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8147818237

BIOLOGY **0610/41**

Paper 4 Theory (Extended) **October/November 2021**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

1 **(a)** Fish, mammals and birds are all groups of vertebrates.

(i) State the names of the **two other** main groups of vertebrates.

..... and ..... [1]

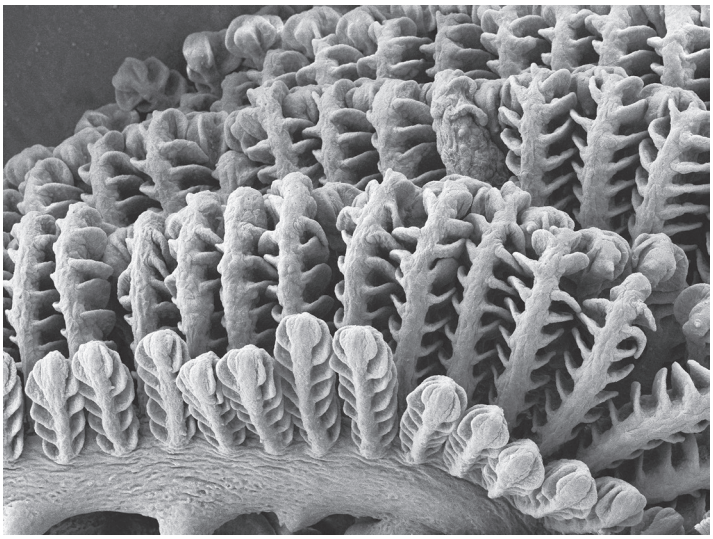
(ii) Complete Table 1.1 to compare the features of fish, mammals and birds.

Table 1.1

feature	fish	mammals	birds
organ involved in gas exchange	gills		lungs
circulatory system			double
body covering		fur	
presence of external ears (pinnae)	no		

[3]

(b) Fig. 1.1 is a micrograph of part of some fish gills.



magnification ×110

Fig. 1.1

Fish gills are adapted for gas exchange by diffusion.

(i) Define the term diffusion.

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..... [2]

(ii) Suggest **one** adaptation, visible in Fig. 1.1, that shows that fish gills are efficient structures for gas exchange by diffusion.

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.....

..... [1]

(c) Some pollutants decrease the concentration of dissolved oxygen in rivers. This can result in the death of fish.

(i) State **one** type of pollutant that can result in a decrease in the concentration of dissolved oxygen in rivers.

..... [1]

(ii) Researchers investigated the effect of the concentration of dissolved oxygen in water on gas diffusion distance in tissues. The thickness of fish gills was used to determine the gas diffusion distance.

The researchers changed the concentration of dissolved oxygen by bubbling different concentrations of oxygen into water. The temperature of the water was kept constant at 15 °C.

Their results are shown in Fig. 1.2.

