

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

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General Certificate of Education
 June 2006
 Advanced Level Examination



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

BYA5

Tuesday 20 June 2006 9.00 am to 10.30 am

For this paper you must have:

- a ruler with millimetre measurements

You may use a calculator.

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

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.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.
- Use accurate scientific terminology in all your answers.

Information

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

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

1 Finches are small birds. Fourteen species of finch are found on the Galapagos Islands.

(a) What is a species?

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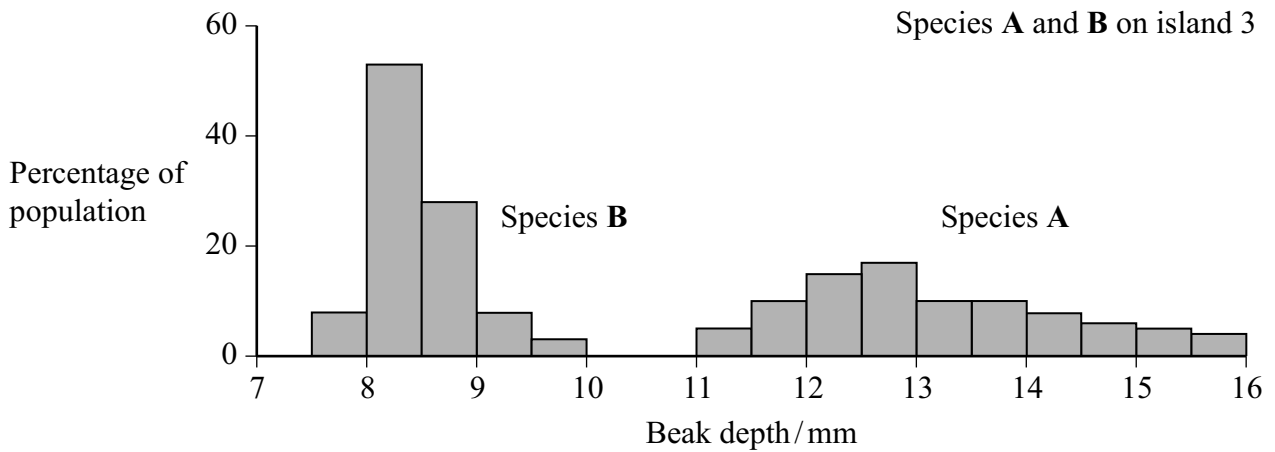
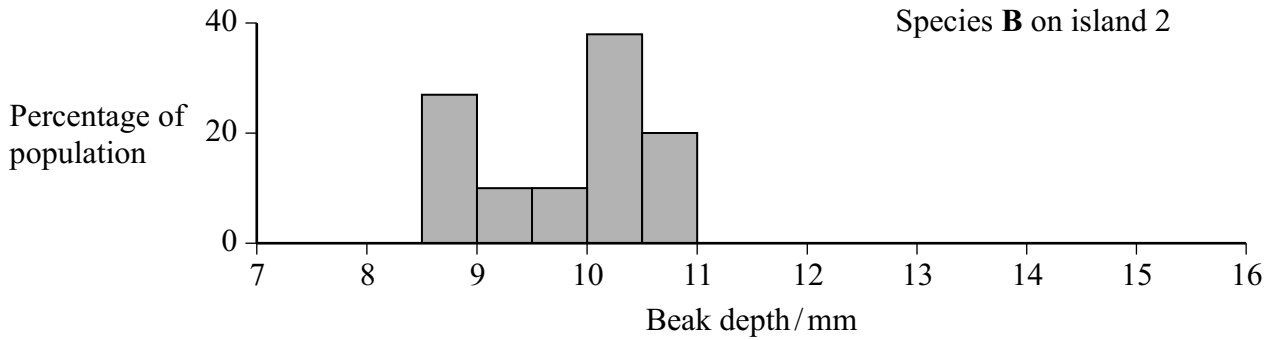
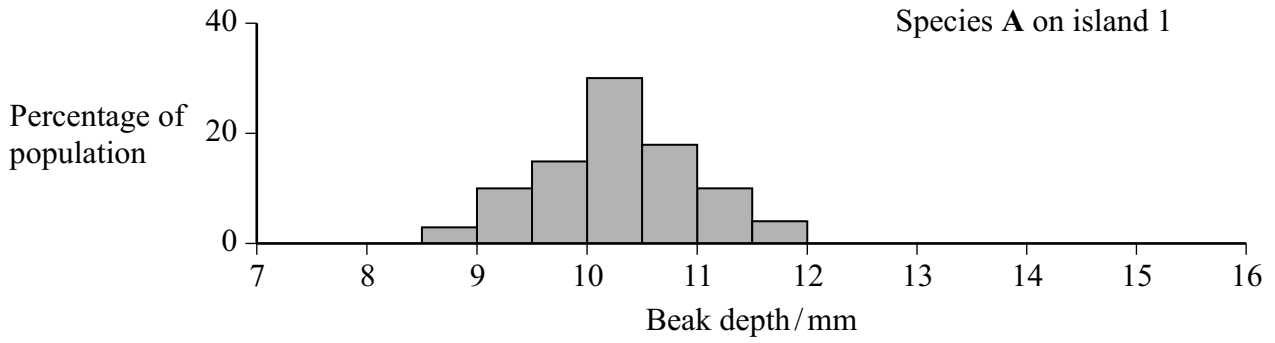
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(2 marks)

