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Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

GCSE BIOLOGY

H

Higher Tier Paper 2H

Monday 11 June 2018

Morning

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.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- 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

- There are 100 marks available on this paper.
- 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.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	



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8461/2H

0 1

Many human actions are reflexes.

unconscious, rapid response

0 1 . 1

Which **two** of the following are examples of reflex actions?

[2 marks]

Tick **two** boxes.

conscious choice

Jumping in the air to catch a ball

Raising a hand to protect the eyes in bright light

unconscious

Releasing saliva when food enters the mouth

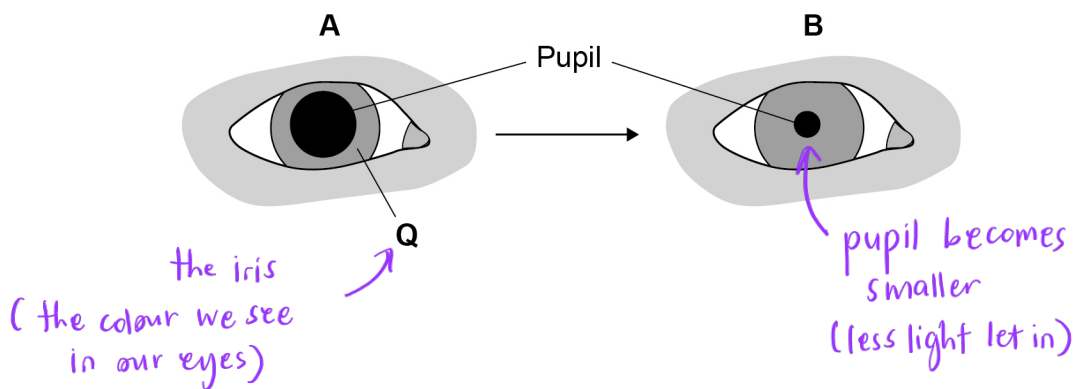
stimulus

Running away from danger

Withdrawing the hand from a sharp object

Figure 1 shows how the size of the pupil of the human eye can change by reflex action.

Figure 1



0 1 . 2

Name **one** stimulus that would cause the pupil to change in size from **A** to **B**, as shown in **Figure 1**.

[1 mark]

Bright light



0 1 . 3 Structure Q causes the change in size of the pupil.

Name structure Q.

[1 mark]

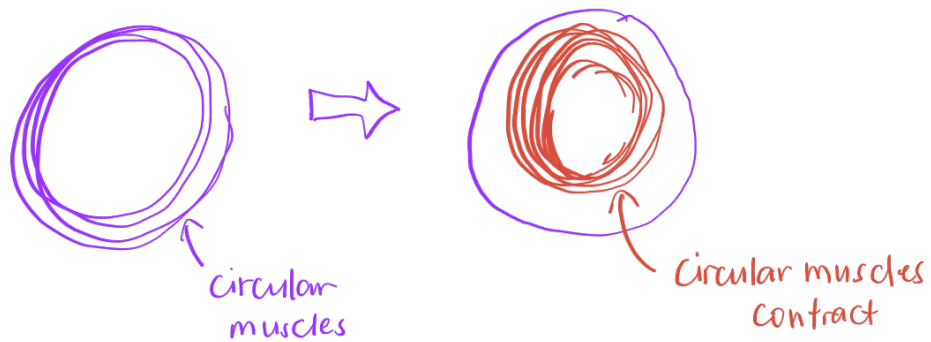
the iris

0 1 . 4 Describe how structure Q causes the change in the size of the pupil from A to B.

[1 mark]

Muscle contraction

Question 1 continues on the next page

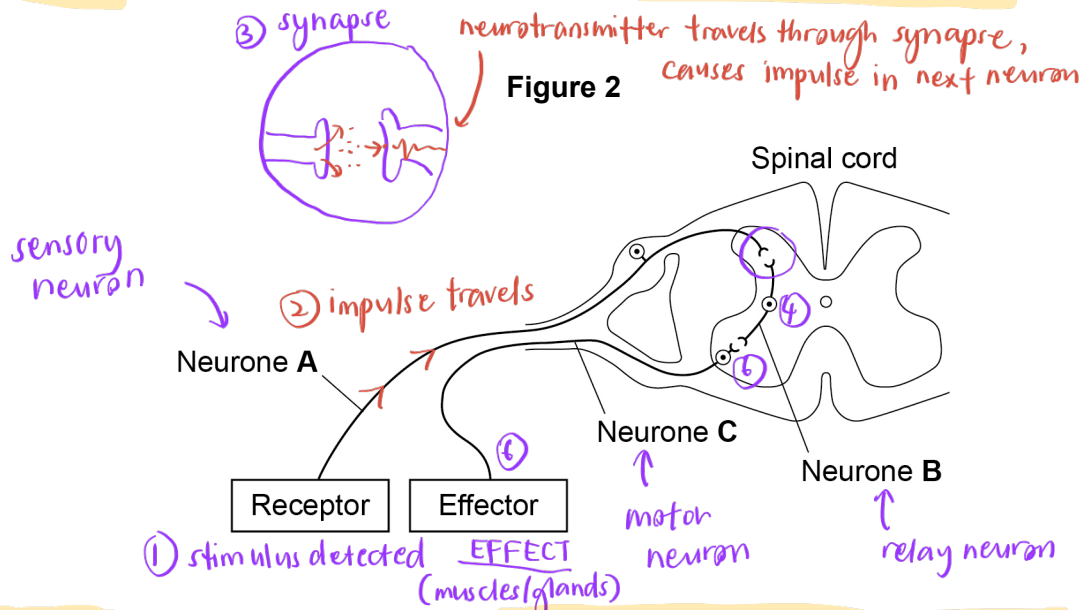


Turn over ►



0 1 . 5

Figure 2 shows some structures involved in the coordination of a reflex action.



Describe how the structures shown in Figure 2 help to coordinate a reflex action.

[6 marks]

A receptor detects a stimulus such as heat. This generates an impulse which is conducted through neuron A, a sensory neuron. The impulse travels to the spinal cord where it reaches a synapse. Neurotransmitters are released which are absorbed by B, the relay neuron, stimulating an impulse through it. The signal moves through another synapse into the motor neurone, C. The impulse moves through this to the muscle, stimulating contraction. OR to a gland, stimulating release of a chemical.