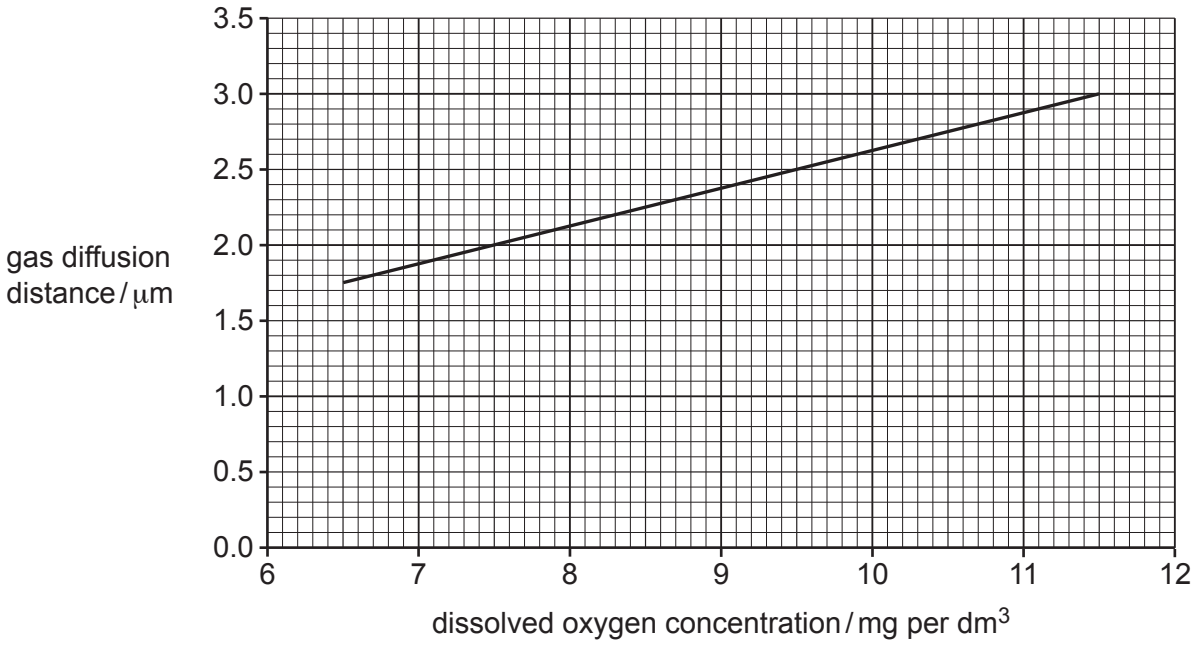

Fig. 1.2

Fig. 1.3 shows the relationship between the concentration of dissolved oxygen and water temperature.

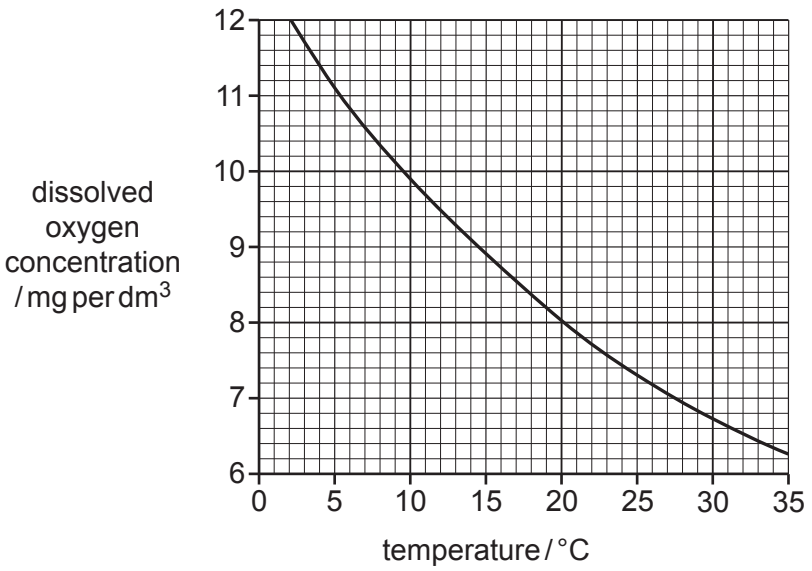

Fig. 1.3

Complete steps 1 to 3 to determine the effect on gas diffusion distance of increasing the temperature of the water from 15 °C to 25 °C.

Step 1
Find the concentration of dissolved oxygen from Fig. 1.3 at:

15 °C: ..... mg per dm^3 25 °C: ..... mg per dm^3

Step 2
Use the values from step 1 to find the gas diffusion distances from Fig. 1.2:

..... μm ..... μm

Step 3
Calculate the difference in the values from step 2.

..... μm
[3]

[Total: 11]

2 **(a)** Two tomato plants that produce red fruit were bred together.

This cross produced 71 offspring plants with red fruit and 26 offspring plants with yellow fruit.

Complete the genetic diagram to show this cross.

Select a suitable letter to represent the alleles and decide which allele will need a capital letter and which allele will need a lower case letter.

letter representing the allele for red fruit .....

letter representing the allele for yellow fruit .....

parental phenotypes red fruit × red fruit

parental genotypes ..... × .....

gametes ..... , ... × ..... , ...

offspring genotypes .....

expected phenotype ratio ..... red fruit : ..... yellow fruit

actual phenotype ratio 71 red fruit : 26 yellow fruit

[6]

(b) Researchers carried out some experiments on tomato plants that were homozygous for fruit colour.

State how the researchers could be sure that the fruit came from homozygous plants.

.....

.....

..... [1]

(c) The researchers analysed two pigments, chlorophyll and lycopene, in homozygous red tomato fruit and homozygous yellow tomato fruit. Chlorophyll is found in unripe tomato fruit.

(i) Describe the function of chlorophyll.

.....

.....

.....

.....

..... [2]

(ii) State the name of **one** mineral required for the synthesis of chlorophyll.

..... [1]

(iii) The researchers analysed the concentration of the pigments in tomato fruits:
- before they were ready to eat (unripe)
- when they were ready to eat (ripe).

The results of the analysis are shown in Table 2.1.