(b) Measurements were made of the beak depth of two species of finch (species **A** and species **B**) on different islands. Species **A** is found on island 1, species **B** is found on island 2. Both species are found on island 3. They are thought to have colonised island 3 from islands 1 and 2 respectively. The graphs show the ranges of beak depths of the two species on the different islands.



What type of natural selection took place in the populations of both species after they had colonised island 3? Explain your answer.

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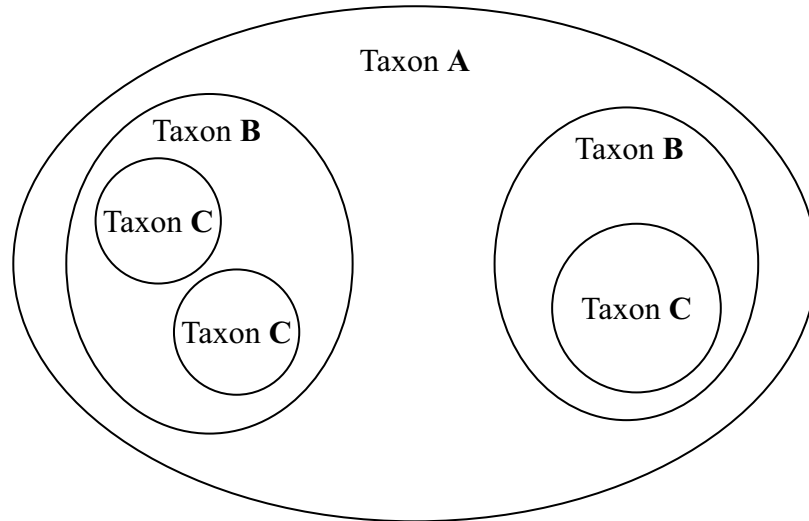
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(3 marks)

Turn over 

2 In taxonomy, each of the levels of classification (class, family, genus, kingdom, order, phylum and species) is called a taxon. The diagram represents just three of these levels of classification.



(a) Explain which of these levels of classification could **not** be

(i) a genus;

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(ii) a phylum.

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(2 marks)

(b) Give **two** features that are characteristic of the kingdom Fungi.

1.

