



**Surname** \_\_\_\_\_

**Other Names** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** \_\_\_\_\_

**Candidate Signature** \_\_\_\_\_

**I declare this is my own work.**

**GCSE  
BIOLOGY**

**H**

**Higher Tier Paper 2H**

**8461/2H**

**Time allowed: 1 hour 45 minutes**

**At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.**

**[Turn over]**



JUN 21 8461 2H 01

**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.
- 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.



## **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 TURN OVER UNTIL TOLD TO DO SO**



**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]**

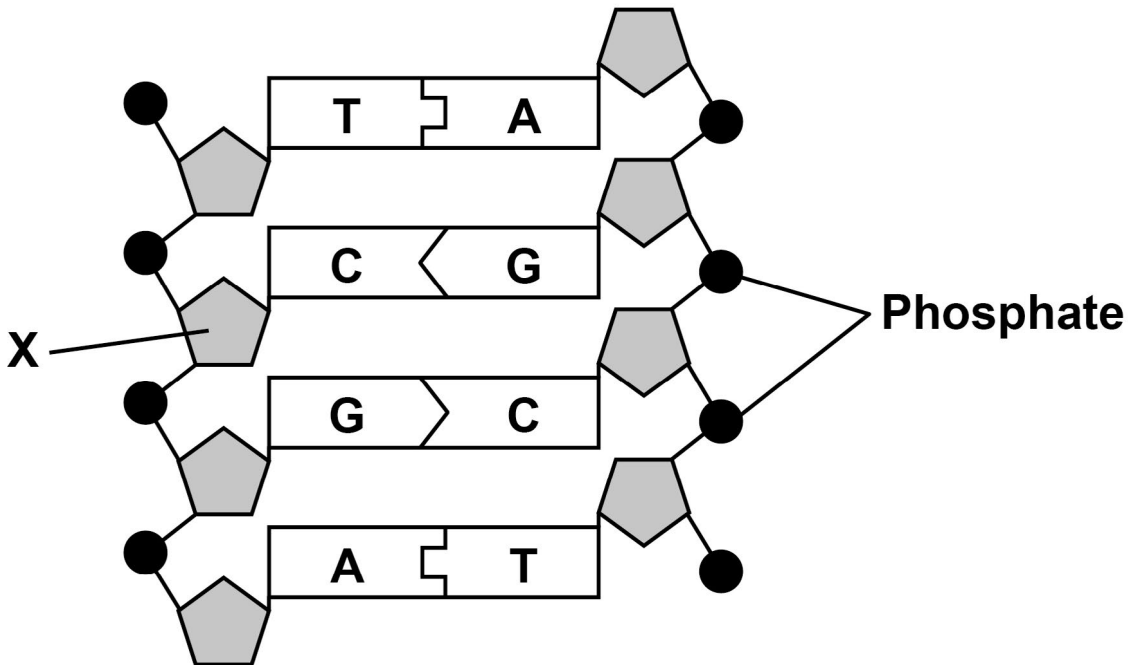
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FIGURE 1 shows part of a DNA molecule.

FIGURE 1



0 1 . 2

Name the part of the DNA molecule labelled X. [1 mark]

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0 1 . 3

What type of substances are labelled A, C, G and T in FIGURE 1? [1 mark]

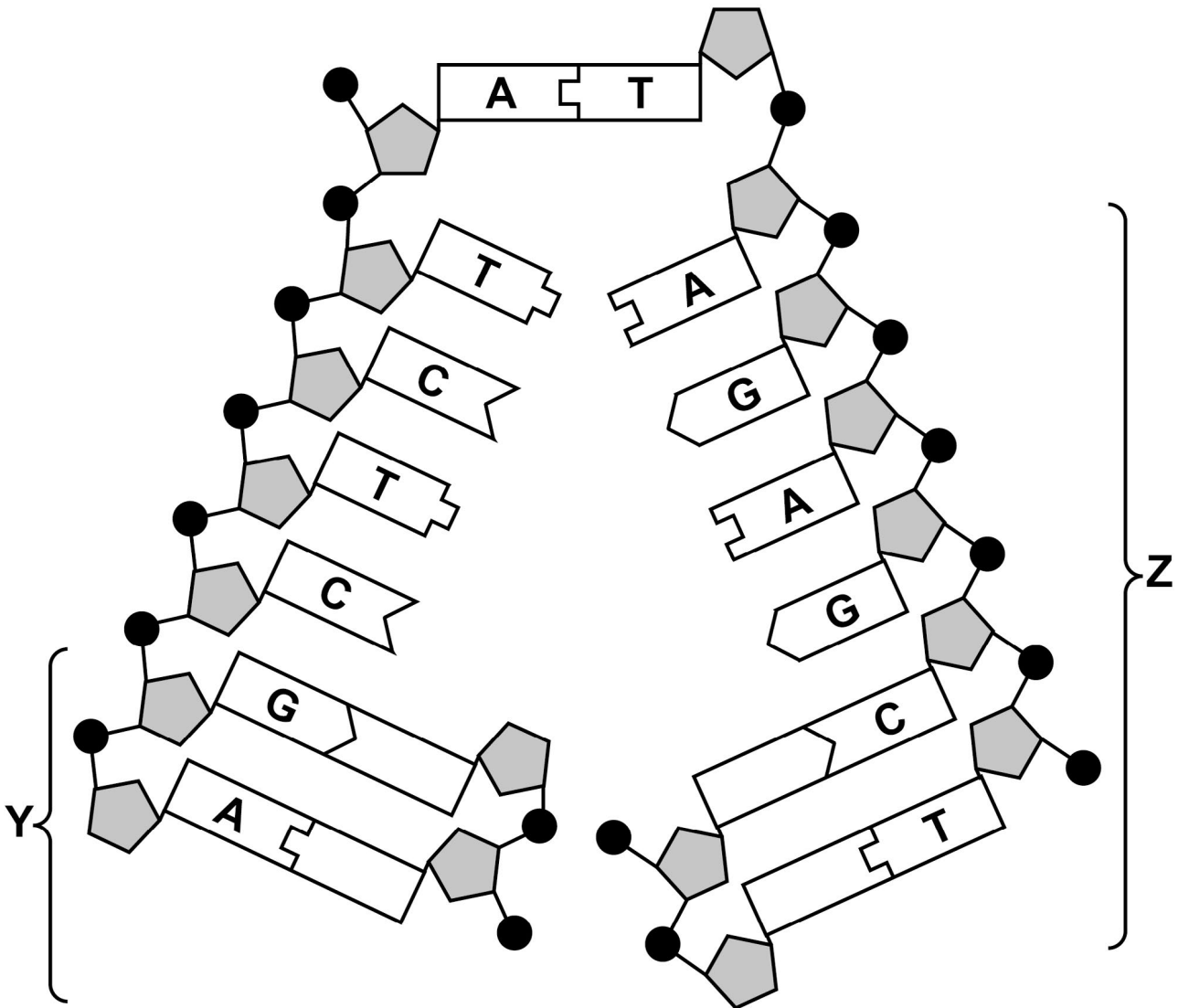
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[Turn over]



FIGURE 2 shows another section of a DNA molecule.

FIGURE 2



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**

**0 1 . 6**

**A gene is a length of DNA.**

**What type of substance does a gene code for? [1 mark]**

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**[Turn over]**



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

What mass of DNA will a human sperm cell contain?  
[1 mark]

Tick (✓) ONE box.