Table 2.1

	chlorophyll concentration / mg per g of tomato fruit	lycopene concentration / mg per g of tomato fruit
unripe red fruit	10.0	0.0
ripe red fruit	1.2	105.7
unripe yellow fruit	6.2	0.0
ripe yellow fruit	0.4	0.7

Use the information in Table 2.1 to compare the changes in pigments in red fruit and yellow fruit as they ripen.

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..... [3]

(d) A gene is responsible for the production of lycopene in fruits. Geneticists have recently produced genetically modified pink pineapples using the gene associated with the production of lycopene.

(i) Genes are found at specific locations on an important biological molecule.

State the name of this biological molecule.

..... [1]

(ii) Describe the disadvantages of genetically modifying crops.

.....

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.....

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..... [2]

[Total: 16]

3 Some washing powders contain enzymes.

(a) Fig. 3.1 shows a box of biological washing powder containing enzymes.

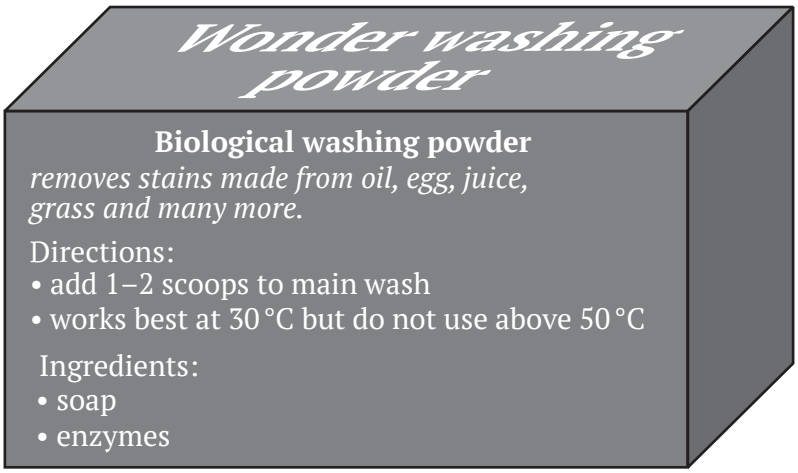

Fig. 3.1

(i) Eggs contain protein.

Describe how the biological washing powder removes egg stains.

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..... [3]

(ii) Explain why the manufacturer states that the washing powder works best at 30 °C and should **not** be used above 50 °C.

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..... [4]

(b) Scientists used enzymes and bile in the early development of biological washing powders.

Outline the roles of bile in the body.

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..... [4]

[Total: 11]

4 Cholera is a transmissible disease.

(a) State the name of the type of pathogen that causes cholera.

..... [1]

(b) A study was designed to test the effectiveness of a cholera vaccine in an area where outbreaks of cholera occur frequently.

The doctors gave some people in this area the new vaccine.

(i) Suggest what the cholera vaccine must contain to be effective.

.....

.....

..... [1]

(ii) Explain why the people were not protected from cholera immediately after receiving the vaccine.

.....

.....

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.....

.....

..... [3]

(iii) The doctors ensured that the people who received the new vaccine had **not** had cholera before.

Suggest why.

.....

.....

..... [1]

(iv) There was an outbreak of cholera in the area two months after the new vaccine was given.

The people who had symptoms of cholera were monitored in hospital for two days.

Some of the infected people had received the new vaccine and others had **not** received the vaccine.

The results are shown in Fig. 4.1.