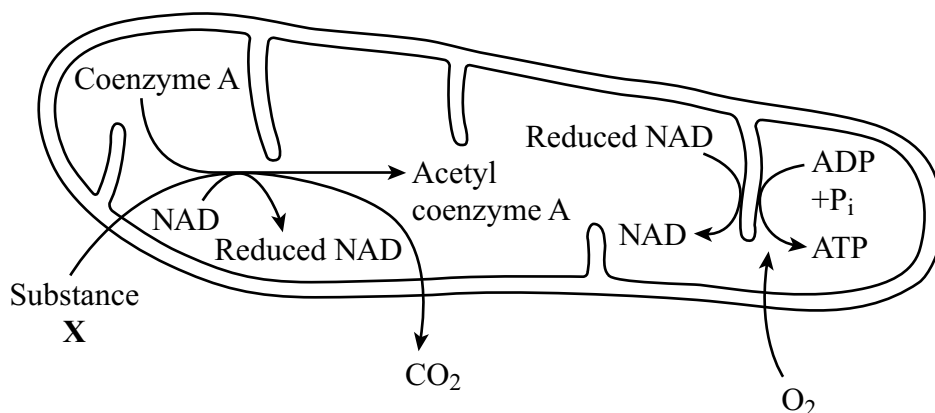
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2.

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(2 marks)

3 The diagram represents two of the stages of aerobic respiration that take place in a mitochondrion.



(a) Name substance X.

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(1 mark)

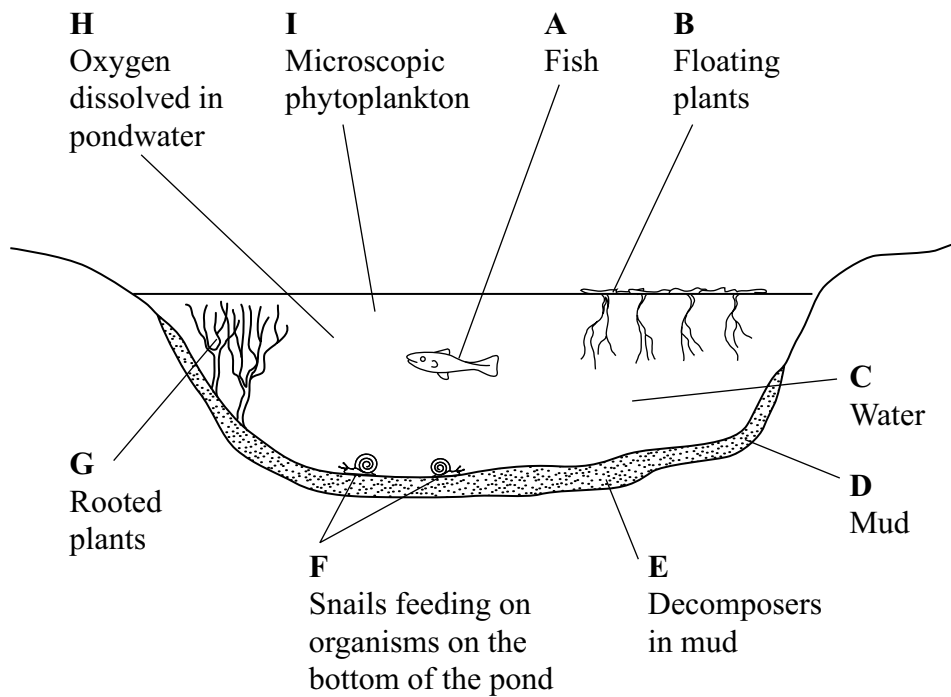
(b) Which stage of aerobic respiration takes place inside a mitochondrion and is **not** represented on the diagram?

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(1 mark)

(c) Explain why oxygen is needed for the production of ATP on the cristae of the mitochondrion.

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(3 marks)

4 The diagram shows some of the components of a pond ecosystem.



(a) (i) What is an ecosystem?

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(1 mark)

(ii) List the letters that represent those components that are part of the pond community.

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(1 mark)

(b) New Zealand pygmy weed has been introduced into many garden ponds and has spread to some natural ponds. Here, it competes with naturally occurring plants. Suggest how the introduction of pygmy weed may lead to a reduction in the diversity of the community in a natural pond.

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(3 marks)

5

Turn over for the next question

Turn over 

- 5 In an investigation into the respiration of soil microorganisms, the following data were obtained.

