Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Variation and selection

Time allowed: 1 hour 30 minutes

Subject code **0610**

Biology

Questions from Paper 3, Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 90

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 90 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

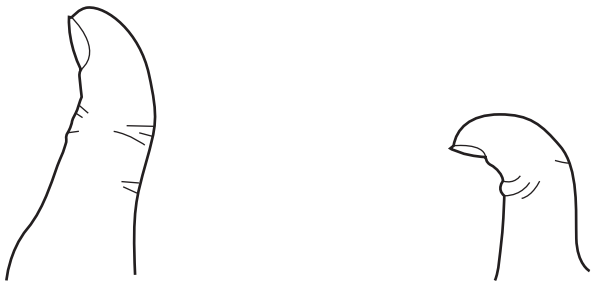
- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 There is variation in the shape of human thumbs.

Fig. 3.1 shows the two forms referred to as ‘straight’ and ‘hitch hikers’.



straight hitch hikers

Fig. 3.1

A survey of thumb shape was carried out on 197 students. The results are shown in Table 3.1.

Table 3.1

age / years	number of students with ‘straight’ thumbs		number of students with ‘hitch hiker’ thumbs	
	male	female	male	female
12	21	24	4	2
13	18	28	3	5
14	19	15	2	3
15	26	20	3	4
total	84	87	12	14

(a) Describe the results shown in Table 3.1.

.....

.....

.....

.....

..... [3]

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(b) Scientists think that thumb shape is controlled by a single gene.

What evidence is there from Table 3.1 to support this idea?

.....

.....

..... [3]

[Total : 6]

Measurements, tables, graphs and conclusions Click for more variations

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2 Blood group is an example of discontinuous variation.

The blood groups of patients in a hospital were recorded.

Fig. 8.1 shows the results.

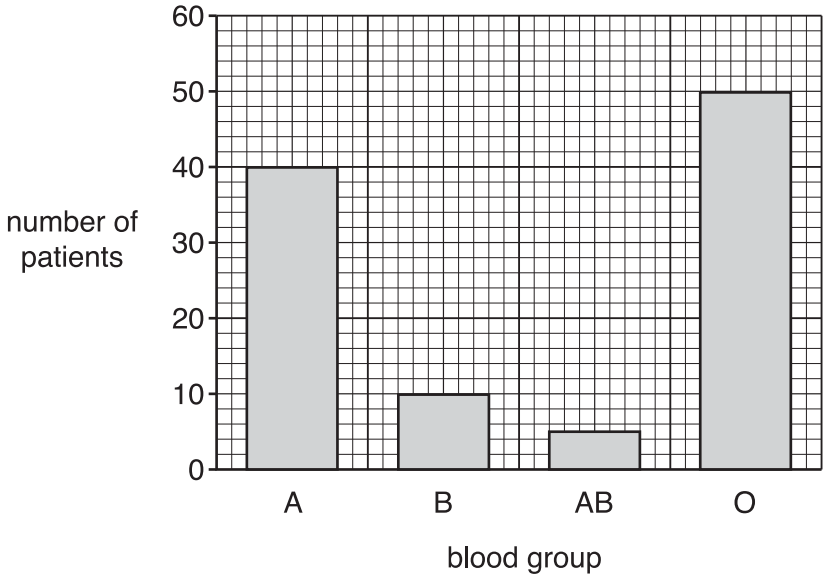


Fig. 8.1

(a) Explain how Fig. 8.1 shows that blood group is an example of discontinuous variation.

.....

.....

.....[1]

(b) Table 8.1 shows different examples of variation.

Tick all the boxes that show examples of discontinuous variation.

Table 8.1

attached or unattached earlobes	
foot length	
gender (male or female)	
height	
tongue rolling	
weight	

[3]

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(c) Variation can be caused by mutation.

The word mutation can be connected to the words in the boxes on the right to make a complete sentence.

Draw **three** lines to join the word 'mutation' to the words in the boxes to make three correct sentences.

Mutation	is a genetic change.
	is a change in the environment.
	only occurs in plants.
	forms new alleles.
	changes your physical appearance only.
	can be caused by ionising radiation.

[3]

[Total: 7]

Variation and mutation Click for more variations

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3 An *adaptive feature* helps an organism survive in its environment.

Adaptive features are inherited.

Fig. 5.1 contains diagrams of three animals.

(a) For each animal, select **one** adaptive feature visible in Fig. 5.1 and briefly suggest how it helps the animal to survive.

An example has been done for you.

not drawn to scale

animal C

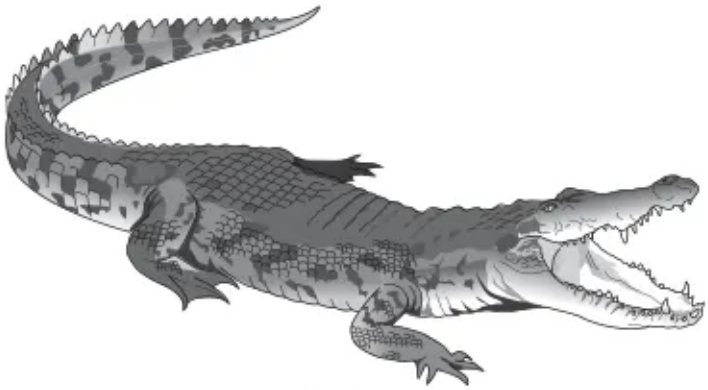


red deer

adaptive feature: antlers (horns) on head

help in survival: used for defence against predators

animal D



saltwater crocodile

adaptive feature: .....

help in survival: .....