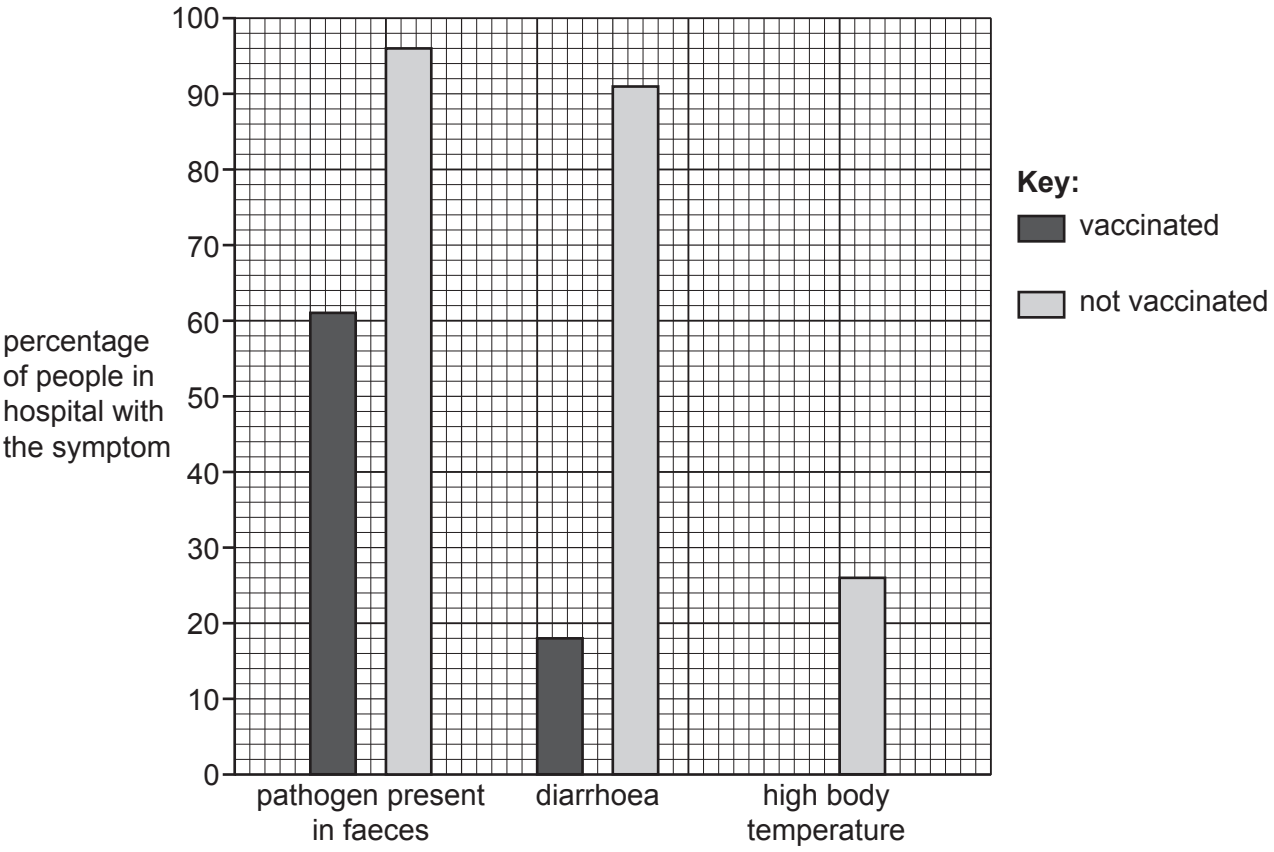

Fig. 4.1

Using the information in Fig. 4.1, discuss how effective the vaccine was at preventing the symptoms of cholera.

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..... [2]

(c) (i) Explain how cholera causes diarrhoea.

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..... [4]

(ii) Describe how diarrhoea is treated.

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..... [2]

[Total: 14]

5 The circulatory system is comprised of the heart, blood vessels and the blood.

(a) Explain how the structures of the heart ensure that blood flows in one direction.

Include the names of these structures in your answer.

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..... [4]

(b) Fig. 5.1 shows a diagram of some blood vessels associated with the skin.