Experiment	Volume of oxygen taken up / $\text{cm}^3 \text{ min}^{-1}$	Volume of carbon dioxide produced / $\text{cm}^3 \text{ min}^{-1}$
1	0.83	0.74
2	0.81	0.69
3	0.76	0.67

- (a) (i) Use the data to calculate the mean respiratory quotient (RQ) of these microorganisms. Show your working.

Mean RQ = (2 marks)

- (ii) In a separate investigation using different microorganisms, the mean RQ was found to be 0.92. What does this RQ indicate about the nature of the substance or substances used by these microorganisms in their respiration?

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(2 marks)

(b) Explain how soil microorganisms contribute to the cycling of carbon.

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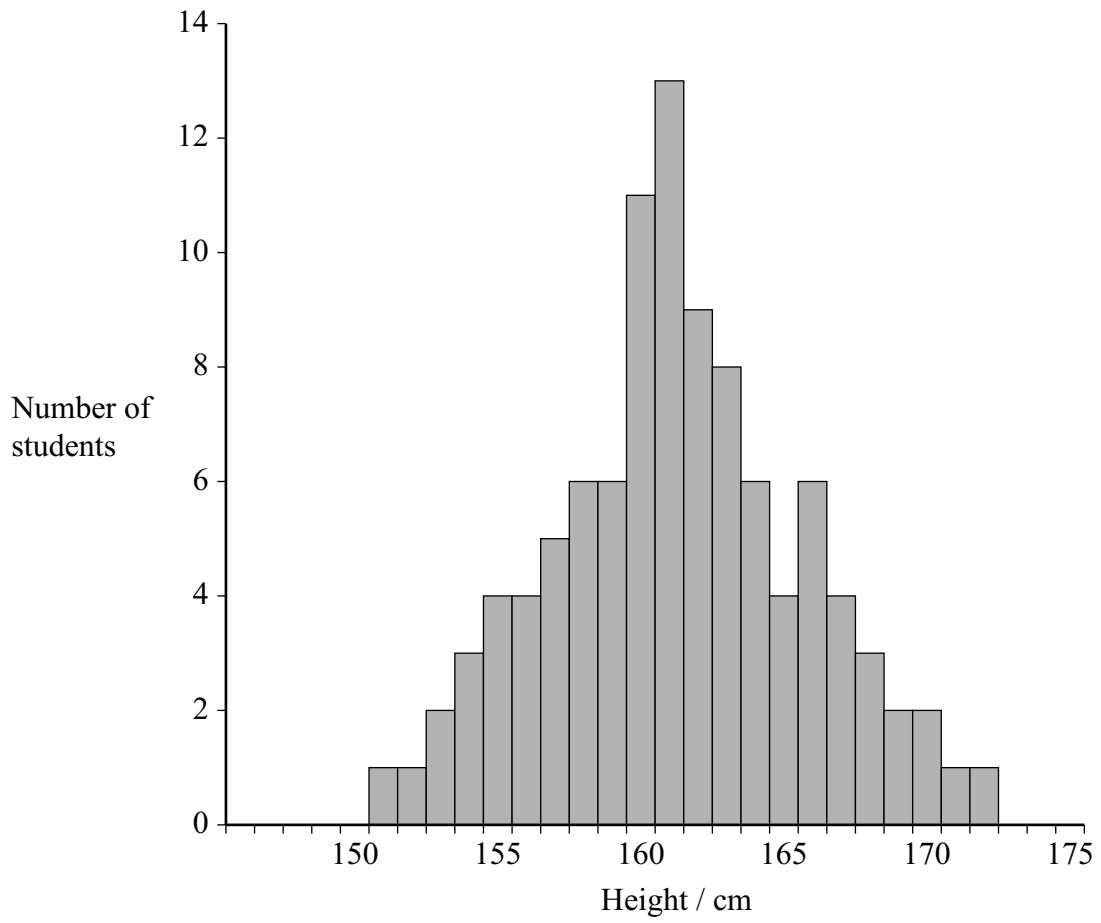
(3 marks)

7

Turn over for the next question

Turn over 

6 The histogram shows the variation in height of 17-year-old male students from one college.



- (a) What does the histogram indicate about the inheritance of this feature? Explain your answer.