.....

.....

animal E



golden eagle

adaptive feature: .....

help in survival: .....

.....

.....

Fig. 5.1

[4]

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(b) Fig. 5.2 shows a giraffe and an okapi.

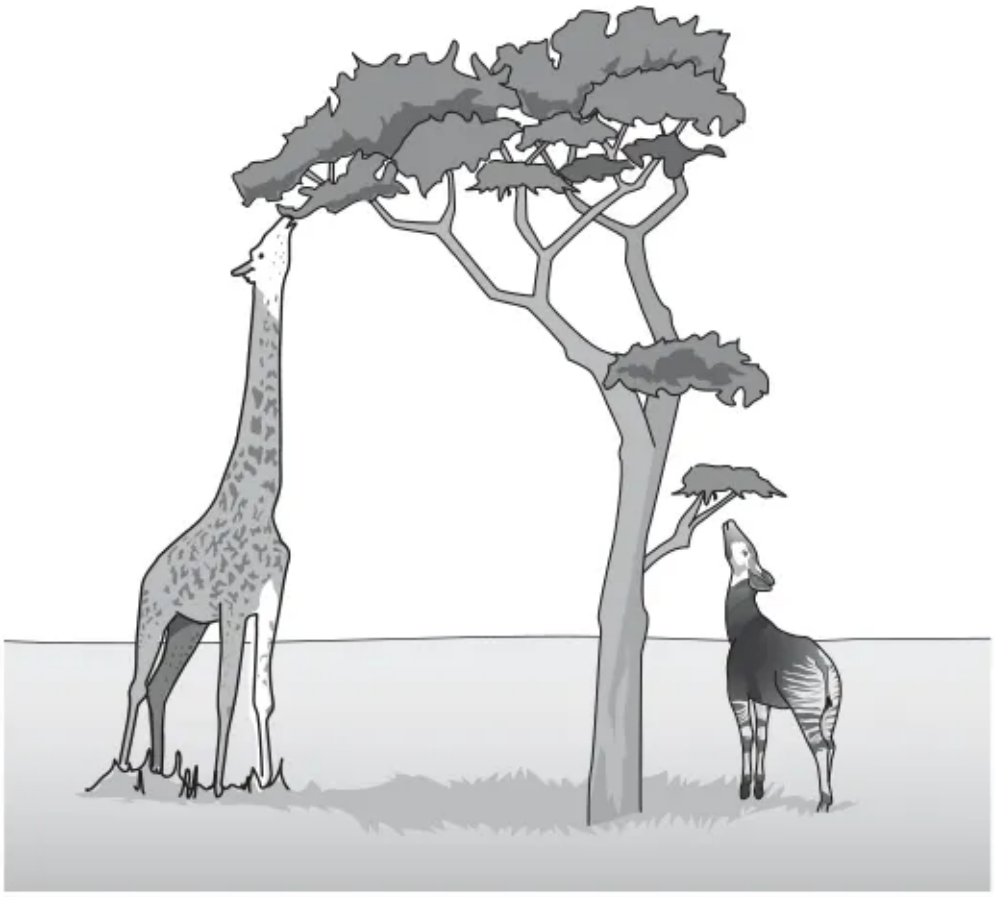


Fig. 5.2

The long neck is an adaptive feature for giraffes.

It helps them feed on leaves that other animals like the okapi cannot reach.

Giraffes developed long necks by the process of natural selection.

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The statements in Table 5.1 are about how natural selection occurred in giraffes.

Table 5.1

statement number	statement
1	More giraffes are born than can survive.
2	Giraffes have necks of different length.
3	The giraffes with the longest necks survive and reproduce.
4	There is competition for food between giraffes.
5	The surviving giraffes pass on their alleles for long necks to their offspring.

Arrange these statements in a sequence to explain how natural selection occurred in giraffes.

One has been done for you.



[3]

[Total: 7]

Adaptive features Click for more variations

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4 Fig. 9.1 shows a potato plant.

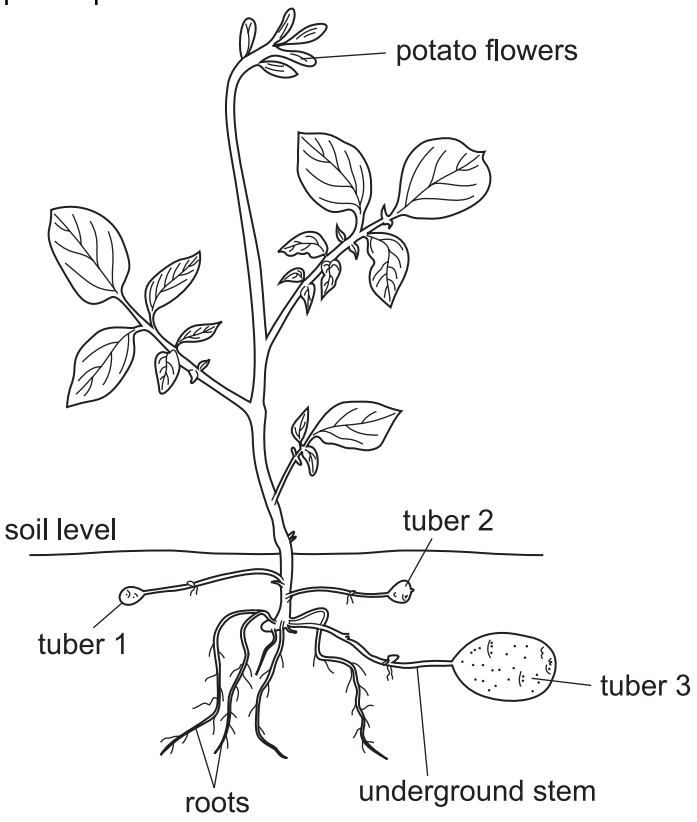


Fig. 9.1

As the plant grows, buds on the underground stem grow into side shoots.
The ends of these shoots swell to form tubers.
The tubers can grow into new plants.

