1 Fig. 2.1 shows the root systems of two species of desert plant, **A** and **B**.

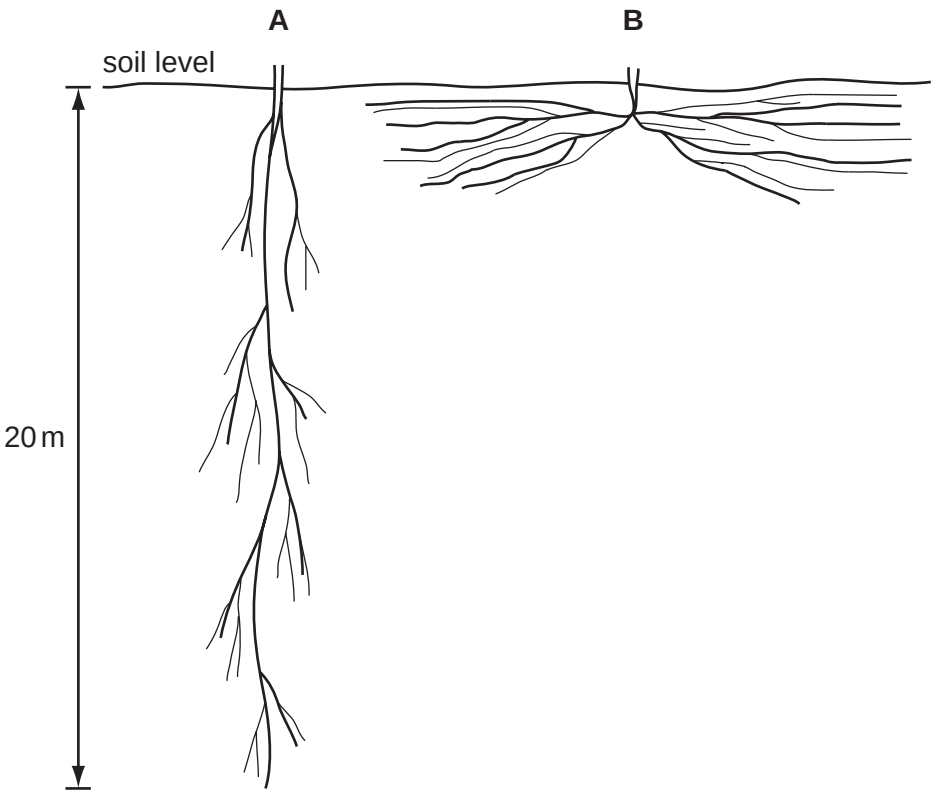

Fig. 2.1

(a) Describe the two root systems shown in Fig. 2.1 **and** explain how each is an adaptation for survival in a desert ecosystem.

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..... [4]

(b) Describe **and** explain two ways in which the **leaves** of desert plants reduce water loss in transpiration.

1. .....

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2. .....

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..... [4]

(c) Xylem and phloem are transport tissues in plants. They transport substances from organs that are known as sources to organs known as sinks.

Complete the table to show:

- **two** substances being transported in each tissue
- an organ that is a source for substances being transported in each tissue
- an organ that is a sink for substances being transported in each tissue.

tissue	substances being transported	source of substances in the plant	sink for substances in the plant
xylem	1 …… 2 ……		
phloem	1 …… 2 ……		

[6]

[Total: 14]

2 **(a)** Define the term *self-pollination*.

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..... [2]

Snapdragon plants have flowers with three colours: red, pink and white.

Some students investigated the inheritance of flower colour in snapdragons.

In **cross 1** they cross-pollinated plants that were homozygous for red flowers with plants that were homozygous for white flowers. They collected and planted the seeds from cross 1. All of the resulting plants had pink flowers.

In **cross 2** they self-pollinated all the pink-flowered plants and found that in the next generation there were red-flowered plants, white-flowered plants and pink-flowered plants.

(b) Complete the genetic diagrams to show how flower colour is inherited in snapdragon plants.

