

1 Many animals, such as mammals, have a heart and circulation. This helps them to meet their requirements by overcoming the limitations of diffusion.

\*(a) Describe the structure of the mammalian heart.

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(b) Giraffes are very tall mammals found roaming the plains of Africa.  
Two giraffes are shown in the photograph below.



Using the information in the photograph and your own knowledge, explain the importance of the heart and circulation to the giraffe.

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**(Total for Question 1 = 9 marks)**

**2** Clear areas with no trees can be found within many forests. These areas usually have communities of animals and plants which are different from those found in the wooded parts of the forest. These clear areas are maintained by the grazing of animals such as rabbits and deer.

(a) Describe what might happen to the clear areas in forests, over a long period of time, if the numbers of rabbits and deer decreased.

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(b) The butterfly *Boloria selene* (Small Pearl-bordered Fritillary) can be found in many of the clear areas of British forests.



Small Pearl-bordered Fritillary Magnification  $\times 1.5$

This butterfly lays its eggs on low-growing plants such as *Viola riviniana* (Dog Violet), on which the caterpillars feed when they hatch.

The adult butterflies feed on nectar from plants such as *Ajuga reptans* (Bugle) and other low-growing species.

Since the plants on which the butterfly depends are able to grow only in forest clearings, small reproductively-isolated populations of *B. selene* can be identified in many forests.

(i) The distribution of plants in a forest is affected by many abiotic factors.

Name **one** of these factors and suggest how this factor could affect the distribution of the low-growing plants within the clear areas of a forest.

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(ii) Explain what is meant by the term **reproductively-isolated populations** of *B. selene*.

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(iii) Suggest why it is unlikely that any individuals within a population of *B. selene* would survive if the numbers of rabbits and deer decreased.

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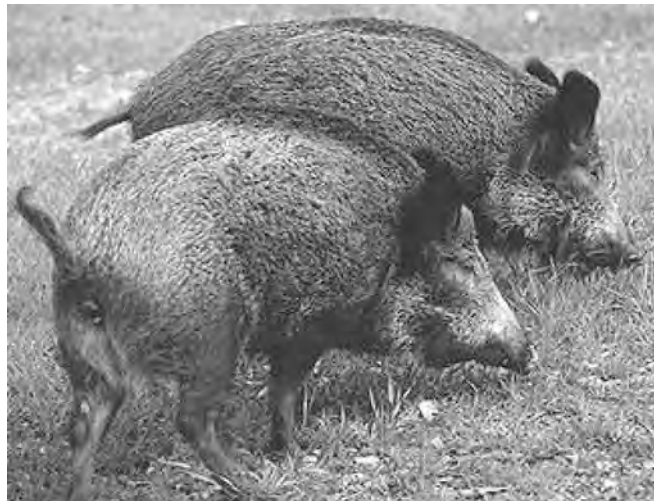
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**(Total for Question 2 = 12 marks)**

- 3 Sardinia is an island in the Mediterranean Sea. Many of the plants and animals on islands, such as Sardinia, show distinct physical and behavioural features that are different from those found in closely-related mainland populations. The Sardinian wild boar is an example of this, shown in the photograph below.



Magnification  $\times 0.1$

(a) Explain what is meant by each of the following terms.

(i) Gene pool

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(ii) Allele frequency

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(b) The population of wild boar in mainland Italy and the population in Sardinia both belong to the species, *Sus scrofa*. The mainland population is placed in the sub-species, *Sus scrofa scrofa*, whilst the Sardinian population is placed in the sub-species, *Sus scrofa meridionalis*.

- (i) Suggest why scientists classify the mainland and Sardinian wild boar as two sub-species rather than as two separate species.

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- \*(ii) Suggest how the two sub-species, *Sus scrofa meridionalis* and *Sus scrofa scrofa*, have developed from a single ancestral population.

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(iii) Explain how the results of DNA profiling of tissue samples from the two sub-species could be used to provide evidence that they share common ancestry.

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**(Total for Question 3 = 12 marks)**



**4** Biodiversity, including both species richness and genetic diversity, is an important concept to be considered when organising captive breeding programmes.

(a) Explain what is meant by each of the following terms.

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Species richness .....

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(b) One way to measure genetic diversity is to find the percentage of genes that have different alleles.

The table below shows the percentage of genes that have different alleles in four types of cat.

Type of cat	Percentage of genes with different alleles (%)
Cheetah	4
Domestic cat	23
Lion	12
Ocelot	21

\*(i) Using the information in the table above and your own knowledge, suggest why the cheetah is the cat at most risk if the environment changes.

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(ii) Cheetahs are unusual amongst the big cats.



Cheetah and cub

Dr P. Marazzi / Science Photo Library

A female cheetah often mates with several different males and gives birth to two or three cubs at a time, each having a different father.

Suggest why this may be advantageous to cheetahs.

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- (c) Rafa was a male cheetah involved in breeding programmes in several zoos. The table below shows some data from Rafa's studbook.

Name of zoo housing Rafa	Event	Date of event
WINSTON	Birth of Rafa	24 Dec 1974
SD-WAP	Transfer	26 Nov 1980
LAGUNA HI	Transfer	9 Apr 1982
SD-WAP	Transfer	5 Dec 1984
BATON ROUGE	Transfer	11 Feb 1986

Suggest what effect transferring Rafa from one zoo to another had on genetic diversity in this species.

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- (d) Place a cross ☒ in the box to the right of the statement that correctly describes an endemic animal.

(1)

Statement	
Ducks that migrate from one continent to another	<input type="checkbox"/>
House fly that is found in all continents except Antarctica	<input type="checkbox"/>
Cheetahs that are exclusive to one continent	<input type="checkbox"/>

**(Total for Question 4 = 11 marks)**