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General Certificate of Education
June 2002
Advanced Level Examination



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

Monday 17 June 2002 Morning Session

No additional materials are required.
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			
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4			
5			
6			
7			
8			
9			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

- 1 (a) What is meant by the term *species*?

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 (2 marks)

- (b) List the following taxonomic groups in sequence according to the number of species they contain. Start with the group with the greatest number of species.

	class	family	genus	kingdom	order	phylum
1.....						
2.....						
3.....						
4.....						
5.....						
6.....						

(1 mark)

- (c) Give **one** way in which cells from members of the kingdom Prokaryotae differ from those of all other kingdoms.

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 (1 mark)

- 2 (a) What is meant by each of the following ecological terms?

(i) Community

(ii) Population

(iii) Ecosystem

(3 marks)



- (b) Suggest why, in a particular ecosystem, two species do not occupy the same niche.

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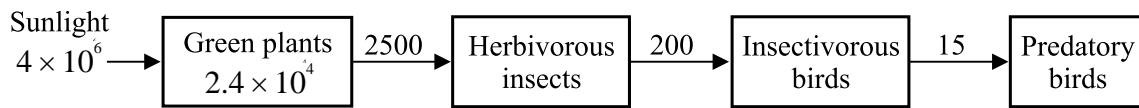
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(2 marks)

- 3 The diagram shows the annual flow of energy through a terrestrial ecosystem. The figures are in kJ m^{-2} .



- (a) Give **two** reasons why very little of the sunlight energy falling on the leaves of a plant can be used in primary production.

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(2 marks)

- (b) Explain why a food chain rarely contains more than four trophic levels.

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(3 marks)

- 4 In tomato plants, the genes for flower colour and for height are on different chromosomes. The allele for yellow flowers (**Y**) is dominant to that for white flowers (**y**) and the allele for tall plants (**T**) is dominant to that for dwarf plants (**t**).

A tall tomato plant with yellow flowers was pollinated with pollen from a dwarf plant with white flowers. The resulting seeds were planted and grew into plants with the following phenotypes:

Tall, yellow: 63
Dwarf, yellow: 58

- (a) (i) To what Mendelian ratio do these results approximate?

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(1 mark)

- (ii) Explain why the results of crosses like this only approximate to the expected Mendelian ratio.

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(1 mark)

- (b) Use a genetic diagram to explain the results of this cross.

(3 marks)

- 5 (a) The table contains descriptions of events that occur during meiosis. Complete the table to show whether each event occurs during the first division (meiosis I) or during the second division (meiosis II). Also give the phase in which each event occurs.

Event	Division I or II	Phase (anaphase, metaphase, prophase or telophase)
1. The chromosomes, each in the form of a pair of chromatids, have arrived at the poles of the spindle and have started to uncoil.		
2. Homologous chromosomes form bivalents with chiasmata.		
3. Sister chromatids move towards opposite poles of the spindle.		
4. Pairs of homologous chromosomes line up at the equator of the spindle.		

(4 marks)

- (b) A cell during early prophase I of meiosis contained 12 picograms of DNA in the nucleus. How much DNA would be present in the nucleus of a gamete which was formed from this cell?

Answer picograms

(1 mark)

5

TURN OVER FOR THE NEXT QUESTION

- 6 Huntington's disease is a human inherited condition resulting in gradual degeneration of nerve cells in the brain. It is caused by a dominant allele but usually no symptoms are evident until the person is at least 30 years old. It is very rare in most populations. However, in one isolated area in Venezuela, 48% of the population possess a genotype which gives rise to Huntington's disease. Many of the inhabitants of this area can trace their origins back to a common ancestor 200 years ago.

- (a) Use the Hardy-Weinberg equation to estimate the percentage of this Venezuelan population which is heterozygous for Huntington's disease. Show your working.

