

Surname						Other Names					
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General Certificate of Education
June 2003
Advanced Level Examination



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

Monday 16 June 2003 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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8			
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Total (Column 1)			
Total (Column 2)			
TOTAL			
Examiner's Initials			

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

- 1 (a) ATP is sometimes described as an *immediate* source of energy. Explain why.

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(1 mark)

- (b) Plants produce ATP in the light-dependent reaction of photosynthesis. Explain why plants cannot use this as their only source of ATP.

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(2 marks)

- (c) Red blood cells do not contain mitochondria but they use ATP. By what process do red blood cells produce ATP? Suggest a reason for your answer.

Process

Reason

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(2 marks)

- 2 (a) The common broomrape, *Orobanche minor*, is an unusual flowering plant. It is a parasite. It has no leaves and does not contain chlorophyll.

- (i) Give **one** feature of the common broomrape which it shares with all other plants but does not share with organisms in other kingdoms.

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(1 mark)

- (ii) Complete the table to show the classification of the common broomrape.

Kingdom	
	Angiospermophyta
	Dicotyledoneae
	Scrophulariales
	Orobanchaceae
Genus	
Species	

(2 marks)

- (b) The common poppy and the long-headed poppy are similar plants. Under natural conditions they sometimes cross to form hybrids between the two. Suggest how you could find out whether the common poppy and the long-headed poppy are different species.

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(2 marks)

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Turn over ►

- 3 In the squirting cucumber, there are three kinds of plants; plants with male flowers only, plants with female flowers only, and hermaphrodite plants with both male and female flowers. Sex is determined by a single gene with three alleles.

A^D is the allele for male. It is dominant over the other two alleles.

A^+ is the allele for hermaphrodite. It is dominant over allele A^d .

A^d is the allele for female. It is recessive to the other two alleles.

- (a) (i) Give the genotype of a female squirting cucumber.

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(1 mark)

- (ii) Explain why a male squirting cucumber cannot have the genotype $A^D A^D$.

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(2 marks)

- (b) Complete the genetic diagram to show how it would be possible for a cross between two hermaphrodite plants to produce female offspring.

Parent phenotypes: hermaphrodite x hermaphrodite

Parent genotypes:

Gametes:

Offspring genotypes:

(2 marks)

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- 4 (a) Explain what is meant by a *gene pool*.

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(2 marks)

- (b) Greater willow herb is a common plant found in damp places. It usually has red flowers controlled by the allele **R**. Plants with the genotype **rr**, however, have white flowers. In a sample of plants growing beside a ditch, 17 had white flowers and 327 had red flowers.

- (i) Calculate the frequency of the **r** allele in this sample. Show your working.

Frequency of **r** allele =
(2 marks)

- (ii) The Hardy-Weinberg equation could be used to find the frequencies of the different genotypes in the population from which this sample was taken. Give **one** assumption that must be made if the equation is to be applied.

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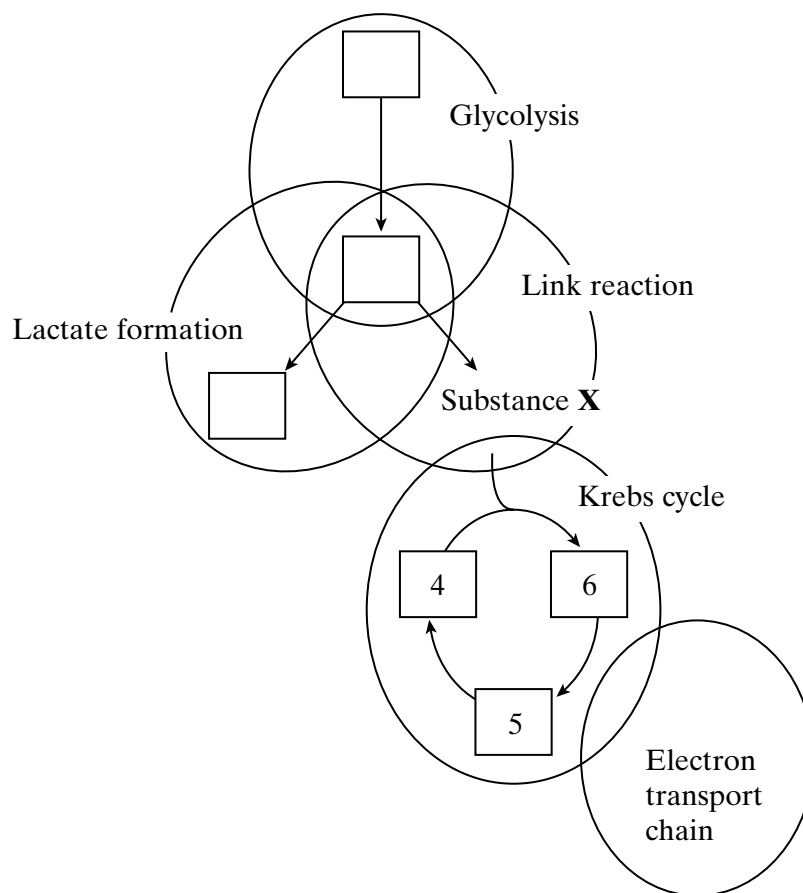
(1 mark)