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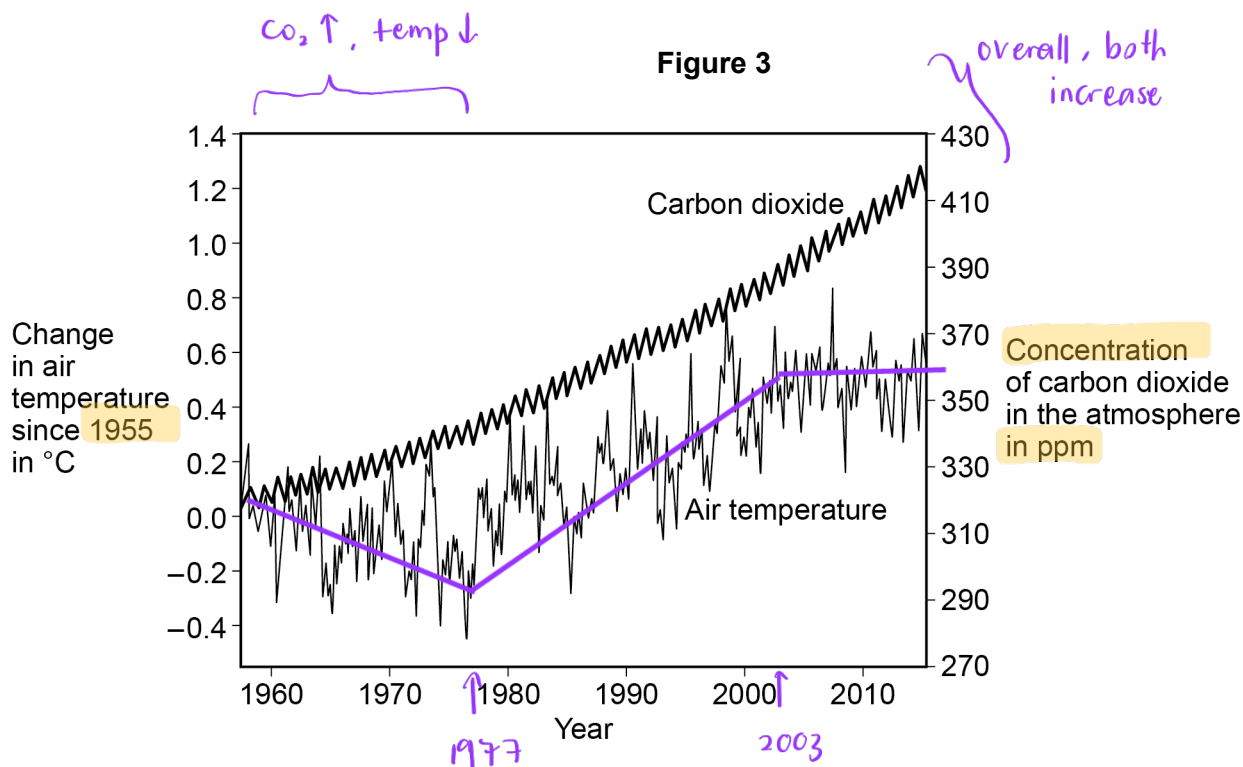


0 5

0 2

Many scientists think that global air temperature is related to the concentration of carbon dioxide in the atmosphere.

Figure 3 shows changes in global air temperature and changes in the concentration of carbon dioxide in the atmosphere.



0 2 . 1

Complete Table 1.

Use information from Figure 3.

[2 marks]

Choose answers from the box.

You may use each answer once, more than once or not at all.

constant	decreasing	increasing
----------	------------	------------

Table 1

	1960 – 1977	1977 – 2003	2003 – 2015
Trend in carbon dioxide concentration	Increasing	increasing	increasing
Trend in air temperature	decreasing	increasing	constant



Many scientists think that an increase in carbon dioxide concentration in the atmosphere causes an increase in air temperature.

0 2 . 2 How would an increase in the concentration of carbon dioxide in the atmosphere cause an increase in air temperature?

[1 mark]

Traps heat

OR insulates OR reduces heat loss

0 2 . 3 Evaluate evidence for and against the theory that an increase in the concentration of carbon dioxide in the atmosphere causes an increase in air temperature.

Use data from **Figure 3** and your own knowledge.

[4 marks]

The theory could be correct because overall the increase in CO_2 correlates with increasing temperature. Also, CO_2 traps long wave radiation. However, between 1960 - 1977, CO_2 concentration rises but temperature falls. Also, correlation is not the same as causation, and other factors could be at play.

Turn over ►



In each year, the concentration of carbon dioxide in the atmosphere is higher in the winter than in the summer.

0 2 . 4 Give one human activity that could cause the higher concentration of carbon dioxide in the winter.

[1 mark]

Burning of fossil fuels for heating

0 2 . 5 Give one biological process that could cause the lower concentration of carbon dioxide in the summer.

[1 mark]

Photosynthesis

in summer : \uparrow temperature } \rightarrow more photosynthesis $\rightarrow \downarrow$ CO₂
 \uparrow light intensity

0 2 . 6 Give two possible effects of an increase in global air temperature on living organisms.

[2 marks]