(a) (i) Which type of nuclear division will occur at the end of a shoot as a tuber develops?

.....

[1]

(ii) The three tubers, shown in Fig. 9.1, are each grown to form separate plants.
They all show the same characteristics as the parent plant.

Explain why this happens.

.....

.....

[1]

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(iii) After two months the three new plants were different sizes.

Suggest **two** reasons why the plants were different.

1 .....

.....

2 .....

..... [2]

(b) The potato plant has purple flowers that are usually insect-pollinated. After pollination the seeds formed can grow into new plants.

(i) Explain why these plants may show features different from the parent plants.

.....

.....

.....

.....

.....

..... [3]

(ii) A scientist has two varieties of potato.

One variety has disease resistance and the other variety grows well in dry soil.

Suggest how the scientist could produce a new variety with both of these characteristics.

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

Variation and mutation Click for more variations

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5 The Galápagos Islands are a group of small islands in the Pacific Ocean.

In 1839 Charles Darwin published a book that described differences in a family of birds called finches.

Each species of Galápagos finch had:

- a different diet
- a different beak shape, as shown in Fig. 5.1.

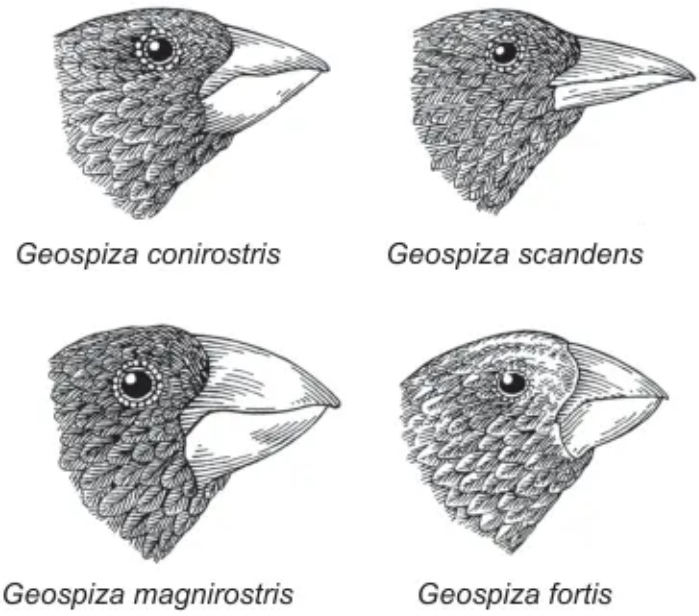


Fig. 5.1

(a) State the genus name for the Galápagos finches shown in Fig. 5.1.

..... [1]

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(b) Galápagos finches share a common ancestor.

Suggest how Galápagos finches have evolved different shaped beaks.

.....

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..... [5]

[Total: 6]

Natural and artificial selection Click for more variations

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6 An ecologist studied variation in a species of xerophyte.

(a) Xerophytes are adapted to a particular type of environment.

State this type of environment.

.....[1]

(b) The ecologist studied the features of the leaves in the species of xerophyte.

Fig. 5.1 shows the variation in the type of leaf spike.

