1 In tulip plants, the petals can have markings called flecks.
There are two alleles for flecks in tulip plants: with flecks **F**; and without flecks **f**.

(a) Explain the meaning of the term *dominant* allele.

.....

..... [1]

(b) A tulip grower crosses two tulip plants.

He finds that 76 of the offspring have petals with flecks and 23 of the offspring have petals without flecks.

(i) Complete the genetic diagram to explain this result.

parental genotypes …… X ……

parental phenotypes …… X ……

gametes (....) (....) X (....) (....)

offspring genotypes …… ……

offspring phenotypes petals with flecks present petals without flecks

[5]

(ii) The tulip grower wants to produce a pure-breeding variety of tulips with petals without flecks.

State the genotypes of the parent plants he should use to produce tulip plants without flecks. Explain your answer.

parental genotypes …… X ……

explanation .....

.....

..... [2]

[Total: 8]

2 **(a)** Sickle cell anaemia is an inherited disease. The gene for haemoglobin exists in two forms, Hb^N and Hb^S. People who are Hb^SHb^S have the disease and experience symptoms including fatigue and extreme pain in their joints. People who are Hb^NHb^S are carriers of the disease and may have mild symptoms, if any at all.

(i) Table 2.1 shows four genetic terms.

Complete Table 2.1 by stating a specific example, used in the paragraph above, of each genetic term.

Table 2.1

genetic term	example used in the passage
an allele	
a heterozygous genotype	
a homozygous genotype	
phenotype	

[4]

(ii) Sickle cell anaemia is not found throughout the whole world. Most cases of the disease occur in sub-Saharan Africa and in parts of Asia. The distribution is similar to that for the infectious disease malaria.

Explain why the distribution of sickle cell anaemia and malaria are similar.

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.....

.....[5]

(b) Down's syndrome is an example of a characteristic that shows discontinuous variation.

State the cause of Down's syndrome.

.....

.....[1]

(c) Explain how discontinuous variation differs from continuous variation, in its expression and cause.

.....

.....

.....

.....

.....

.....[3]

[Total: 13]

3 **(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:

$\mathbf{H^A}$ codes for the normal form of haemoglobin;
$\mathbf{H^S}$ 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]

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

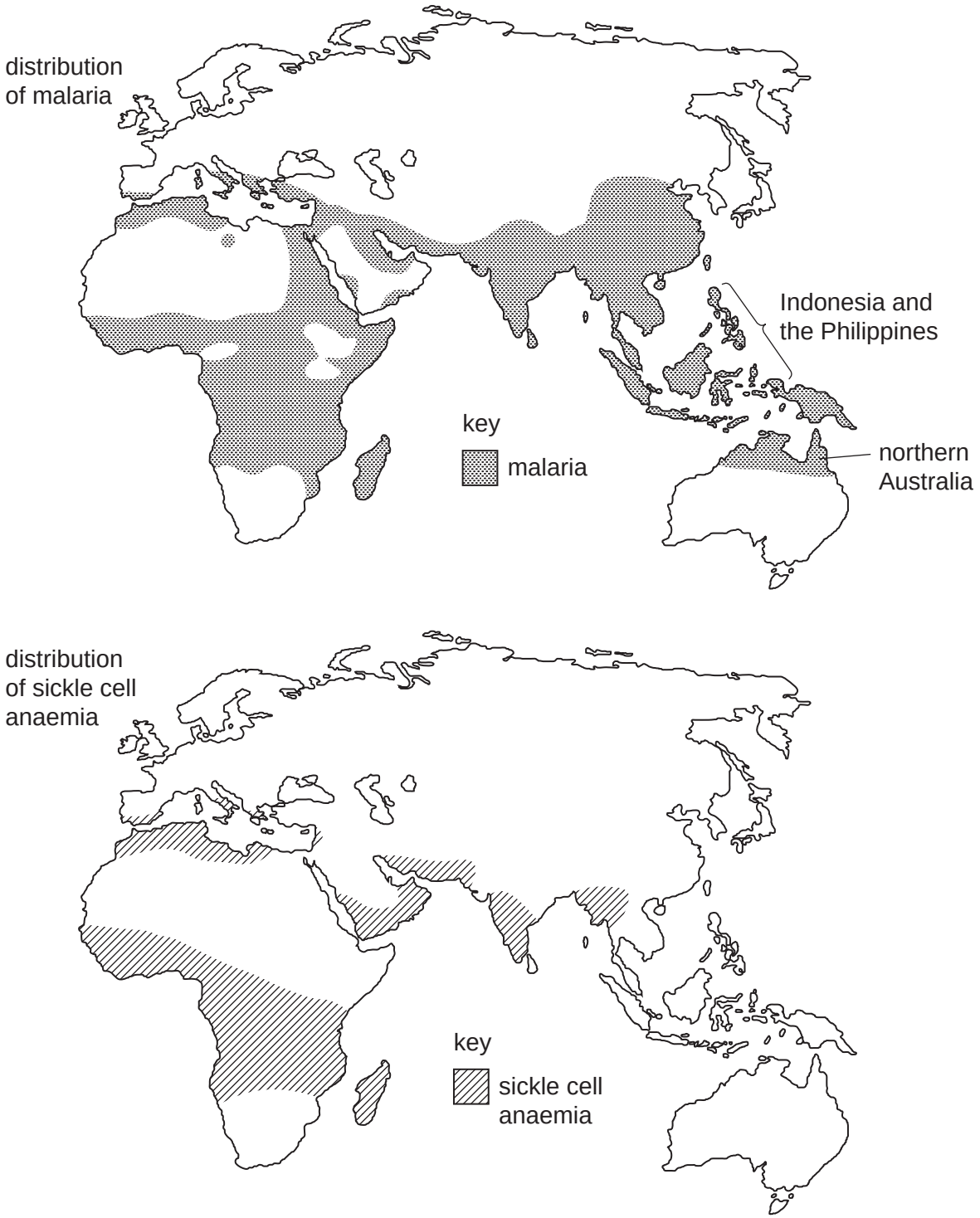

Fig. 4.2

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

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..... [4]

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

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..... [2]

[Total: 14]

4 **(a)** The production of human gametes involves the type of nuclear division known as meiosis.