1 Greater yield of some plants

2 Migration to cooler areas

OR loss of habitat

OR extinction

11



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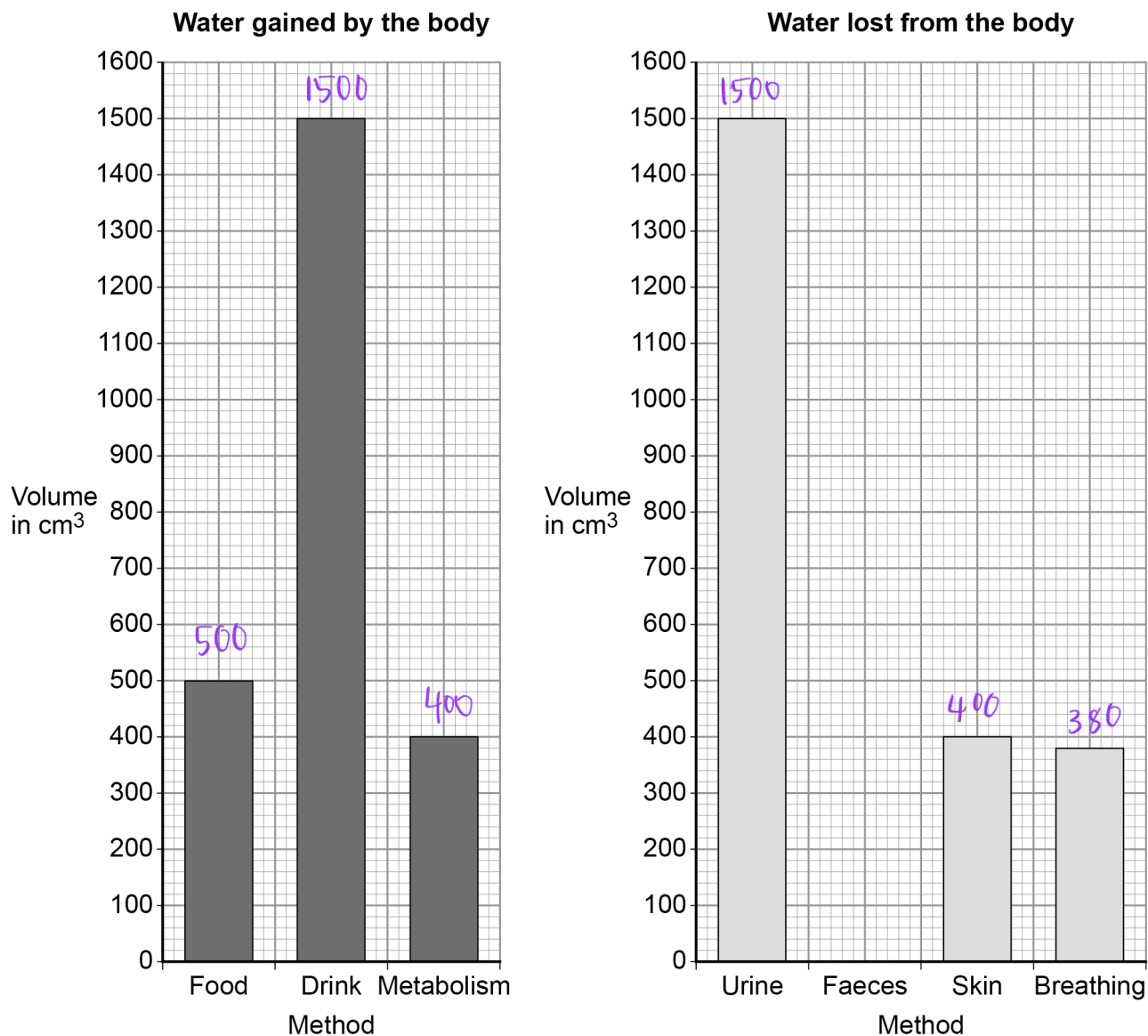
0 9

0 3

It is important to maintain water balance in the body.

Figure 4 shows how much water a person gained and lost by different methods in one day.

Figure 4



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When **water is balanced**, the volume of water taken in by the body **is equal to** the volume of water lost from the body.

0 3 . 1 Calculate the volume of water the person lost in one day in faeces.

Use information from **Figure 4**.

[2 marks]

$$2400 - 2200 = 120$$

Volume lost in faeces = 120 cm³

0 3 . 2 Figure 4 shows that **one method of gaining water** is by **metabolism**.

Which metabolic process produces water?

[1 mark]

Tick **one box**.

Breakdown of protein to amino acids

Changing glycogen into glucose

Digestion of fat

Respiration of glucose

} these actually require water



Question 3 continues on the next page

Turn over ►



The next day, the person ran a 10-kilometre race.

The volume of water lost from the body through the skin and by breathing increased.

0 3 . 3 Explain why more water was lost through the skin during the race.

[2 marks]

Sweat gland



More sweating to cool the body

OR - running produces heat

need to maintain body temperature

evaporation of water
cools the student (running creates lots of heat)

0 3 . 4 Explain why more water was lost by breathing during the race.

[3 marks]

During the race, more energy was needed for muscle contraction.

Therefore, more aerobic respiration is required. This uses oxygen, so

faster breathing rate is necessary to take in more oxygen.

running → muscle contraction → more energy → more respiration
→ more oxygen → greater breathing rate



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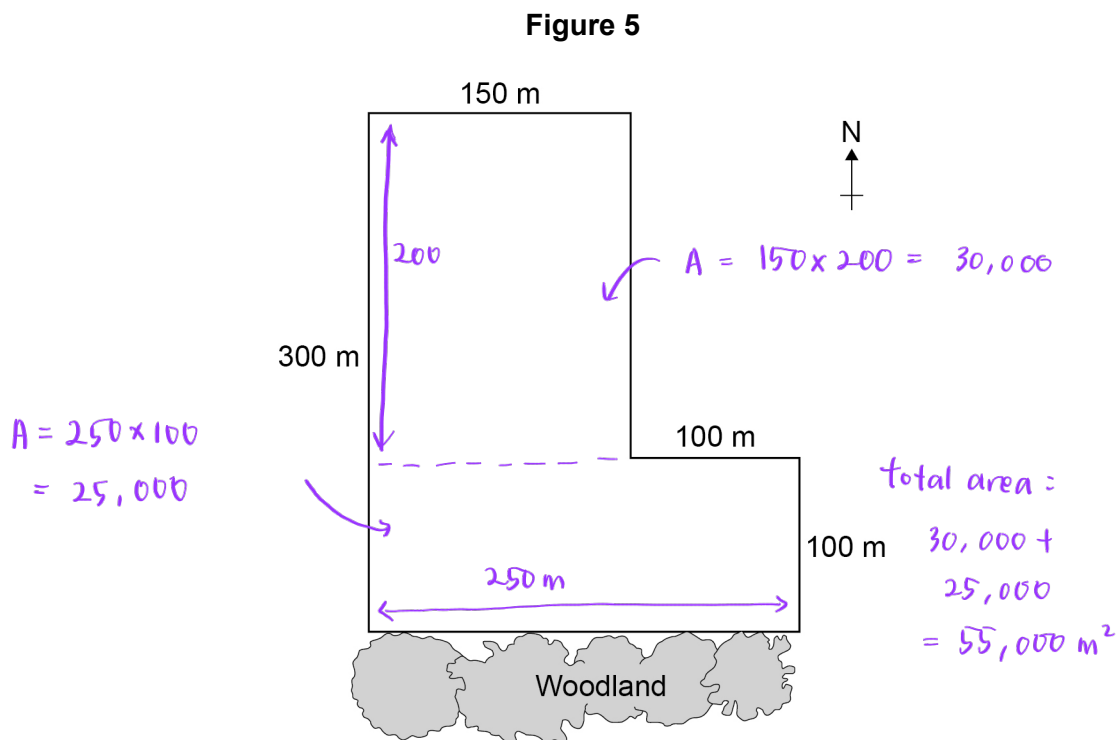
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0 4

Some students investigated the size of a population of dandelion plants in a field.