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(2 marks)

- (b) The standard error of the mean was calculated. What information would this give about the mean height of 17-year-old males?

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(2 marks)

4

Turn over for the next question

Turn over 

- 7 In the ABO blood-grouping system, a single gene with three alleles controls the production of the antigens that determine a person's blood group. **Table 1** shows the alleles and the antigens whose production they control. **Table 2** shows the different genotypes and their corresponding blood groups.

Table 1

Allele	Antigen produced
I^A	Antigen A
I^B	Antigen B
I^O	Neither antigen

Table 2

Genotype	Blood group
$I^A I^A$ or $I^A I^O$	A
$I^B I^B$ or $I^B I^O$	B
$I^A I^B$	AB
$I^O I^O$	O

- (a) (i) Explain why people with the genotype $I^A I^B$ have the blood group AB.

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(2 marks)

- (ii) Explain how meiosis results in people with the blood group AB producing two different types of gamete with respect to the gene for the ABO blood groups.

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(3 marks)

- (b) (i) In one family, the four children each have a different blood group. Their mother is group A and their father is group B. Complete the genetic diagram to show how this is possible.

Parental phenotypes	Blood group A	Blood group B
Parental genotypes	_____	_____
Gametes	_____	_____
Offspring genotypes	_____	
Offspring phenotypes	_____	

(3 marks)

Question 7 continues on the next page

- (ii) In many families where the parents could have produced children of all four blood groups, the total number of children with each blood group was

Blood group A	26
Blood group B	31
Blood group AB	39
Blood group O	24
Total	120

The χ^2 test can be used to test the hypothesis that there is no significant difference between these results and the expected 1: 1: 1: 1 ratio. Complete the table to calculate the value for χ^2 for these results.

Blood group	Observed (O)	Expected (E)	$(O - E)$	$(O - E)^2$	$\frac{(O - E)^2}{E}$
A	26				
B	31				
AB	39				
O	24				
			$\sum \frac{(O - E)^2}{E} =$		

(2 marks)

- (iii) The critical value for χ^2 with three degrees of freedom at the 0.05 probability level is 7.82. Explain what the calculated value of χ^2 tells us about these results.

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(2 marks)

- (c) On an island with a population of 750, the frequency of the I^O allele was 0.8. Assuming that the conditions of the Hardy–Weinberg equilibrium apply, calculate how many people on this island had blood group O. Show your working.

Answer (3 marks)

15

Turn over for the next question

Turn over 

8 In the activated sludge method of sewage treatment, organic matter in untreated sewage supplies nutrients to bacteria in the treatment tank. These bacteria include decomposers and nitrifying bacteria. The bacteria are eaten by ciliated protoctists, which are, in turn, eaten by carnivorous protoctists.

- (a) (i) Sketch and label a pyramid of energy for the organisms found in the treatment tank.

(1 mark)

- (ii) Explain what causes this pyramid of energy to be this shape.

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(2 marks)

- (b) (i) Explain the roles of the decomposers and the nitrifying bacteria in converting nitrogen in organic compounds in the sewage into a soluble, inorganic form.

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(3 marks)

- (ii) Nitrifying bacteria are one kind of bacteria that are important in the nitrogen cycle; nitrogen-fixing bacteria are another kind. Describe the part played by nitrogen-fixing bacteria in the nitrogen cycle.