Answer = %
(3 marks)

- (b) Suggest why

- (i) there is such a high incidence of Huntington's disease in this population;

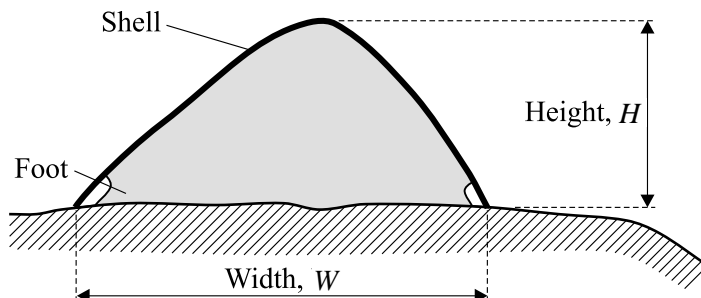
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- (ii) Huntington's disease has not been eliminated from this population by natural selection.

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(3 marks)

- 7 Limpets are animals which live on rocky sea shores. When the tide is out, a limpet is firmly attached to the rock by a muscular ‘foot’. Taller limpets are more likely to be dislodged by wave action. Variation in the size of limpets was investigated on two shores, **A** and **B**. The height and width of each limpet was measured as shown in the diagram.



The results of the investigation are given in the table.

	Shore A	Shore B
Mean $\frac{H}{W}$	0.33	0.47
Standard deviation	0.08	0.12
Sample size	28	33

- (a) (i) On which shore did the limpets have a greater variation in values of $\frac{H}{W}$? Give evidence from the table for your answer.

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(1 mark)

- (ii) Which shore had limpets that were better adapted to withstand wave action? Use evidence from the table to explain your answer.

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(3 marks)

- (b) (i) In investigations like this, why is it necessary to collect data from a large number of specimens which are selected at random?

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(2 marks)

(ii) Describe how you would select limpets at random.

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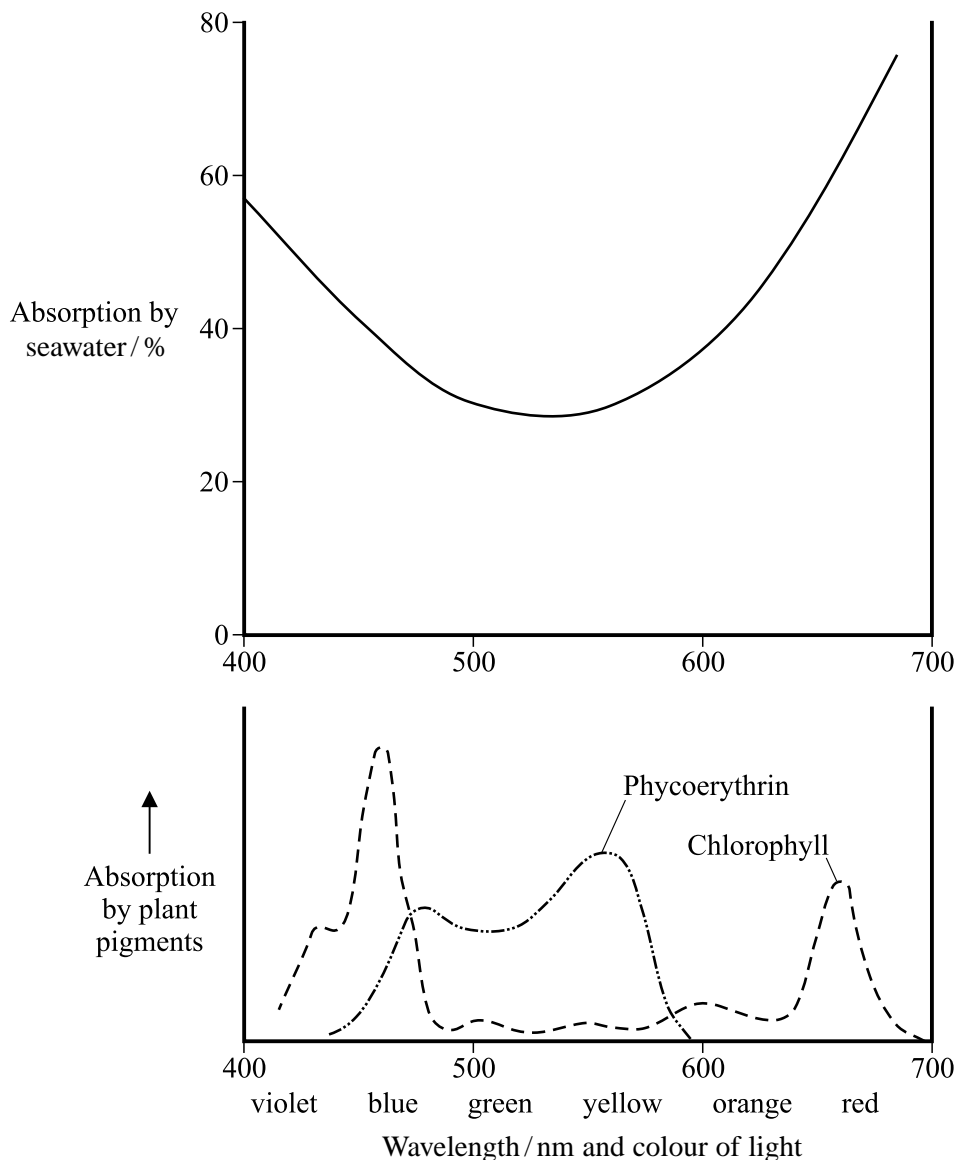
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(3 marks)