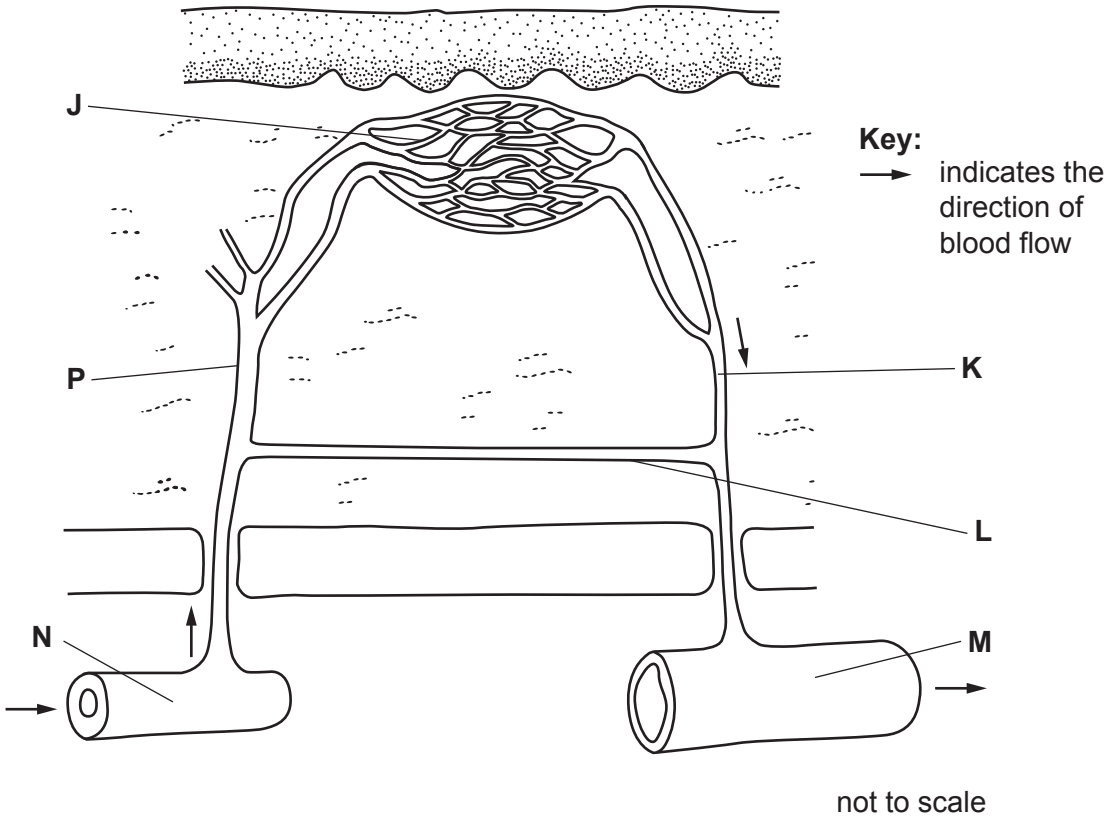

Fig. 5.1

Table 5.1 shows the functions of some blood vessels.

Complete Table 5.1 by:

- naming the type of blood vessel
- stating the letter of the type of blood vessel from Fig. 5.1.

Table 5.1

function	type of blood vessel	letter on Fig. 5.1
regulates blood flow by constricting and dilating		
collects blood from a network of the narrowest blood vessels		
withstands the highest blood pressure		
allows the transfer of substances to and from tissue fluid		
transports blood towards the heart		
redirects blood flow deeper under the surface of the skin		

[6]

(c) State the name of the blood vessels that deliver blood to the:

kidneys .....

heart muscle .....

[2]

(d) Describe how blockages in the vessels that deliver blood to the heart muscle can be treated.

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..... [4]

[Total: 16]

6 Many crop plants are grown as monocultures.

Fig. 6.1 shows the destruction of a monoculture of maize as a result of drought.

Fig. 6.1

(a) Describe the negative impacts to an ecosystem of large-scale monocultures, such as the one shown in Fig. 6.1.

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..... [3]

(b) The fruits of maize are produced on structures called cobs. Each cob has many fruits.

Fig. 6.2 shows how the maize cobs have changed over thousands of years as a result of selective breeding.

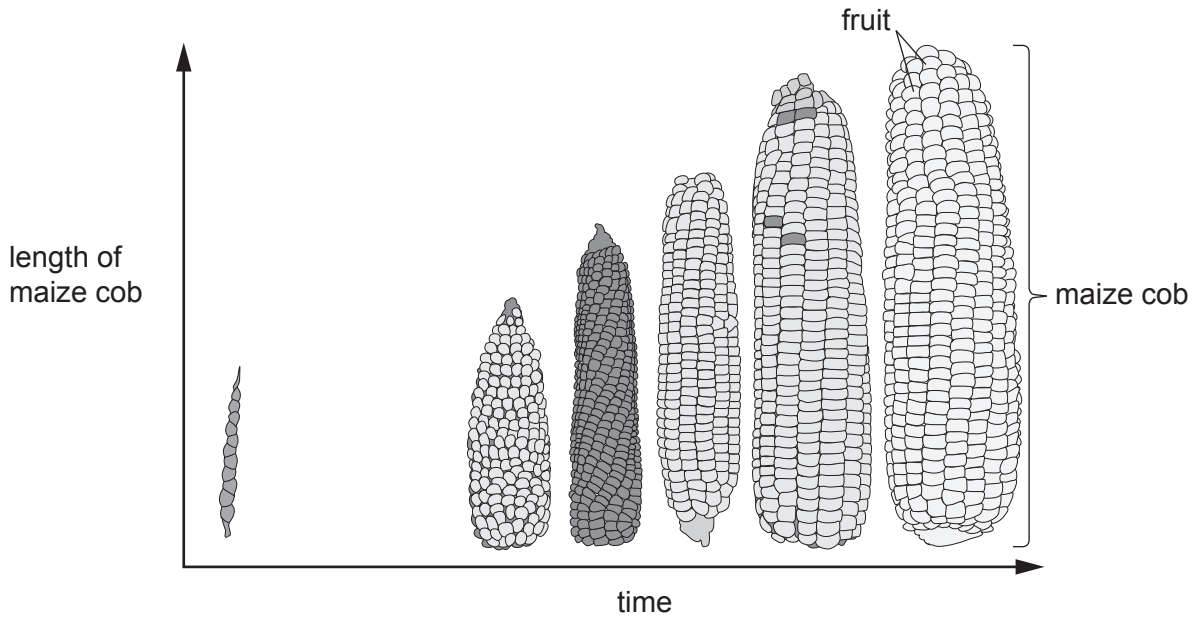

Fig. 6.2

State **two** desirable features, visible in Fig. 6.2, that have been selected from the more ancient varieties of maize.

1 .....

2 .....

[2]

(c) The process of selective breeding involves a series of steps, as shown in Fig. 6.3.

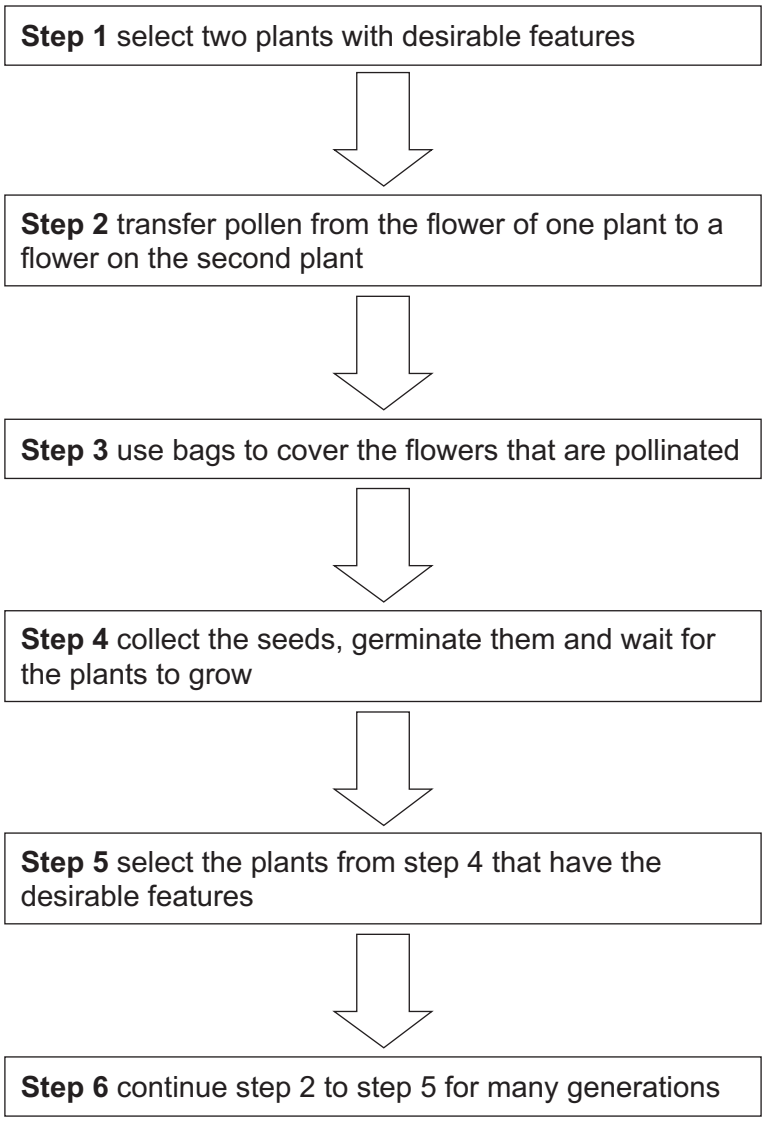

Fig. 6.3

(i) Explain why the flowers are covered with bags in step 3.

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..... [1]

(ii) Explain why the seeds in step 4 need oxygen to germinate.

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..... [2]

(iii) Explain why some of the plants in step 5 may show features **not** visible in the parent plants.

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..... [1]

(iv) Suggest why selective breeding should continue for many generations (step 6).

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..... [2]

(v) State how new features, which did **not** exist in ancient varieties of a crop plant, could appear.

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..... [1]

[Total: 12]

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