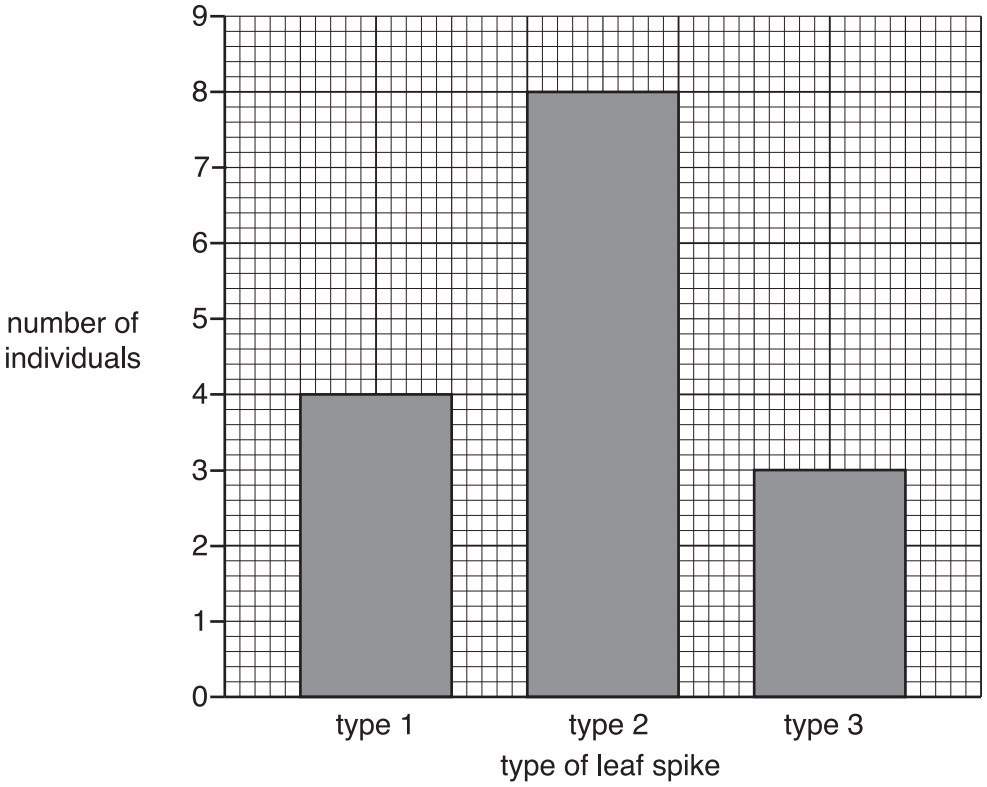


Fig. 5.1

(i) State the type of variation shown in Fig. 5.1.

.....[1]

(ii) Explain why the type of leaf spike is an example of the variation shown in Fig. 5.1.

.....

.....

.....[2]

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(c) The ecologist also measured other features of the leaves.

Fig. 5.2 shows the variation in leaf feature **B**.

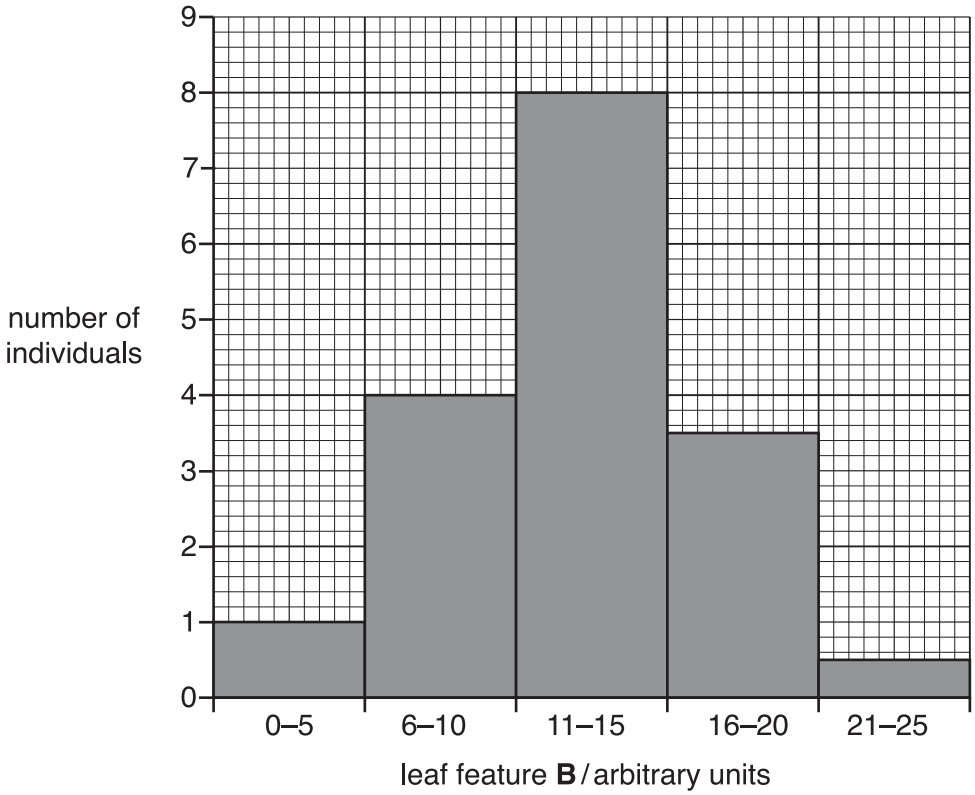


Fig. 5.2

State **two** named features of leaves that show the type of variation shown in Fig. 5.2.

1 .....

2 .....

[2]

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(d) After one year, the ecologist recorded the variation in leaf feature **B** again.

The results are shown in Fig. 5.3.