- (c) Red seaweeds are algae which contain, in addition to chlorophyll, a red pigment called phycoerythrin. Green seaweeds do not contain phycoerythrin. Both phycoerythrin and chlorophyll absorb light energy which can be used in photosynthesis. The graphs show the percentage of light of different wavelengths absorbed by sea water, by chlorophyll and by phycoerythrin.



Use information from the graphs to explain why red seaweeds are usually found in deeper water (further down the shore) than green seaweeds.

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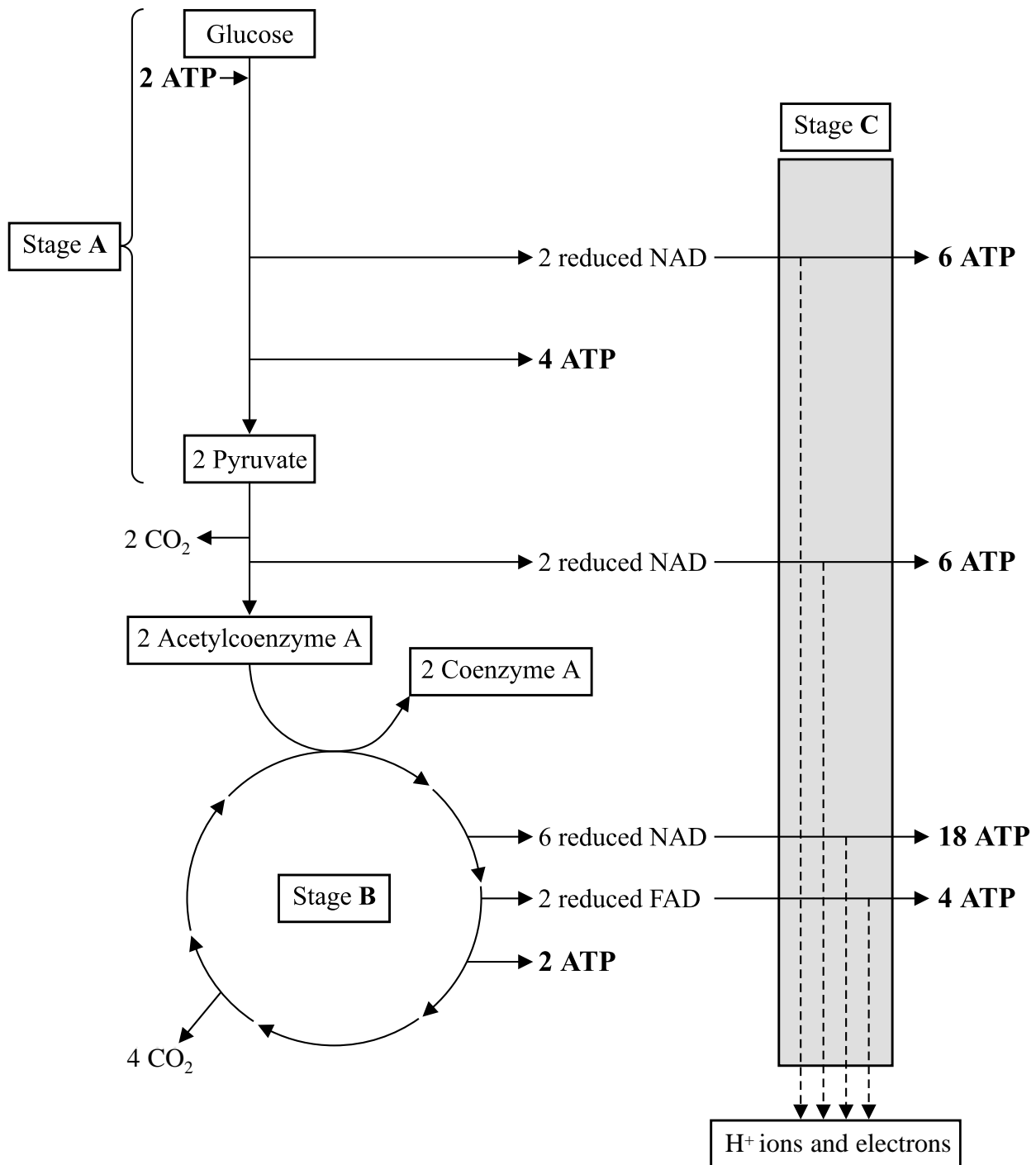
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(6 marks)

