 marks)

(c) Phytoplankton are mainly unicellular Protoctista. Give **two** structural features you would expect to find in phytoplankton cells.

Feature 1 .....

.....

Feature 2 .....

.....

(2 marks)

5

6 (a) Explain how large-scale deforestation for agriculture would lead to a decrease in the diversity of organisms in the area.

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(2 marks)

(b) Explain how large-scale deforestation could

(i) increase the concentration of carbon dioxide in the atmosphere in the area;

.....

.....

.....

.....

(ii) decrease the concentration of carbon dioxide in the atmosphere in the area.

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(3 marks)

5

7 In fruit flies, the allele for grey body, **G**, is dominant to the allele for ebony body, **g**, and the allele for normal wings, **N**, is dominant to the allele for vestigial wings, **n**. Vestigial-winged flies, heterozygous for grey body colour, were crossed with ebony-bodied flies, heterozygous for normal wings.

(a) Complete the genetic diagram to show the genotypes and phenotypes in this cross.

Parental phenotypes Grey body, vestigial wings Ebony body, normal wings

Parental genotypes ....

Gamete genotypes ....

Offspring genotypes .....

Offspring phenotypes .....

(4 marks)

(b) The numbers of offspring from several such crosses were

Grey body, normal wings	241
Grey body, vestigial wings	220
Ebony body, normal wings	272
Ebony body, vestigial wings	267
Total offspring	1000

The χ^2 test can be used to find out whether or not these results fit the expected 1:1:1:1 ratio.

(i) Give a suitable null hypothesis for the investigation.

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.....

(1 mark)

(ii) Complete the table below to calculate the value for χ^2 for these results.

Feature	**Observed** ***(O)***	**Expected** ***(E)***	***(O - E)***	$(O - E)^2$	$\frac{(O - E)^2}{E}$
Grey body, normal wings	241				
Grey body, vestigial wings	220				
Ebony body, normal wings	272				
Ebony body, vestigial wings	267				
			$\chi^2 = \Sigma \frac{(O - E)^2}{E} =$		

(2 marks)

(iii) Explain how you would find out whether the value obtained for χ^2 indicates that the null hypothesis should be accepted or rejected.

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(3 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

(c) The allele for vestigial wings probably arose as a mutation of the allele for normal wings.

(i) What is a gene mutation?

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.....

(1 mark)

(ii) Name **two** different types of gene mutation and explain the consequences of each.

1 .....

.....

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2 .....

.....

.....

(4 marks)

15

8 (a) Explain the meaning of these ecological terms.

Population .....

.....

Community .....

.....

(2 marks)

(b) Some students used the mark-release-recapture technique to estimate the size of a population of woodlice. They collected 77 woodlice and marked them before releasing them back into the same area. Later they collected 96 woodlice, 11 of which were marked.

(i) Give **two** conditions necessary for results from mark-release-recapture investigations to be valid.

1 .....

.....

2 .....

.....

(2 marks)

(ii) Calculate the number of woodlice in the area under investigation. Show your working.

Answer .....

(2 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

(c) Explain how you would use a quadrat to estimate the number of dandelion plants in a field measuring 100 m by 150 m.

