

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2009
Advanced Level Examination



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

BYA5

Thursday 22 January 2009 1.30 pm to 3.00 pm

For this paper you must have:

- a ruler with millimetre measurements.
You may use a calculator.

Time allowed: 1 hour 30 minutes

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. **Answers written in margins or on blank pages will not be marked.**
- If you need extra space use page 20 for your answers.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You will be marked on your ability to use good English, to organise information clearly and to use accurate scientific terminology where appropriate.

For Examiner's Use			
Question	Mark	Question	Mark
1			
2			
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Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			



J A N 0 9 B Y A 5 0 1

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

- 1 (a) **Table 1** gives some features of three kingdoms of living organisms. Complete the table by giving the name of each kingdom.

Table 1

Features	Kingdom
Multicellular, cells have a nucleus, no cell wall	
Thread-like hyphae, cells have a nucleus, cell wall made of chitin	
Single-celled, cells have no nucleus, cell wall made of murein	

(3 marks)

- 1 (b) The horse, *Equus caballus*, and the donkey, *Equus asinus*, are two closely related animals. **Table 2** gives some details of their classification, in hierarchical order.

Table 2

Taxon	Horse	Donkey
Kingdom	Animalia	Animalia
	Chordata	Chordata
	Mammalia	Mammalia
	Perissodactyla	Perissodactyla
	Equidae	Equidae
	<i>Equus</i>	<i>Equus</i>
Species	<i>caballus</i>	<i>asinus</i>

- 1 (b) (i) Name the class and the family to which the horse and the donkey belong.

Class

Family

(1 mark)



1 (b) (ii) The diploid chromosome number in the horse is 64. The diploid chromosome number in the donkey is 62.

Crosses between a male donkey and a female horse result in offspring called mules. Explain why scientists still regard the horse and the donkey as distinct species.

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(3 marks)

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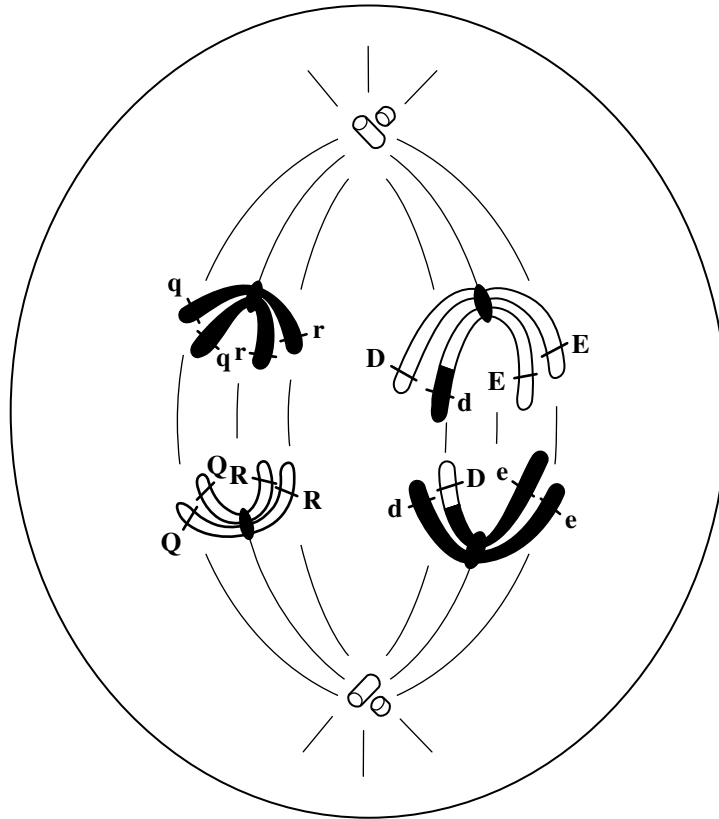
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Turn over for the next question

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- 2 The diagram shows the chromosomes in a cell during one stage of meiosis. The positions of the alleles of four genes are shown. The genotype of the cell is **Dd Ee Qq Rr**.



- 2 (a) Name the stage of meiosis shown in the diagram. Explain your answer.

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(2 marks)



2 (b) At the time shown in the diagram, this cell contains 0.52 picograms of DNA.
What mass of DNA will be present in a gamete formed from this cell?

..... picograms (1 mark)

2 (c) (i) List the genotypes of each of the gametes that can be formed from the cell shown
in the diagram.

..... (2 marks)

2 (c) (ii) Explain the advantage to the species of producing gametes with different
genotypes.