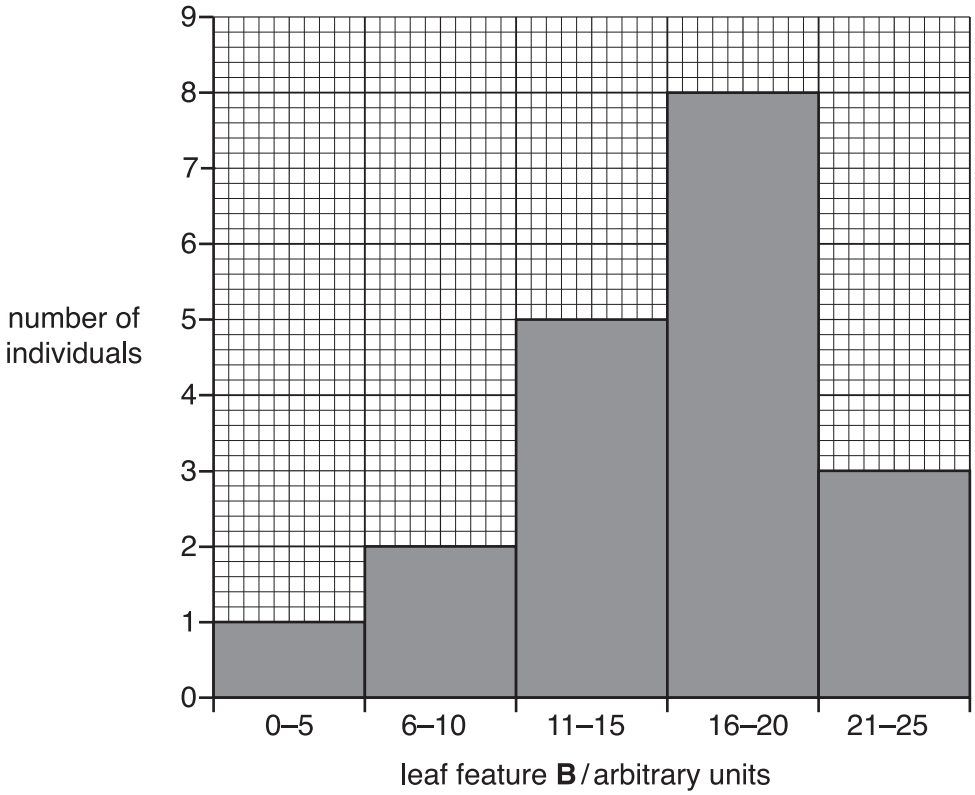


Fig. 5.3

Suggest **one** reason for the difference in variation of leaf feature **B** after one year.

.....

.....[1]

[Total: 7]

Variation and mutation Click for more variations

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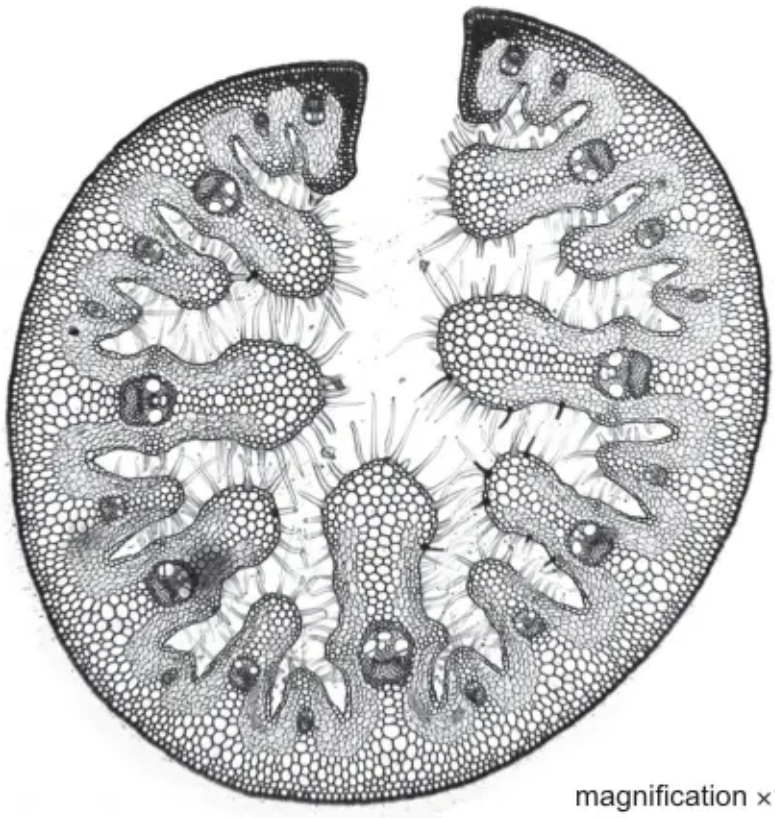
7 Xerophytes are plants that show adaptive features for dry habitats.

(a) Complete the sentence to define the term adaptive feature.

An adaptive feature is an ..... feature that helps an organism to ..... and ..... in its environment. [2]

(b) Marram grass is a xerophytic plant.

Fig. 4.1 is a photomicrograph of a cross-section of a marram grass leaf.



magnification ×10

Fig. 4.1

Using Fig. 4.1, describe the visible features that identify this as a xerophyte leaf.

.....

.....

.....

.....

..... [2]

(c) **(i)** The mean cell wall thickness of an epidermal cell from one species of xerophyte is 1.276 μm.

Convert 1.276 μm to mm.

..... mm [1]

(ii) State the name of the carbohydrate molecule used to build cell walls in xerophytes.

..... [1]

(iii) Suggest **one** way the stem of a xerophyte is adapted for dry habitats.

.....

.....

..... [1]

(d) Fig. 4.2 is a diagram showing the root systems of two different species of xerophyte.