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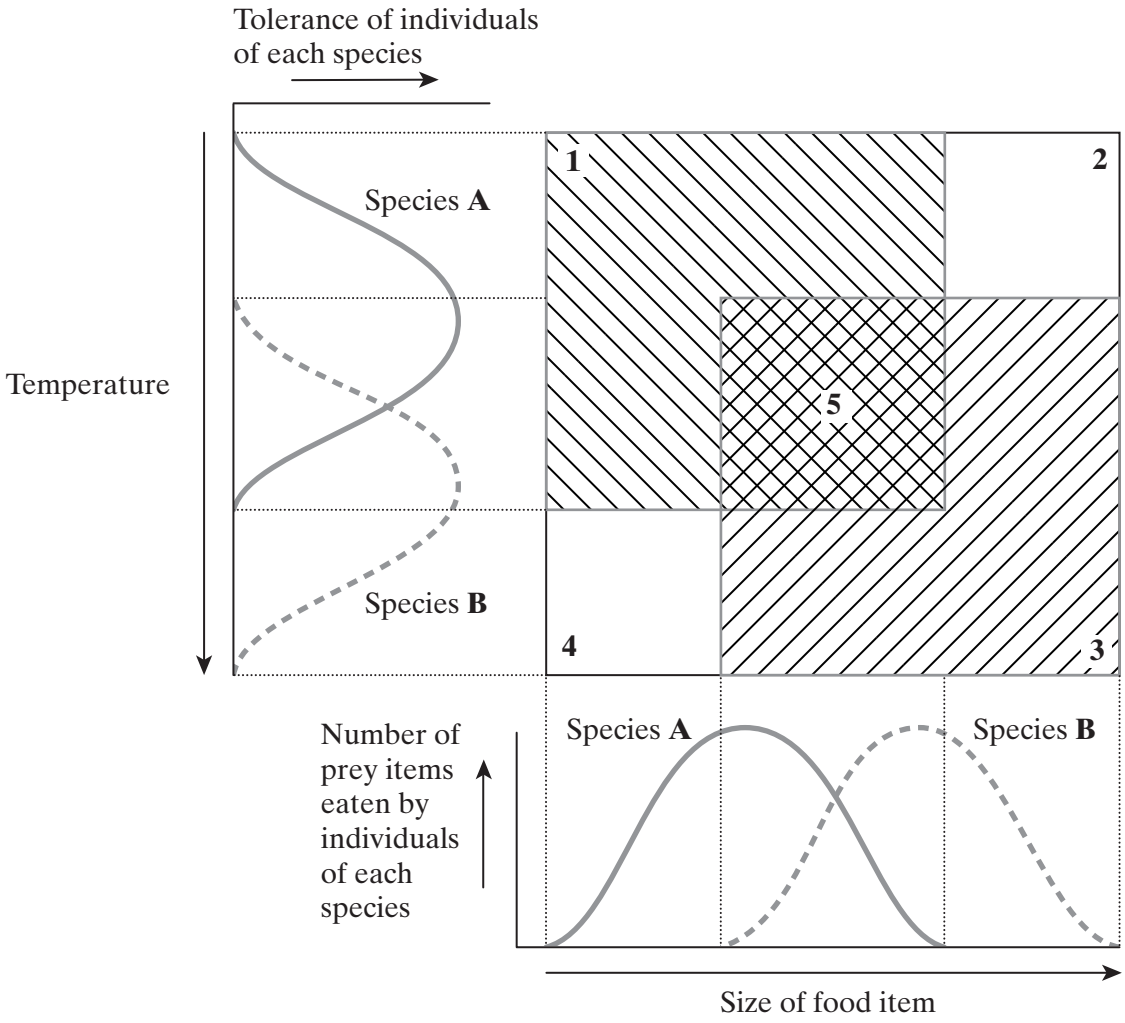
(3 marks)

(d) Two similar species of birds (species **A** and species **B**) feed on slightly different sized insects and have slightly different temperature preferences. The diagram represents the response of each species to these factors.



(i) Which of the numbered boxes describes conditions which represent

the niche of species **A**; .....

the niche of species **B**; .....

insects too small for species **B** and temperature too warm for species **A**; .....

insects too large for species **A** and temperature too cool for species **B**? .....

(2 marks)

(ii) These two species are thought to have evolved as a result of sympatric speciation. Suggest how this might have occurred.

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(4 marks)

15

TURN OVER FOR THE NEXT QUESTION

9 (a) Explain what is meant by stabilising selection and describe the circumstances under which it takes place.

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(5 marks)

(b) Some European clover plants can produce cyanide. Those plants that can produce cyanide are called cyanogenic; those that cannot produce cyanide are called acyanogenic. Cyanide is toxic to the cells of animals and plants.

(i) **Figure 1** shows how the production of cyanide in a species of European clover is genetically controlled.

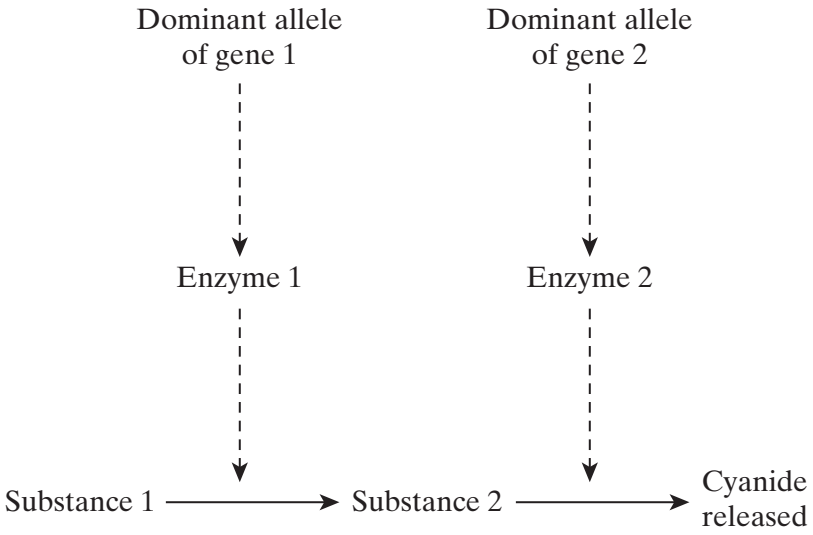

Figure 1

Use information in **Figure 1** and your own biological knowledge to explain how the production of cyanide depends on the genotypes of the clover plants.