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..... (2 marks)

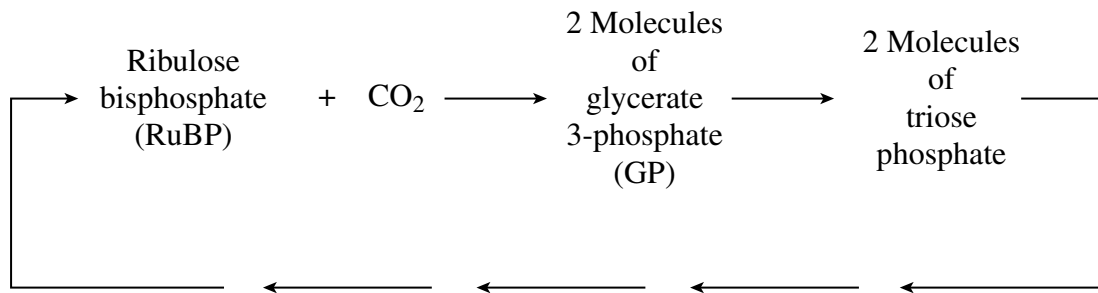
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3 The diagram shows part of the light-independent reactions of photosynthesis.



3 (a) Two substances formed in the light-dependent reactions are necessary for the conversion of GP into triose phosphate. Name these **two** substances.

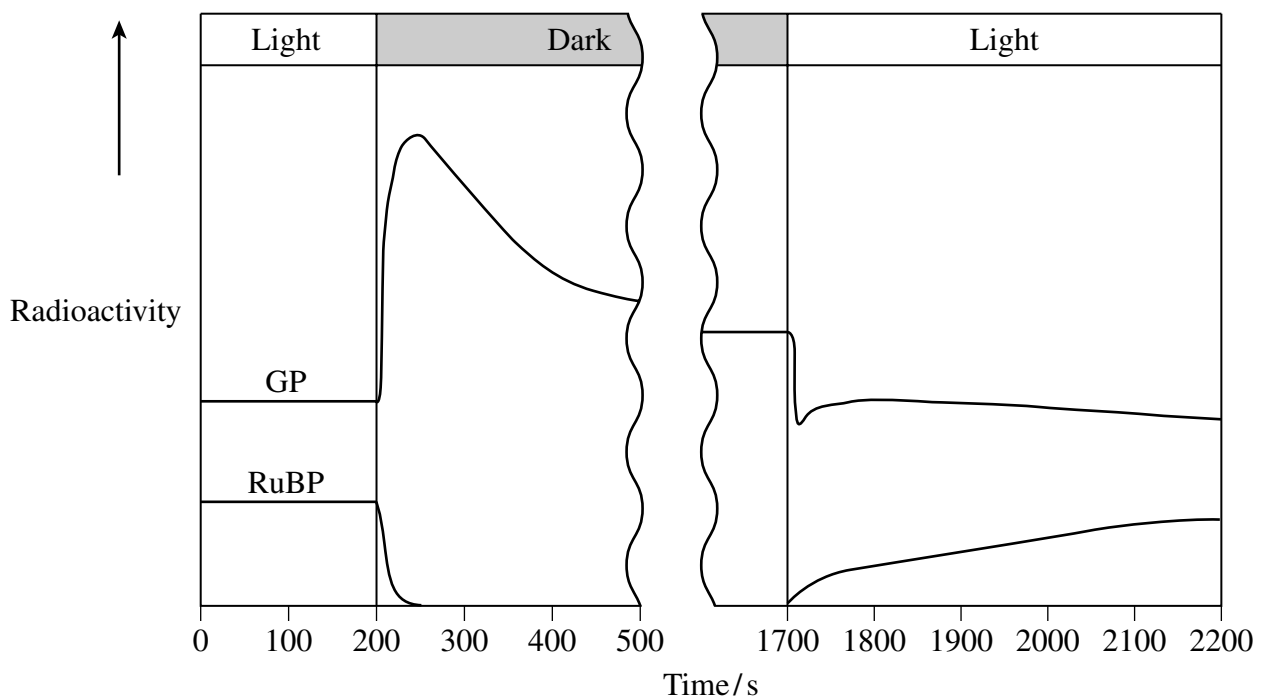
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2

(2 marks)

Scientists supplied carbon dioxide containing the radioactive isotope ¹⁴C to a culture of photosynthesising single-celled algae. The algae were kept in the light for 200 seconds, then in the dark for a further 1500 seconds, and were then returned to the light.