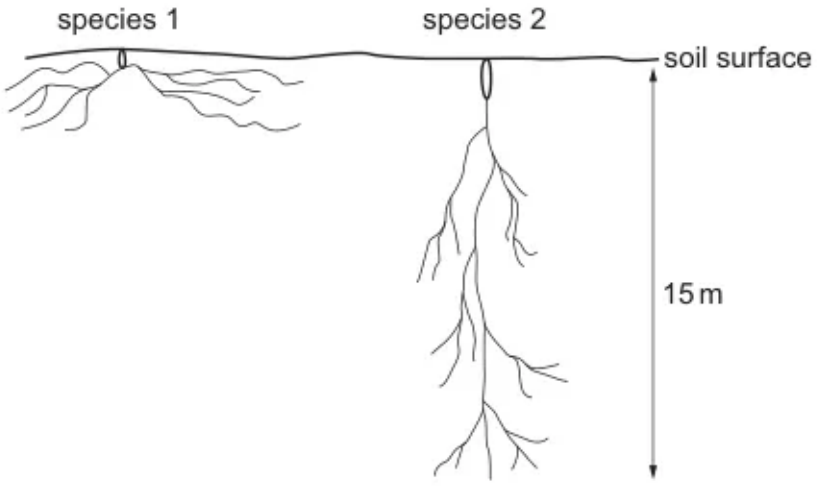


Fig. 4.2

Describe the **two** root systems shown in Fig. 4.2 **and** suggest how each one is an adaptation for living in a dry environment.

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.....

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..... [3]

[Total: 10]

Adaptive features Click for more variations

8 **(a)** Fig. 1.1 shows seven species of fish that live on reefs in the Caribbean.

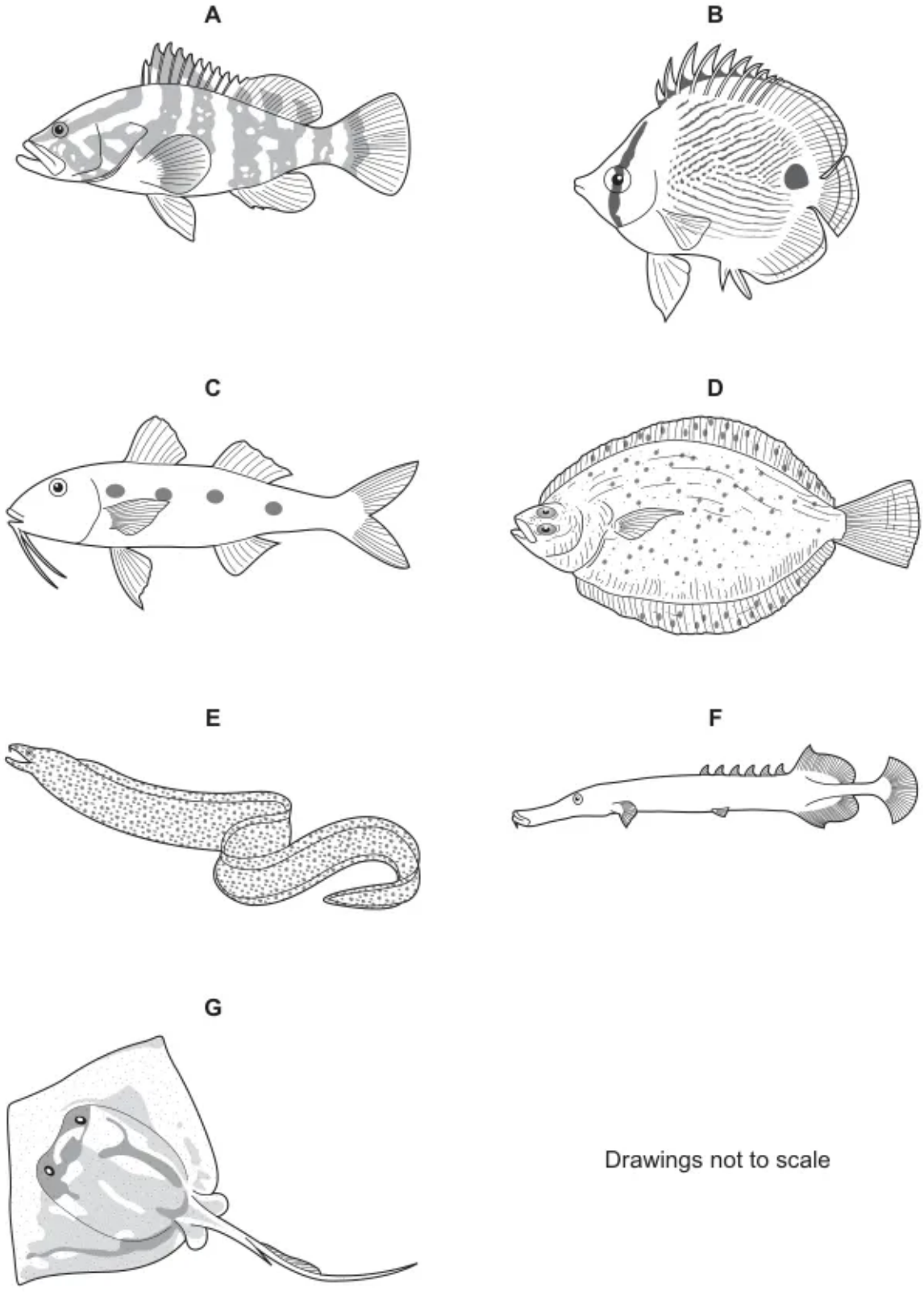


Fig. 1.1

Use the key to identify each species. Write the letter of each species (**A** to **G**) in the correct box beside the key. One has been done for you.