State **two** reasons why meiosis is suitable for gamete production.

1 .....

.....

2 .....

..... [2]

(b) The sex of a human fetus is determined by the sex chromosomes, X and Y.

Fig. 5.1 shows the determination of sex in four different examples.

Examples **3** and **4** show sex determination in twins.

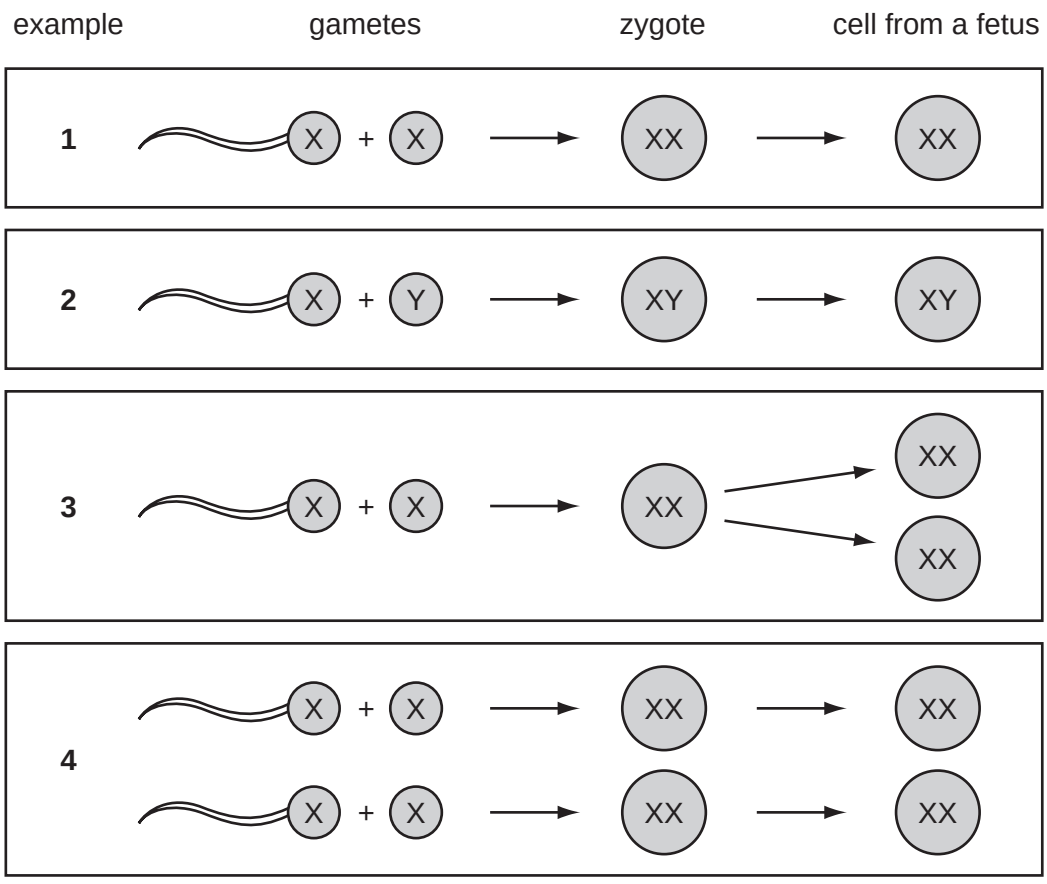

Fig. 5.1

(i) Use 5.1 to explain how the sex of a fetus is determined.

.....

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..... [2]

(ii) Examples **3** and **4** show two ways in which twins are formed.

The twins in example **3** are identical.

Use Fig. 5.1 to explain why.

.....

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..... [2]

(c) During the development of a fetus, different genes are expressed at different times.

Explain what is meant by the term *development*.

.....

.....

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..... [2]

(d) One of the genes that controls the ability of blood to clot is found **only** on the X chromosome.

X^H represents an X chromosome with the dominant allele for normal blood clotting.

X^h represents an X chromosome with the recessive allele which causes the blood to clot slowly.

The Y chromosome is small and does not have the gene for blood clotting.

Here is a list of four genotypes.

X^HX^H, X^HX^h, X^HY, X^hY

Choose the genotype from the list that matches each of the following:

- gives a phenotype of long clotting time; .....
- is heterozygous; .....
- is homozygous. ..... [3]

(e) Haemophilia is a rare genetic condition in which the blood clots very slowly.

In the USA, haemophilia affects 1 in 5000 male births each year. In some cases these births occur in families where the condition has not occurred before.

Explain how boys can have haemophilia when the condition has not previously existed in their family.

.....

.....

.....

.....

..... [2]

[Total: 13]