The graph shows the amounts of radioactivity found in RuBP and in GP at different times throughout the investigation.



3 (b) Describe the evidence in the graph which supports each of the following statements.

3 (b) (i) The process by which RuBP is used to make GP is light-independent.

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(2 marks)

3 (b) (ii) RuBP is formed using GP only if substances formed in the light-dependent reactions are present.

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(2 marks)

3 (c) The amount of radioactive GP falls between 250 and 1700 seconds. Suggest why.

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(1 mark)

7

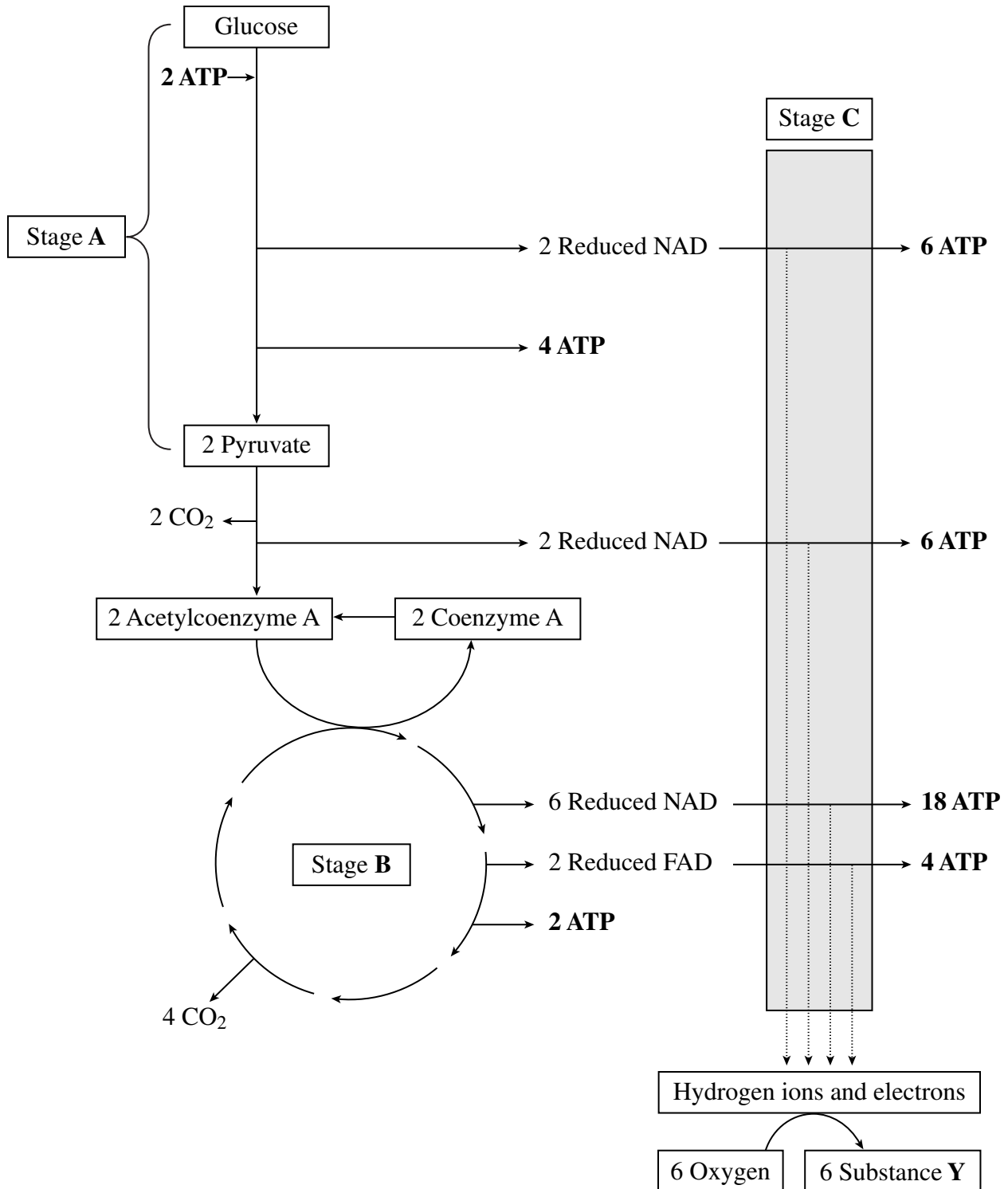
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4 The diagram shows aerobic respiration of glucose.