Figure 5 shows the field.



The students:

- placed a 1 m x 1 m square quadrat at 10 random positions in the field
- counted the number of dandelion plants in each quadrat.

Table 2 shows the students' results.

$$\text{mean} = \frac{6 + 9 + 5 + 8 + 10 + 2 + 1 + 8 + 11}{10}$$

Table 2

Process for question 4.2 :

- ① Find mean of dandelions
- ② Find area field
- ③ Multiply
- ④ Convert to standard form

Quadrat number	Number of dandelion plants
1	6
2	9
3	5
4	8
5	0
6	10
7	2
8	1
9	8
10	11

$$= \frac{60}{10} = 6$$



0 4 . 1 Why did the students place the quadrats at **random positions**?

[1 mark]

To make the study representative of the whole field

OR to avoid bias OR because there is an uneven dandelion distribution

0 4 . 2 Estimate the total number of dandelion plants in the field.

Calculate your answer using information from **Figure 5** and **Table 2**.

Give your answer in standard form.

[5 marks]

$$\text{mean dandelions per m}^2 = 6$$

$$\text{total area} = 55,000 \text{ m}^2$$

$$\begin{aligned} \text{total dandelions} &= 55,000 \times 6 = 330,000 \\ &= 3.3 \times 10^5 \end{aligned}$$

$$\text{Total number of dandelion plants} = 3.3 \times 10^5$$

Question 4 continues on the next page

Turn over ►



Quadrats 5, 7 and 8 were each placed less than 10 metres from the woodland.

These quadrats contained low numbers of dandelion plants.

The students made the hypothesis:

'Light intensity affects the number of dandelion plants that grow in an area.'

0 4 . 3 Plan an investigation to test this hypothesis.

[6 marks]

Identify two areas, one light and the other dark. At each, divide the area into coordinates. Use a random number generator function on your calculator to generate 20 coordinates for each place. At each of these, place a 1m^2 quadrat and count the number of dandelions. Measure also the light intensity at each. Record these and compare the data at the different intensities.

make choice of quadrat location quantitative so can be random



0 4 . 4

Light is an environmental factor that affects the growth of dandelion plants.

Give two other environmental factors that affect the growth of dandelion plants.

[2 marks]

1 Water

2 Temperature

growth → requires photosynthesis → this needs correct temperature,
ions/minerals and water

Turn over for the next question

OR-soil - very important

14

Turn over ►



0 5

Cell division is needed for growth and for reproduction.

0 5 . 1

Table 3 contains three statements about cell division.

Complete **Table 3**.

[2 marks]

Tick **one box** for each statement.

Table 3

produces two genetically identical daughter cells

produces 4 genetically different cells

Statement	Statement is true for		
	Mitosis only	Meiosis only	Both mitosis and meiosis
All cells produced are genetically identical	✓		
In humans, at the end of cell division each cell contains 23 chromosomes		✓	
Involves DNA replication			✓

normal body (somatic) cells have 46 chromosomes



gametes from meiosis have 23



Bluebell plants grow in woodlands in the UK.

- Bluebells can reproduce sexually by producing seeds.
- Bluebells can also reproduce asexually by making new bulbs.

0 5 . 2 One advantage of asexual reproduction for bluebells is that only one parent is needed.

Suggest two other advantages of asexual reproduction for bluebells.

[2 marks]

1 Many offspring produced

2 Takes less time (no need for fertilisation of gametes or pollination)

OR more energy efficient / allows colonisation of local area etc.

0 5 . 3 Explain why sexual reproduction is an advantage for bluebells.

[4 marks]

Sexual reproduction results in genetic variation in offspring, so some individuals will be better adapted to survive. Seeds may disperse long distances, allowing colonisation of new areas. Also, many offspring so higher probability some will survive.

uses meiosis to produce gametes



this introduces variation



some individuals better adapted to survive

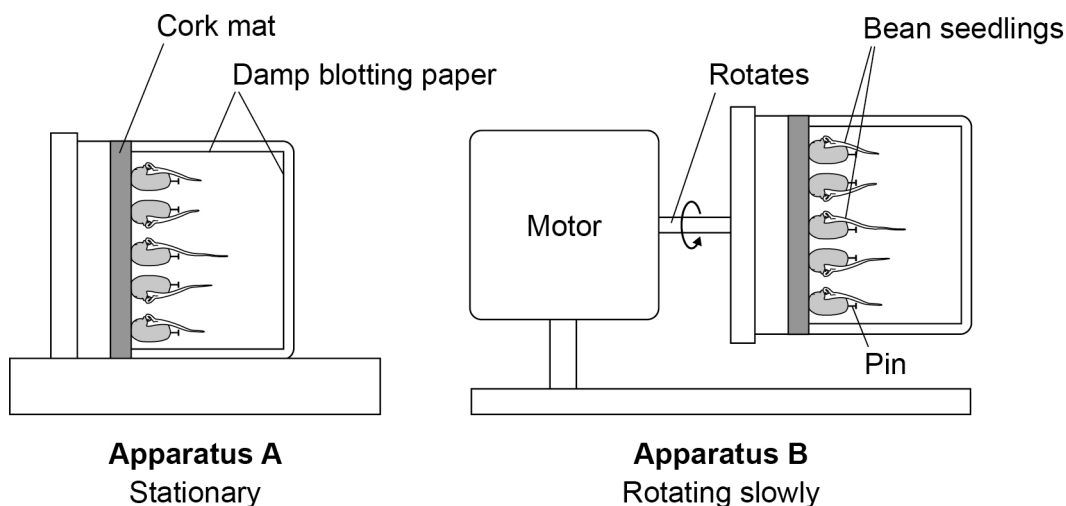


0 6

Some students investigated geotropism in the roots of bean seedlings.

Figure 6 shows the apparatus used.

Figure 6



This is the method used.

1. Measure the length of the root of each of 10 bean seedlings.
2. Pin 5 seedlings to the cork mat in apparatus A.
3. Pin 5 seedlings to the cork mat in apparatus B.
4. Leave A and B in a dark cupboard for 2 days.
5. After the 2 days:
 - make a drawing to show the appearance of each seedling
 - measure the length of the root of each seedling.

0 6 . 1

Why did the students surround the seedlings with damp blotting paper?

[1 mark]

Tick one box.

affects water not light

To prevent light affecting the direction of root growth

To prevent photosynthesis taking place in the roots

To prevent the growth of mould on the roots

To prevent water affecting the direction of root growth



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Apparatus **B** is a control.

Apparatus **B** rotates slowly.

0 6 . 2 How does apparatus **B** act as a control?

[1 mark]

Gravity acts evenly on all sides

Table 4 shows the students' results.

Table 4

if excluded, then mean = 13.75

	Apparatus A					Apparatus B				
Seedling number	1	2	3	4	5	1	2	3	4	5
Length at start in mm	35	41	32	33	39	30	33	29	28	31
Length after 2 days in mm	49	57	43	45	54	45	45	44	29	44
Length change in mm	14	16	11	12	15	15	12	15	1	13
Mean length change in mm	14					11				

0 6 . 3 One student stated:

'The mean length change for the seedlings in apparatus **B** is **not** valid.'

Suggest the reason for the student's statement.

[1 mark]

The anomaly of seedling 4 has been included

0 6 . 4 Suggest **one** improvement the students could make to obtain a **more valid mean length change** for the seedlings in **apparatus B**.

[1 mark]

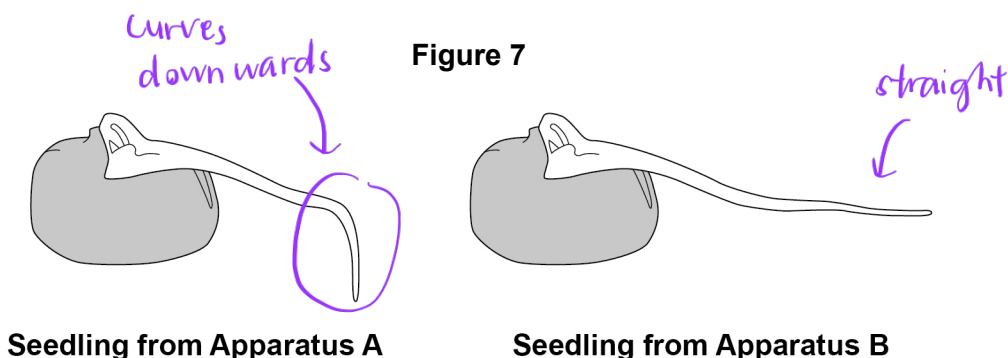
Recalculate mean with seedlings 1, 2, 3 and 5

OR repeat experiment and calculate new mean

Turn over ►



0 6 . 5 Figure 7 shows the students' drawings of two seedlings at the end of the 2 days.



A plant hormone is made in the root tip.

The hormone diffuses from the tip into the tissues of the root.

Explain how the hormone causes the appearance of the seedlings in Figure 7 to be different.

You should refer to both seedlings in your answer.

[3 marks]

There is more auxin at the bottom of the root in A, but even distribution throughout the root in B. Therefore there is reduced cell elongation at the bottom cells of the root in B, causing the root to bend.

OR top grows faster than bottom



0 6 . 6

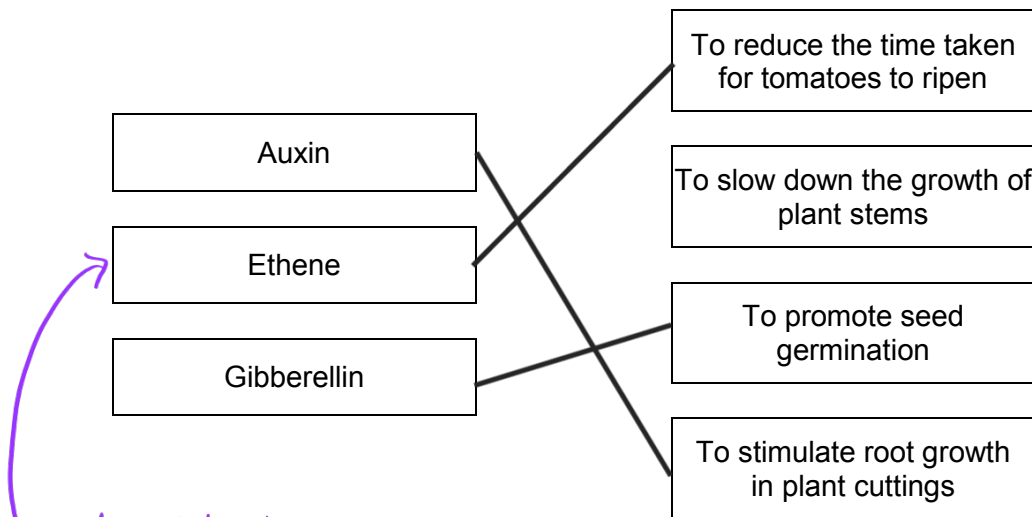
In horticulture plant hormones are used for controlling plant growth.

Draw **one** line from each plant hormone to the correct use of that hormone.

[3 marks]

Plant hormone

Use of hormone



*produced by bananas,
they make fruit around them ripens.*

10

Turn over for the next question

Turn over ►

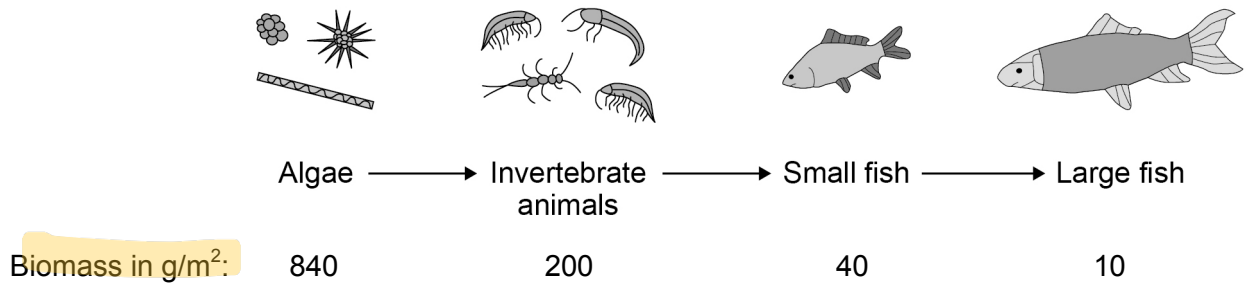


0 7

Figure 8 shows:

- a food chain for organisms in a river
- the biomass of the organisms at each trophic level.

Figure 8



0 7 . 1

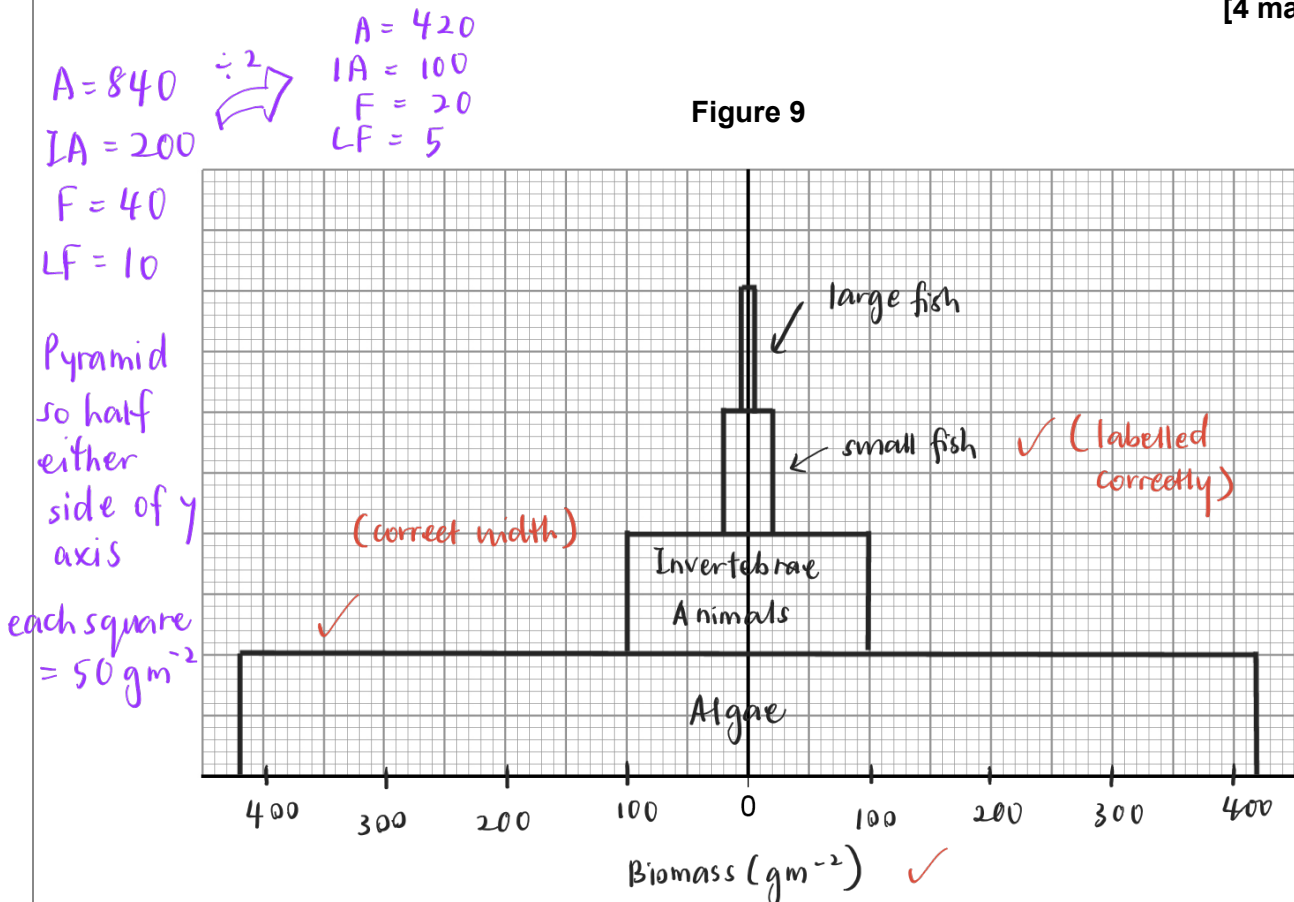
Draw a pyramid of biomass for the food chain in Figure 8 on Figure 9.

You should:

- use a suitable scale
- label the x-axis
- label each trophic level.

[4 marks]

Figure 9



07.2

Calculate the percentage of the biomass lost between the algae and the large fish.

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Give your answer to 2 significant figures.

[3 marks]

 $\% \text{ lost} =$

$$\frac{\text{initial} - \text{final}}{\text{initial}} \times 100$$

$$\frac{840 - 10}{840} \times 100 = 98.8095\% \checkmark$$

$$= 99\% \checkmark$$

$$\text{Percentage loss} = 99\% \checkmark$$

07.3

Give one way that biomass is lost between trophic levels.

[1 mark]

Respiration

OR through gases

Question 7 continues on the next page

Turn over ►



0 7 . 4

A large amount of untreated sewage entered the river. Many fish died.

Untreated sewage contains organic matter and bacteria.

Explain why many fish died.

[5 marks]

Bacteria decay organic matter by digestion. They respire aerobically, lowering the oxygen concentration of the river water. Fish have less oxygen, hence reduced energy supply so they die.

13



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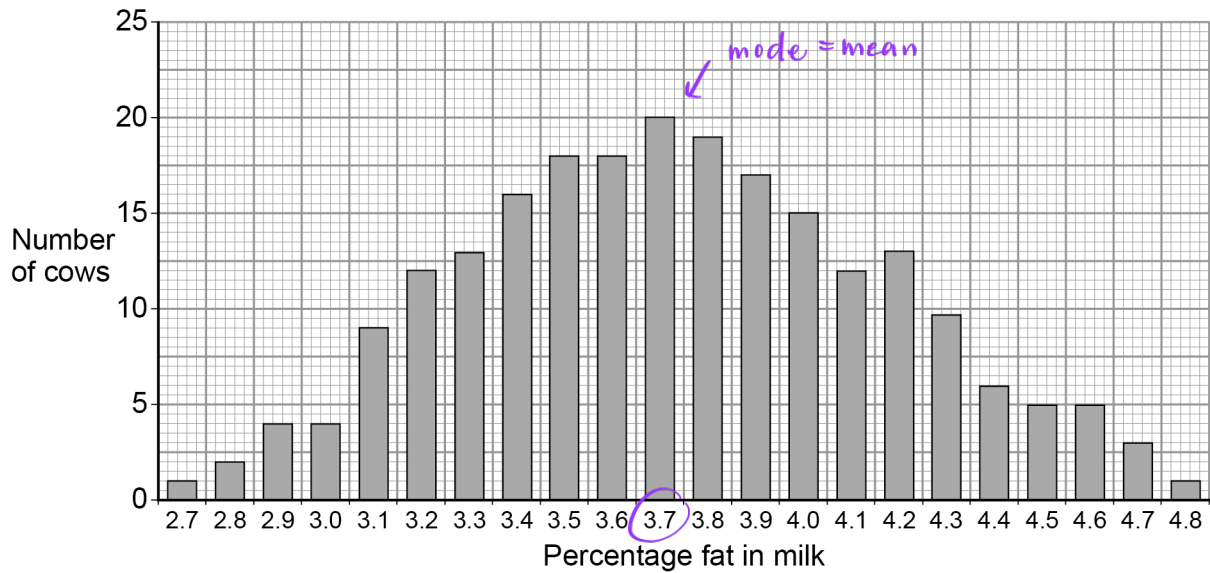
0 8

Scientists want to breed cows that produce milk with a low concentration of fat.

Figure 10 shows information about the milk in one group of cows.

The cows were all the same type.

Figure 10



0 8 . 1

In Figure 10 the mean percentage of fat in the milk is equal to the modal value.

Give the mean percentage of fat in the milk of these cows.

[1 mark]

Mean percentage = 3.7%

0 8 . 2

A student suggested:

'The percentage of fat in milk is controlled by one dominant allele and one recessive allele.'

How many different phenotypes would this produce?

[1 mark]

genotypes Tick one box.

FF = phenotype 1
Ff = phenotype 1
ff = phenotype 2

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3	<input type="checkbox"/>
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22	<input type="checkbox"/>
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0 8 . 3

Give the evidence from **Figure 10** which shows the percentage of fat in the milk is controlled by **several genes**. *larger range of phenotypes*

[1 mark]

Large range of values

OR not only 2 values OR in between values

0 8 . 4

One of the genes codes for an enzyme used in fat metabolism.

A mutation in this gene causes a reduction in milk fat. *fat production*

The mutation changes one amino acid in the enzyme molecule.

Explain how a change in one amino acid in an enzyme molecule could stop the enzyme working.

[3 marks]



mutation



active site
no longer
complementary

A different protein is produced with an altered active site. Substrate does not bind so no enzyme substrate complex formed.

Question 8 continues on the next page

Turn over ►



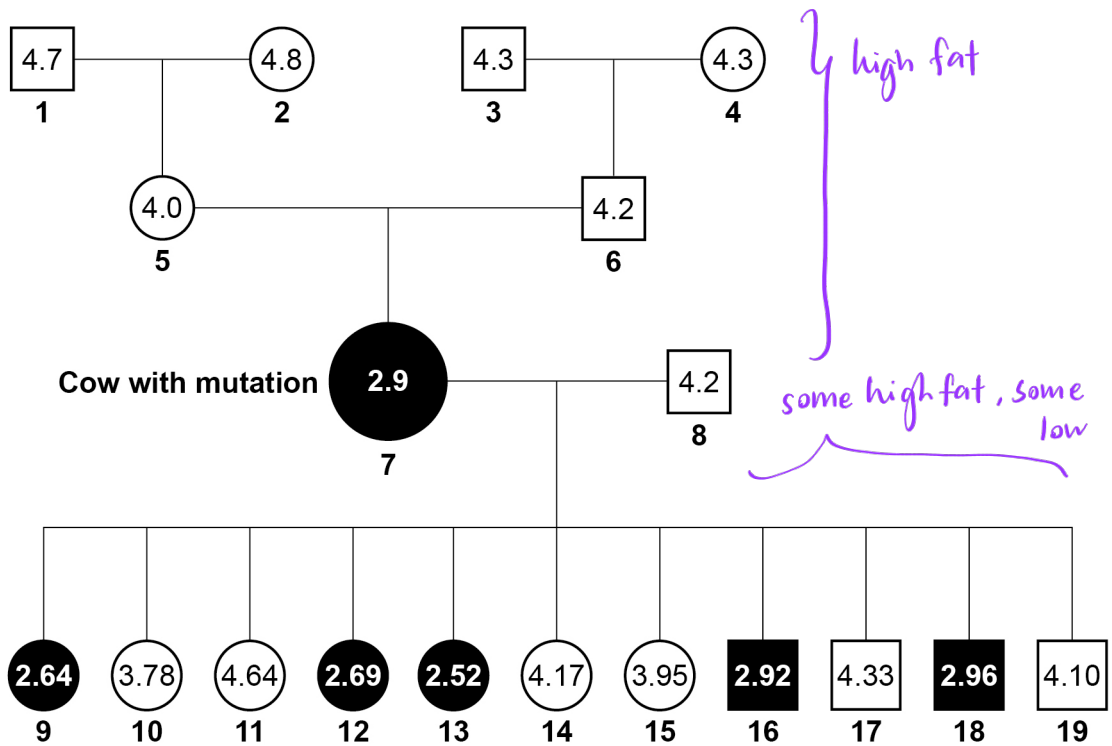
The scientists found one cow with a mutation.

The cow's milk contained only 2.9% fat.

Figure 11 shows the percentage of fat in the milk of cattle related to the cow with the mutation.

The values for male cattle are the mean values of their female offspring.

Figure 11



Key

- Female with low-fat milk
- Male whose female offspring have low-fat milk
- Female with high-fat milk
- Male whose female offspring have high-fat milk



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0 8 . 5

Animal 8 is homozygous.

The mutation in animal 7 produced a dominant allele for making low-fat milk.

Give evidence from Figure 11 that animal 7 is heterozygous.

[1 mark]

Produces some offspring with high fat milk.