$6 \times 10^{-6}$  grams

$6 \times 10^{-12}$  grams

$3 \times 10^{-6}$  grams

$3 \times 10^{-12}$  grams





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

Mitosis

8

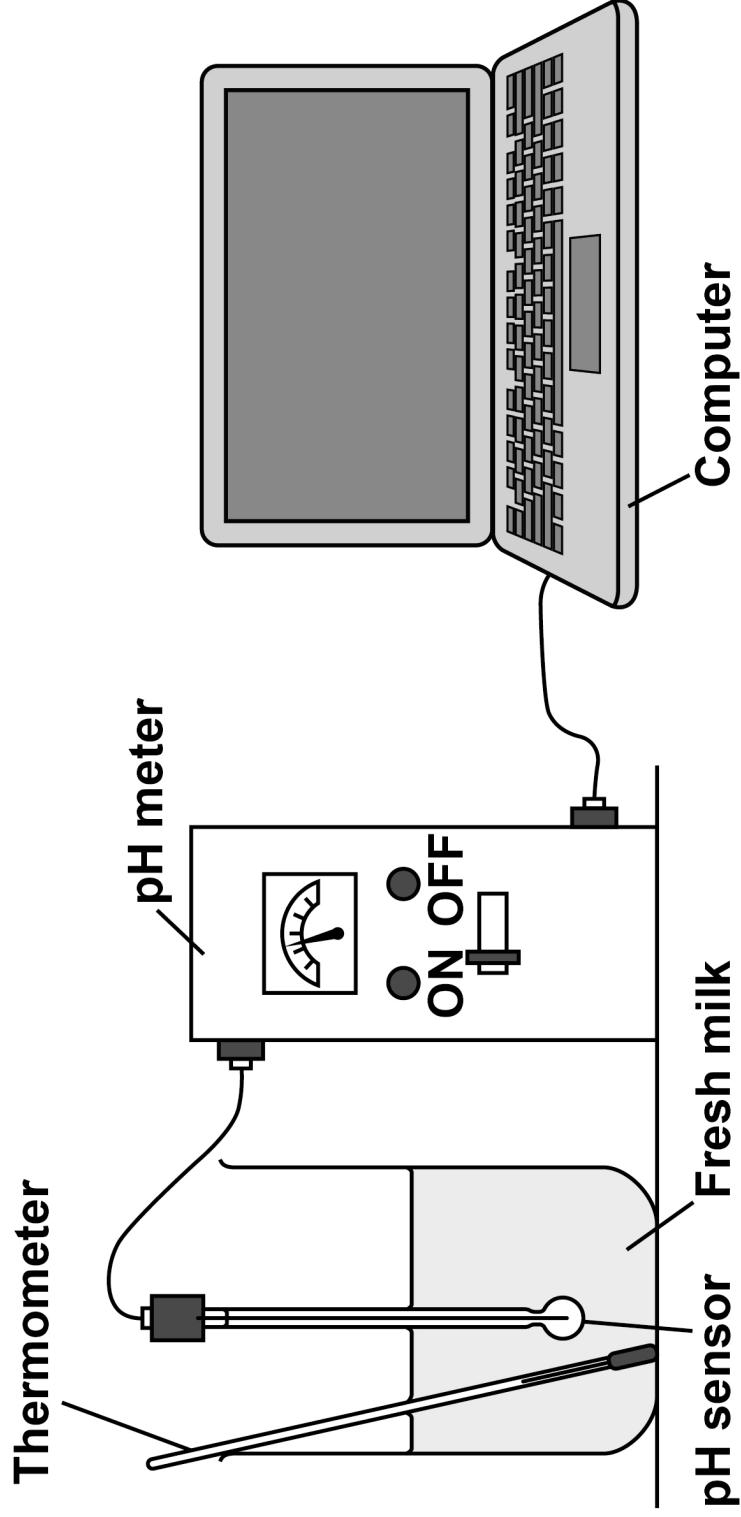
[Turn over]



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]

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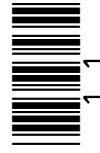
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0 2 . 2

Give ONE variable the student should keep constant.  
Do NOT refer to temperature in your answer. [1 mark]

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[Turn over]

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

**TABLE 1**

<b>Time in days</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>pH</b>	<b>6.7</b>	<b>6.7</b>	<b>6.3</b>	<b>5.3</b>	<b>4.6</b>	<b>4.4</b>

**0 2 . 3**

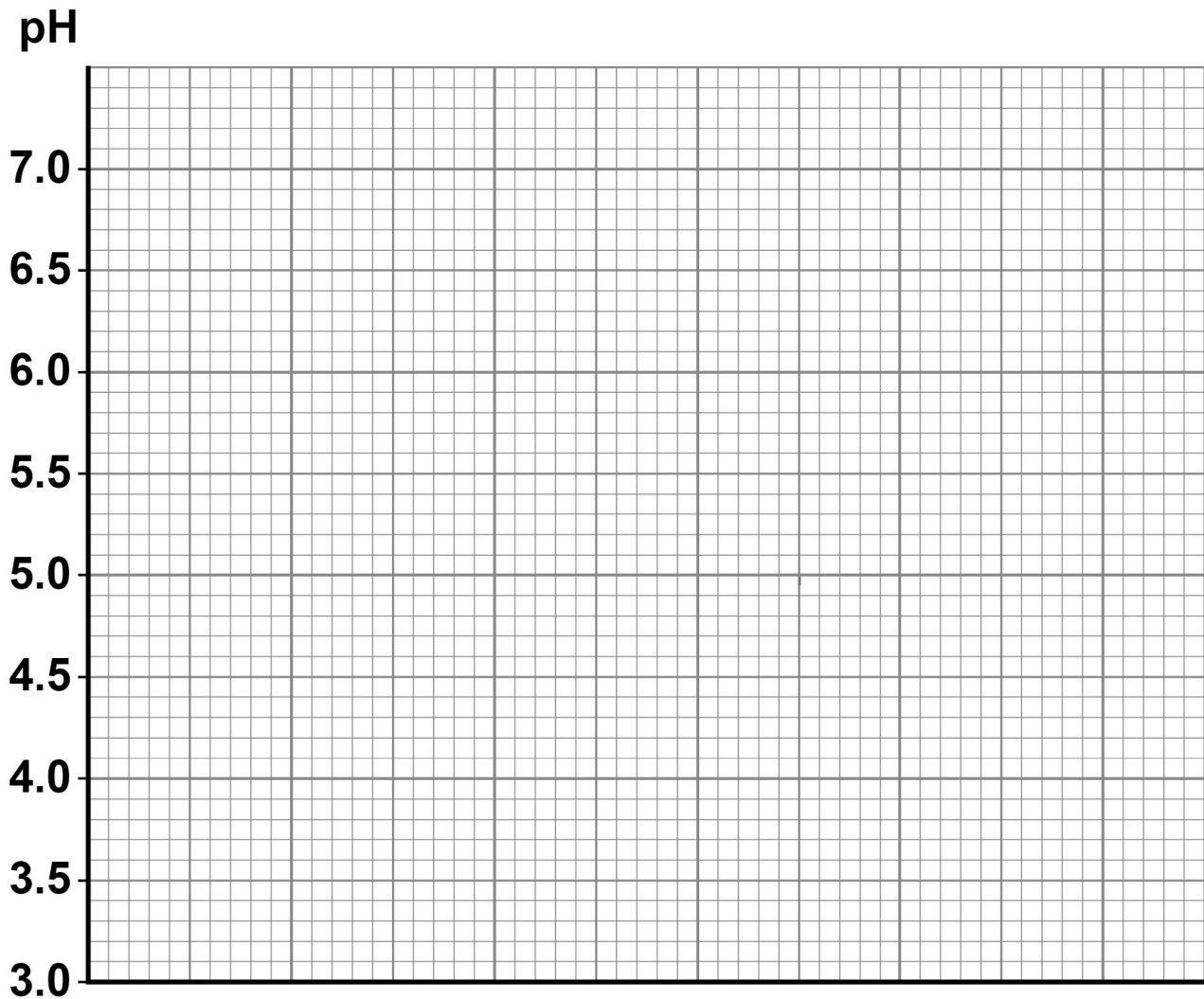
**Complete FIGURE 4, on the opposite page. [4 marks]**

**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
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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]

[Turn over]

8



0	3
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**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 cm<sup>3</sup> of ice-cold water to drink.**
- 5. Continue to measure the person's internal body temperature and sweating rate for a further 50 minutes.**



03.1

**Give the reason why the person should NOT move during the investigation. [1 mark]**

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**[Turn over]**

FIGURE 5, below, and FIGURE 6, on the opposite page, show the scientists' results.

FIGURE 5

Internal body  
temperature  
in °C

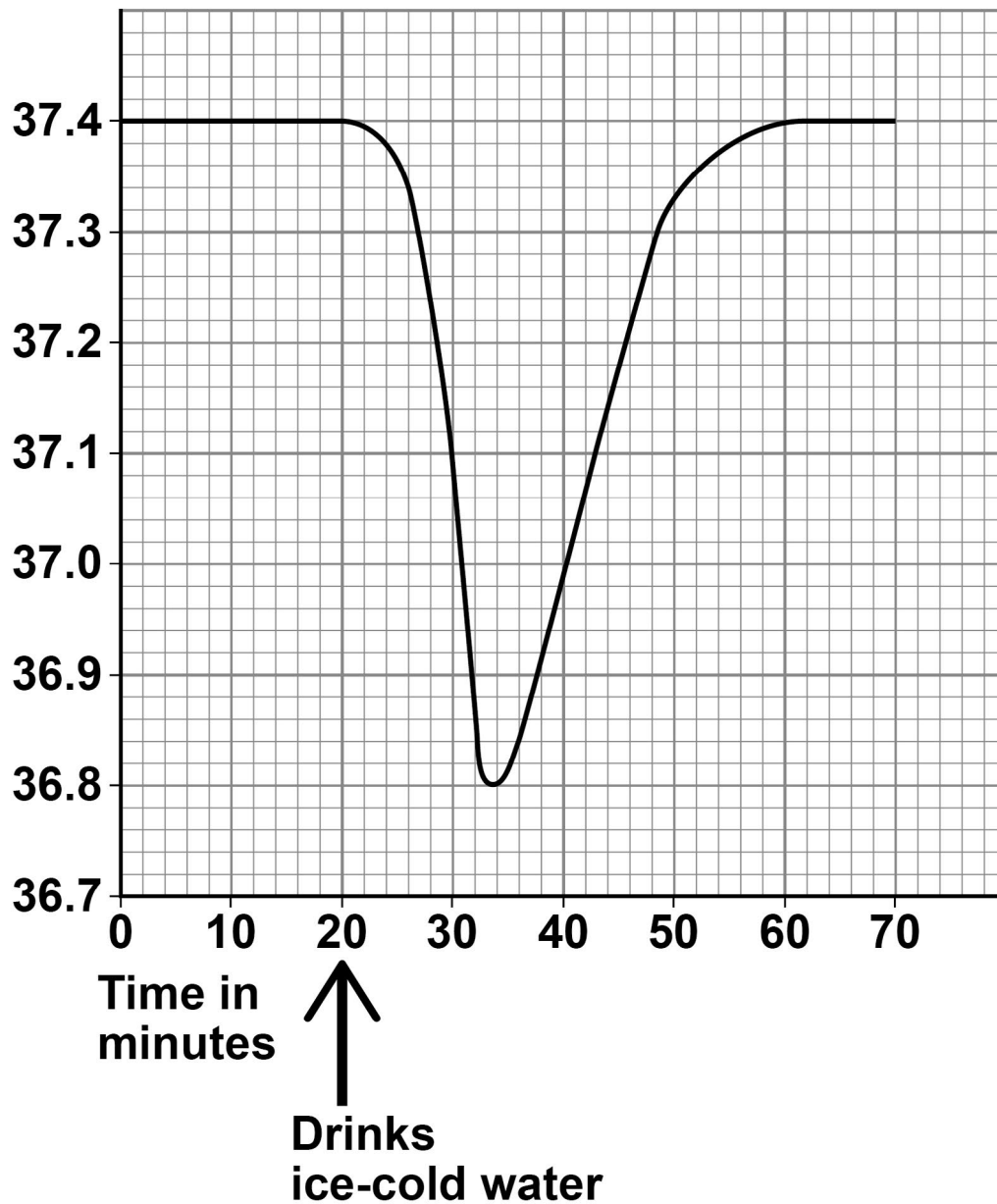
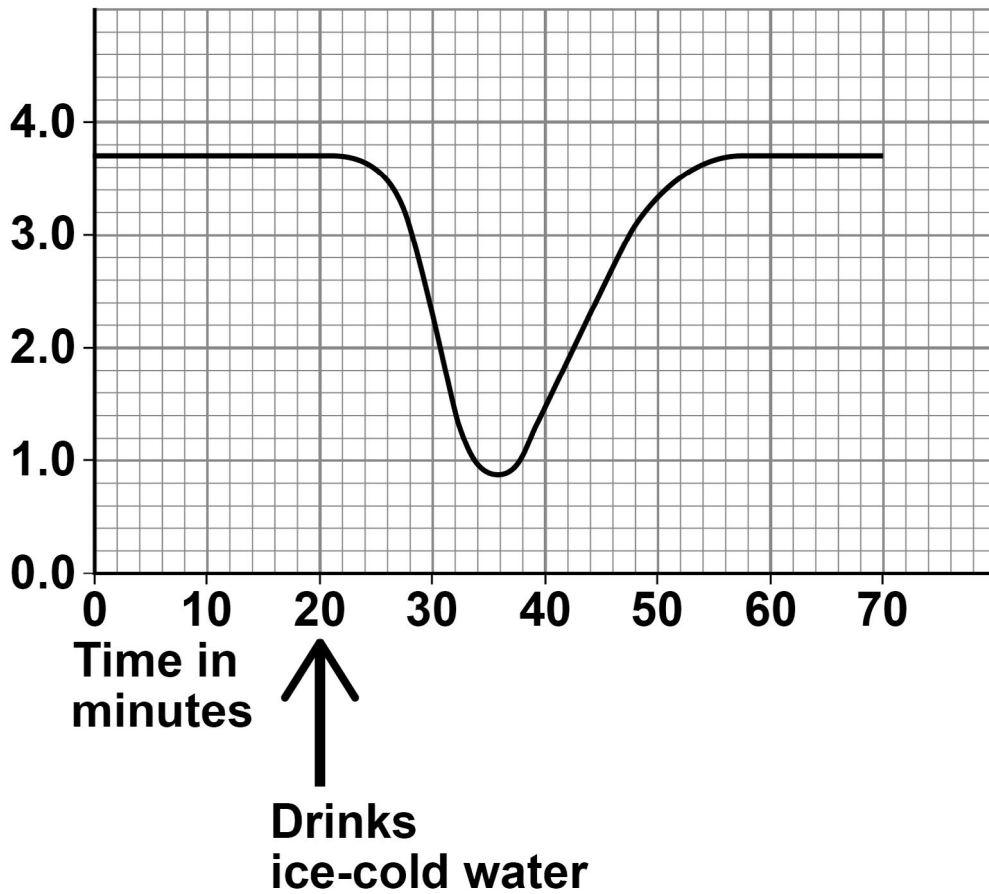




FIGURE 6

Rate of sweating  
in arbitrary  
units



[Turn over]



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**03.2**

**What is this person's normal internal body temperature? [1 mark]**

**Tick (✓) ONE box.**

**36.8 °C****37.0 °C****37.4 °C**

**[Turn over]**



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

03.3

Explain why the temperature near the brain decreased.  
[2 marks]

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03.4

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]

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03.5

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]

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[Turn over]



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03.6

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

[Turn over]

8

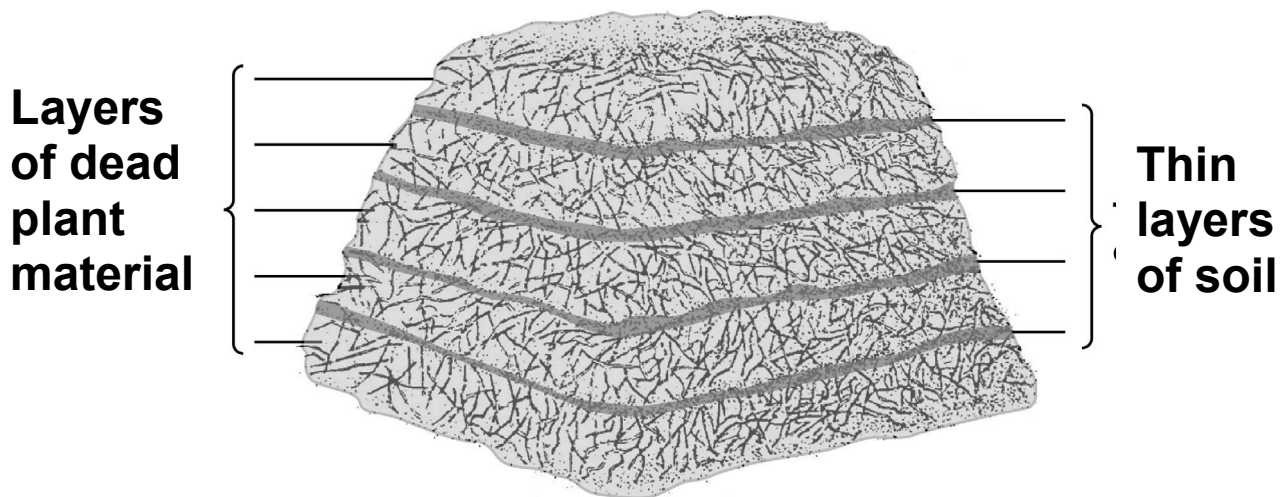


0 4

Decay occurs in a compost heap.

FIGURE 7 shows a compost heap.

FIGURE 7



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]

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05

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

05.1

TABLE 2 shows six factors.

Tick (✓) ONE box in each row to show whether the factor is biotic or abiotic. [3 marks]

TABLE 2

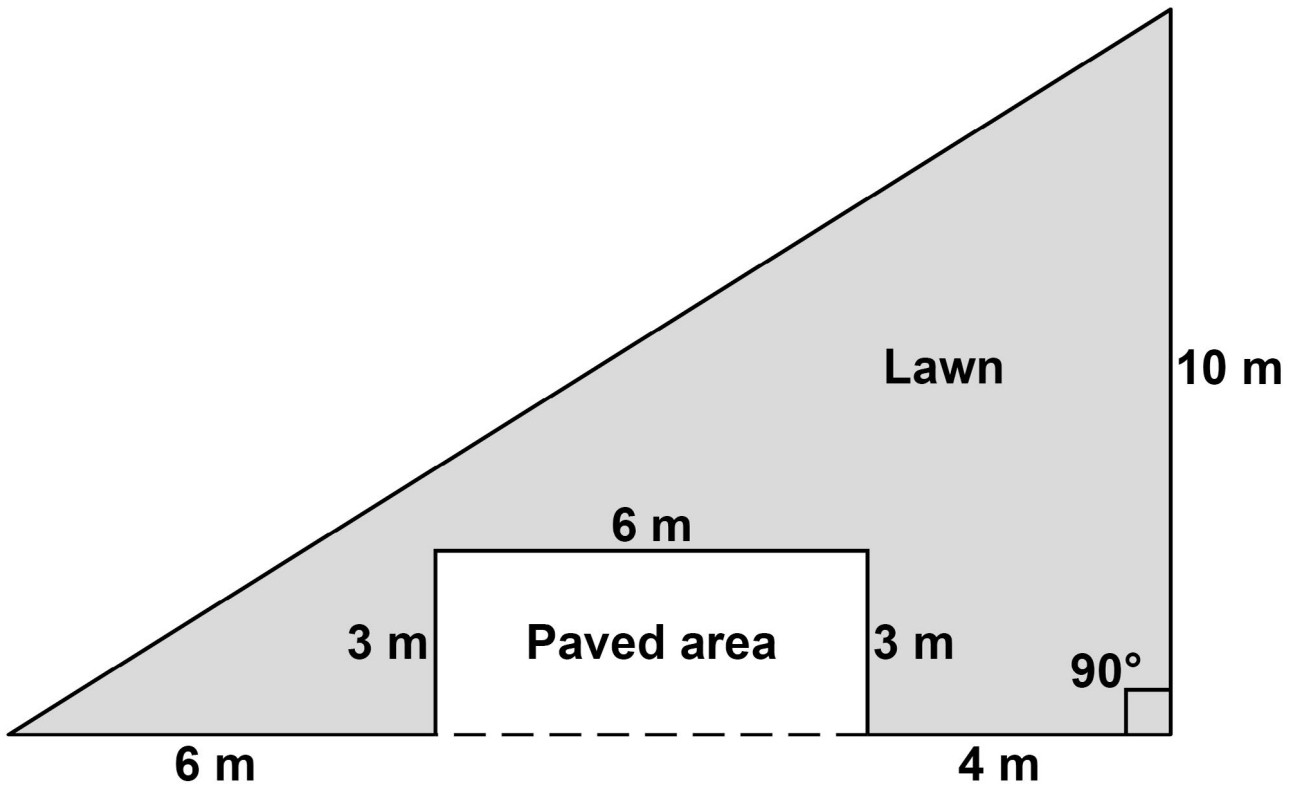
FACTOR	BIOTIC	ABIOTIC
Nitrates in the soil		
Rabbits eating the plants		
Shading by a building		
Soil pH		
Temperature		
Trampling by people		

[Turn over]



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  $\times$  50 cm.

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



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

**Give the reason for your answer. [2 marks]**

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**[Turn over]**





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Number of daisy plants on the lawn = \_\_\_\_\_

[Turn over]

0	5	.	4
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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

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2

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13





0 6

Reflex actions are coordinated by the nervous system.

0 6 . 1

What is meant by the term 'reflex action'? [2 marks]

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[Turn over]







0	6	.	3
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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

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2

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3

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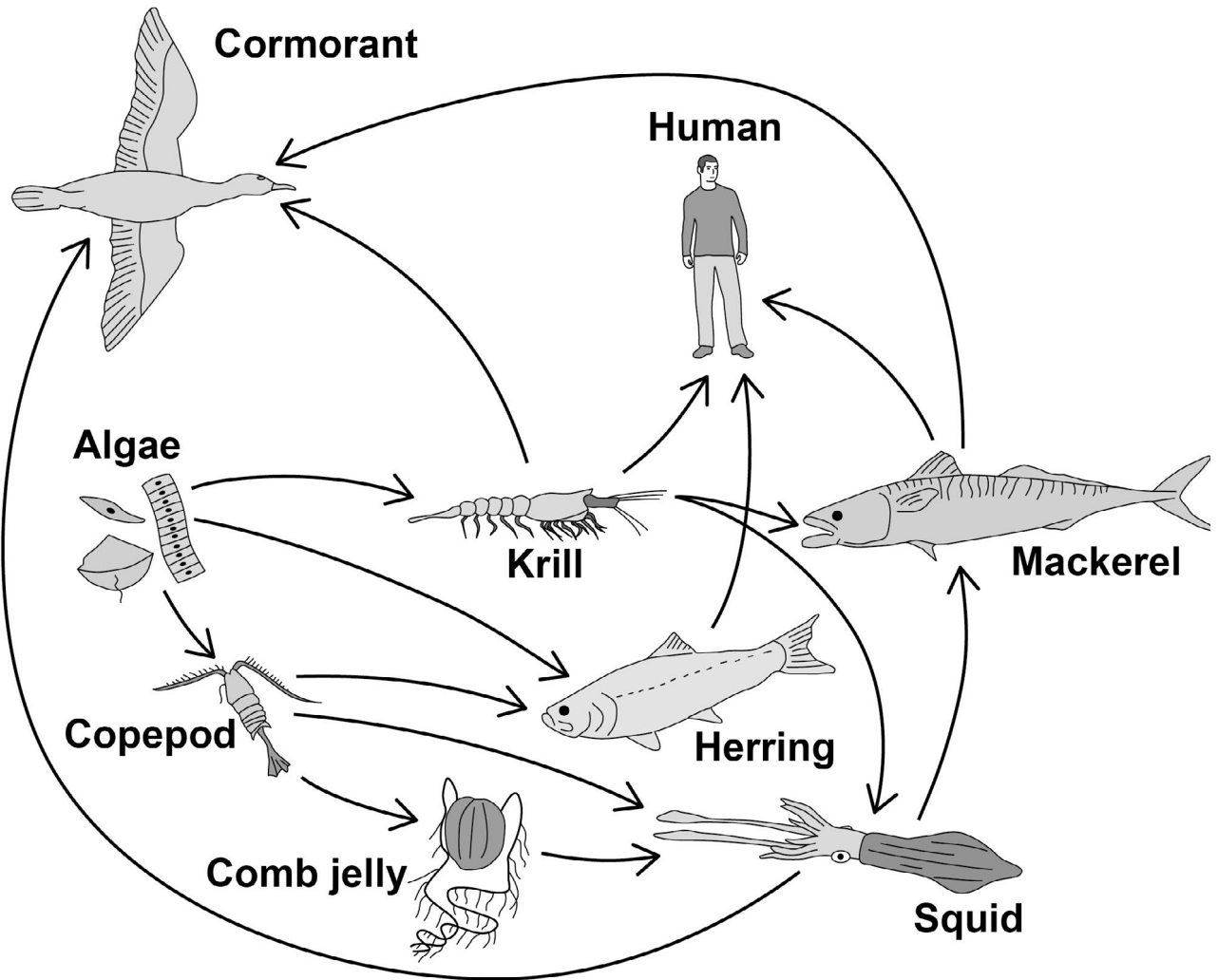


07

A food web contains several food chains.

FIGURE 9 shows a food web.

FIGURE 9



Not to scale



07.1

The animals in FIGURE 9 get their energy by eating other organisms.

Describe how the algae get energy. [2 marks]

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07.2

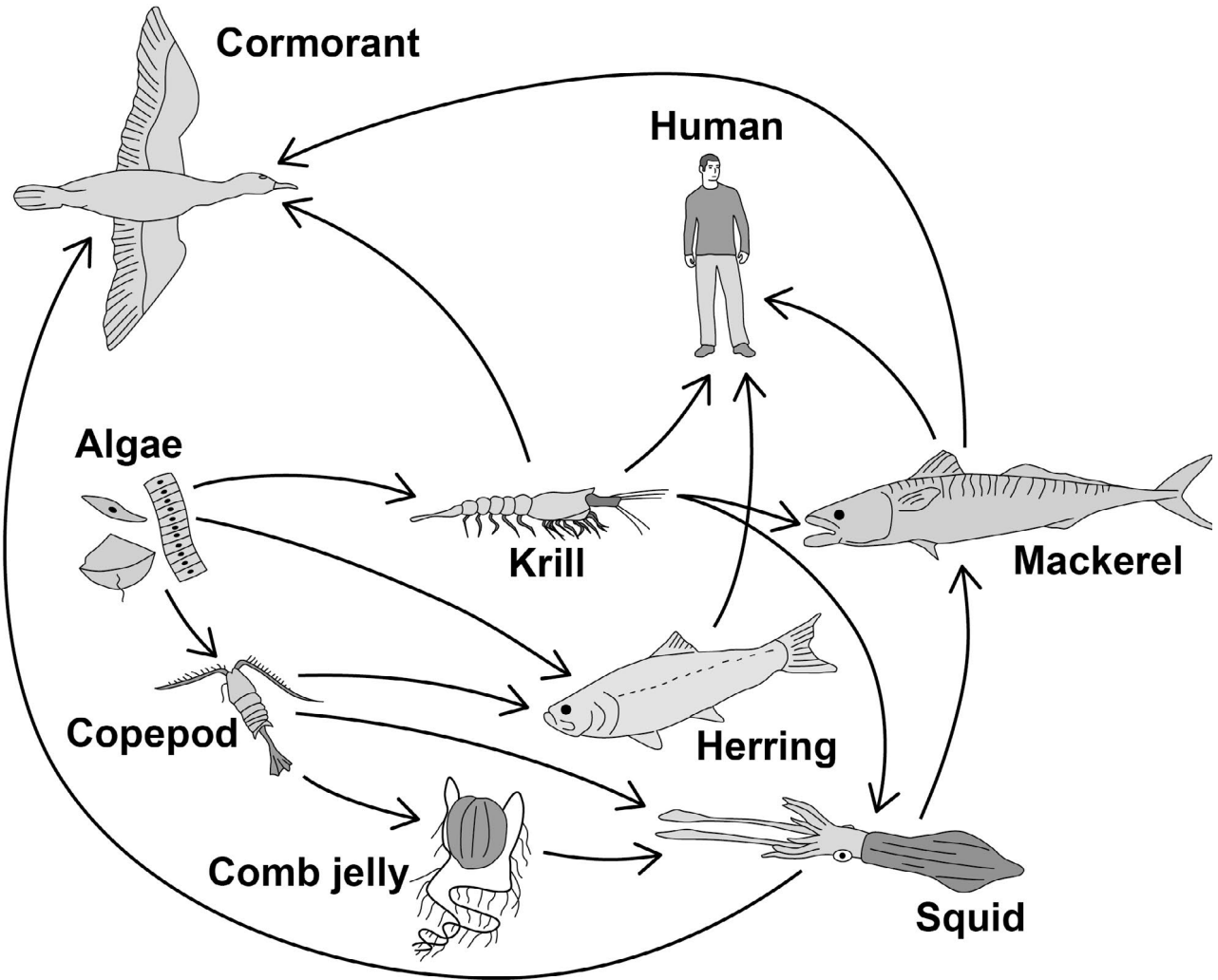
Name ONE primary consumer in FIGURE 9. [1 mark]

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[Turn over]

## REPEAT OF FIGURE 9



Not to scale

07.3

Name ONE producer in FIGURE 9. [1 mark]

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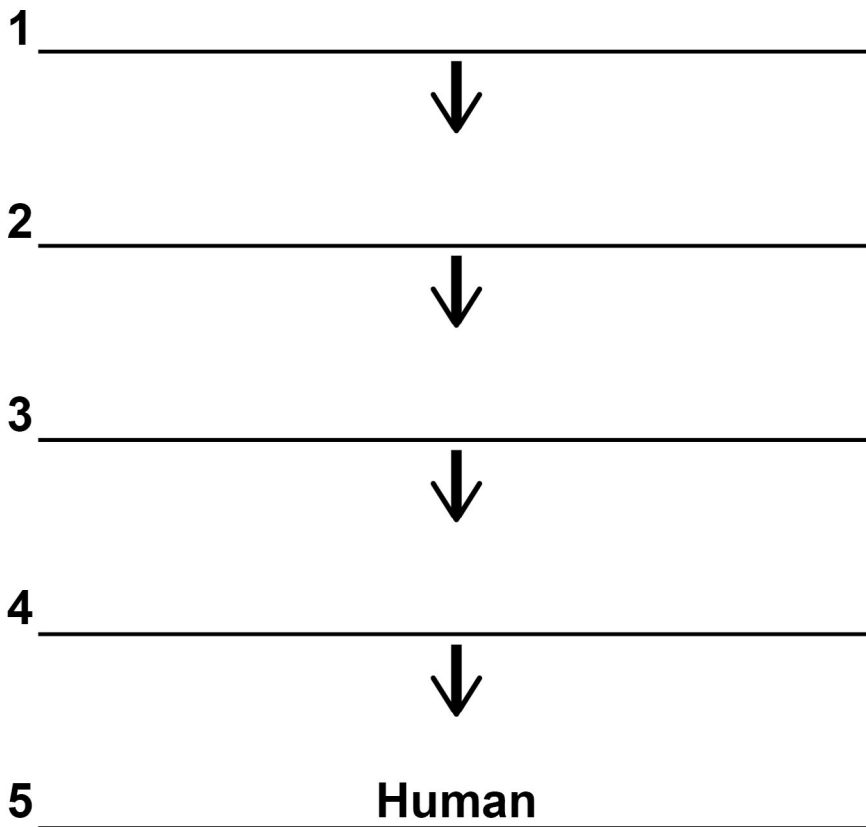


**07.4**

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**



**[Turn over]**



**07.5**

**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

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2

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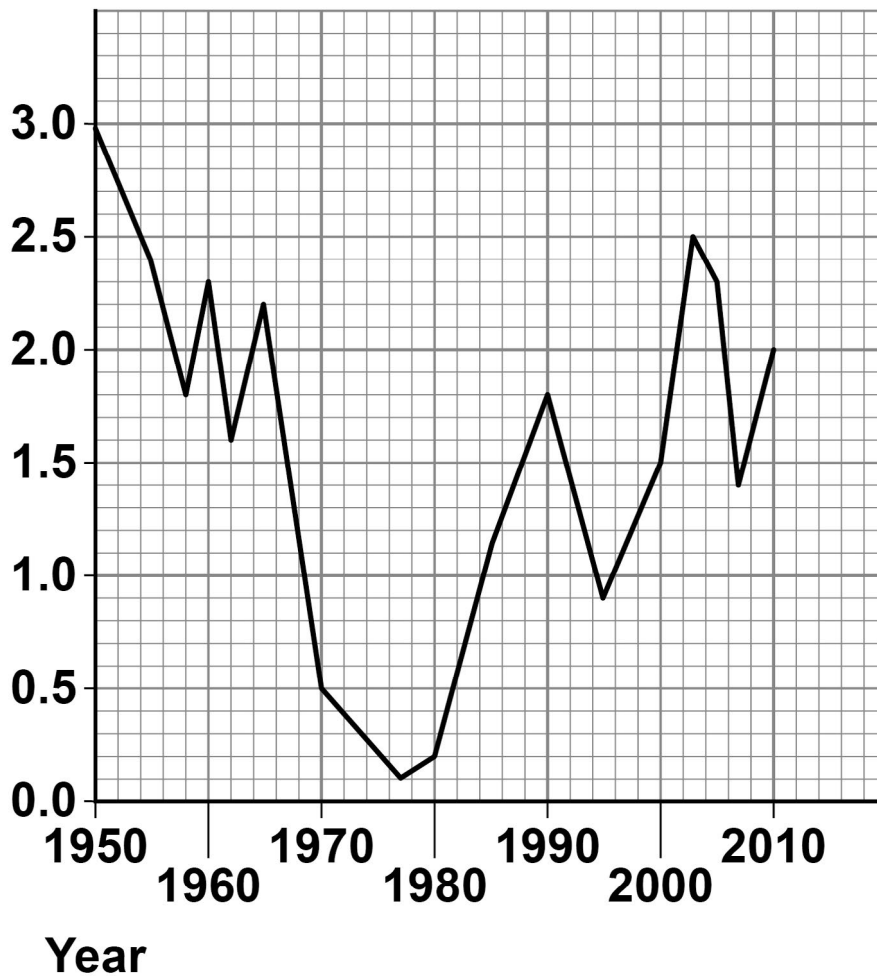
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**FIGURE 11** shows how the biomass of adult herring in the North Sea has changed between 1950 and 2010.

**FIGURE 11**

**Biomass of  
adult herring in  
millions of tonnes**





**07.7**

**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.**

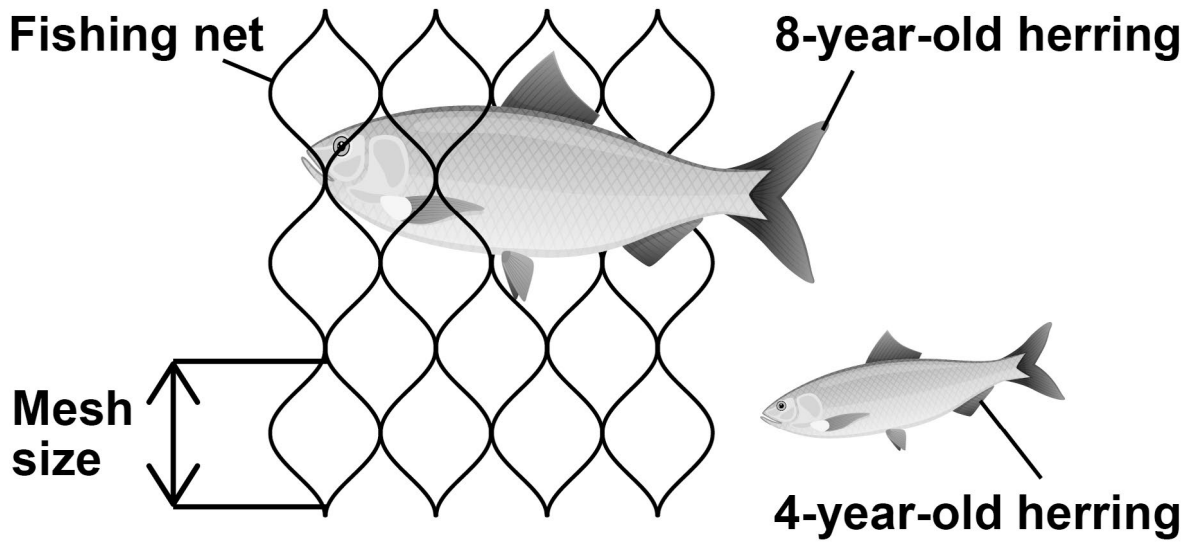
**Laws have been introduced to help conserve herring:**

- **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, on the opposite page, shows how a minimum mesh size helps to conserve herring.**



**FIGURE 12**



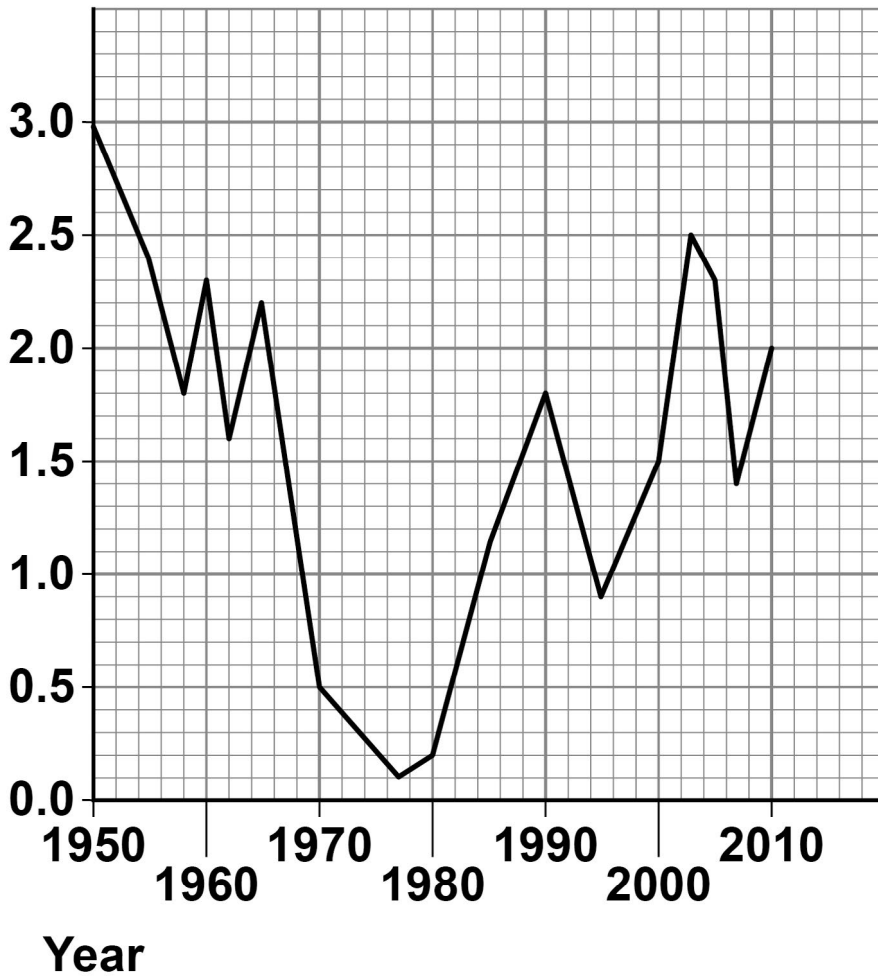
**[Turn over]**



FIGURE 11 is repeated below.

## FIGURE 11

**Biomass of  
adult herring in  
millions of tonnes**









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**[Turn over]**

17



0	8
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**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.



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

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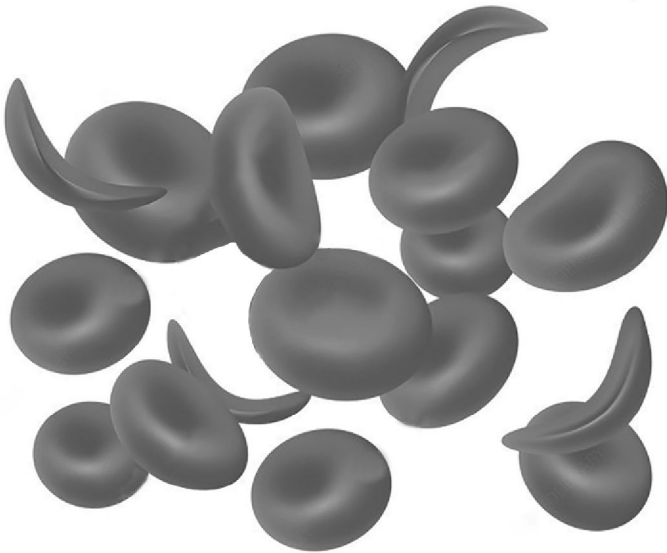
**[Turn over]**



**08.2**

**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]

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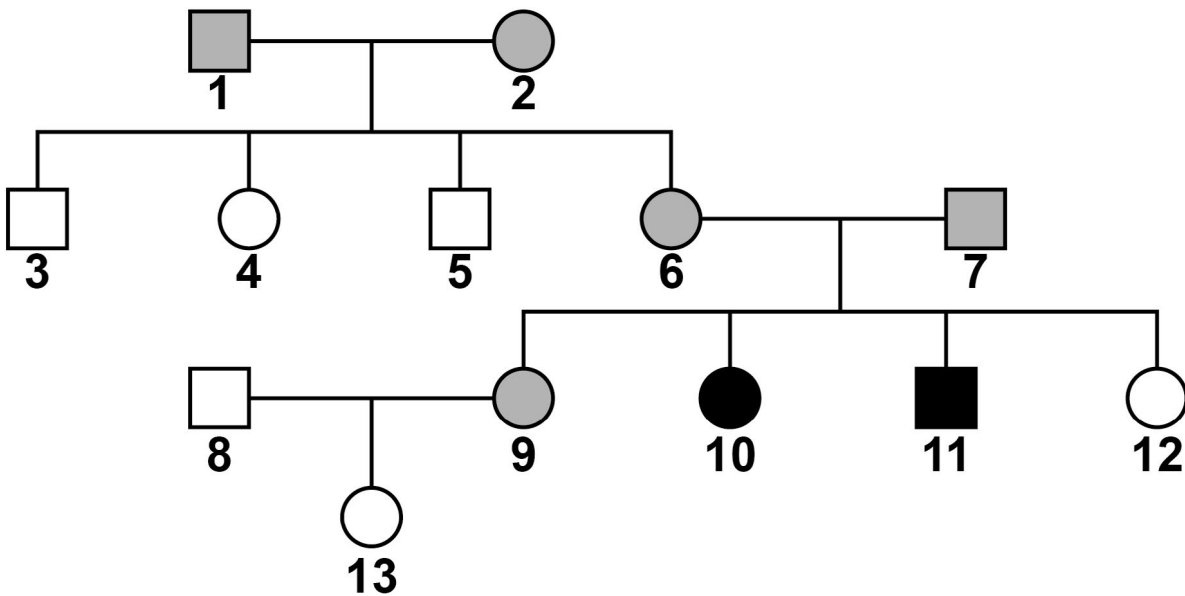
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Proportion = \_\_\_\_\_

[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

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]

Probability of a girl with sickle cell trait = \_\_\_\_\_

[Turn over]



0	8	.	4
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**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<sup>S</sup> allele.**

**A scientist stated:**

**'It is an advantage for people to have the H<sup>S</sup> allele in countries where malaria occurs.'**

**Evaluate the scientist's statement. [3 marks]**

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[Turn over]

11



09

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, below and on the opposite page, 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'
	'Chordata'	'Chordata'
Class	'Aves'	'Aves'
	'Passeriformes'	'Passeriformes'
	'Thraupidae'	'Thraupidae'
Genus	'Geospiza'	'Geospiza'
	'fortis'	'fuliginosa'

09.1

Complete FIGURE 15 to give the names of the missing classification groups. [2 marks]

09.2

Give the binomial name of the medium ground finch.

Use information from FIGURE 15. [1 mark]

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[Turn over]



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

FIGURE 16 shows how beak depth is measured.

FIGURE 16

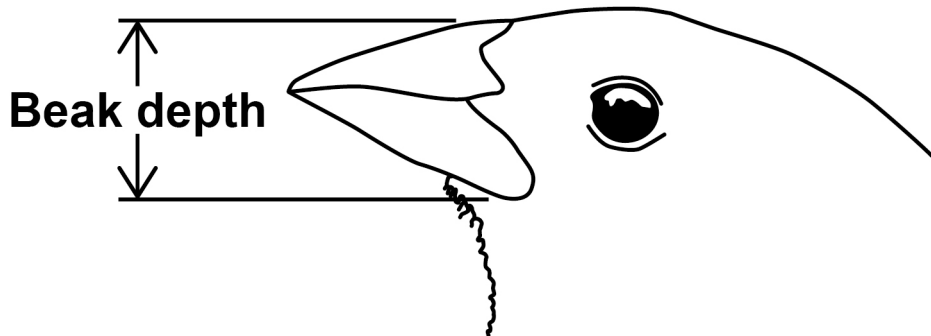
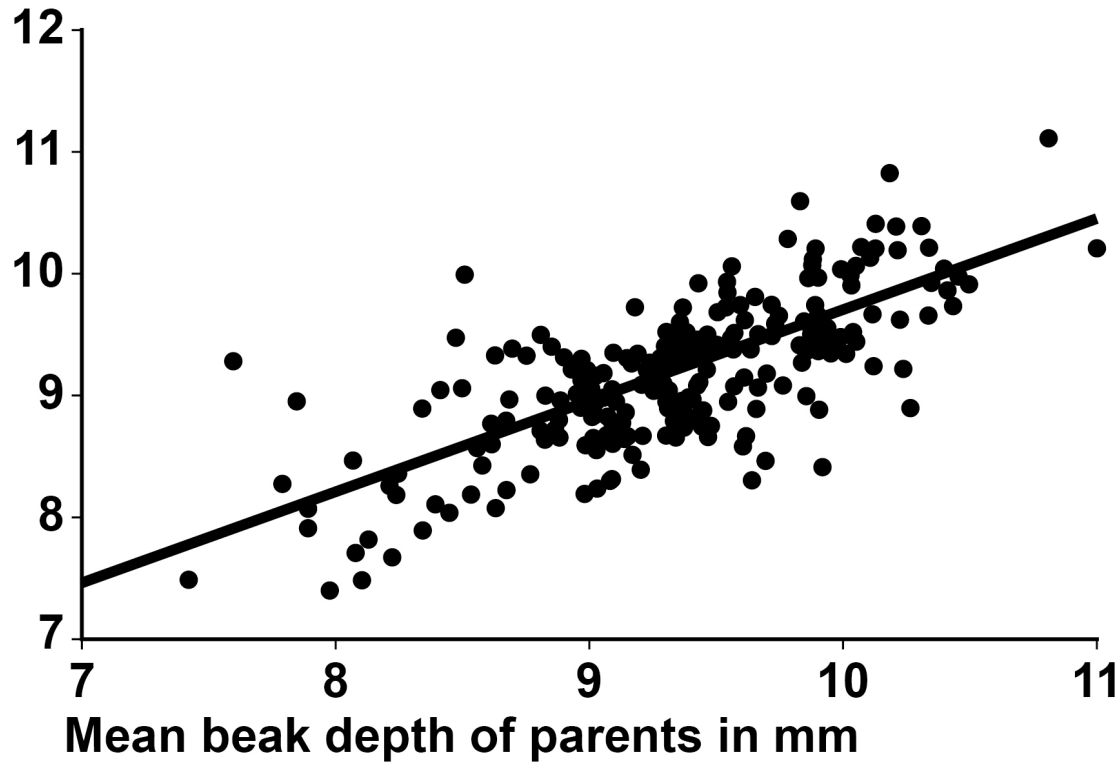


FIGURE 17, on the opposite page, shows the relationship between the beak depth of parent birds and the beak depth of their offspring.



FIGURE 17

Mean beak depth  
of offspring in mm



0 9 . 3

Give evidence from FIGURE 17 that beak depth is an inherited characteristic. [1 mark]

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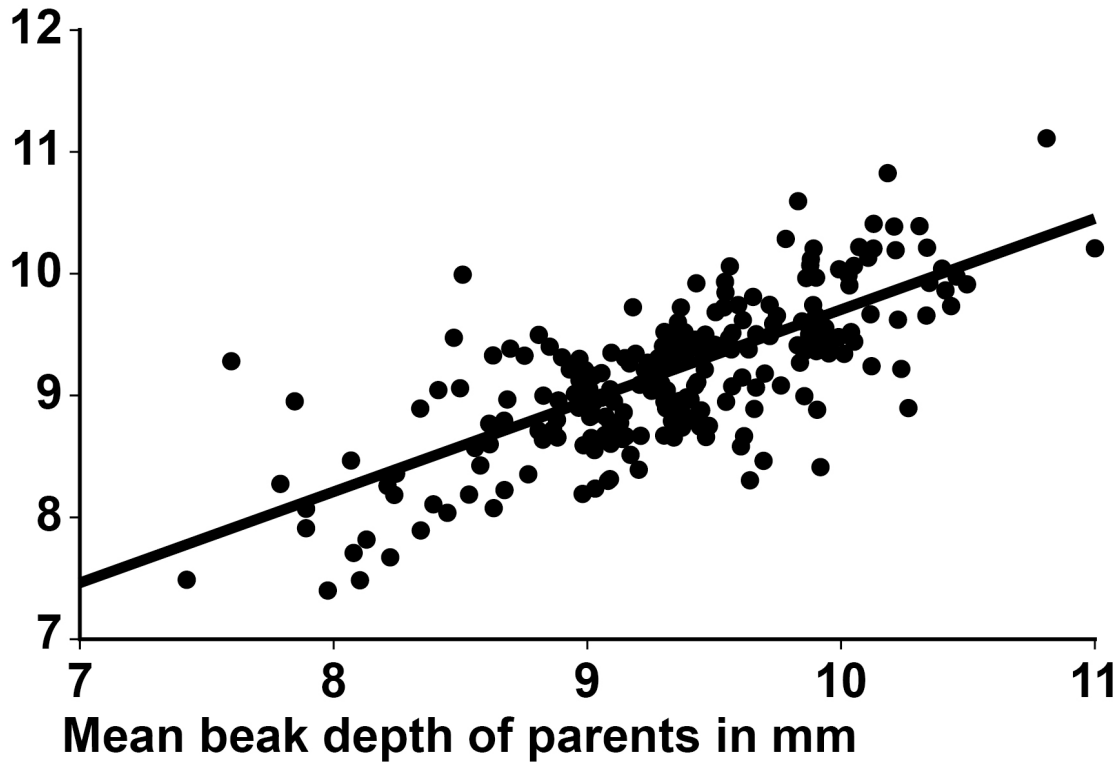
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[Turn over]



## REPEAT OF FIGURE 17

Mean beak depth  
of offspring in mm



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]

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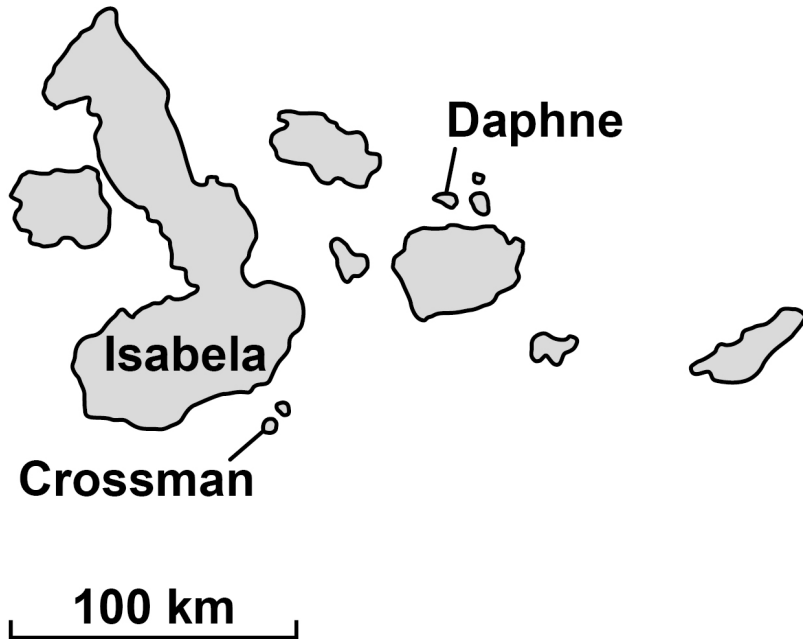




**FIGURE 18** is a map of the Galapagos Islands.

The diagram is **NOT** drawn to scale

**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.**

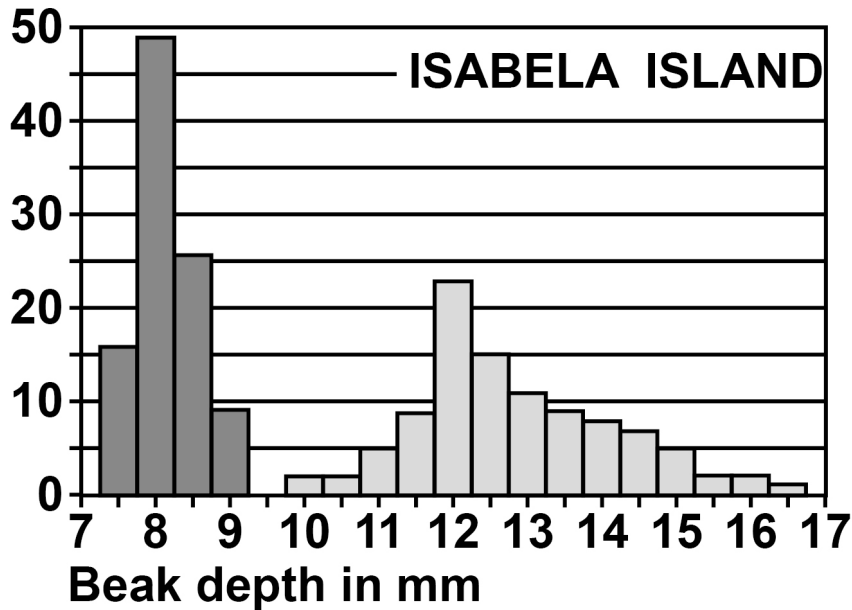
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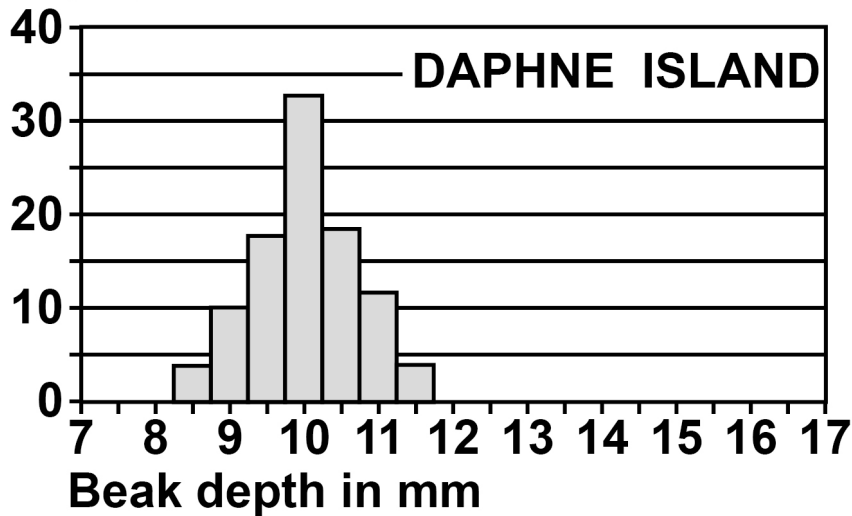
**FIGURE 19** shows how the beak depth of each species varies on each island.

**FIGURE 19**

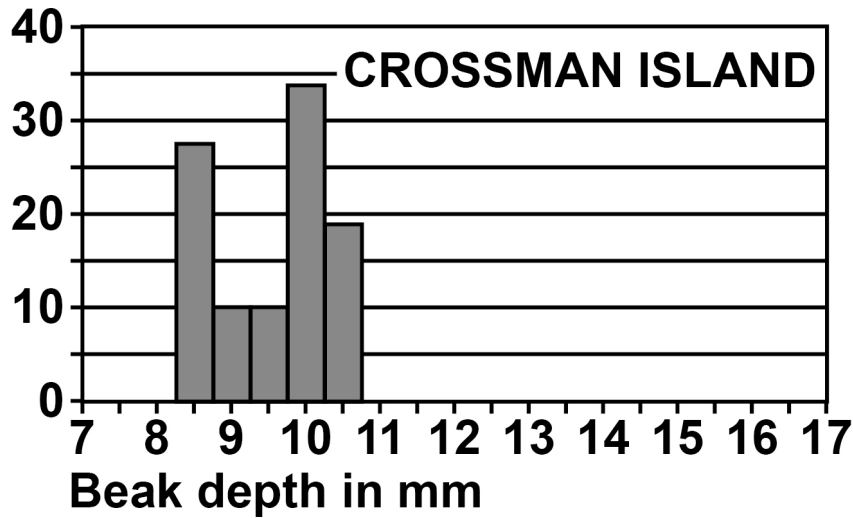
Percentage  
of population



Percentage  
of population



Percentage  
of population



**KEY**

- Small ground finch
- Medium ground finch

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.

[Turn over]



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