Use the symbol I^R for the allele for red flowers and I^W for the allele for white flowers.

cross 1	parental phenotypes	red flowers	×	white flowers
	parental genotypes	.....	×	.....
	gametes	.....		.....

offspring genotypes	.....
offspring phenotypes	pink flowers

cross 2

parental phenotypes	pink flowers	×	pink flowers
parental genotypes	.....	×	.....
gametes	.....		.....	

offspring genotypes ……

ratio of offspring phenotypes …… [4]

(c) Another student cross-pollinated pink-flowered plants with white-flowered plants.

Complete the genetic diagram to show the results that the student would expect.

phenotypes	pink flowers	×	white flowers
genotypes	.....	×	.....
gametes	.....		.....

offspring genotypes ……

ratio of offspring phenotypes …… [3]

(d) Explain the advantages of sexual reproduction to a species of flowering plant, such as the snapdragon.

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..... [4]

[Total: 13]

3 **(a** Define the term *gene*.

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..... [1]

The medical condition sickle cell anaemia is widely distributed in Africa, parts of Asia and the Americas. People with sickle cell anaemia have red blood cells with an abnormal form of haemoglobin.

The gene for haemoglobin exists in two forms:

$\mathbf{H^N}$ = allele for normal haemoglobin
$\mathbf{H^S}$ = allele for abnormal haemoglobin

(b) Complete the genetic diagram below to show how two people who are heterozygous for this gene may have a child who has sickle cell anaemia.

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

parental phenotypes	normal	x	normal
parental genotypes	……	x	…….
gametes	……	+	…….

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

[3]

(c) Describe the effects of sickle cell anaemia on the body.

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..... [4]

(d) Fig. 5.1 is a map that shows the distribution of the allele for the abnormal form of haemoglobin ($\mathbf{H^S}$) and malaria in Africa.

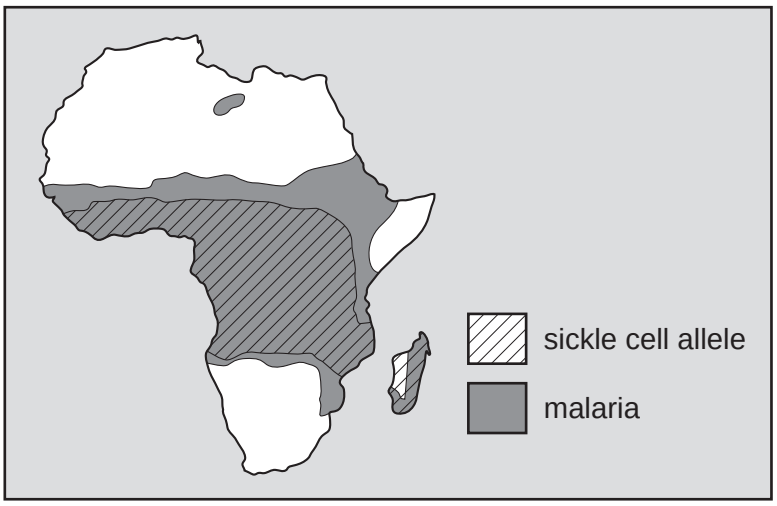

Fig. 5.1

Explain how natural selection is responsible for the distribution of the allele for the abnormal form of haemoglobin ($\mathbf{H^S}$).

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..... [5]

(e) Sickle cell anaemia is an example of the variation that exists in the human population. It is a form of discontinuous variation.

Explain why sickle cell anaemia is a form of discontinuous variation.

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..... [3]

[Total: 16]

4 Transpiration and translocation are processes responsible for transporting materials around a plant.

(i) Complete the table by stating the materials moved by these processes, their sources and their sinks.

process	materials moved	source of materials in the plant	sink for materials in the plant
transpiration	1 ..... 2	.....	.....
translocation	1 ..... 2	.....	.....

[6]

(ii) State **two** reasons why the source and sink for translocation in a plant may change at different stages in the growth of a plant.

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..... [2]

[Total: 8]