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(5 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

(ii) When the leaves of cyanogenic plants are damaged by slugs, or exposed to low temperatures, membranes within the cells are broken. This causes the release of the enzymes that control the reactions which produce cyanide.

The proportions of cyanogenic and acyanogenic plants in clover populations were determined in different parts of Europe. These are shown in **Figure 2**, together with the mean minimum winter temperatures. Slugs are not usually active at temperatures below 0 °C.

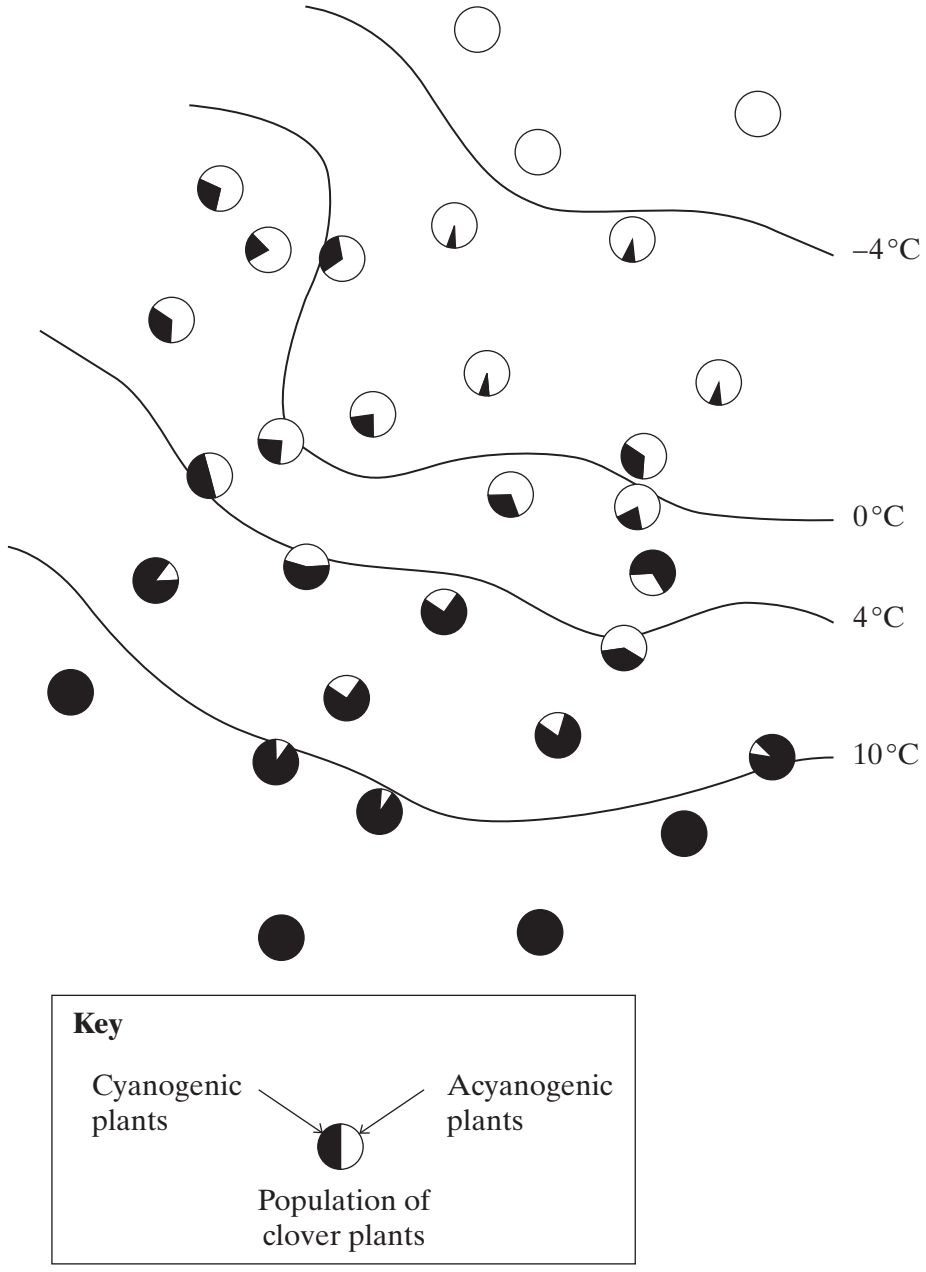

Figure 2

Explain the proportions of cyanogenic and acyanogenic plants in clover populations growing in the area where the mean minimum winter temperature is below −4 °C and in the area where it is above 10 °C.

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(5 marks)

15

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE