AQA

GCSE
BIOLOGY

H

Higher Tier   Paper 2H

Time allowed: 1 hour 45 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator.

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

Answer **all** questions in the spaces provided.

0 1 The nucleus of a cell contains DNA.
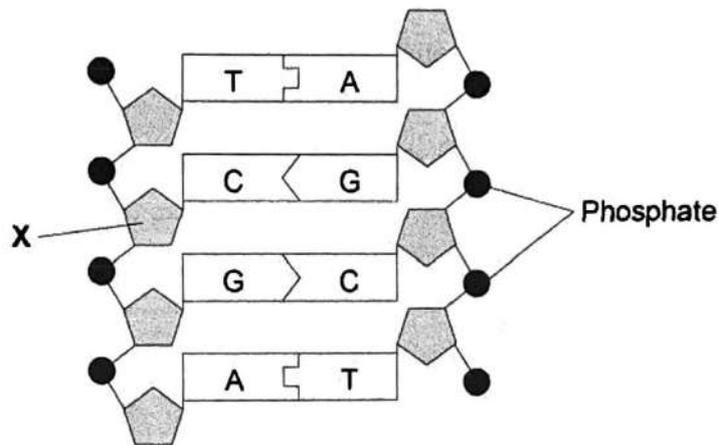
0 1 . 1 Name the structures inside the cell nucleus that contain DNA.

[1 mark]

Chromosome (DNA is organised into Chromosomes)

Figure 1 shows part of a DNA molecule.

Figure 1

X →

Phosphate

0 1 . 2 Name the part of the DNA molecule labelled **X**.

[1 mark]

Sugar (deoxyribose sugar)

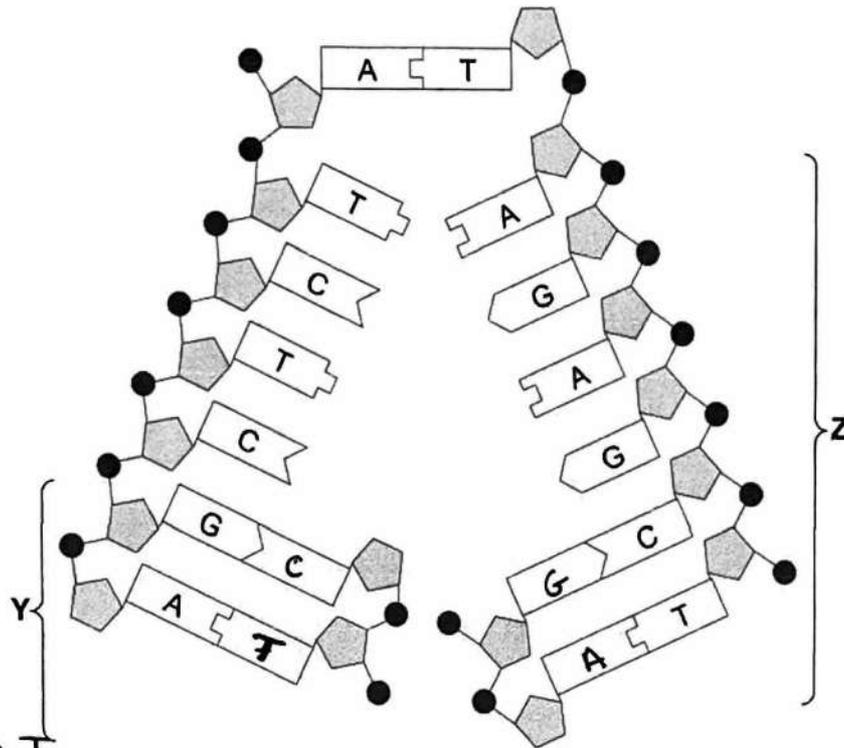**0 1 . 3** What type of substances are labelled **A, C, G** and **T** in **Figure 1**?

[1 mark]

bases (nitrogen rich bases)
(adenine, cytosine, guanine and thymine)

Figure 2 shows another section of a DNA molecule.

Figure 2

A pairs with T
C pairs with G

0 1 . 4 Four of the substances you named in Question **01.3** are **not** labelled in part **Y** of **Figure 2**.

Label each of these substances with the correct letter, **A**, **C**, **G** or **T**.

Use information from other parts of **Figure 2** to help you.

[1 mark]

0 1 . 5 What is happening to the DNA in part **Z** of **Figure 2**?

[1 mark]

Tick (✓) **one** box.

Differentiation ☐

Evolution ☐

Fertilisation ☐

Replication ✓

Turn over ▶

0 1 . 6 A gene is a length of DNA.

What type of substance does a gene code for?

[1 mark]

protein (codes for an amino acid sequence that is
folded into a protein)

0 1 . 7 Most human body cells contain 6×10^{-12} grams of DNA.

What mass of DNA will a human sperm cell contain?

[1 mark]

Tick (✓) **one** box.

6×10^{-6} grams ☐

6×10^{-12} grams ☐

3×10^{-6} grams ☐

3×10^{-12} grams ✓ exactly half of 6×10^{-12} g as
sperm cells are haploid containing
half of the genetic material
of a normal cell.

0 1 . 8 What is the name of the type of cell division that produces sperm cells?

[1 mark]

Tick (✓) **one** box.

Binary fission ☐

Differentiation ☐

Meiosis ✓ Sex cells are produced
through meiosis
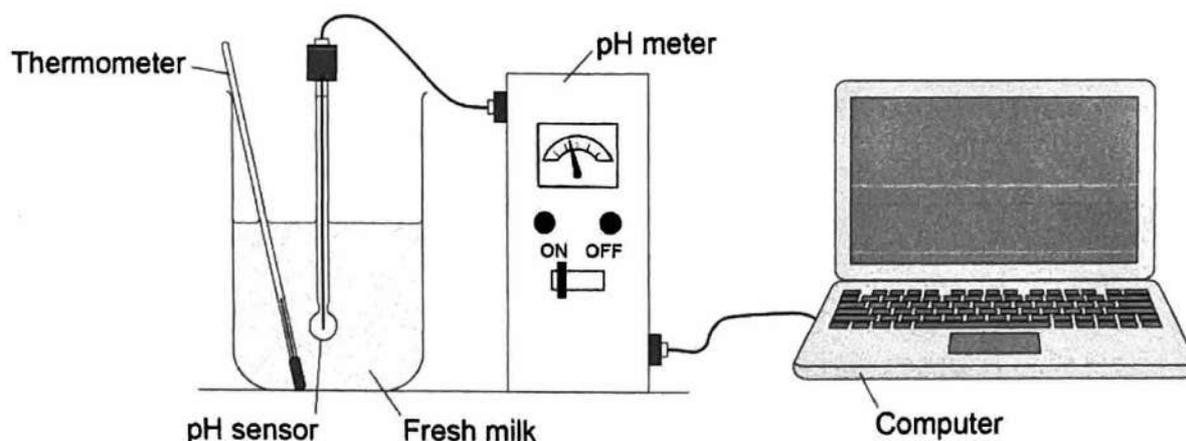
Mitosis ☐

8

0 2   A student investigated the effect of temperature on the decay of milk.

Figure 3 shows the apparatus the student used.

Figure 3

This is the method used.

1. Set up the apparatus as shown in **Figure 3** with the milk at 20 °C.

2. Record the pH over 5 days using the computer.

3. Repeat with another batch of fresh milk at 25 °C.

0 2 . 1   How could the student keep the milk at a constant temperature for 5 days?

[1 mark]

Keep in a constant temperature water bath.

0 2 . 2   Give **one** variable the student should keep constant.

Do **not** refer to temperature in your answer.

[1 mark]

The type of milk they are using (eg.: cow/goat);
skimmed / semi skimmed)

Question 2 continues on the next page

Turn over ▶

Table 1 shows the student's results for the milk at 20 °C.

Table 1

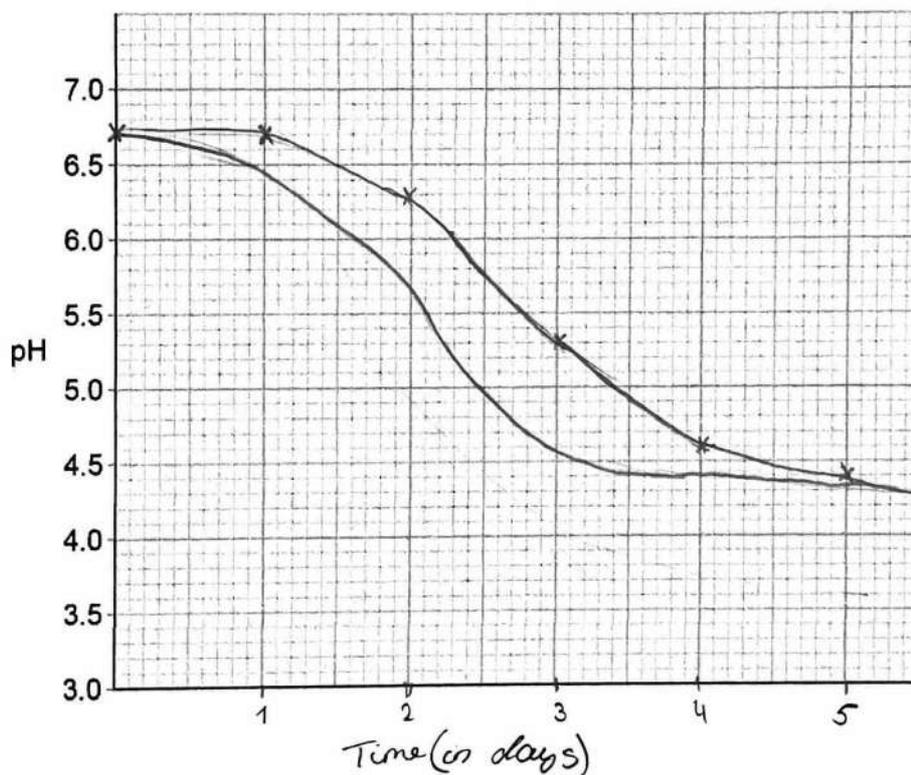| Time in days	0	1	2	3	4	5
pH	6.7	6.7	6.3	5.3	4.6	4.4

0 2 . 3 Complete **Figure 4**.

[4 marks]

You should:

- label the x-axis
- use a suitable scale for the x-axis
- plot the data from **Table 1**
- draw a line of best fit.

Figure 4

0 2 . 4 The data you plotted in Question **02.3** were obtained at 20 °C.

Sketch a line on **Figure 4** to show the results you would expect at 25 °C.

Label this line '25 °C'.

[2 marks]

8

Maths Made Easy

0 3 Human body temperature is controlled within very narrow limits.

Scientists investigated the effect of drinking ice-cold water on:

- internal body temperature
- the rate of sweating.

This is the method used.

1. Sit a person inside a room kept at a constant temperature of 25 °C.

2. Measure the person's internal body temperature near the brain.

3. Measure the person's rate of sweating.

4. After 20 minutes, give the person 500 cm³ of ice-cold water to drink.

5. Continue to measure the person's internal body temperature and sweating rate for a further 50 minutes.

0 3 . 1 Give the reason why the person should **not** move during the investigation.

[1 mark]

movement would release more heat, so increase the body themperafue more.

Question 3 continues on the next page

Turn over ▶

Maths Made Easy

Figure 5 and **Figure 6** show the scientists' results.

Figure 5

Internal body temperature in °C

Time in minutes

Drinks
ice-cold water

Figure 6

Rate of
sweating
in arbitrary
units

Time in minutes

Drinks
ice-cold water
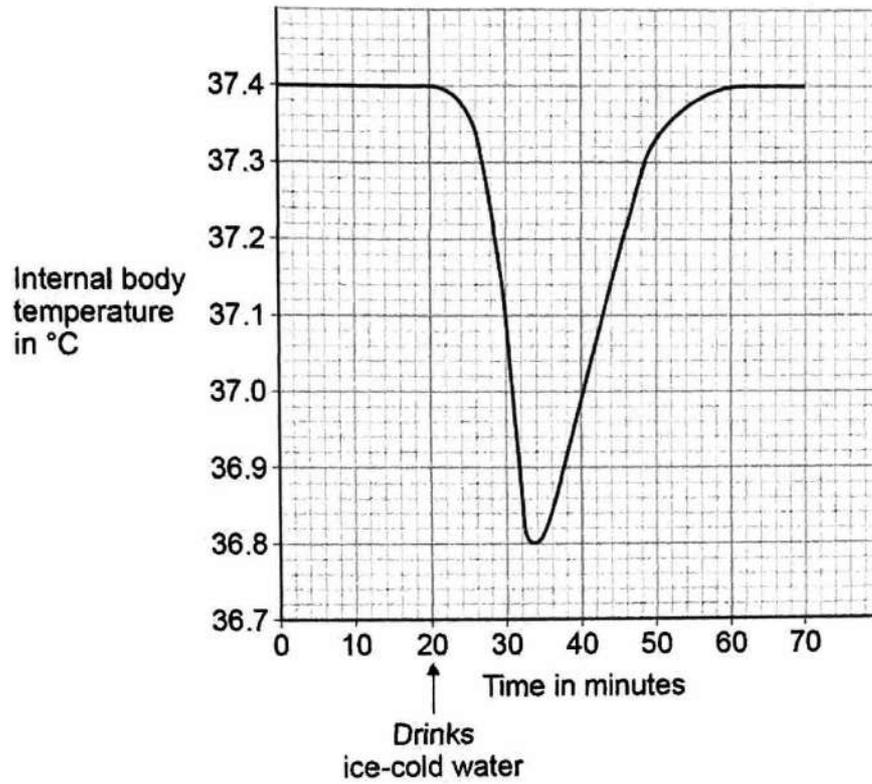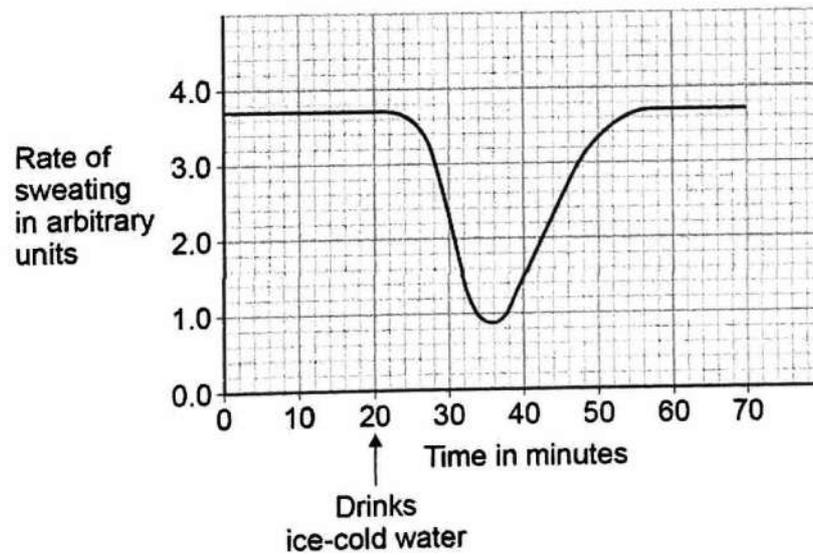
0 3 . 2 What is this person's normal internal body temperature?

[1 mark]

Tick (✓) **one** box.

36.8 °C ☐   37.0 °C ☐   37.4 °C ✓

The results show that when the ice-cold water was drunk, the temperature near the brain decreased.

0 3 . 3 Explain why the temperature near the brain decreased.

[2 marks]

As the person drinks the cold-water it cools their mouth and stomach. As, blood flows past these surfaces it is cooled. When this cooled blood travels to the brain it decreases temperature there as well.

0 3 . 4 The thermoregulatory centre in the brain responds to the decrease in temperature.

How does the thermoregulatory centre send information to sweat glands in the skin?

[1 mark]

Through the nervous system that contains neurones. Impulses are sent along them with a message.

0 3 . 5 The rate of sweating changes between 24 minutes and 36 minutes.

Explain how this change helps to maintain the person's normal body temperature.

[2 marks]

The rate of sweating decreases. Sweating cools the body, as sweat evaporates from the skin, heat is lost by the body. By reducing sweating, less heat is lost, so the body returns faster to the higher temperature.

Question 3 continues on the next page

Turn over ▶

0 3 . 6 During exercise, the skin appears red.

What causes the skin to appear red?

[1 mark]

Tick (✓) **one** box.

Blood vessels moving closer to the skin surface ☐

Constriction of blood vessels in the skin ☐

Decrease in heart rate ☐

Dilation of blood vessels in the skin ✓

Dilation is the expansion of the lumen of the vessles.
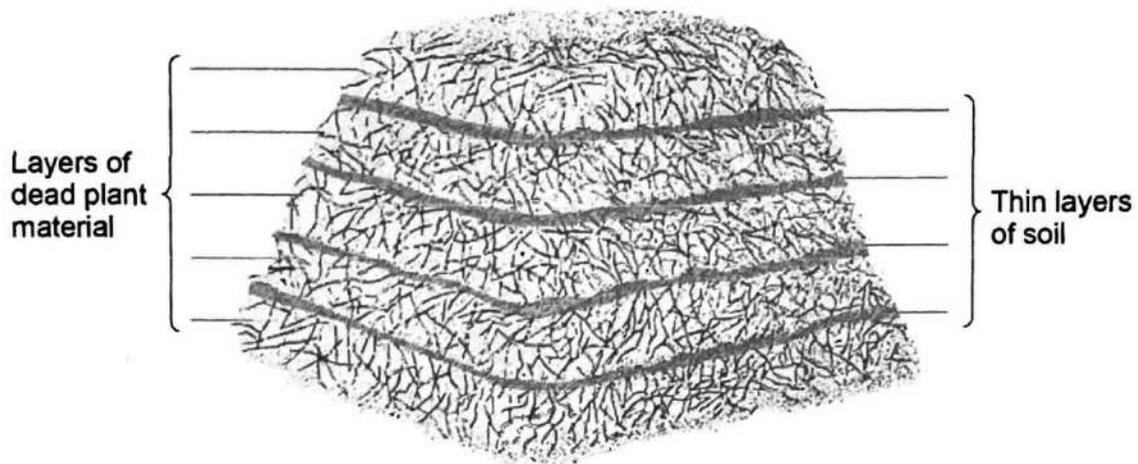
Turn over for the next question

8

0 4   Decay occurs in a compost heap.

Figure 7 shows a compost heap.

Figure 7

Layers of
dead plant
material

Thin layers
of soil

Describe:

- how microorganisms in the layers of soil help to recycle chemicals in the
  dead plants
- how the chemicals are used again by living plants.

[6 marks]

Dead plants contain all kinds of useful molecules, but these are fixed up in large complex molecules. The function of microorganisms is to decompose this dead plant matter containing large molecules into smaller ones. They use enzymes to 'cleave' of smaller molecules that they can then metabolise in respiration. Organic molecules are metabolised into carbon dioxide, that gets released into the atmosphere. Other mineral ions also get released into the compost, such as nitrates and phosphates and magnesium.

These ions can be then taken up by plants later from the compost through active transport in the roots. They use the nitrates to produce amino acids, which are monomers of proteins. The phosphate is used in DNA's sugar-phosphate backbone, the magnesium in chlorophyll in the chloroplast. In addition, they take up carbon dioxide from the atmosphere through the stomata on their leaves by diffusion. They use it in the process of photosynthesis, to produce sugars they can use for growth and repair.

6

Turn over for the next question

0 5 The growth of daisy plants on a lawn is affected by biotic factors and by abiotic factors.

0 5 . 1 **Table 2** shows six factors.

Tick (✓) **one** box in each row to show whether the factor is biotic or abiotic.

[3 marks]

Table 2

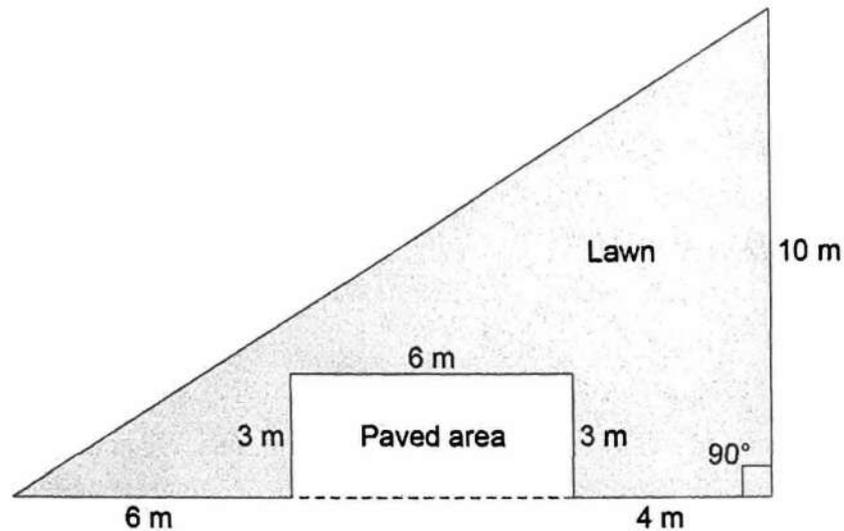| Factor	Biotic	Abiotic
Nitrates in the soil		✓
Rabbits eating the plants	✓	
Shading by a building		✓
Soil pH		✓
Temperature		✓
Trampling by people	✓	

Question 5 continues on the next page

Figure 8 shows a plan of a garden.

Figure 8

A student estimates the number of daisy plants growing on the lawn.

The student places a quadrat at 10 different positions on the lawn.

The quadrat measures 50 cm × 50 cm.

The student counts the number of daisy plants in each quadrat.

| 0 | 5 | . | 2 | How should the student decide where to place the quadrat?

Give the reason for your answer.

[2 marks]

Draw a grid over the plot and allocate a
coordinate to each smaller unit. Choose
coordinates of quadrats by random.

0 5 . 3 The mean number of daisy plants in each quadrat is 6.

Calculate the number of daisy plants on the lawn.
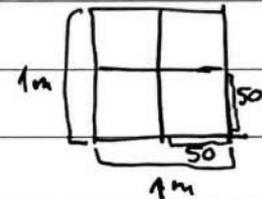
Give your answer to 3 significant figures.

[6 marks]

Area of the lawn = area of tringle − area of paved area

$$= \frac{1}{2} \times 10 \times (6+6+4) \quad - \quad (6 \times 3)$$

$$= 80 \quad - \quad 18 \quad = \quad \underline{62 \, m^2}$$

There are 6 daisis by quadrat (50cm × 50cm)

There are 4 quadrats in 1 m²

$$4 \times 6 = 24 \text{ daisys} / 1 m^2$$

$$62 \, m^2 \times 24 \text{ daisys} / m^2 = \underline{1488 \text{ daisys}}$$

$$3sf \Rightarrow \underline{1490}$$

Number of daisy plants on the lawn = _____ 1490 _____

0 5 . 4 Using the mean from this investigation to calculate the number of daisy plants on the lawn may **not** be accurate.

Give **two** reasons why.

[2 marks]

1 Random sample is not fully representative of whole lawn (not random enough)

2 To few quadrat samples (small sample size to use)

Turn over for the next question

13

Turn over ▶

0 6 Reflex actions are coordinated by the nervous system.

0 6 . 1 What is meant by the term 'reflex action'?

[2 marks]

Its a response to a stimuli that is unconscious. The person doesnt have to think about their reaction for it to happen.

0 6 . 2 A woman's hand accidentally touches a hot object.

The woman moves her hand away rapidly.

Describe how the woman's nervous system coordinates the reflex action.

[6 marks]

When the woman touches the hot object receptors in her skin can sense that its to hot. This is the stimulus that triggers the receptor to generate a nerve impulse. This nerve impulse travels along the sensory neurone to the relay neurone. Here it is transmitted to the relay neurone in the CNS through the synapse, which is a gap between 2 neurones. Signal is transmitted through the synapse by neurotransmitters diffusing across. From the relay neurone the signal is transmitted in the same way to the motor neurone. The impulse travels along the motor neurone to the effector, which are the muscles in her arm, The nerve induces contraction in the muscles causing the arm to move away from the hot object.

0 6 . 3 The endocrine system coordinates many internal functions of the body.

Give **three** ways coordination by the endocrine system is different from coordination by the nervous system.

[3 marks]

1 It is much slower having effect over minutes, hours, years not seconds and milliseconds.

2 Signals travel in the blood to target organs not through neurones

3 effect of the endochrine system are much longer lasting, bringing about change for longer time period.

0 6 . 4 Describe how hormones control the menstrual cycle.

[5 marks]

FSH is released from the pituatry gland that travels to the ovaries where they cause the maturation of an egg. This causes the ovaries to release oestrogen that causes the build up of uterous lining and inhibits FSH production, but promotes LH production. LH stimulates the release of the egg through ovulation. Following this progesterone is produced by the ovaries, which helps to maintain the lining of the uterous. It also inhibits FSH and LH production.
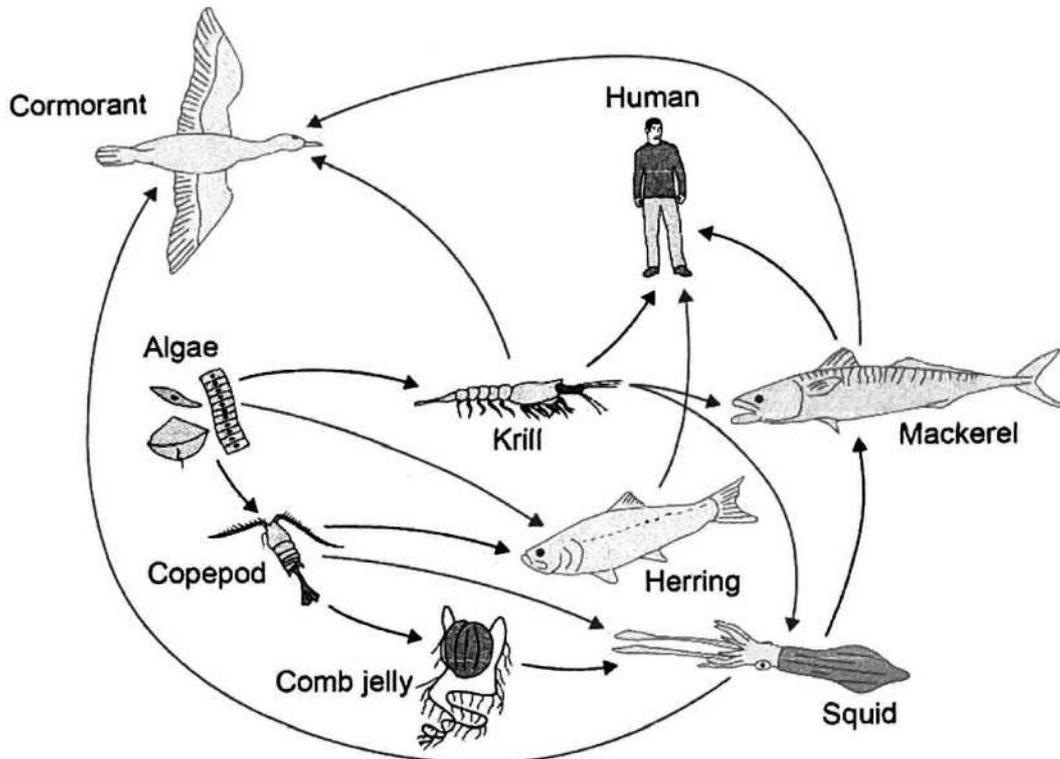
16

Turn over for the next question

0 7   A food web contains several food chains.

Figure 9 shows a food web.

Figure 9

Not to scale

0 7 . 1   The animals in **Figure 9** get their energy by eating other organisms.

Describe how the algae get energy.

[2 marks]

They use light from the sun, but that they absorb
with their Chlorophyll in their chloroplas to use in
photosynthesis.

0 7 . 2   Name **one** primary consumer in **Figure 9**.

[1 mark]

krill OR herring OR copepod

0 7 . 3 Name **one** producer in **Figure 9**.
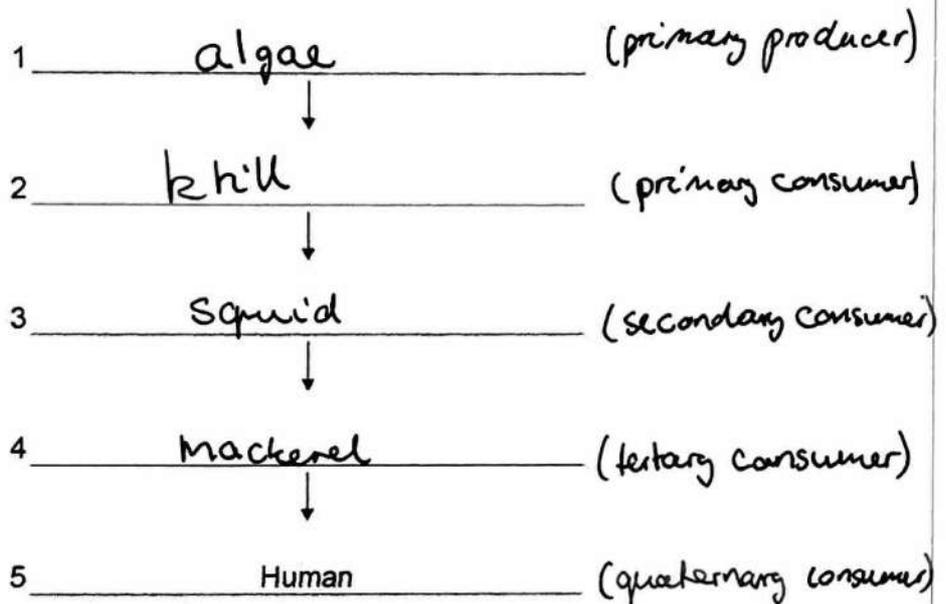
[1 mark]

Algea

(as its producing biomass from small inorganic molecules)

0 7 . 4 The different food chains in **Figure 9** have different numbers of organisms.

Complete **Figure 10** to show a food chain in **Figure 9** with **five** organisms, including the human.

[1 mark]

Figure 10

1 _algae_ (primary producer)

↓

2 _krill_ (primary consumer)

↓

3 _Squid_ (secondary consumer)

↓

4 _Mackerel_ (tertiary consumer)

↓

5 Human (quaternary consumer)

0 7 . 5 **Figure 9** shows that mackerel eat krill and squid.

The biomass of mackerel is much less than the combined biomass of krill and squid.

One reason for this is that the mackerel cannot digest all parts of the krill and squid.

Give **two** other reasons.

[2 marks]
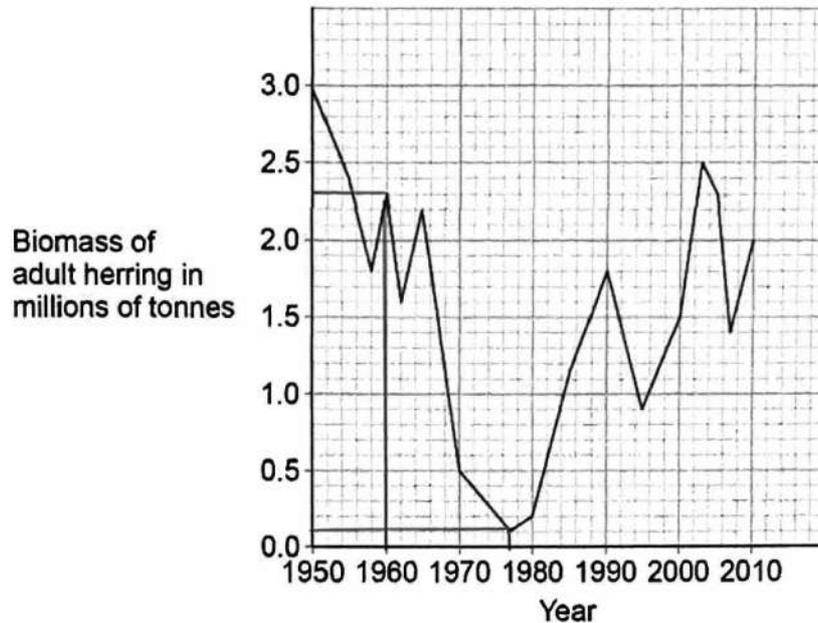
1 _Respiration by the mackrel uses up biomass_

2 _Excretion, not all of its food is 100% absorbed by the mackrel its excretions are wasted._

Turn over ▶

Do not wri
outside th
box

Figure 11 shows how the biomass of adult herring in the North Sea has changed between 1950 and 2010.

Figure 11

Biomass of adult herring in millions of tonnes

Year

| 0 7 |. 6 | Calculate the percentage decrease in the biomass of herring between 1960 and 1977.

Give your answer to the nearest whole number.

[4 marks]

biomass in 1960 - 2.3 million; biomass in 1977 - 0.1 million

$$\text{percentage decrease} = \frac{(\text{biomass in 1960} - \text{biomass in 1977})}{\text{biomass in 1960}} \times 100$$

$$= \frac{(2.3 - 0.1)}{2.3} \times 100$$

$$= 95.652173930\ldots$$

whole number $\Rightarrow$ <u>96 %</u>

Percentage decrease = _____96_____ %

0 7 . 7 Too many herring were caught by fishermen between 1960 and 1977.

Herring can live for up to 12 years and begin to reproduce when 3 to 4 years old.

Laws have been introduced to help conserve herring:

- 1977 to 1981 – herring fishing was banned in the North Sea
- 1984 to present day – control of mesh size of fishing nets
- 1997 to present day – fishing quotas were introduced
- 1998 to present day – herring fishing was banned in breeding grounds during the breeding season.

Figure 12 shows how a minimum mesh size helps to conserve herring.
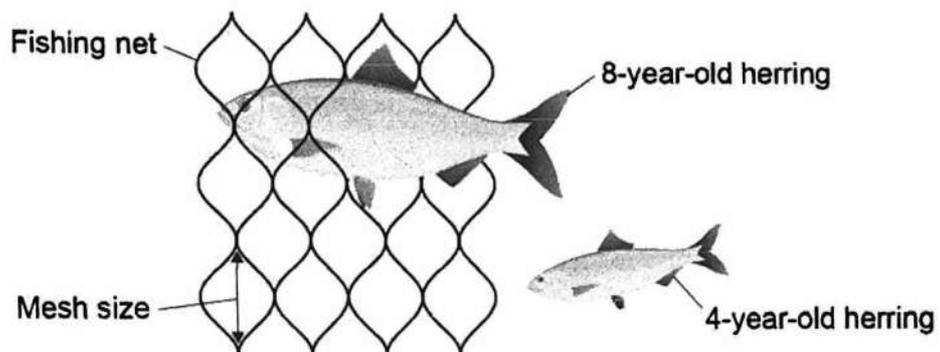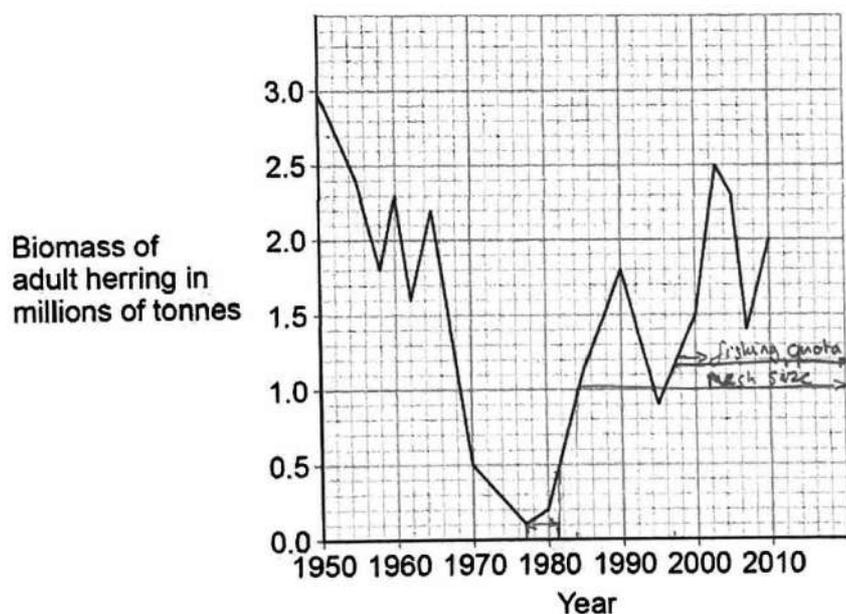
Figure 12

Fishing net

8-year-old herring

Mesh size

4-year-old herring

Figure 11 is repeated below.

Figure 11

Biomass of adult herring in millions of tonnes

fishing quota
mesh size

Year

Evaluate the effect of these laws on the conservation of herring stocks.

Use data from **Figure 11** and information from **Figure 12** in your answer.

[6 marks]

As fish younger than 4-5 years old are small enough to fit through mesh they can survive long enough to reproduce. We can also see in Figure 11 that after larger mesh size is introduced there is an increase from 0.9 million to 1.8 million till 1990. This suggest it has been helpfull to increase their population. The fishing ban appears to be also helpful as from 1977 to 1981 population biomass increases from 0.1 to 0.48. After quotas in 1997 and fishing ban at breeding grounds (1998) there is further increases in biomass. For quotas from 1.15 to 1.25 and for ban from 1.25 to 2.5. So together these laws seem to help to increase the biomass of herring.

However, we can not conclude that this correlation also means causation. Increase could also be due to different factors. Also, even if it is laws cause the change we cant tell which ones if all as they are superimposed with each other. So we cant see the independent effect of each law alone. We also see decreases and fluctuations after, laws not just a steady increase. Overall laws seem to help increase populations so are effective. and should be kept in place together.

17

Turn over for the next question

| 0 | 8 |

Sickle cell anaemia is an inherited condition that affects red blood cells.

Sickle cell anaemia is caused by a mutation in the gene for haemoglobin. Haemoglobin is the red pigment found in red blood cells.

A person who is homozygous for the normal haemoglobin allele (H^A) produces normal red blood cells.

A person who is homozygous for the mutated allele (H^S):

- produces red blood cells with abnormal haemoglobin
- has red blood cells that can form an altered shape
- has sickle cell anaemia and becomes ill.

A person who is heterozygous:

- has both normal and abnormal haemoglobin in the red blood cells
- has sickle cell trait
- is generally healthy but can become ill in certain circumstances.

| 0 | 8 |.| 1 |

Give the reason why a mutation in the gene coding for haemoglobin could be harmful.
[1 mark]

Haemoglobin is responsible for carrying oxygen. Mutation to it can mean less oxygen is transported to the cells for respiration.
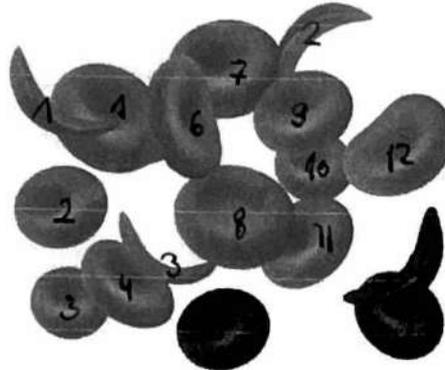
0 8 . 2 **Figure 13** shows some red blood cells from the blood of a person with sickle cell trait.

Figure 13

Calculate the proportion of cells in **Figure 13** that have an altered shape.

[2 marks]

17 cells ; 13 normal cells ; 4 altered cells

4 /17 is altered

$\frac{4}{17}$ = 0.2352941176...

= 0.235

Proportion = _____ 0.235 _____
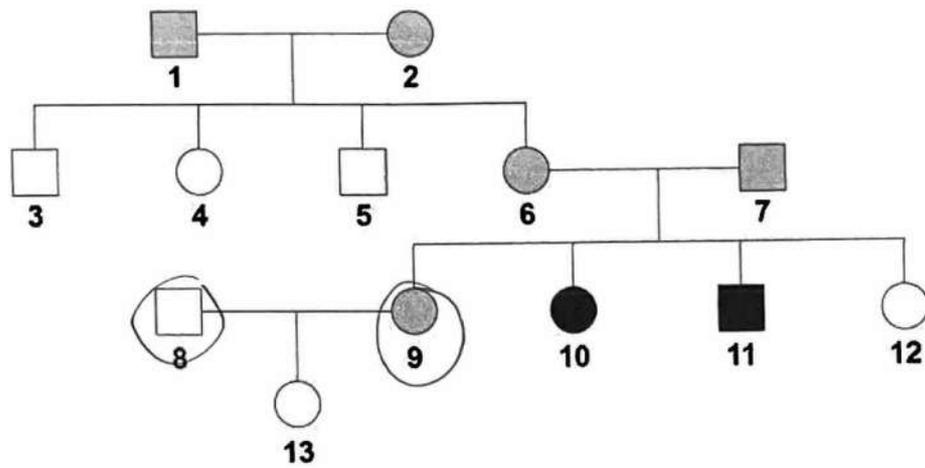
Question 8 continues on the next page

Turn over ▶

Figure 14 shows the inheritance of sickle cell anaemia in one family.

Figure 14

Key

☐ Unaffected male

○ Unaffected female

■ Male with sickle cell anaemia

● Female with sickle cell anaemia

▨ Male with sickle cell trait

◉ Female with sickle cell trait

Do not write outside the box

| 0 8 . 3 | Persons **8** and **9** in **Figure 14** are expecting a second child.

Determine the probability that the child will be a girl with sickle cell trait.

You should:

- draw a Punnett square diagram
- identify the phenotype of each offspring genotype
- use the symbols:

  H^A = normal haemoglobin allele

  H^S = mutated haemoglobin allele.

[5 marks]

father : $H^A H^A$ mother: $H^A H^S$

50% $H^A H^A$ — child unaffected
50% $H^A H^S$ — child with sickle cell trait

50% — girl
50% — boy

$$50\% = 0.5 = \frac{1}{2}$$

Probability of girl with sickle cell trait

$$= 0.5 \times 0.5$$

$$= 0.25$$

Probability of a girl with sickle cell trait = _____ 0.25

Question 8 continues on the next page

Turn over ▶

Maths Made Easy

0 8 . 4 Without medical treatment, people with sickle cell anaemia are frequently ill and have a reduced life expectancy.

The malarial parasite cannot live in the red blood cells of a person who has the H^S allele.

A scientist stated:

'It is an advantage for people to have the H^S allele in countries where malaria occurs.'

Evaluate the scientist's statement.

[3 marks]

While H^AH^A are at risk of dieing from malaria more than other groups H^SH^S are at high risk of dieing from sickle cell anemia. But, H^AH^S seem to be safe from getting malaria also survive sickle cell anaemia giving them an advantage. However, offspring of H^AH^S individuals can have off H^AH^A or H^SH^S genotype making it possible for either malaria or sickle cell anemia to be a death risk.

11

0 9 The Galapagos Islands are located in the Pacific Ocean.

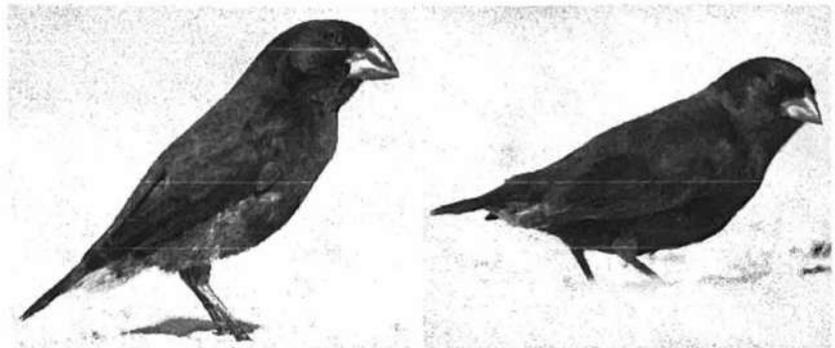Several species of birds called finches live on the Galapagos Islands.

These finches are very similar to each other.

Figure 15 shows two modern species of Galapagos finch and their classification.

Figure 15

Medium ground finch   **Small ground finch**

Classification group	Medium ground finch	Small ground finch
Kingdom	Animalia	Animalia
Phylum	Chordata	Chordata
Class	Aves	Aves
Order	Passeriformes	Passeriformes
Family	Thraupidae	Thraupidae
Genus	Geospiza	Geospiza
Species	fortis	fuliginosa

Maths Made Easy

0 9 . 1 Complete **Figure 15** to give the names of the missing classification groups.

[2 marks]

0 9 . 2 Give the binomial name of the medium ground finch.

Use information from **Figure 15**.

[1 mark]

Geospiza fortis

Question 9 continues on the next page

Turn over ▶

IB/M/Jun21/8461/2H

In each species of finch, there is a variation in beak depth.

Figure 16 shows how beak depth is measured.
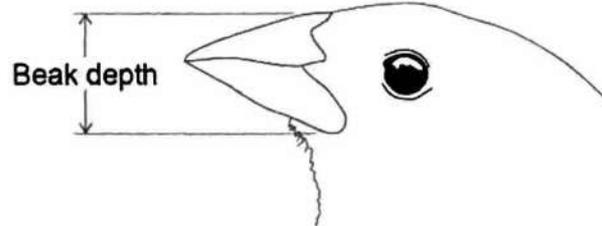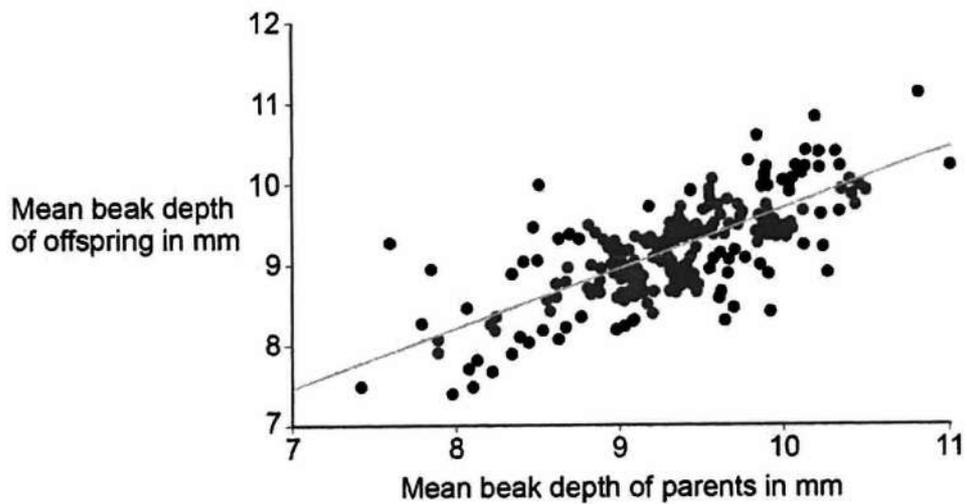
Figure 16

Figure 17 shows the relationship between the beak depth of parent birds and the beak depth of their offspring.

Figure 17

| 0 | 9 | . | 3 | Give evidence from **Figure 17** that beak depth is an inherited characteristic.

[1 mark]

offspring have similar beak depth as parents, suggesting they inherited the casacteristic from their parents

0 9 . 4 Scientists suggested that more than one gene controls beak depth.

Give evidence from **Figure 17** to support the scientists' suggestion.

[1 mark]

There is a spread of results for one beak ~~length~~ depths value parent, so they produced offspring with varying beak depth.
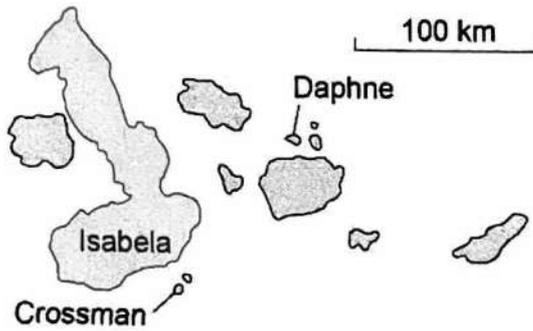
Question 9 continues on the next page

Turn over ▶

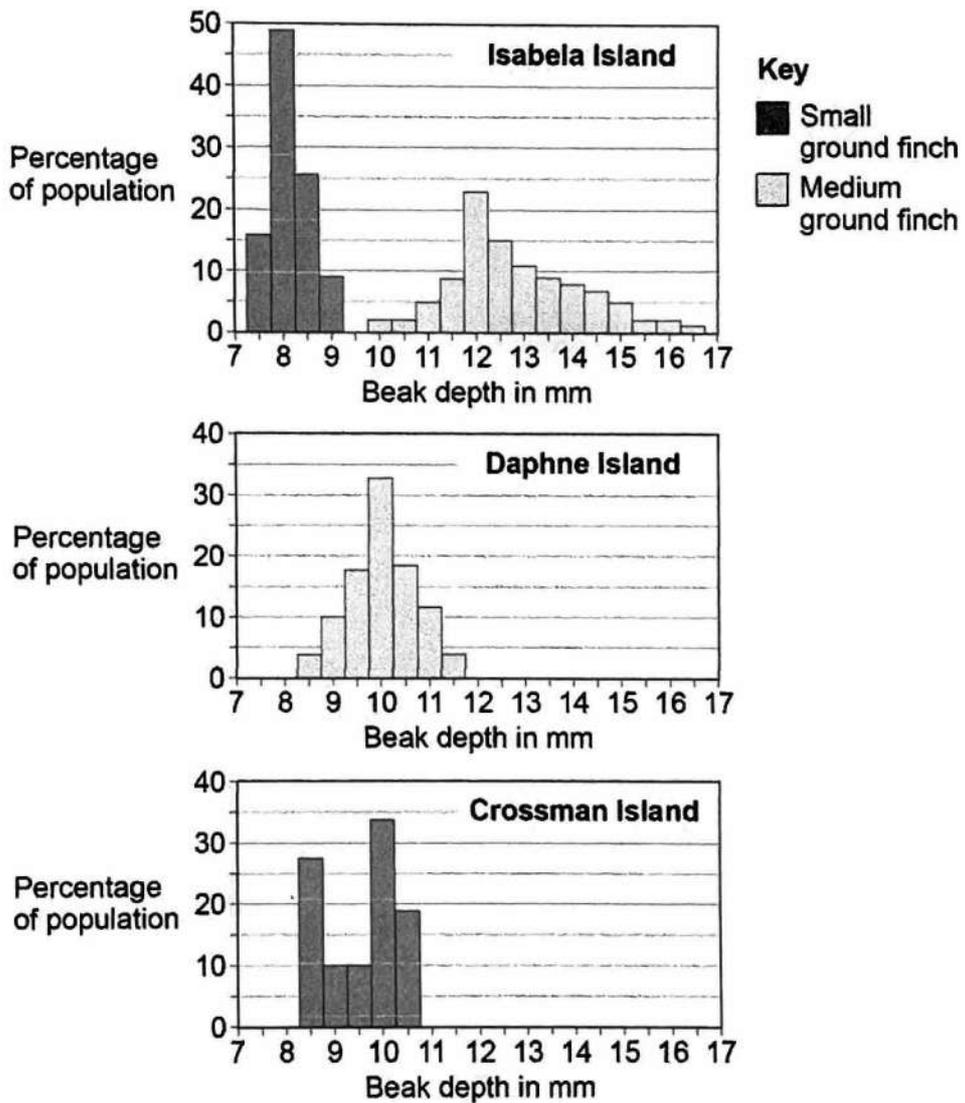**Figure 18** is a map of the Galapagos Islands.

Figure 18

On Isabela Island, the medium ground finch **and** the small ground finch are found.
On Daphne Island, only the medium ground finch is found.
On Crossman Island, only the small ground finch is found.

Figure 19 shows how the beak depth of each species varies on each island.

Figure 19

The medium ground finch and the small ground finch both feed on seeds.

The size of seeds eaten by each bird depends on the depth of the bird's beak.

0 9 . 5 The range of beak depth of **medium ground finches** on Isabela Island is different from the range on Daphne Island.

Explain what might have caused this difference.

[6 marks]

There is a natural variation in the beak depths, this is because of different alleles for the same gene being present in the population.
On Isabella Island there is a large range of seeds available This means birds with larger beak depth get enough food to reproduce and pass on their genes to the next generation.
On Daphne there is less competition with other finch for smaller seeds, so birds with smaller beak lengths depths survive and reproduce. This could also be because of the smaller range of seed sizes on Daphne is available for the birds to eat.

Question 9 continues on the next page

Turn over ▶

| 0 | 9 | . | 6 |

Figure 19 shows:

- the **two** species of finch live on Isabela Island
- only **one** of the species lives on Daphne Island
- only **one** of the species lives on Crossman Island.

Suggest why both species of finch are able to live on Isabela Island.

[2 marks]

Isabela is much larger than the other two with probably a larger variety of plan species on it, producing a larger variety and amount of seeds. So, there is enough seeds to support both populations of finches to survive.

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END OF QUESTIONS