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TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 5 The diagram summarises the five main stages in respiration in an animal cell. The boxes show the number of carbon atoms in various molecules or ions.



- (a) Complete the diagram by filling in the three empty boxes with the relevant number of carbon atoms. (1 mark)

- (b) Name

- (i) substance **X**;

..... (1 mark)

- (ii) **two** stages shown in the diagram in which carbon dioxide is produced.

1.

2.

(1 mark)

- (c) During glycolysis, NAD is reduced. Explain what happens to this reduced NAD when the cell is respiring anaerobically.

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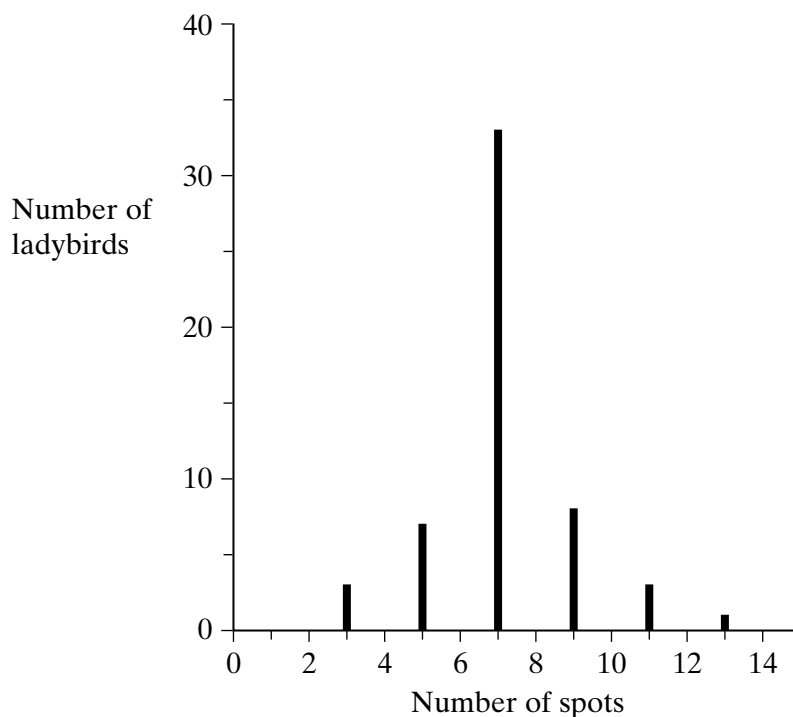
(2 marks)

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TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 6 The graph shows variation in the number of spots on the wing-cases of a species of ladybird.



- (a) The number of spots on the wing cases of this species of ladybird is determined by genes. What does the graph suggest about the genetic control of spot number in this species?

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(1 mark)

- (b) Give **one** piece of evidence from the graph that variation in the number of spots is normally distributed.

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(1 mark)

- (c) The population of ladybirds from which this sample was taken is undergoing stabilising selection. Describe how stabilising selection will affect the mean and standard deviation. Give the reason for your answer.

Mean

Standard deviation

Reason

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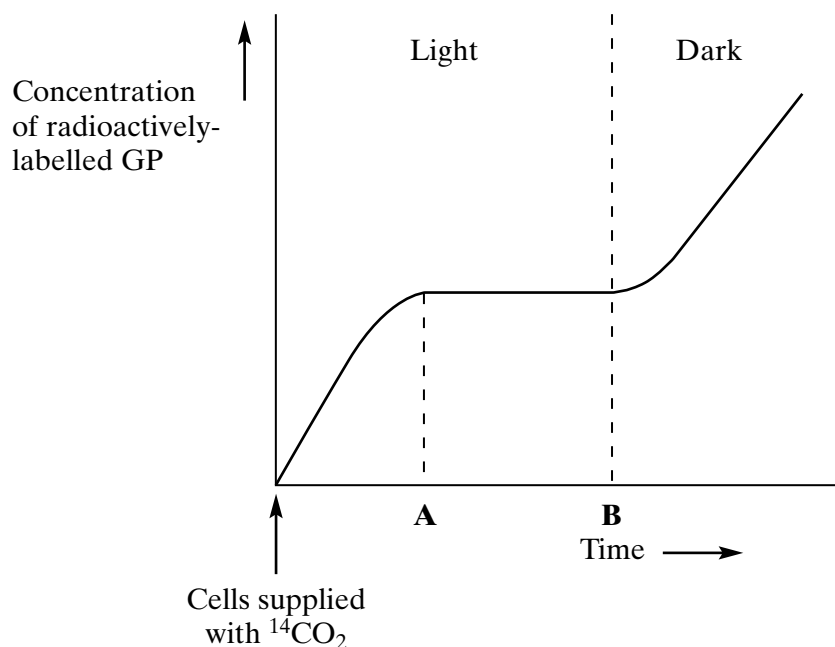
(3 marks)

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TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 7 In an investigation, leaf cells were supplied with $^{14}\text{CO}_2$, carbon dioxide labelled with a radioactive isotope of carbon. These cells were kept in the light and allowed to photosynthesise. After a period of time, the light was switched off and the cells were left in the dark. The graph shows the concentration of radioactively-labelled glycerate 3-phosphate (GP) over the course of the investigation.



- (a) (i) Describe how GP is formed from carbon dioxide in photosynthesis.

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(2 marks)

- (ii) In this investigation, the $^{14}\text{CO}_2$ was supplied in excess. Explain why the concentration of radioactively-labelled GP remained the same between times **A** and **B** on the graph.

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(1 mark)

- (b) Explain the change in the concentration of radioactive GP after the light was switched off.

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(3 marks)

The table shows some results from an investigation of the concentration of carbon dioxide in samples of air taken from among the leaves in a potato crop.

Date	Mean carbon dioxide concentration in parts per million between	
	8 pm and 4 am	8 am and 4 pm
10 July	328	309
20 July	328	299
30 July	326	284
10 Aug	322	282

- (c) (i) The figures in columns 2 and 3 of the table were calculated from readings obtained at different times of the day. Explain why the figures in column 3 are lower than those in column 2.

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(2 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

Turn over ►

- (ii) How would you expect the mean carbon dioxide concentration between 8 am and 4 pm to have differed if the air samples had been collected at soil level? Give a reason for your answer.

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(2 marks)

- (d) Suggest why, in this investigation, the investigators recorded the wind speed.

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(2 marks)

- (e) Some of the leaves from this crop die and fall to the ground. Describe how the carbon contained in the dead leaves becomes available and can be taken up by plants.

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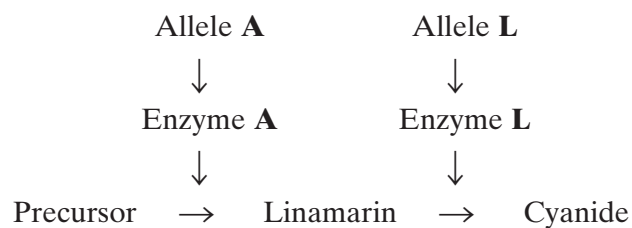
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(3 marks)

- 8 Cyanide is a poisonous substance. Cyanogenic clover plants produce cyanide when their tissues are damaged. The ability to produce cyanide is controlled by genes at loci on two different chromosomes. The dominant allele, **A**, of one gene controls the production of an enzyme which converts a precursor to linamarin. The dominant allele, **L**, of the second gene controls the production of an enzyme which converts linamarin to cyanide. This is summarised in the diagram.



- (a) Acyanogenic clover plants cannot produce cyanide. Explain why a plant with the genotype **aaLl** cannot produce cyanide.

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(1 mark)

- (b) A clover plant has the genotype **AaLl**.

- (i) Give the genotypes of the male gametes which this plant can produce.

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(1 mark)

- (ii) Explain how meiosis results in this plant producing gametes with these genotypes.

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(2 marks)

- (c) Two plants, heterozygous for both of these pairs of alleles, were crossed. What proportion of the plants produced from this cross would you expect to be acyanogenic but able to produce linamarin? Use a genetic diagram to explain your answer.

(3 marks)

In an investigation, cyanogenic and acyanogenic plants were grown together in pots. Slugs were placed in each pot and records were kept of the number of leaves damaged by the feeding of the slugs over a period of 7 days. The results are shown in the table.

	Undamaged	Damaged
Cyanogenic	160	120
Acyanogenic	88	192

- (d) A χ^2 test was carried out on the results.

- (i) Suggest the null hypothesis that was tested.

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 (1 mark)

- (ii) χ^2 was calculated. When this value was looked up in a table, it was found to correspond to a probability of less than 0.05. What conclusion can you draw from this?

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 (3 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

Turn over ►

A second investigation was carried out in a field of grass which had been undisturbed for many years. The table shows the population density of slugs and the numbers of cyanogenic and acyanogenic clover plants at various places in the field.

Population density of slugs	Number of acyanogenic clover plants per m ²	Number of cyanogenic clover plants per m ²
Very low	26	10
Low	17	26
High	0	10
Very high	0	5

- (e) Explain the proportions of the two types of clover plant in different parts of the field.

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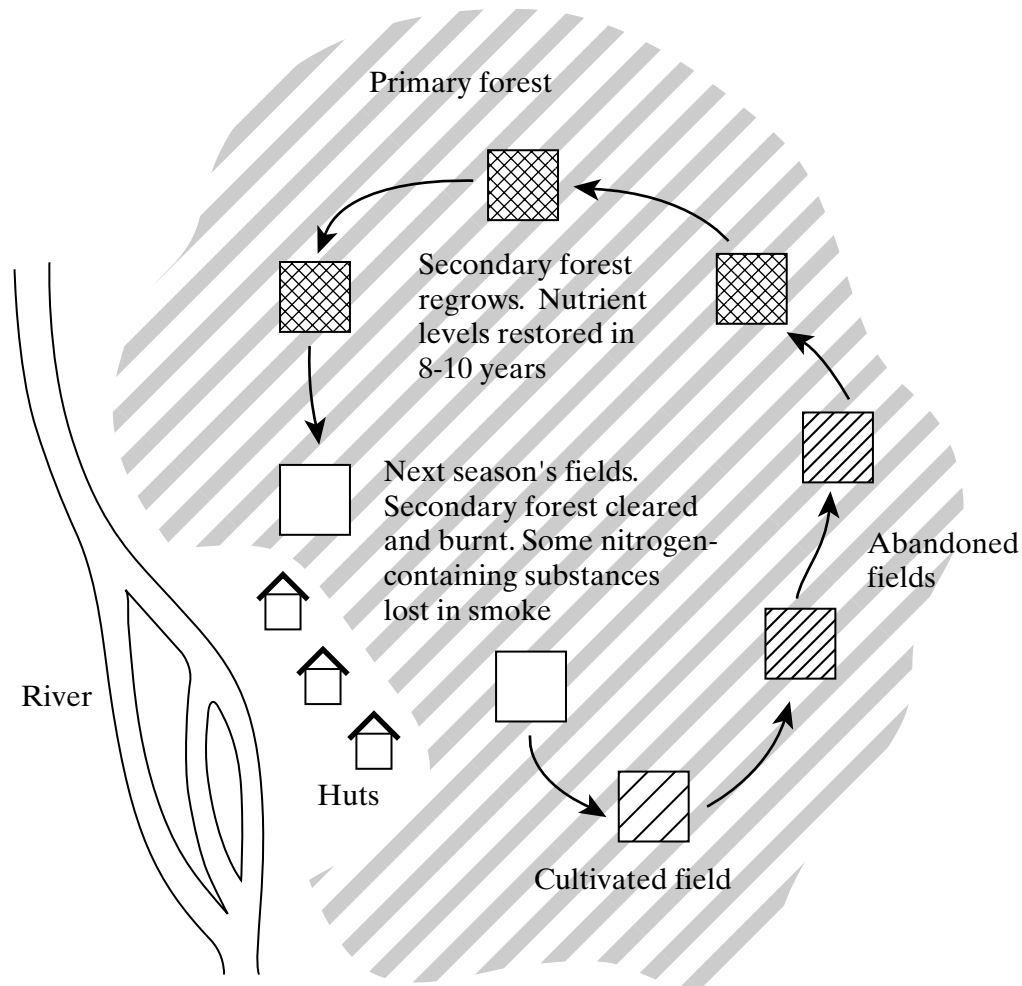
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(4 marks)

- 9 Some ways of clearing forest for agriculture are described as sustainable. The diagram shows one way in which agriculture can continue indefinitely on infertile forest soils.



- (a) One way to catch flying insects is to trap them on a sticky surface.
- (i) Describe how you could use sticky traps to compare the diversity of flying insects in the primary forest and in a cultivated field.

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(4 marks)

- (ii) Describe and explain how the diversity of insects in the primary forest would differ from the diversity of insects in the cultivated field.

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(4 marks)

- (b) Use your knowledge of nitrogen cycling to explain

- (i) why crops can be grown in the cleared field for only two or three years;

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(2 marks)

- (ii) how the concentration of nitrates in the soil is restored 8 - 10 years after cultivation is abandoned.

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(5 marks)

END OF QUESTIONS