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(2 marks)

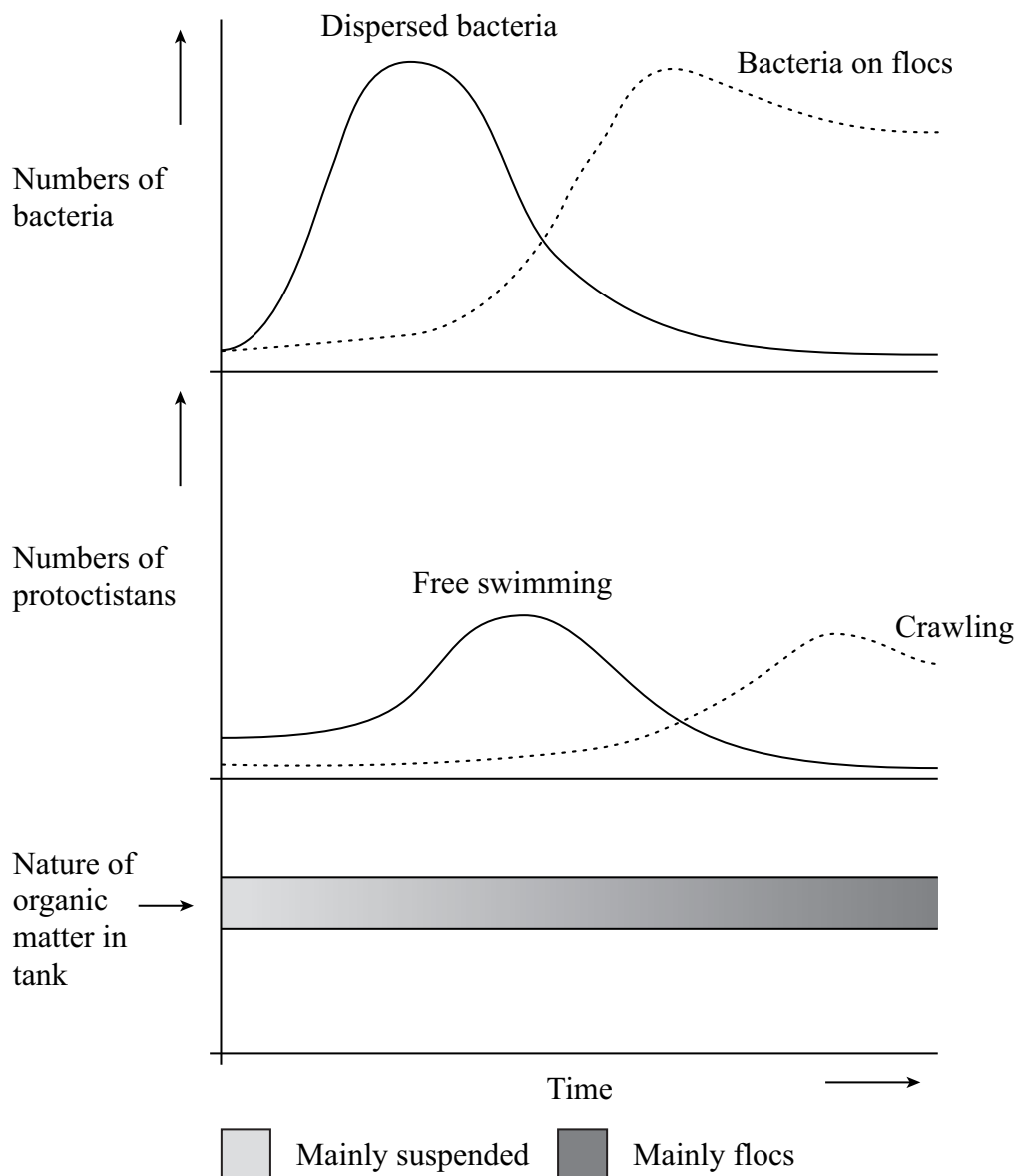
Question 8 continues on the next page

Turn over 

(c) The organic matter in untreated sewage consists of small particles, which are suspended in water. Activated sludge consists of solid lumps (flocs) of organic matter and bacteria. When the two are mixed in the treatment tank, bacteria from the flocs become dispersed in the water and feed on the suspended organic matter, converting it to flocs. Different types of ciliated protoctists feed on the bacteria.

- Free-swimming protoctists are able to move throughout the tank.
- Crawling protoctists can only move over the surface of the flocs.