Key

1 (a)	Body shape is long and narrow, at least 10 times as long as its depth	go to 2	
(b)	Body shape is not long and narrow, less than 10 times long as its depth	go to 3	
2 (a)	Fins are pointed	*Aulostomus maculatus*	**F**
(b)	Fins are smooth	*Gymnothorax moringa*	
3 (a)	Both eyes are on top of the head	go to 4	
(b)	Eyes are on either side of the head	go to 5	
4 (a)	Tail fin is long and thin	*Dasyatis americana*	
(b)	Tail fin is short	*Bothus ocellatus*	
5 (a)	Fish has one or several dark spots	go to 6	
(b)	Fish has no dark spots	*Epinephelus striatus*	
6 (a)	Fish has two fins on its back	*Pseudupeneus maculatus*	
(b)	Fish has more than two fins on its back	*Chaetodon capistratus*	

[4]

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The wavelengths of light that penetrate water influence the features of fish. Blue light does not penetrate far into water; red light penetrates much further.

Many different species of cichlid fish live in Lake Victoria in Africa. Some species live in shallow water and others live in deeper water.

Table 1.2 summarises some of the features of males and females of these species.

Table 1.2

habitat	body colour of males	retina in eyes of females
shallow water	blue	detects blue light
deep water	red	detects red light

Body colour and colour vision are both inherited features. Females select the males that they mate with and prefer bright coloured males. Male and female eyes of the same species of cichlid fish are similar.

(b) (i) The ancestors of red and blue cichlid fish were brown.

State how the different body colours of the males first happened.

.....

..... [1]

(ii) Suggest the advantages of different cichlid fish being able to detect blue and red light.

.....

.....

.....

.....

..... [2]

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(c) Lake Victoria receives considerable pollution from the surrounding area which makes the water cloudier and reduces the penetration of blue light.

Suggest and explain the likely long-term effects of the cloudy water on the red and blue cichlid fish.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 11]

Classification, species and dichotomous keys Click for more variations

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9 All commercial breeds of sheep belong to the species *Ovis aries*.

(a) Define the term *species*.

.....

.....

.....

.....

..... [2]

The Merino is a breed of sheep that is farmed mainly for its wool. The wool is very thick and is made of lots of very thin hairs.

Fig. 1.1 shows a female Merino sheep with her newborn lamb.



Fig. 1.1

(b) The presence of hair is a feature that is only found in mammals.

State **two other** features that distinguish mammals from all other vertebrates.

1 .....

2 .....

[2]

STEM

(c) Merino sheep in South Africa have high quality wool with very thin hairs.

Breeders in New Zealand have used selective breeding programmes to improve the wool of their sheep to match the quality of South African wool.

Describe the steps that breeders would take to breed sheep that have wool with very thin hairs.

.....

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..... [5]

(d) Explain how natural selection differs from selective breeding.

.....

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.....

.....

.....

..... [3]

[Total: 12]

Natural and artificial selection Click for more variations

10 **(a)** Sickle cell anaemia is a genetic disorder that is found among people in certain parts of the world.

A sample of blood was taken from a person with sickle cell anaemia and examined with an electron microscope.

Fig. 4.1 shows some of the red blood cells in the sample.

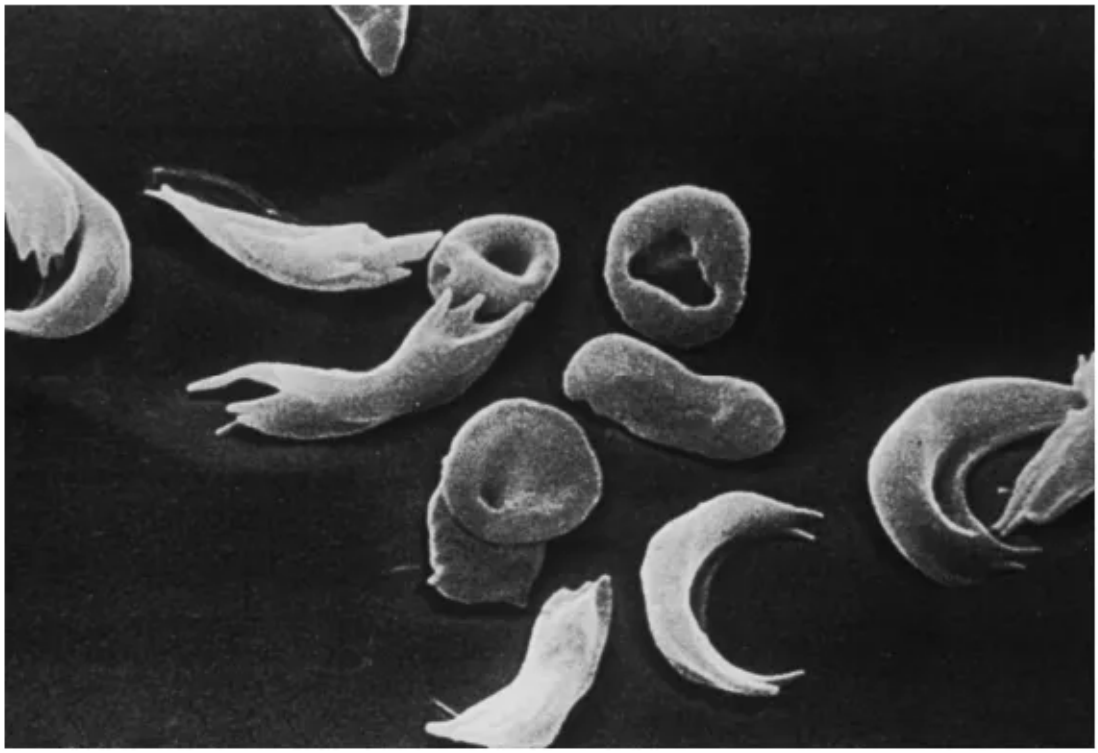


Fig. 4.1

Explain the problems that may occur as these cells circulate in the blood system.