0 8 . 6

Animals 7 and 8 produced 11 offspring. These offspring were produced by in vitro fertilisation (IVF).

The embryos from IVF were transferred into 11 other cows.

produce one calf per mating season (usually)

Suggest why IVF and embryo transfer were used rather than allowing animals 7 and 8 to mate naturally.

[1 mark]

Allows more offspring to be produced at the same time.

0 8 . 7

Draw a Punnett square diagram to show a cross between animals 7 and 8.

Identify which offspring produce low-fat milk and which offspring produce high-fat milk.

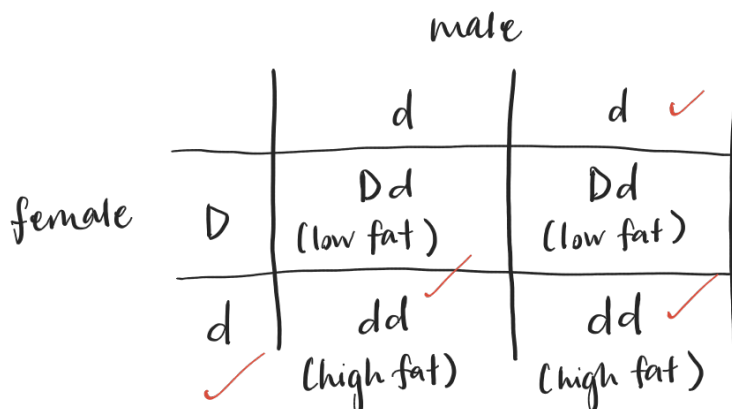
[4 marks]

Use the following symbols:

D = dominant allele for making low-fat milk

d = recessive allele for making high-fat milk

hetero (female) homo Recessive (male)



Turn over ►



0 8 . 8

The scientists want to produce a type of cattle that makes large volumes of low-fat milk.

The scientists will selectively breed some of the animals shown in Figure 11.

Describe how the scientists would do this.

[4 marks]

Find the female with the highest yield and lowest fat and the male who's offspring have the same characteristics. Cross these individuals. Select the best offspring for both characteristics from each generation and repeat for several generations.

16



0 9

Figure 12 shows a ring-tailed lemur.

Figure 12



Table 5 shows part of the classification of the ring-tailed lemur.

Table 5

(Delicious)
King
Prawn
Curry
OR
Fat
Greasy
Sausage

Classification group	Name
Kingdom	<i>Animalia</i>
Phylum	<i>Chordata</i>
Class	<i>Mammalia</i>
Order	<i>Primates</i>
Family	<i>Lemuroidea</i>
Genus	<i>Lemur</i>
Species	<i>catta</i>

0 9 . 1

Complete Table 5 to give the names of the missing classification groups.

[2 marks]

0 9 . 2

Give the binomial name of the ring-tailed lemur.

Genus species Use information from Table 5.

[1 mark]

Lemur catta

Turn over ►



Lemurs are only found on the island of Madagascar.

Madagascar is off the coast of Africa.

Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.

Today there are many species of lemur living on Madagascar.

Figure 13 shows information about water currents.

Figure 14 shows the distribution of three species of lemur on Madagascar.

Figure 13

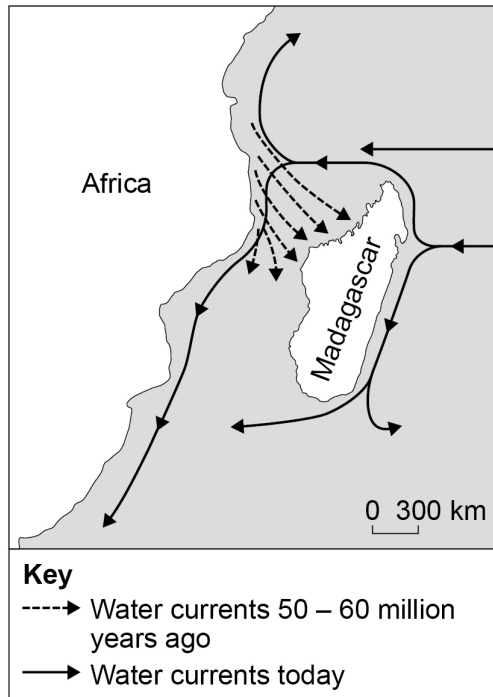
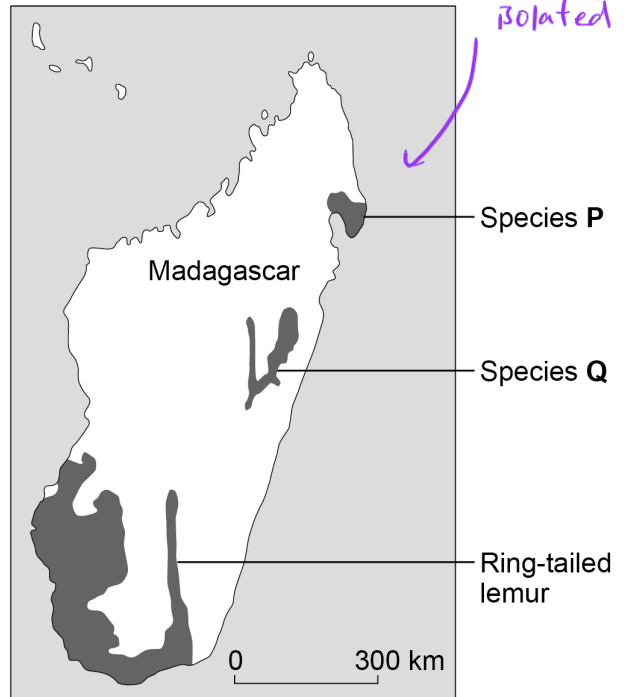


Figure 14



0 9 . 3

Suggest how ancestors of modern lemurs reached Madagascar.

[1 mark]

Carried by favourable currents on masses of vegetation



speciation

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09.4

Describe how the ancestors of modern lemurs may have evolved into the species shown in Figure 14.

[5 marks]

Different populations become isolated from one another. There was variation between the habitats of different populations. There was substantial genetic variation within lemur populations. These individuals that are better adapted survive to reproduce and pass on favourable alleles to offspring. Eventually, individuals of one population cannot produce fertile offspring with another. They are now separate species.

9

END OF QUESTIONS



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