The numbers indicate how many molecules of each named substance are formed or used when one molecule of glucose is respired.



4 (a) (i) Name substance **Y**.

4 (a) (ii) Name stage **B**.

4 (a) (iii) Name the organelle in which stages **B** and **C** occur.

(3 marks)

4 (b) How many carbon atoms are there in one molecule of pyruvate? Use evidence from the diagram to explain your answer.

Number

Evidence

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(2 marks)

4 (c) Aerobic respiration of glucose gives a respiratory quotient (RQ) of 1.0. Use information from the diagram to explain how.

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(2 marks)

4 (d) (i) For each molecule of glucose, how many molecules of ATP are formed by oxidative phosphorylation?

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(1 mark)

4 (d) (ii) ATP is better than glucose as an immediate energy source for cell metabolism. Give **one** reason why.

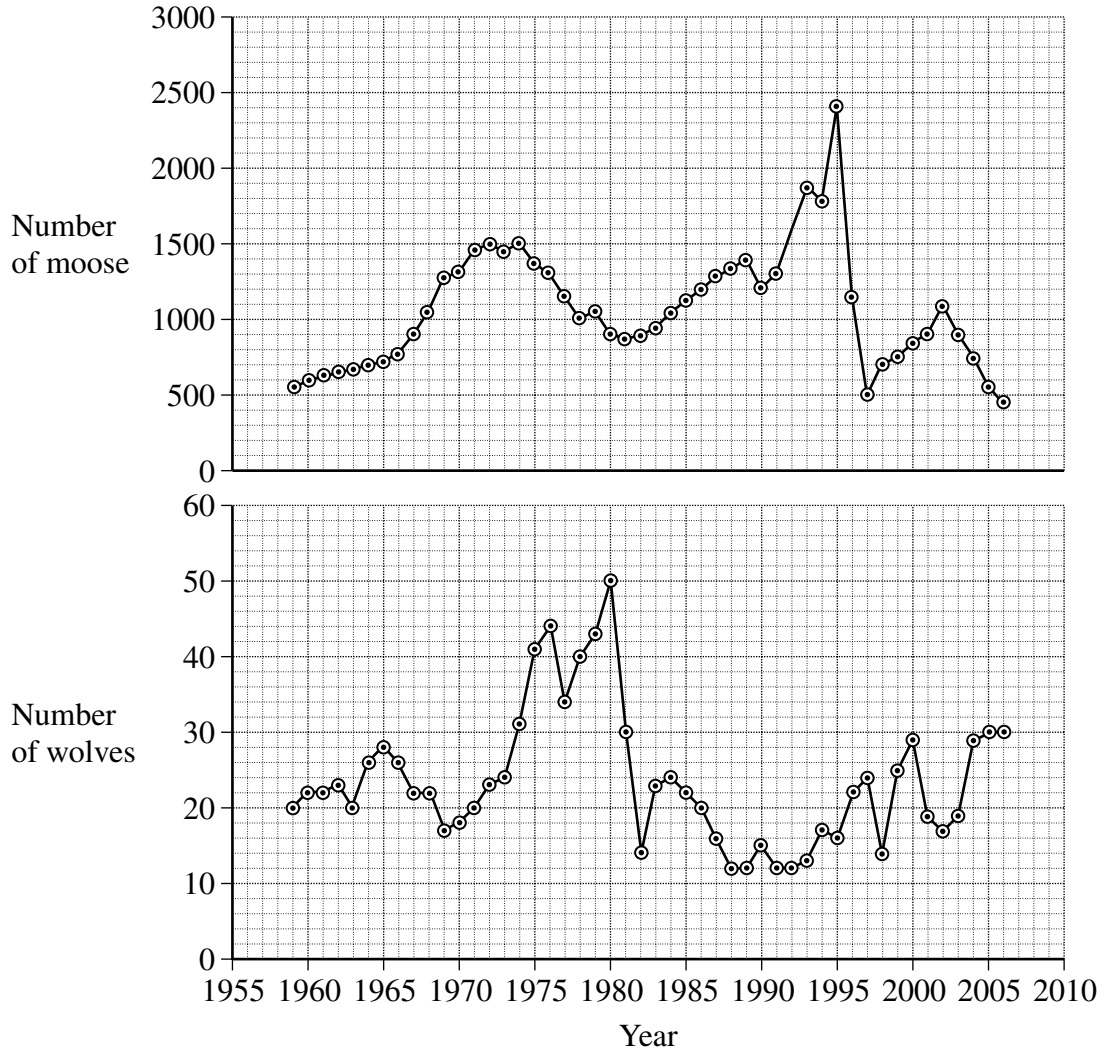
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(1 mark)



- 5 Isle Royale is an island about 56 km long and 11 km wide in the middle of Lake Superior. The moose is a type of deer. It is the largest herbivore on the island. The wolf is the only carnivore on the island capable of killing a moose.