.....

.....

.....

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.....

.....

.....

.....

..... [4]

(b) The gene for haemoglobin exists in two alternative forms:

H^A codes for the normal form of haemoglobin;
H^S codes for the abnormal form of haemoglobin.

(i) State the name for the alternative forms of a gene.

.....

[1]

(ii) A child has sickle cell anaemia. The parents do not have this disorder.

Complete the genetic diagram to show how the child inherited the disorder.

Use the symbols H^A and H^S in your answer.

parental phenotypes	normal	×	normal
parental genotypes	H^AH^S	×	H^AH^S
gametes	◯ ◯	+	◯ ◯

child's genotype	.....
child's phenotype	sickle cell anaemia

[2]

(iii) The parents are about to have another child.

What is the probability that this child will have sickle cell anaemia?

.....

[1]

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(c) The maps in Fig. 4.2 show the distribution of sickle cell anaemia and malaria in some parts of the world.

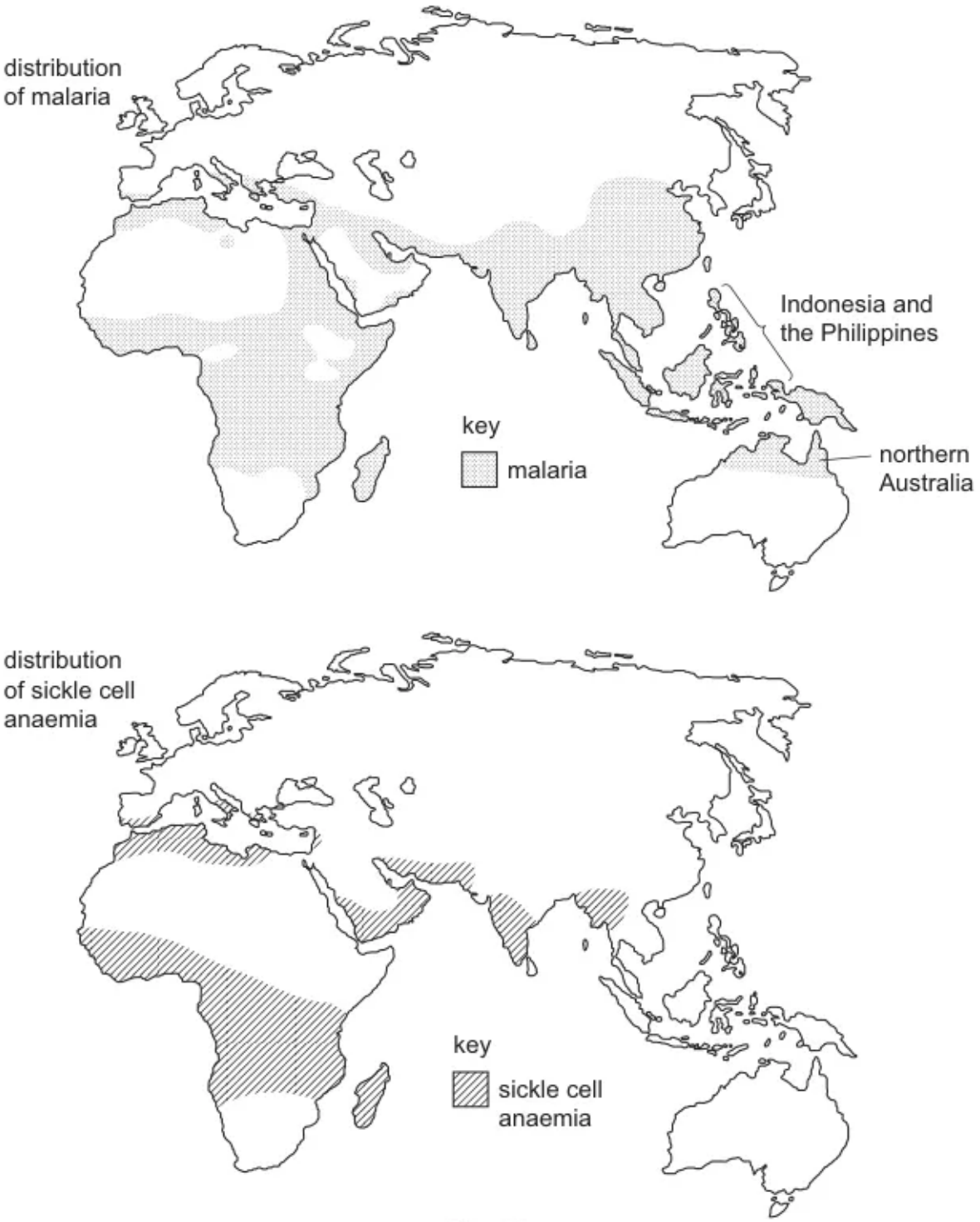


Fig. 4.2

STEM EX

(i) Explain why sickle cell anaemia is common in people who live in areas where malaria occurs.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Suggest why sickle cell anaemia is very rare among people who live in Indonesia and northern Australia.

.....

.....

.....

.....

..... [2]

[Total: 14]

Variation and mutation Click for more variations

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