15

TURN OVER FOR THE NEXT QUESTION

8 The diagram gives an outline of the process of aerobic respiration.



- (a) (i) Complete the table by naming stages **A** and **B** and giving the location of each stage in a cell such as a liver cell.

Stage	Name of stage	Location in cell
A		
B		

(2 marks)

- (ii) How many carbon atoms are there in each pyruvate ion?
(1 mark)

- (iii) What happens to the H^+ ions and electrons released in stage **C**?

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(2 marks)

- (b) In aerobic conditions, ATP is produced by substrate-level phosphorylation and by oxidative phosphorylation. Use information in the diagram to find the net yield of molecules of ATP per molecule of glucose by

(i) substrate-level phosphorylation;

(ii) oxidative phosphorylation.
(2 marks)

- (c) (i) One mole of glucose releases 2880 kJ of energy when burned completely in oxygen. Hydrolysis of one mole of ATP to ADP and phosphate releases 31 kJ of energy. Use your answers from part (b) to calculate the percentage efficiency of energy transfer from glucose to ATP by aerobic respiration. Show your working.

Percentage efficiency =%
(2 marks)

- (ii) What happens to the energy which is **not** transferred to ATP?

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(1 mark)

QUESTION 8 CONTINUES ON THE NEXT PAGE

- (iii) Explain why ATP is better than glucose as an immediate energy source for cell metabolism.

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(2 marks)

- (iv) Give **three** uses of energy from ATP in a liver cell.

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(3 marks)

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TURN OVER FOR THE NEXT QUESTION

9 Read the following passage.

Deforestation, particularly in tropical rain forests, has proceeded at an alarming rate over the last 60 years. In addition to local decreases in biodiversity, there have been other, global, effects, especially on climate. Deforestation has been paralleled by an enormous rise in the burning of fossil fuels. These two factors have been important contributors to rising levels of carbon dioxide in the earth's atmosphere and increases in global temperatures.

Recent discussions on what to do about global warming have produced two new ideas. One is that farmers should plant trees on their land to act as carbon 'sinks'. These would offset increased carbon dioxide emissions by industry.

The second idea is that farmers should reduce the amount of ploughing they do. Ploughing allows air to enter the soil and helps with the recycling of both carbon and nitrogen. A reduction in ploughing would cut the oxidation of organic matter being stored in soils, which would then act as another carbon 'sink'.

Use information from the passage and your own knowledge to answer the following questions.

- (a) Explain how deforestation could lead to decreases in biodiversity (line 2).

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(3 marks)

- (b) Explain how trees can act as carbon 'sinks' (line 7).

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(3 marks)

- (c) (i) Explain how a reduction in the amount of ploughing would lead to more carbon being stored in the soil (lines 9 – 12).

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(4 marks)

- (ii) Ploughing can increase the activity of nitrifying bacteria in the soil. Explain how ploughing can do this and how the activity of nitrifying bacteria can benefit crop plants.

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(5 marks)

END OF QUESTIONS

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