The graph shows the numbers of moose and of wolves on Isle Royale from 1959 to 2006.



5 (a) (i) Describe and explain the relationship between the number of moose and the number of wolves from 1965 to 1976.

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(3 marks)

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5 (a) (ii) The mark-release-recapture method would **not** be suitable for estimating the size of the wolf population on Isle Royale between 1988 and 1992. Use information from the graph to suggest why.

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(3 marks)

(Extra space)
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5 (a) (iii) If a disease killed all the wolves on the island. What would you expect to happen to the number of moose over the next 15 years?

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(1 mark)

Question 5 continues on the next page

Turn over ►



A and **a** are alleles of a single gene which controls one characteristic in the moose. In 1995, a survey showed that 91% of the moose on the island had the phenotype caused by the dominant allele **A**.

- 5 (b) Use the Hardy-Weinberg equation, and information from the graph, to calculate the expected number of moose, in 1995, that were heterozygous for this characteristic.

Number of moose = (4 marks)

- 5 (c) (i) If allele **a** gives a selective advantage, its frequency would be expected to rise in subsequent generations. Explain why.

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(2 marks)



5 (c) (ii) Give **two** causes of a change in allele frequency other than the effect of selection.

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(2 marks)

15

Turn over for the next question

Turn over ►



6 The border collie is a breed of dog. Most border collies have fur that is black and white. Some have fur that is brown and white. The allele for black fur, **B**, is dominant to that for brown fur, **b**.

Another gene can affect the expression of the gene for black or brown fur. The recessive allele, **n**, of this gene causes black fur to become 'blue' (a dark grey) and brown fur to become 'lilac'. The presence of the allele **N** results in normal black or brown fur colour. Fur colour in collies is **not** sex-linked.

6 (a) A breeder crossed two collies with black fur. The first litter of puppies were
 3 black, 1 brown, 1 lilac.

6 (a) (i) The parents were crossed again to produce a second litter. Complete the genetic diagram to show offspring genotypes. Use information from the diagram to explain how blue puppies could be produced in this cross.

Parental genotypes and

Female gametes \ Male gametes				

.....
 (4 marks)

6 (a) (ii) What is the probability of obtaining a blue, female puppy in this litter? Use your answer to part (i) to explain your answer.

Probability of a blue, female puppy = (3 marks)



6 (b) The breeder had one blue female, called ‘Megan’. He wanted to know if Megan was homozygous for fur colour. In an attempt to determine this, he crossed Megan with a lilac male. The first litter contained 5 blue puppies. A second cross with the same male produced a litter of 3 blue and 4 lilac puppies.

6 (b) (i) Why did the breeder choose a lilac male for this cross rather than any other colour?

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(2 marks)

6 (b) (ii) A χ^2 test can be used to determine whether the observed results fit the expected 1 : 1 ratio. Give a suitable null hypothesis which can be checked using the χ^2 test.

.....

(1 mark)

6 (b) (iii) Complete **Table 3** to calculate the value of χ^2 for the results.

Table 3

Characteristic	Observed (O)	Expected (E)	(O - E)	(O - E) ²	$\frac{(O - E)^2}{E}$
Blue fur	8				
Lilac fur	4				

$$\chi^2 = \sum \frac{(O - E)^2}{E} =$$

(2 marks)

Question 6 continues on the next page

Turn over ►



7 (a) Trees are sometimes described as ‘carbon sinks’. Suggest what this means.

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(2 marks)

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Question 7 continues on the next page

Turn over ►



7 (b) Large areas of rainforest are being cut down and the land used for growing crops such as maize.

7 (b) (i) Removing the trees and replacing them with maize plants could lead to a decrease in the diversity of animal species. Explain how.

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(3 marks)

(Extra space)
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7 (b) (ii) After the trees are cut down, the land may not be suitable for growing maize for more than a few seasons. Suggest why.

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(3 marks)

(Extra space)
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7 (c) An atom of nitrogen, present in nitrogen gas in the atmosphere, can become part of an amino acid molecule in a maize plant. Describe how.

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(7 marks)

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END OF QUESTIONS

15