The diagram shows the change in the nature of the organic matter in the treatment tank and the changes in the numbers of the different types of organisms present.



- (i) Explain the changes in the numbers of dispersed bacteria and the numbers of free-swimming protoctistsans.

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(3 marks)

- (ii) Explain how the changes that occur in the treatment tank illustrate the process of succession.

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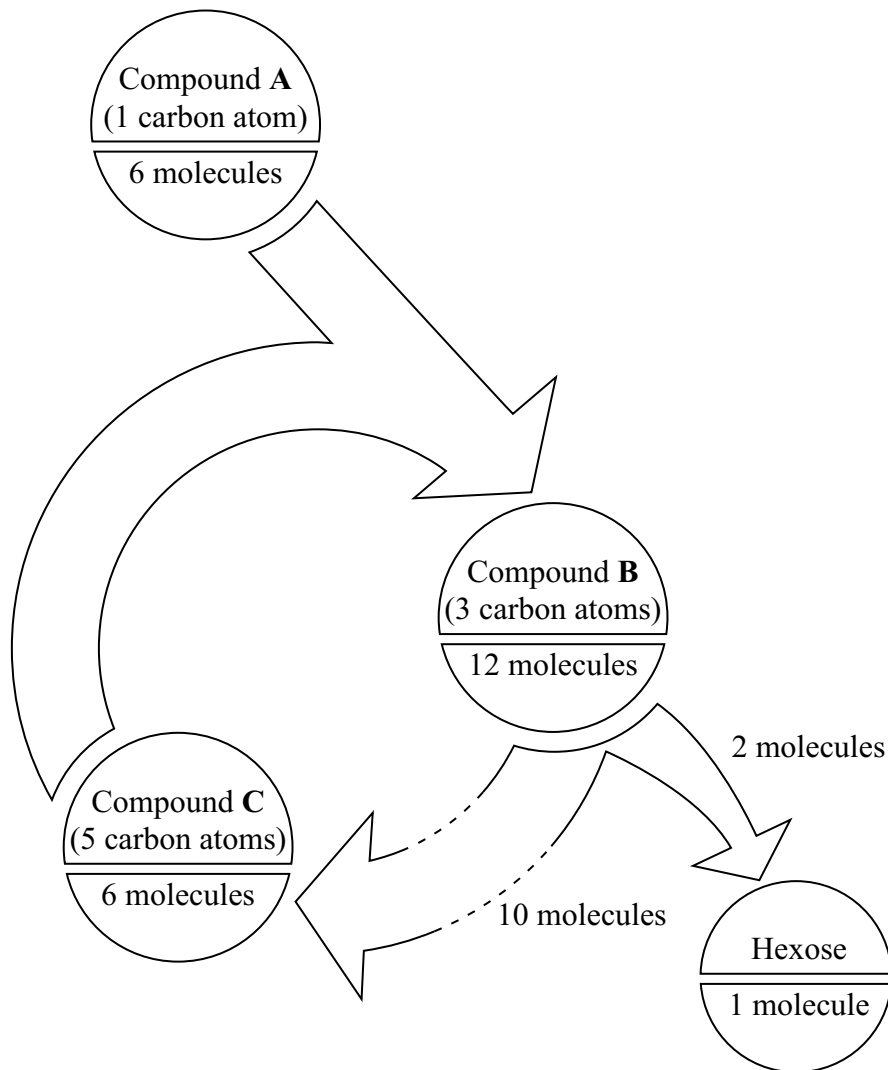
(4 marks)

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Turn over for the next question

Turn over 

9 The diagram represents some of the light-independent reactions of photosynthesis.



- (a) Describe the light-independent reactions of photosynthesis and explain how they allow the continued synthesis of hexose sugars.

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(6 marks)

- (b) Describe the role of electron transport chains in the light-dependent reactions of photosynthesis.

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(6 marks)

Question 9 continues on the next page

Turn over 

- (c) Explain why the increase in the dry mass of a plant over twelve months is less than the mass of hexose produced over the same period.

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(3 marks)

15

END OF QUESTIONS

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